Water Movement in Saturated, Unsaturated and Vapour Conditions

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Bagging of Fruit Bunches: An Eco-Friendly Approach for Quality Production and Protection from Physiological Disorder in Litchi

Article ID: 32500

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Introduction

Litchi (*Litchi chinensis* Sonn.) is one of the most important fruit trees of family Sapindaceae (Lal et al., 2017a) which has strong mycorrhizal association (Lal and Nath 2020). It is highly specific to its climatic requirements particularly low temperature during flower bud differentiation (Lal et al., 2017a) and probably due to this reason its cultivation is restricted to a few countries in the world and few states (North and Eastern India) in the Country. India is second largest producer of litchi after China. In India, Bihar is leading in the quality litchi production. In this state, litchi is the livelihood for millions of people as it provides both on-farm and off-farm employment. The fruiting body is panicle accelerated by high temperature and low temperature slows down the panicle emergence (Lal, 2018; Lal et al., 2019a). For genetic improvement in litchi, emphasis on length and girth of panicle should be given during selection of improved cultivars (Lal et al., 2020). The induction of flowering depends on internal as well as external factors. Higher phenol content promotes flowering (Lal et al., 2019b) and success of fruit set depends on the sources of pollen grains in litchi (Lal et al., 2019c and d). Fruit retention, yield and fruit quality are highly affected from temperature (Lal et al., 2017b) as well as crop load. Least fruit load results in maximum fruit weight (Nagraj et al., 2019). Litchi is good source of sugar, ascorbic acid, phenolics and flavonoids (Lal et al., 2018a and b).There are some major problems in litchi production like seed and fruit borer (Lal et al., 2019c), fruit drop (Lal et al., 2017c and d), pericarp browning (Purbey et al., 2019b), fruit cracking and sun burn (Lal and Sahu, 2017; Lal et al., 2018c). Among these, sun burn, fruit cracking and fruit borer can be managed with intervention of bagging to the fruit bunches in litchi. Bagging of fruit (Fig 1) is becoming most popular in litchi (Singh et al., 2019) as it not only reduces sun burn, fruit cracking and fruit borer but it also improves colour of fruit and reducing blemishes which is one of the most important character of litchi to attract the consumers. Development of fruits inside bags on the tree avoids the infestation of fruit borer because the bags served as a successful physical barrier against the fruit borer. Thus, pesticides load can be drastically reduced in litchi.

Figure 1. Bagging in fruit bunches of litchi

Types of Bagging

The bags act as a barrier to protect the fruit against sun burn and fruit cracking and attack by seed and fruit borer. Individual litchi fruit bunches are bagged with different types of bags at pea stage (March- April) when remain bagged till harvest (May to June). The stage of bagging to fruit bunches also affect the level of control of borer, sun burn and fruit cracking. The pesticide or fungicides pressure can be reduced once the bags are placed on the fruit. There are different types of bag available such as: Kraft paper, Maslin cloth, Poly ethylene, Butter paper, Light-yellow coloured bag, Black and blue bags, Nylon bags, Cellophane or fabric bag, White coated bag, news paper bag, brown paper, pink paper bag etc. which can be used to protect the fruits. The efficacy of bags depends on the type of materials and colours.

Effect of Bagging in Litchi

1. Effect of bagging on physical quality of fruits: Bagging significantly improves physical quality of fruits in litchi. Fruit weight was increased by 14.49% with bagging to the fruit bunches. Fruit were free from ant spot or blacking of skin. Bagging exhibits 70-90 percent healthy marketable fruits as compared to un-bagged (Table 1). Bagging of fruits bunches improve the physical quality of fruit through modifying micro-environment conducive for better physical appearance of fruit. It improves the physical appearance of the fruit which helps to get better price in the market as consumers prefers red colour of litchi fruits. Bagging promotes anthocyanin content and improve red colour.

2. Effect of bagging on internal quality of fruits: Bagging not only improves physical appearance but also alter chemical properties (Table 1). The TSS concentration was lower (18.65 Brix) in bagged fruits as compare to un-bagged fruits (20.56 Brix). Bagged fruit exhibited highest acidity (0.48%) and ascorbic acid (57.26 mg/100g) whereas un-bagged fruit exhibited lower acidity (0.35%) and ascorbic acid (48.62 mg/100g).

Table 1. Effect of bagging in different traits of litchi

Traits	Bagging	Un-bagging
Fruit weight (g)	22.63	19.35
Healthy marketable fruit (%)	76-90	32-65
TSS (Brix)	18.65	20.56
Ascorbic acid (mg/100g)	57.26	48.62
Titratable acidity (%)	0.48	0.35
Sun burn (%)	2.56	21.56
Fruit cracking (%)	1.24	20.45
Borer infestation (%)	2.56	35.65

3. Effect on physiological disorder and pest infestation: Bagging is one of the best techniques to reduce pesticides load in litchi. It will be highly useful in organic litchi cultivation where pesticides need to be totally avoided. Sun burn and fruit cracking are major physiological disorder of litchi especially in early ripening cultivars (Lal et al., 2017). The high quality of litchi fruits with least sun burn, fruit cracking and borer infestation can be produced when bagged to fruit bunches. Fruit cracking was reduced by 93.93% with bagging of fruit bunches and similarly, sun burn was reduced by 88.12%. Borer infestation was reduced by 92.81% with intervention of bagging to the fruit bunches. Bagging of litchi fruits prevents the contact of female moth and other pest with the fruits, thus protecting the fruits from borer infestation.

Benefits of Bagging of Litchi Fruits

1. It increases in fruit growth, size and weight.
2. It reduces the incidence or attack of birds and insect pests.
3. It is a good technique to maintain a physical separation between the environment and the produce.
4. It reduces the direct penetration of light and improves the fruit colour. Fruit colour is the fundamental feature that attracts consumers.
5. It also reduces the incidence of sun burn and fruit cracking.
6. It reduces the amount of damaged fruits.

7. It also prevents pathogens from reaching the developing fruit, which protects them from several diseases that can cause major losses.
8. It increases the marketable yield.
9. It helps to harvest the fruits in bunches.
10. Consumers prefer appearance of bagged over un- bagged fruit.
11. Potential for higher net return.

Conclusion

It is concluded that bagging of fruit bunches is a simple, grower-friendly and cost-effective technology which is safe for health as well as environment and has several beneficial effects on the physical appearance and quality of fruit. Furthermore, it is the safest approach to protect fruit from insect pests and physiological disorders.

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Agriculture and Food Security Beyond COVID-19

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Introduction

The COVID-19 pandemic is a health and human crisis threatening the food security and nutrition of millions of people around the world. Hundreds of millions of people were already suffering from hunger and malnutrition before the virus hit and, unless immediate action is taken, we could see a global food emergency. In the longer term, the combined effects of COVID-19 itself, as well as corresponding mitigation measures and the emerging global recession could, without large-scale coordinated action, disrupt the functioning of food systems. The COVID-19 pandemic also raises the alarm on the urgent need to transform the world's food systems. Globally, food systems remain a driver of climate change and the planet's unfolding environmental crisis. Food systems contribute up to nearly a third of all greenhouse gas emissions and have contributed to substantial biodiversity loss. There is an urgent need to rethink rapidly how we produce, process, market, consume our food and dispose of waste. This crisis can serve as a turning point to rebalance and transform our food systems, making them more inclusive, sustainable and resilient.

IMF managing director Kristalina Georgieva stated on March 23, 2020 that the outlook for global growth in 2020 was "negative." Recovery, if any, is expected only in 2021. According to the International Labour Organisation (ILO), the rise in unemployment because of Covid--19 could be up to 25 million worldwide. The Indian economy, which was already facing a sharp downturn by the end of 2019, will surely record an extraordinarily poor growth rate for the months of March, April, and May 2020 (though they technically fall into different quarters of the financial year). If the lockdown continues beyond a month, the impact is likely to be even more severe on the working people and on the economy as a whole.

Our Strengths

1. Extensive network of staff and partners on the ground, across sub-Saharan Africa and Asia.
2. Technical and scientific knowledge to partner with development teams.
3. Specialization in the drylands.
4. A wide range of scientific tools – from GIS and remote sensing to genomics modelling and social tools.
5. Nutrient-dense and drought-tolerant mandate crops – millets, sorghum, groundnut, chickpea and pigeon pea.
6. Scaling expertise for a range of solutions.
7. Agribusiness innovation platform to support agri-entrepreneurs with product development and market analysis.
8. Digital solutions across the whole value chain.
9. Eastern and Southern Africa: Equipping smallholders with tools to combat COVID-19.

Strengthening of Agriculture and Food Security System

1. Move towards mechanization of farm activities including harvesting and transplanting to be implemented uniformly amongst all states in India.
2. Greater push for e-NAM to strengthen last-mile delivery of produce.
3. Provision of technical expertise to farmers to facilitate smooth operation of online mandis.
4. Investing in better infrastructure for maintenance of food-grain stocks which stood at 73.85 MT as on 1 April (3.5 times more than the minimum operational–cum- strategic requirement).

5. Making provisions for health coverage to farmers akin to health insurance scheme to COVID-19 health workers in the medical sector.
6. More budgetary allocations in the Agricultural sector, especially in R&D to enable the scientists to support new and creative research solutions.

COVID 19: Impact on Climate Change

1. COVID 19 has demonstrated a profound impact that human activities have on our environment.
2. Greenhouse gas emission are declining.
3. Water and air quality are improving.
4. Birds and wildlife are returning to furslkan habitats.
5. Re-emphasize the importance of conserving natural resources, especially agro biodiversity.
6. Increasing carbon sequestration.
7. Improving soil health and water quality
8. Generation of renewable energy.
9. Scientific eco-regional planning.
10. Efficient water and nutrient use.
11. Diversification.
12. Greater dependence on locally available plant based good systems.

Impact on Agriculture

1. Difficulty in rabi crops harvesting and selling: Public Health Foundation of India reported that 10% of farmers could not harvest their crop in April month and 60% of those who did harvest reported a yield loss.
2. Crisis of labours.
3. Disrupting supply chain.
4. Significant loss of perishable items like fruits, flower, vegetables.
5. Import export restrictions adversely affected the farm community.
6. Livestock and fisheries sector faced hugemcrisis due to reduced demand.
7. Unemployment in MSME sector.

Opportunities After/ During Lockdown

1. Change in food habit.
2. Reverse migration: blessing in disgust.
3. Online portals: auction, selling and purchase.
4. Resources (land, human, water) based crop planning: glut regulation mechanism.
5. Farm level Digitization of crop inventory.
6. Contract farming: assured purchase.
7. Processing: industry in villages.
8. Farm mechanization: for small and medium farmers.
9. Farm produce Organizations (FPO) : forward and backward linkages.
10. Promoting export: India is second largest fruit and vegetable producer after China.

Opportunity to Explore Make-in-India in Pharma Pesticide Industry

1. India relies heavily on import of crop protection chemicals for making end-use formulations.
2. With imports taking a hit due to COVID pandemic, the government could encourage "backward integration by the pharma industry to reduce reliance on imports, particularly from china"
3. With the right kind of investment in this industry, India could emerge as an alternative global player to China of "both formulation products and technical material"
4. Manufacturing of active ingredients to avoid losing patent protection in the next few years.
5. Speeding up the process of granting registration of the manufacture by the domestic players.

Lockdown Effect

1. Industries are shut up.
2. Fuel consumption dipped 45.8% in April from a year earlier.
3. Cooking gas or LPG sales spike about 19.6% compared to the last year mainly due to government free cooking gas cylinders to poor households.
4. Sales of bitumen, used for making roads slumped 71% in April.

Long-Team Challenges to be Addressed in the Farming Sector

1. Investments in key logistics.
2. Small & medium enterprises dealing with raw materials as well as e-commerce and delivery companies and start-ups need a boost
3. Dedicated toll-free help lines or call-centres to address farmers grievance in contingency situations.
4. Institutional lending of crop loans for smooth flow of credit to farmers
5. Welcoming more intervention by the private sector.
6. Structural reforms such as land leasing, contract farming and private agricultural markets.

Long-Term Land & Tech Reforms

1. To re-think the bias of MSP and PDS systems in favour of the 'big two' staples like rice and wheat.
2. Crop diversification.
3. Aggregation of millions of small and scattered farms across the country.
4. Developing of agri-logistics to strengthen value-chains.
5. Using smart technologies-artificial intelligence and block chain or safe delivery of produce and real-time monitoring.
6. With a possible switch to healthy dietary practices in view of virus, the government also needs to promote healthy and nutritious food chains to boost immunity.
7. Promotion of localized production of diverse and bio-fortified crops.

Measures Taken by the Government So Far

1. Announcement of INR 1.7 trillion package to protect the vulnerable sections of including farmers from the adverse impact of the virus.
2. This included an advance release of INR 2000 to bank accounts of farmers under PM-KISAN Scheme.
3. Increase in wage-rate of workers under NREGS.
4. Pradhan Mantri Garib Kalyan Yojna (PMGKY) announced
5. Additional grain allotments to registered beneficiaries for the next three months.
6. Cash and food assistance to migrant labourers.
7. Nation – wide applicable ration cards.

ICAR Advisories to Agricultural Universities During COVID-19

Curricula delivery through e-learning:

1. Utilization of online tools for conducting classes, assignments and other student related activities.
2. e-courses for under-graduate programmes in seven disciplines available at http://ecourses.icar.gov.in
3. Regular communication with students through WhatsApp groups, other social media tools and emails.
4. e-resources of agricultural education available with and developed under NAIP, CAFT and NAHEP shall be made available to all the students free of cost.
5. 24*7 online accesses of journals in Agricultural and Allied Sciences through CeRA.

In my view, the intervention of the Government of India will have to be considerably enhanced in the following ways:

1. The payment to farmers through PM-Kisan should be raised to at least Rs 12,000 per year, and 50 per cent of this amount (Rs 6,000) should be paid immediately. Tenant farmers should be included as beneficiaries of the scheme.

2. There should be an immediate expansion of the Pradhan Mantri Fasal BimaYojana (PMFBY) to ensure compensation payments to farmers affected by the Covid-19 pandemic.

3. Holders of all MGNREGS job cards should be provided an unemployment allowance or assistance, worth at least half the payments to be received by them, assuming 100 days' work/year.

4. The Government should take steps to ensure that food grain is distributed to all households outside the priority list also for a period of three months at the rate of 5 kg per capita per month.

5. There should be efforts to arrange food, shelter, and clothing to all migrant workers in villages. Steps should be explored to provide migrant workers with cooked food by the government agencies.

6. The Government should consider waiving the interest costs of all outstanding crop loans and ensure a fresh flow of credit to small and marginal farmers for the kharif season of 2020.

7. MSPs for farmers in the 2020-21 seasons should be substantially raised to 1.5 times the cost of production. Procurement should also be significantly expanded.

8. In case the crisis prolongs to beyond further, the government should prepare itself for the take-over of large parts of the procurement and supply of essential food items from the private sector, including trucks, warehouses, go-downs and establishments.

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Biofloc: An Eco-Friendly Aquaculture Practice

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Introduction

According to FAO, more than 820 million people in the world are still hungry today, and about 2 billion people in the world experience moderate or severe food insecurity (FAO et al. 2019). Demand of food is consistently increasing in all over world due to increasing of population. Even in India also more than 189.2 million people are undernourished, means 14% of the population is undernourished in India (FAO et al. 2019). To fulfill all this requirement, availability of food is necessary for each person. To achieve this goal the production of nutrient rich food is necessary. Major food producing sectors are agriculture, horticulture, dairy, fisheries (aquaculture and marine), etc. In which fisheries globally furnish about 3.3 billion people with almost 20 percent of their average per capita intake of animal protein, and 4.3 billion people with about 15 percent of such protein (FAO, SOFIA 2020). From which Aquaculture accounted for 46 percent of the total fish production (82.1million tones) and 52 percent of fish for human consumption. Aquaculture having different method such as pen culture, cage culture, pond culture, recirculatory aquaculture system, etc. for producing fish, but Bio floc is one the best ecofriendly methods in now a day that used by several farmers who have land and water scarcity. Demand of aquaculture products in consistently increasing in the world due to high nutrient quality and it is also the cheaper source of protein, which can be afford easily by poor peoples also. So, to achieve higher production of fish and it's product, development in aquaculture is necessary without significantly increasing the usage of the basic natural resources of water and land. Biofloc technology mainly depend on the principle of nutrient recycling in which nutrient is reuse from the waste water by microbial biomass that can be used in situ by the aquatic animals or be harvested and processed into feed ingredients. Heterotrophic microbiota is stimulated to grow by controlling the C/N ratio in the water through the modification of the carbohydrate content in the feed or by the addition of an external carbon source in the water, so that the bacteria can assimilate the waste ammonium and the other waste product for new biomass production. Relative to non biofloc system, biofloc system improve the net productivity by 8-43% for some species.

What is Biofloc?

Fig: An indoor biofloc unit

It works on the same principle of waste water treatment plant. In this system microbes are allowed to grow and aggregate on the waste product of organism, that change into less complex organic matter that again enter in food chain after consuming by cultured organism. Water quality can be controlled, as long as sufficient aeration and mixing is provided in water for culturing of bacteria. It also reduces the maintenance cost, because of providing food for cultured organism.

Composition and Nutritional Value of Biofloc

It is a heterogenous mixture of microorganism or aggregates (flocs) of algae, bacteria, protozoans, and other kinds of particulate organic matter such as feces and uneaten feed. It is a compound made up of 60 to 70% of organic matter. Loose matrix of mucus that is secreted by bacteria bound each floc by electrostatic attraction. Mostly biofloc are microscopic, can reach a size up to 1000 µm, irregular shape, full of pores, and allow the pass of fluids. Nutritional quality of bioloc varies and the dry-weight protein content ranges from 25 to 50 %, and fat content ranges from 0.5 to 15 percent. Bioflocs are rich sources of minerals and vitamins, especially phosphorus. It also has probiotic effects. Dried bioflocs also have significant benefits in aquafeeds. It could replace animal or plant protein sources such as fish meal and soyabean meal used in commercial scale aquafeed manufacturing because only limited quantities are available. The cost-effectiveness of producing and drying biofloc solids at a commercial scale is controversial.

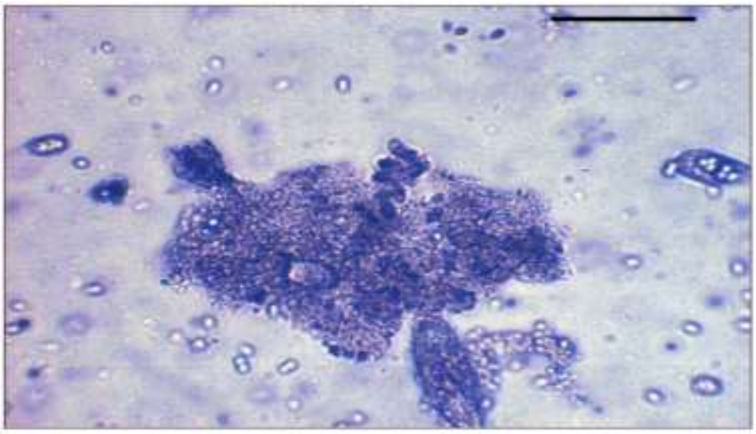

Fig: An isolated biofloc from an indoor system.

How Biolfloc Work?

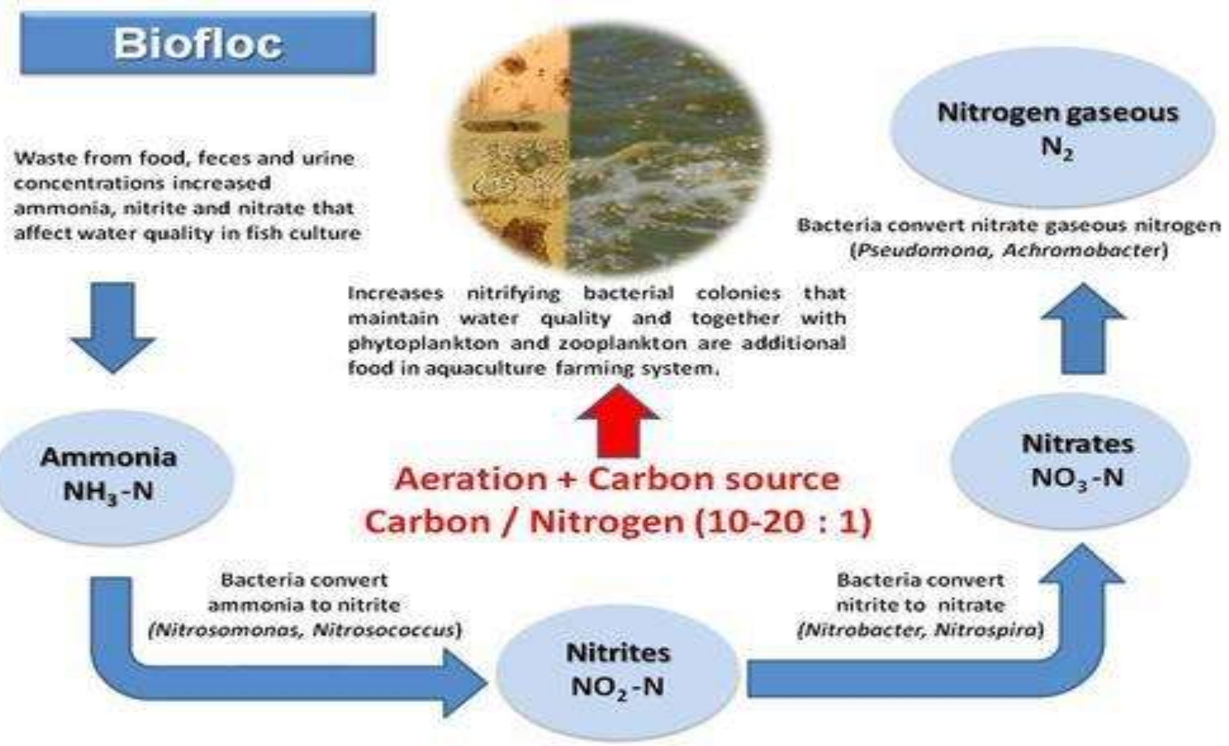

Fig:- Functioning and preparation of biofloc (source: google)

Biofloc mainly depend on two factors- providing nutrition and energy from the consumption of floc and treating waste material remain after feeding in the system that affect the water quality. Water exchange at very low rate can be operated in biofloc. This low water exchange provides long water resistance time to microorganism that develop a dense and active biofloc community that maintain the water quality by consuming waste material. So, water exchange is very low in this system and it emphasized and encourage the internal waste treatment. According to a research, it was noticed that biofloc provide growth enhancing factor to shrimp and tilapia. Flocs used as a supplemented feed on which shrimp grazes. it was noticed that about 70 to 80 percent of nitrogen added as feed is released to the culture environment as waste, that can be recycle by biofloc system and change into microbial protein and researcher found that 20 to 30 percent of shrimp or tilapia growth is derived from the consumption and digestion of this microbial protein. However, the value of flocs in nutrition is restricted at the highest levels of production intensity because the contribution of feed to growth of cultured animals is very large.

Carbon: Nitrogen (C:N) Ratio and its Application

The C:N ratio of feed and other inputs controls the ammonium concentration in the biofloc system. High carbon-to-nitrogen ratio (12–20:1) in water is a key factor to promote and stabilize the heterotrophic community. Increasing the C:N ratio of inputs to 12 to 15:1 favours the heterotrophic pathway for ammonia control and it induce the nitrogenous by-product assimilation by heterotrophic bacteria. Low C: N should be maintained by providing through external sources that should be reach in carbohydrate. After carbohydrate supplementation, ammonia uptake rapidly increased by heterotrophic bacteria. Many processed materials such as grain pellets, molasses, sugar cane bagasse, and chopped hay, etc. have been used as carbon sources in biofloc systems. The simple organic matter always preferred in biofloc because it can easily degrade by heterotrophic bacteria, within minutes to hours.

To promote complete control of ammonia concentration by the heterotrophic pathway, carbohydrate additions in biofloc must be made in accordance with feeding rate. For each 1 kg of 30 to 38 % protein feed added, add 0.5 to 1 kg of a carbohydrate source such as sugar. High concentration of carbohydrate is required at the higher protein level. It is clear that relatively large quantities of carbohydrate must be added to control ammonia concentration.

Consistently adding of organic matter or carbohydrate material in biofloc create several problems. These methods encourage the bacterial solid that accumulate in the system. If appropriate steps not taken at correct time, this solid concentration reach a level that cause gill clogging. More oxygen will be needed to support the respiratory demands of a greater bacterial load, and additional energy is needed to keep solids in suspension. Accumulated solid should be removed regularly otherwise farmers can get catastrophic loss due to deterioration in water quality.

Types of Carbon Sources Used in Biofloc

The carbon sources provided in biofloc system are mainly the by-products that derived from human and/or animal food industry, preferentially cheap and local available. Cheap and easily available sources of carbohydrates such as molasses, glycerol, and plant meals (i.e., wheat, corn, rice, tapioca, etc.) will be applied before the fry/post larvae stocking. Application of organic fertilizer mainly depending on the carbon source chosen by farmer. Local available sources of organic fertilizer should be tested and bacteria assimilation's characteristics will certainly need to take into account before application of it. Monosaccharide or simple carbohydrate-rich types (e.g., glucose, sucrose-rich sugars, etc.) versus polysaccharide complex-rich types (e.g., starch and cellulose) will lead different bacteria assimilations, nutritional value, and growth in biofloc system. For each phase of growth of microorganism such as initial and formation phase or maintenance phase, different sources should be chosen according to the price and purpose. For example, the unrefined sugar (monosaccharide) without protein and lipid promoted the best growth and the highest protein content into the tilapia tissue.

Suitable Culture Species

Biofloc systems work best with species that are able to extract some nutritional benefit from the direct consumption of floc. This system is also most suitable for species that can tolerate high solids concentration in water and are generally tolerant of poor water quality. Some species having physiological adaptations that allow them to consume biofloc and digest microbial protein, thereby taking advantage of biofloc as a food resource, example shrimp and tilapia. All biofloc systems are used to grow shrimp, tilapia, or carps. Channel catfish and hybrid striped bass are examples of fish that cannot easily adopt the environmental condition of this system because they cannot tolerate water with very high solids concentrations.

Advantages of Biofloc Systems

1. It can improve biosecurity.
2. It Improved feed conversion.
3. It enhances the water use efficiency.
4. Its increased land-use efficiency.
5. Its improved water quality control.
6. It reduced sensitivity to light fluctuations (weather).

Disadvantages of Biofloc Systems

1. This system increased energy requirement for mixing and aeration.
2. It reduced response time because water respiration rates are elevated.
3. It required start-up period.
4. Its increased instability of nitrification.
5. Additional alkalinity supplementation required.
6. Increased pollution potential from nitrate accumulation.
7. Inconsistent and seasonal performance for sunlight-exposed systems.

Conclusion

Biofloc is an ecofriendly technology that can improv aquaculture production and could contribute to the achievement of sustainable development goals. We can get higher production with less impact to the environment. Consumption of microorganisms in biofloc system reduces FCR and consequently costs in feed. Microbial community can maintain water parameter at optimum level by using all waste material. The biofloc technology is still in its young stage. Lots of research and study require to know the complexity of physical, chemical, and biological interactions that occur into the biofloc systems. In addition, to commercialize this technology at farmer level required the upgrading their skills.

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Biotechnology: Transcriptomics

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Transcriptomics is one of the most developed fields in the post-genomic era. Transcriptome is the complete set of RNA transcripts in a specific cell type or tissue at a certain developmental stage and/or under a specific physiological condition, including messenger RNA, transfer RNA, ribosomal RNA, and other non-coding RNAs. It focuses on the gene expression at the RNA level and offers the genome-wide information of gene structure and gene function in order to reveal the molecular mechanisms involved in specific biological processes. With the development of next-generation high-throughput sequencing technology, transcriptome analysis has been progressively improving our understanding of RNA-based gene regulatory network.

Introduction

Transcriptome encompasses everything relating to RNAs. It also includes the structures of transcripts and their parent genes with regard to start sites, 5'and 3'end sequences, splicing patterns, and posttranscriptional modifications (Wang et al., 2009).

Modern transcriptomics uses high-throughput methods to analyse the expression of multiple transcripts in different physiological or pathological conditions and this is rapidly expanding our understanding of the relationships between the transcriptome and the phenotype across a wide range of living entities.

Scope of Transcriptomics

The term can be applied to the total set of transcripts in a given organism, or to the specific subset of transcripts present in a particular cell type (Pietu et al., 1999). Unlike the genome, which is roughly fixed for a given cell line (excluding mutations), the transcriptome can vary with external environmental conditions. Because it includes all mRNA transcripts in the cell, the transcriptome reflects the genes that are being actively expressed at any given time, with the exception of mRNA degradation phenomena such as transcriptional attenuation. The study of transcriptomics, also referred to as expression profiling, examines the expression level of mRNAs in a given cell population, often using high-throughput techniques based on DNA microarray technology.

Aims

1. To catalogue all species of transcripts, including mRNAs, noncoding RNAs and small RNAs.
2. To determine the transcriptional structure of genes, in terms of their start sites, 5' and 3' ends, splicing patterns and other post-transcriptional modifications.
3. To quantify the changing expression levels of each transcript during development and under different conditions.

Technologies

1. Hybridization-based approaches:

a. Fluorescently labelled cDNA with custom-made microarrays.
b. Commercial high-density oligo microarrays.

2. Sequence-based approaches:

a. Sanger sequencing of cDNA or EST libraries.
b. Serial analysis of gene expression (SAGE).
c. Cap analysis of gene expression (CAGE).

d. Massively parallel signature sequencing (MPSS).

Hybridization Approaches

1. Microarrays and related techniques: The technology has been developed in several variants but two are the most popular:

a. "Two colour" (or cDNA or two-channel) microarrays.
b. "One colour" (or oligonucleotides or one-channel) microarrays.

Two colour microarrays are based on the competitive hybridization of two samples each of which has been labelled with a different fluorescent dye (e.g. red or green). After hybridization, the array is exposed to red and green laser light. The array emits fluorescence proportional to the quantity of RNA. The image produced is scanned yielding after some corrections a value which represents the expression of one sample relative to the other. One channel microarray is based on RNA of one sample which has been labelled with a fluorescent dye and hybridized to a single array where millions of copies of short (around 24 base pairs) oligonucleotide probes representing all known genes (several probes for gene form a "probe set") have been synthesized. After exposition to laser light and scanner the intensity of each location is measured yielding a value which represents an absolute measure of expression. Gene expression microarrays have been very useful to provide an overall view of how gene expression changes between two or more biological conditions.

2. RNA seq: Sequencing approaches to study the transcriptome. RNA seq transcriptomics replaces the hybridization of nucleotide probes with sequencing individual cDNAs produced from the target RNA. Emerging methods for these fully quantitative transcriptomic analyses have the potential to overcome the limitations of microarray technology and there are ongoing discussions about whether sequencing approaches may replace microarrays in the middle or even short term (Wolf, 2013).

Sequencing Approaches to Study the Transcriptome

As a massively parallel process, next-generation sequencing (NGS) generates hundreds of megabases to gigabases of nucleotide sequence output in a single instrument run, depending on the platform.

Three NGS (Next-Generation Sequencing) Technologies

1. Roche 454: A template DNA is fragmented and the fragments are end-repaired and ligated to adapters. These are clonally amplified by emulsion PCR inside microscopic "beads". After amplification, the beads are deposited into picotiter-plate wells with sequencing enzymes where iterative pyrosequencing is performed. Every time a nucleotide is incorporated a pyrophosphate (PPi) is released and well-localized luminescence is emitted and recorded.

2. Illumina Genome Analyser sequencing: Adapter-modified, single stranded DNA is added to the flow cell and immobilized by hybridization. Amplification generates clonally amplified clusters which are then denatured and cleaved. Sequencing is initiated with addition of primer, polymerase and 4 reversible dye terminators. At incorporation each nucleotide generates fluorescence which is recorded.

3. Applied Biosystems solid sequencing technology employs sequencing by ligation: A pool of all possible oligonucleotides a fixed length is labelled according to the sequenced position. Oligonucleotides are annealed and ligated; the preferential ligation by DNA ligase for matching sequences results in a signal informative of the nucleotide at that position. Before sequencing, the DNA is amplified by emulsion PCR. The resulting bead, each containing only copies of the same DNA molecule are deposited on a glass slide.

Application of Transcriptomics

1. Transcriptome assembly and profiling: The widespread use of transcriptome sampling strategies is a complementary approach to genome sequencing, and results in a large collection of expressed sequence tags (ESTs) for almost all the important plant species. The plant EST database has recently passed the five million sequence landmark. More than 50 plant species, each with >5000 ESTs, are represented.

2. Small RNA characterization: Small RNAs (sRNA) are non-protein-coding molecules ranging from 20 to 30 nt that have a role in development, genome maintenance and plant responses to environmental stresses. Most sRNAs belong to two major groups: MicroRNAs (miRNA) and short interfering RNAs (siRNA).

3. eQTL: Metabolite, protein and transcript profiles can also be directly mapped onto a segregating population to provide information on loci that control gene expression levels, protein modification or levels of a particular secondary metabolite. The QTLs associated with such traits are known as expression (eQTL), protein (pQTL) or metabolite (mQTL).

Conclusion

The advent of high throughout sequencing technologies is providing unprecedented insights into the composition and complex interactions of the transcriptome. In the space of less than two decades, understanding of transcriptome has been transformed from a simple view that RNA species serve solely as intermediaries between DNA and protein, to one where interactions between protein coding RNAs amplify the complexity of multicellular organisms. With future advances in sequencing technology and computational capacity, it is likely that the transcriptome will reveals itself to be both far more intricate and far more influential than ever before imagined.

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Aromapathy - Flowers' Essence Therapy Towards Healing Stress

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Flowers are the finest creation of nature and share with us the highest sentiments by bringing forth in us the best of emotion and feelings. The term 'Aromapathy' is combination of two words 'aroma' means fragrance or smell and 'therapy' means treatment; which simply means 'treating using scents' and can also defined as an art and science of utilizing volatile plant materials, known as essential oils to balance, harmonize and promote the health of human body, mind and spirit by affecting or altering persons mood or behaviour. This holistic approach imparts controlled use of aromatic plant oils for therapeutic or preventive purposes is a fascinating alternative medicine that cares the body with scented flowers (rose, jasmine, lavender, champak, kewda, tuberose); buds (clove); leaves (ajwain, bayleaf, eucalyptus, geranium, patchouli, teatree); bark(cassia, cinnamon); wood (sandalwood); grass (citronella, lemongrass, palmarosa); fruits(black pepper, allspice); seeds(ambrette, anise, cardamom, coriander, cumin, fennel, nutmeg, parsley); rind (grapefruit, lemon, lime, mandarin, orange) and roots (ginger, vetiver) for improving physiological and physical wellbeing.

Essential oils are volatile in nature and extracted from plant parts, that is responsible for its unique aroma due to a calculative proportion of chemical component viz; alcohols, easters, ketones, aldehydes and terpenes that differs from other essential oils, which works wonders on the brain and nervous system through stimulation of olfactory nerves when inhaled thus affect mood, relieves chronic stress or anxiety, muscle pain, insomnia, joint pain, depression, respiratory infection, epigastric upsets, menopause symptoms, skin problems like cellulite, acne and other, helps in boosting memory, fatigue alleviation, anxiety reduction, enhance energy level, eliminate headache, immune booster, promote relaxation.

Types of Aromapathy

There are 3 types of aromapathy that acts overwhelmingly dominant in releasing the powerful emotions in the body thus leading to a complete healing of body stress and strain. They are:

1. Cosmetic aromapathy.
2. Massage aromapathy.
3. Olfactory aromapathy.

Cosmetic Aromapathy finds its usages in salons and parlours that combines the essential oil to manufacture facial, skin, body and hair care products. Massage therapy is an excellent healing method uses a combination of massage with aromatic benefits of essential oils. Particular or a mixture of essential oil in a unique concentration is made out of the product and the body is massaged. In olfactory aromapathy diffusion process is generally, used to calm or soothe nerves also helps in treating some respiratory problems and can be done by spraying oil-containing compounds into the air act similar to an air freshener. It can also be done by placing a few drops of essential oil in a diffuser and turning on the heat source. Normally a treatment of about 30 minutes by sitting within three feet of the diffuser helps in relaxing the mood.

Mode of Application

Application of Aromapathy can be categorized into 2 groups:

1. Inhalation.
2. External application.

Inhalation therapy uses oil diffusers, potpourri cookers, vaporizers and inhaling the fragrance directly etc and are suitable for respiratory problems. Inhalation are further of two types i.e., direct inhalation and indirect inhalation. In case of direct inhalation Aromapathy essential oil is applied directly to the affected area but the surroundings of the person are treated with a specified scent in case of indirect inhalation.

In external application, cosmetically the skin is exposed to the essential oil application having low molecular weight thus enabling it to quickly penetrate in skin. Massage therapy and aromatic bath are coming under this category. Hot or cold compresses containing essential oils can be used for muscle aches and pains, bruises or headaches. Soaking baths containing essential oils and lasting for 10-20 minutes are recommended for skin problems and for calming or soothing nerves.

History

The use of essential oils for therapeutic and spiritual purposes can be dated back to ancient civilizations, including the Chinese, Indians, Egyptians, Greeks, and Romans.in 11th century a break-through invention was done by Avicenna by use of coiled cooling pipes instead of straight pipes in essential distillation unit.in 12th century Hildegard grew and distilled the lavender for some medicinal purposes.in 13th century A new pharmaceutical company had taken birth. This helped greatly in the distillation of different types of essential oils.in 14th century Many herbal preparations were used to fight against Black Death (Bubonic plague).in 15th century more plants like rose, rosemary was discovered to be used for distillation. In 17th century people started making perfumes. In 19th century use of perfume steadily increased giving rise to more perfume industry. However, the beginning of contemporary aromatherapy is often attributed to the pioneer work of the chemist Rene-Maurice Gattefosse and doctor Jean Valnet from the early twentieth century in France. They used essential oil for medicinal purposes. Aromatherapy became popular in the United States and began to gain attention for its potential clinical applications in 1980.

Mechanism of Aromapathy: Olfactory-Nervous-Endocrine System Nexus

Aromapathy undergoes a series of stimuli that simultaneously arises as a result of olfactory-nervous system-endocrine system nexus from point of application to its effect. Olfactory system composed of receptors is a part of sensory system plays a central role in the sense of smell i.e., olfaction influencing significant impact on our feelings. The main part housed in brain is Limbic system that encompasses many structures like hippocampus (new memory formation), amygdala (emotion centre), thalamus, hypothalamus, ganglia and cingulate gyrus that supports a variety of functions such as emotion, behaviour, motivation, long term memory and olfaction. Endocrine system consists of hormone glands that secretes hormone into main blood stream thus strongly influences affect and regulate the complete body function including metabolism, mood, growth and development.

It is the tiny olfactory nerves located in the roof of the inner nose helps in sending an immediate signal to brain and carries the excited aromatic molecules (the resultant of essential oil inhalation through nose) through nasal cavity lining towards limbic system. Thereafter the limbic system influences the master gland endocrine system and automatic nervous system for further impact.by virtue of the healing component of essential oil, it gets absorbed into the blood stream by the pores and hair follicles when applied on skin and thus they disperse to the targeted organs and promote whole body healing, affecting heart rate, blood pressure, breathing, brain wave activity and the release of various hormones throughout the body. Their effect on the brain can sedate or stimulate the nervous system, as well as possibly aid in normalizing hormonal secretions. Other mechanism is direct pharma logical effect of essential oils through external application. Large chunks of flower and flower derivatives oils are used in aromapathy fronts than leaves, bark and other parts derived oils. Some principal flower that are used for the purpose of aromatherapy are summarized below.

Sl no.	Flower name	Uses in Aromapathy
1.	Rose	Anti-depressant, deodorant, Immune system booster.
2.	Jasmine	Anti-depressant, Sedative, relieves muscle cramp, relaxes nerve.

3.	Tuberose	Antispasmodic, deodorant.
4.	Lavender	Rrelieves tension and depression, bronchitis, asthma, colds, throat infections, nervous exhaustion, headache, insomnia, migraines.
5.	Champaka	Anti-depressant, anti-inflammatory, treats nervous and mental exhaustion, anxiety, skin moisturizer and rejuvenator, relieves headache, ophthalmia, rheumatism.
6.	Marigold	Anti-spasmodic, digestive, treats gastric, indigestion, improves respiration.
7.	Kewra	Soothing, relaxes nerves, antiseptic, stimulant, treats rheumatoid pains.
8.	Viola	Diuretic, cure skin disorders, bronchitis, cough, asthma cancer of breast, lungs, treats mouth and throat infection, treats migraine, headache and insomnia.
9.	Salvia	Anti-inflammatory, Anti-depressant, relaxes muscle and nerve, digestive.
10.	Pyrethrum	Stimulant, Cure acne, prevents sore throat, treats dizziness, blurring, dimished vision.

Pros and Cons

1. Essential oil is the main component of aromatherapy that triggers and strengthen our body's own natural response.
2. Inhalation and tropical application are best form to realise the benefits in physical, mental and emotional state.
3. Inhaling essential oils can ease respiratory symptoms, while localized application of diluted oils can be helpful for certain localized conditions.
4. Massage combined with essential oils provides mental relaxation, as well as relief from body pain, muscle stiffness and spasms.
5. Some essential oils applied to the skin can have anti-microbial, antiseptic, anti-fungal, or anti-inflammatory properties.
6. Essential oils may affect different people in different ways.
7. Gentle massage of specifically sage and lavender oil has beneficial effect on high blood pressure. Other essential oils can proliferate the side effects.
8. Pregnant and lactating woman should stay away from its use as it sometimes, poses hazardous effect.
9. Lemon, lime and other citrus fruit peel oil may have phytotoxic reactions.
10. Sometimes chemical component present in the essential oil, reacts on skin if used regularly.
11. Certain essential oil have carcinogenic property e.g. calamus oil, yellow and brown camphor oil.
12. Internal application of Eucalyptus oil is strongly prohibited as it is highly toxic.
13. No essential oil should be taken without prior prescribed by a licensed medical authority.
14. Application pure and undiluted form of essential oil may irritate skin leading to rashes so it is always advised to dilute it with carrier oil like coconut, castor and olive oil etc.

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Heavy Metals Contamination and its Remediation in Agriculture

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Heavy metals in the soil refers to some significant heavy metals of biological toxicity, including mercury (Hg), cadmium (Cd), lead (Pb), chromium (Cr), and arsenic (As), etc. These are naturally occurring elements that are found throughout the earth's crust. Heavy metal pollution is caused as a result of both natural and anthropomorphic activities like mining, smelting, industrial production, using of metals, and metal containing compounds for domestic and agricultural applications. The intensive use of agricultural land and changes in farming practices along with technological advancement have led to heavy metal pollution in soil. Metals/metalloids concentrations in the soil are increasing at alarming rate and affect plant growth, food safety, and soil microflora. Metal toxicity has direct effects on crops that forms an integral component of the agricultural systems. It altered the biochemical, physiological, and metabolic processes of plants. However, it is required in trace amounts by plants for their metabolic processes.

Characteristics, Sources and Harmfulness of Heavy Metal Contamination

1. Heavy metal contamination in agricultural soils: Heavy metal contamination is a prime environmental concern that threatens plant, animal, and human health, as well as the quality of the environment. These heavy metals and metalloids are bio-accumulative and may slowly enter plants, animals, and humans through air, water, and the progression of the food chain over a certain period of time. In modern agricultural practices due to increased application of agrochemicals and inorganic fertilizers have resulted in degradation of the ecosystem and the environment (Malik et al., 2017). Additionally, land application of sewage sludge, organic waste manure, industrial by-products, and irrigation with waste water are major sources of heavy metals into agricultural systems. (Srivastava et al., 2016). Heavy metal contamination is colourless and odourless, so it is difficult to be noticed. It does not explicitly damage the environment in a short period. Nevertheless, when it exceeds the environmental tolerance, or when environmental conditions have changed, heavy metals in the soil may be activated. If the air and water are polluted, the pollution problem can be reversed certainly by dilution and self-purification after switching off the sources of pollution. However, it is difficult to use dilution or self-purification techniques to eliminate heavy metal contamination and to get soils improved. Some soils contaminated by heavy metals are likely to take one or two hundred years to be remediated. In the past, soil contamination was mainly caused by a single heavy metal. However, in recent years more cases are found to be caused by a variety of heavy metals. The complex contamination caused by a variety of heavy metals will always amplify the contamination by heavy metals separately.

2. Sources of heavy metals in agriculture: Excess heavy metals in the soil originate from many sources, which include:

a. Natural Sources: Weathering of rock is considered the most significant contributor of heavy metals. Generally, the weathering process is influenced by the nature of the rock and the environmental conditions on which the concentration and composition of heavy metals largely depends (Abdu et al., 2011). Volcanic eruptions and windblown dust particles are also the source of heavy metals.

b. Agricultural Sources: A major contributor of heavy metals in agricultural soil is inorganic fertilizers that also include liming, irrigation waters, and sewage sludge. Varying concentrations of Cd, Cr, Ni, Pb, and Zn have been contributed by other sources, predominantly by fungicides, phosphate fertilizers, and inorganic fertilizers (Tóth et al., 2016). Heavy metal content is relatively low in nitrogen and potash fertilizers, while phosphoric fertilizers usually contain considerable toxic heavy metals. The content of heavy metals in fertilizers is generally as follows: phosphoric fertilizer> compound fertilizer> potash fertilizer> nitrogen fertilizer (Boyd, 2010). Cd is an important heavy metal contaminant in the soil. Cd is brought to soils with the application of phosphoric fertilizers. In recent years, the mulch has been promoted and used in large areas, which results in white pollution of soils, because the heat stabilizers, which contain Cd and Pb, are always added in the production process of mulch. This also increases heavy metal contamination of soils (Satarug et al., 2003).

c. Industrial Sources: Different industrial activities like mining and refinement activities are another major source of contamination. Mining activities emits various types of heavy metals which depend on the nature of mining practices used. For example, the coal mines are the chief source of As, Cd, and Fe which can pollute the nearby soil. Vaporized heavy metals like Cu, Zn, Pb, As, Sn, and Cd combine with water and condense to form aerosols (Nagajyoti et al., 2010). These may be either dry deposited (dispersed by winds) or wet deposited (precipitated in the form of rainfall) can also contributing to water and soil contamination.

3. Impact of heavy metal contamination of Agriculture:

a. Impact on soil microorganisms and enzymatic activity: Microbial activity and enzymatic activity of the soil can sensitively reflect the quality of the soil held that microbial biomass of the soil was an important indicator of determining the extent of soil contamination. Microbial activity is inhibited significantly in the heavy metal contaminated soil. The soil's microbial biomass near the mine were significantly lower than that far away from the mine. In addition, the enzymes in the soil play an important role in the process of organic matter decomposition and nutrient cycling. Studies have showed that the activities of enzymes in the soil are related to the heavy metal contamination. Activities of almost all enzymes in the soil were significantly reduced by 10 to 50 times with the increase of the concentration of heavy metals.

b. Impact on the crop plants: Low concentration of soil heavy metals, regardless of necessary or unnecessary to plants, will not affect the growth of plants in a certain range but plant exceeds its tolerance threshold, will be poisoned and it even leads to death of the plant. Cd may interfere crop photosynthesis and protein synthesis, and may cause membrane damage.

Remediation of Heavy Metal Contaminated Soils

1. Engineering remediation: Engineering remediation refers to using physical or chemical methods to control heavy metal contamination of soils.

a. Replacement of contaminated soil, soil removal and soil isolation: Replacement of contaminated soil means adding large amount of clean soil to cover on the surface of the contaminated soil or to blend with the latter. Soil removal refers to remove the contaminated soil and renew it with the clean soil, which is necessary for the seriously contaminated soil with little area. Soil isolation means that to isolate the contaminated soil from the uncontaminated soil, but to completely remedy it still needs other auxiliary engineering measures (Zheng et al., 2002). All of these methods will cost large amount of manpower and material resources, so they can only be applied to small area of soils.

b. Electrokinetic method: Soil electrokinetic remediation is an economically effective technology. The principle is that the DC-voltage is applied to form the electric field gradient on both sides of the electrolytic tank which contains the contaminated soil; contaminants in the soil is taken to the processing chamber, which is located at the two polar sides of electrolytic cell, through the way of electro-migration, electric seepage or electrophoresis, and thus reduce the contamination. The method performs well in the soil with low permeability.

c. Soil leaching: The principle of soil leaching is to wash the heavy metal contaminated soil with specific reagents and thus remove the heavy metal complex and soluble irons adsorbed on the solid phase particles. By using this method, heavy metals are separated from the soil, and heavy metals are then recycled from extracting solution.

d. Adsorption: Adsorption method is based on the fact that almost all heavy metal ions can be fixed and adsorbed by clay mineral (bentonite, zeolite, etc.), asteel slag, furnace slag, etc.

2. Bioremediation:

a. Phytoremediation: Grow specific plants in the soil contaminated by heavy metals. These plants have the certain hyper-accumulation ability for the contaminants in the soil (accumulated mainly in the root or above the root). When the plants mature or reach certain enrichment level of heavy metals, remove heavy metals in the contaminated soil layer thoroughly by harvesting, burning and curing plants. Using plants and their coexisting microbial system to remove heavy metals is a new technology. The key of the method is to find the suitable plants with strong ability for heavy metal accumulation and tolerance. Now more than 400 species of such plants have been found in the world, and most of them belong to Cruciferae, including the genus Brassica, Alyssums, and Thlaspi.

b. Microbial remediation: Microbial remediation refers to using some microorganisms to perform the absorption, precipitation, oxidation and reduction of heavy metals in the soil. Fungi secretes amino acids, organic acids and other metabolites to dissolve heavy metals and the mineral containing heavy metals. David et al. (2001) reported that the fungi, *Gomus intraradices*, may improve the tolerance and absorption of sunflower to Cr. Cultivating microorganisms that have degradation capacity on heavy metals by using biotechnology (genetics, genetic engineering, etc.).

c. Animal remediation: Some animals living in the soil (maggots, earthworms, etc.) can take heavy metals in the soil. It was also proved that when the concentration of Cu was low in the soil, the activities and secretion of earthworms could promote the absorption of Cu by ryegrass.

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Drying of Apricot (*Prunus armeniaca* L.)

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Apricot (*Prunus armeniaca* L.) belongs to family "Rosaceae", is an edible delicious temperate fruit. It is one of the most important and an economically-viable fruit crop of the farming community of Ladakh. Ladakh a cold arid region with dry climate and low precipitation has two district Leh and Kargil. Apricot (*Prunus armeniaca* L.) is widely spread over the whole Ladakh with larger part of kargil district and lower belt of leh district includes areas from Saspol to Batalik and Nubra valley. The fruit of apricot usually has short growing period extended from april to august and ripens at the end of July till the middle of August. Almost every part of the fruit is used by the local inhabitants and is deeply associated with the culture and traditions of the people of Ladakh.

Apricot which is locally known as "chuli" in Ladakh is classified into two broad categories based on kernel taste. Fruits with bitter kernel are known as "khante" which means bitter and the fruits with sweet kernel are known as "ngarmo" meaning sweet. Based on seed coat colour "ngarmo" is divided into two sub-groups. Raktsey karpo: fruit with white seed coat are called raktsey karpo. It has a unique genotype and popular table purpose cultivar known for its sweetness. In Ladakh white seed coat is always associated with sweet kernel. Nyarmo: fruits with brown seed coat are called nyarmo.

Based on different size, shape, taste (sweet, bitter, sour) and physical appearance, there are many varieties of apricot grown in Ladakh. Some of these varieties include Raktse-karpo, Khante, Halman, Safaida, etc. Raktse-karpo and Halman are the mostly popular apricot cultivar of trans- Himalayan ladakh region.

Due to high perishable nature of Apricots, it has a short shelf life of 4–5 days under ambient conditions, so about 85% of fruits are dried to extend its availability throughout the year. The main objective of drying apricots is to reduce the moisture content to a level that allows safe storage for a longer period. During drying process, the vibrant colour of the ripe fruit is lost and the product turns brownish. Dried apricot is the only horticultural product which has a demand from outside Ladakh and can be exported.

Nutritional Composition of Apricots

Both the fruit and kernel of apricot has high nutritive and medicinal values. Apricot fruits are good source of phytochemicals such as polyphenols, carotenoids and vitamins. The apricot fruits are rich in protein, fiber, soluble sugars, as well as fatty acids. The carotenoids compound found in apricots are β-cryptoxanthin, β-carotene, γ-carotene, and lycopene, among them β-carotene constituting 60-70% of the total carotenoid level. The phenolic compounds found in Apricots are (+)-catechin and (−)-epicatechin, chlorogenic and neochlorogenic acids and rutin. They are rich in volatile components (linalool etc) due to its appealing smell. Apricots are excellent source of provitamin A carotenoids since 30 g of dried or fruit 250 g of fresh provides 100% of the recommended daily allowance and also a good source of vitamin C. Apricot are also rich in mineral elements including Ca, Fe, Na, P, K, Mg, Zn, Mn, and Cu.

Apricot varieties exert various biological activities beneficial for human health. The antioxidant activity of the apricot is quite high due to its rich polyphenolic content and consumption of apricot has been desirable to combat degenerating diseases.

Apricot kernel is also rich in nutrients and Table 1 shows the proximal composition of apricot kernels.

Table 1. Approximate composition and mineral content of apricot kernel(dry basis).

Assay	Apricot
Crude oil(%)	38.4
Crude Protein(%)	21.2

Crude Fibre (%)	5
Ash(%)	3
Total carbohydrate (%)	32.4
Ca (mg/100g)	19.2
Fe (mg/100g)	1.3
P (mg/100g)	519
K (mg/100g)	685
Mg (mg/100g)	156
Zn (mg/100g)	1.5

(Sources: Lazos, 1991).

Nutritional Composition of Halman and Raktsey Karpo Varieties of Ladakh

TSS of the both the cultivars are high, the TSS value of Halman was 15.8° Brix and Raktsey karpo was 19.6° Brix. Vitamin content of Raktsey karpo and Halman were Niacin (1.6 and 2.4mg/100g), Vitamin B6 (1.1 and 0.2mg/100g), Vitamin C (26.4 and 21mg/100g), Vitamin E (3.1 and 4.1mg/100g), Pantothenic acid (0.6 and 2.1mcg/100g), respectively. Mineral composition of Raktsey karpo and Halman were Calcium (126.2 and 228.7), Iron (8.9 and 13), Potassium (4800 and 4190), Magnesium (33.8 and 115), sodium (15.2 and 11.7), Manganese (0.51 and 0.52), Zinc (1.4 and 1.3), Selenium (0.08 and 0.08) mg per kg of fresh weight, respectively (Korekar et al., 2012).

Drying of Apricot

In ladakh, the most common drying method for apricots is open air sun drying, which is the oldest form of preservation known to local Ladakhis and is still in practicing.

The main reason for this is the availability of abundant solar energy, low capital, simple equipment and low energy input. Apricots in Ladakh are sun dried traditionally, as whole fruits as well as slip pits (in which the stone has been removed) on the roof top or on the rocks in open space. Whole-dried apricots are known as “fating” and split slip pits dried apricots are known as “Shali-chuli” or “Chuli”. Apricots which have high TSS (>20ºBrix) are considered suitable for drying and cultivars that are grown in Ladakh (eg, Rakchey Karpo, Halman, Safaida, Tokpopa, etc) are good in soluble solids (occasionally some have >30ºBrix). Halman cultivar being high in soluble solids, low moisture content and attractive colour after drying is mostly used for drying purpose and has a very high demand, both in the market and locally.

Methods of Drying

1. Traditional method of drying of apricots: The traditional method of drying apricots is sun drying and is usually done in month of August when the fruits riped. In traditional methods after washing the fruits, the whole apricots (with stone) and slip pits apricots(without stone) were dried in direct sunlight without subjecting them to any pre-treatment Fig 1. Generally, the fruit are spread on any available space such as on rooftops, rocks, flat pieces of stones, large boulders and even parapets along the roadsides and are given several turnings during drying. This conventional method is slow and fruit gets contaminated with dust⁄dirt, flies, ants, micro-organisms due to exposed to open environment and rains during drying period cause blackening of the dried fruit. This results in an unhygienic and inferior quality of dried apricots, thereby raising concerns for the safety of the consumers and completely reduces the market value of product.

2. Improved methods of drying:

a. Treatment of apricots before drying: To decrease the effect of spoilage, brown discoloration, to improve the quality and to get a dried product with good golden yellow colour some pre-treatments are advised before drying. The pre-treatment includes the exposing of whole or half apricot pieces to sulphur dioxide fumes or dipping in KMS solution for retention of colour during drying and storage Fig 2. After this treatment, apricots are put under sun drying.

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b. Osmotic dehydration: Osmotic dehydration (OD) is one of the modern methods of fruit preservation and is based upon the principle of osmosis. The depitted fruits are kept in a sugar syrup of 70◦Brix, having citric acid (0.25 %), calcium phosphate (0.06 %) and KMS (1500 ppm) for 24 h. The drained fruits are then dipped in water for 30 seconds to remove excess sugar syrup and chemicals from their surfaces. Treated fruits are then kept for drying over a nylon net hanged 50 cm above the ground, in a dryer or on a roof top under open sun. The advantages of osmotic Dehydration for apricots are the final product is hygienic and attractive, it is easy to perform and reduces the drying time.

c. Solar drying: Solar drying is a possible replacement for open sun drying to overcome the problems arising due to potential contamination of the produce, rain damage, variability in drying times and so on. Different types of solar dryers are currently used to improve the apricot drying in Ladakh. Table 2. Shows the different types of solar dryers its capacity and drying periods.

Table2. Capacity and drying periods of different types of solar dryers:

Dryers	Capacity (quintals)	Drying time (days)
Tent Dryer	1	5-6
Solar Tunnel Dryer	5-7	3-5
Solar Cabinet Dryer	1	3-4
Solar polyhouse Dryer	3	4-5
Sunbest Solar Dryer	0.30-0.70	2-3
Metallic Solar Dryer	0.70	2-3

(Sources: Hussain et a1., 2012).

The advantage of Solar dryers is it prevent the fruits from dust, insects and discoloration due to rain. These also minimise the drying period and improved the quality of the dried fruits.

Fresh Apricot		Traditional drying		Dried Apricot
				
Khante		Sun drying on rocks		Shali chuli/chuli
				
Ngarmo		Sun drying on roof top		Fating

Fig 1. Traditional method of drying Apricot

Fig 2. Sulphur treated dried Apricot

Uses of Apricot

Ripe apricot is used as fresh fruit and dessert fruit. Dried apricots are consumed directly or boil in water and kept overnight and then served with bread. The sweet apricot kernel is used as a dry fruit and the bitter kernel for extraction of oil which has used in hair oil, massage oil, cosmetics, religious and medicinal purpose.

Conclusion

Drying of apricots under sun drying without treatment have undesirable effect on products thereby fetching low returns. The improved methods include use of pre-treatments, osmotic dehydration and solar dryers for drying of apricots can improves the colour, quality, and reduce drying period which will improve the market value of apricot and economy of locals as compare to the traditional methods.

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Websites and Databases Related to Insect Taxonomy

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Introduction

Insects are the largest and the most abundant community of species in the world. This means, the number of insect species is more than any other group of organisms. So before dealing with all these species, we have to know their characteristics and their names. To know these, we have to again classify them into different groups and sub-groups, which is a very tough job for us. So, to all these things we have to study the taxonomy and systematics. Though taxonomy is a vast field of science, we cannot get all the information about it. So, for the easy access of the students and the researchers there are many websites and databases through which one can know about the taxonomy of any species in an organized manner which has been already stored in that databases. Some of the important websites and databases are discussed below.

Mayfly Central

Mayfly Central was introduced on the web in 1995 and was the first website available on the web devoted to information about mayflies. It is affiliated with the Department of Entomology at Purdue University and the Division of Science at Indiana University Purdue University Columbus. The program is a multi-dimensional research and education system devoted to the acquisition and dissemination of information from around the world about mayflies. The tool provides details on mayflies, in particular the taxonomy and geographical distribution of species in North and Central America. When Mayfly Central was first introduced, the mayfly collection grew from 250,000 specimens and is now considered to be one of the most extensive collections in nature. This collection includes specimens from all over the world, representing the most known taxa and numerous new taxa yet to be described; it includes more than 689,000 specimens, 2000+ species, and approximately 3900 holotypes and paratypes.

Orthoptera Species File: http://Orthoptera.SpeciesFile.org

The Orthoptera Species File (OSF) is a taxonomic database of both living and fossil Orthopterans (grasshoppers, catydids, crickets and related insects). For more than 28,700 valid species, it has completed taxonomic and synonymic details, 46,890 scientific names, 223,200 citations to 14,000 references, 105,200 photos, 1800 sound recordings and 103,200 specimen records.

Integrated Taxonomic Information System (ITIS): https://www.itis.gov

Here we can find authoritative taxonomic information about North America and the world`s plants, animals, fungi and microbes. ITIS has a partnership of U.S., Canadian and Mexican Agencies (ITIS-North America) partnership; other organizations; and taxonomic specialists. ITIS is also a member of Species 2000 and Global Biodiversity Information Facility (GBIF). The relationship between ITIS and Species 2000 Catalogue of life (Col) is proud to lay the taxonomic foundation for the Encyclopaedia of Life (EOL). The aim is to create an easily accessible database with accurate information about the names of the species and their hierarchical classification. The database will be revised annually to ensure high quality of the newly described species with correct classifications, updates and additions. The ITIS contains recorded taxonomic knowledge of both marine and terrestrial environments including flora and fauna. By providing a shared structure for taxonomic data, the use of ITIS and the taxonomic serial numbers would promote the exchange of biological information between researchers and collaborating agencies.

ITIS Integrated Taxonomic Information System

Species 2000: https://www.sp2000.org

Species 2000 is an independent community of custodians of taxonomic databases, including taxonomists from around the world. Its purpose is to collate a standardized and validated index of known species (plants, animals, fungi and microbes) in the world. Species 2000 is registered as a guaranteed private, non-profit corporation (registered in England No. 3479405). Species 2000 began as a joint programme between CODATA (International Council for Science: Committee on Data for Science and Technology), IUBS (International Union of Biological Sciences) and the IUMS (International Union of Microbiological Societies) in the early 1990's. Species 2000 provides the residual legal body for the global Catalogue of Life programme, holding its Intellectual Property Rights, copyright, domain names, access licences, Memoranda of Understanding (MoU), taking responsibility for continuity between major projects and providing the ongoing governance of the global programme. Species 2000 is a member of the Global Biodiversity Information Facility (GBIF) and the Taxonomic Databases Working Group (TDWG) and has MoU's with the Integrated Taxonomic Information System (ITIS), the Encyclopaedia of Life (EoL) and the Consortium for the Barcode of Life (CBOL). It is a Small to Medium Enterprise (SME) registered in the United Kingdom and has a distributed Secretariat: the administrative office and staff are hosted and sponsored by Naturalis Biodiversity Center, Netherlands, the Editorial Office is hosted and sponsored by the Illinois Natural History Survey, USA, and the Data managers are hosted by FIN (the FishBase Information and Research Group, Inc.) in the Philippines.

species 2000

Catalogue of Life: https://www.catalogueoflife.org

Catalogue of Life

The catalogue of life is currently available as the most extensive and authoritative global species database. Species 2000 and ITIS (Integrated Taxonomic Information System) jointly produce the Catalogue of Life. The Catalogue of Life was the driving vision of Frank Bisby, its founder and champion. Frank was a leader in the global communication of taxonomy and biodiversity informatics and a passionate advocate for his science. It is composed of a single hierarchical checklist and taxonomic hierarchy of species. The list includes important

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information about the names, relationships and distributions of more than 1.9 million species. This figure keeps on that as knowledge is gathered from different sources around the world. The Catalogue of Life is a global checklist of species arranged in a single classification of management.

Global Biodiversity Information Facility (GBIF): https://www.gbif.org

GBIF—the Global Biodiversity Information Facility—is an international network and research infrastructure funded by the world's governments and aimed at providing anyone, anywhere, open access to data about all types of life on Earth. GBIF arose from a 1999 recommendation by the Biodiversity Informatics Subgroup of the Organization for Economic Cooperation and Development's (OECD) Mega-science Forum. The OECD panel specifically recommended the establishment of a Global Biodiversity Information Facility, to "enable users to navigate and put to use vast quantities of biodiversity information, advancing scientific research serving the economic and quality-of-life interests of society, and providing a basis from which our knowledge of the natural world can grow rapidly and in a manner that avoids duplication of effort and expenditure." The goal of GBIF is to make the biodiversity data accessible freely and uniformly via the internet. The primary data store for biodiversity at GBIF offers an index of more than 300 million data records from over 10,000 different databases.

Barcode of Life Data Systems (BOLD): http://www.boldsystems.org

The Barcode of Life Data Systems is an informatics workbench that assists in collecting, storing, analysing and publishing DNA barcode information. It bridges a conventional bioinformatics chasm by combining molecular, morphological, and distributional data. BOLD is available freely to any DNA barcoding researcher with an interest. The various “Barcode of Life” initiatives such as the Consortium for the Barcode of Life (CBOL), the European Consortium for the Barcode of Life (ECBOL), the International Barcode of Life Project (iBOL) or the Quarantine Barcode of Life project (QBOL) are currently one of the major sources of new species. BOLD projects and principles are helping scientists to discover substantial numbers of cryptic species. BOLD consists of four main modules:

1. Data Portal: A data retrieval interface that requires many search parameters, including, but not limited to, geography, taxonomy and depository, to search more than 1.7 million public records in BOLD.

2. Education Portal: Custom forum for educators and students to explore barcode data and introduce new barcodes to the BOLD database.

3. Bin Database: Barcode Index Numbers (BINs) searchable database, sequence clusters that closely resemble the organisms.

4. Workbench: A data collecting and processing environment that facilitates the assembly and validation of DNA barcodes and other sequences.

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Streptomyces spp. (Actinomycetes): Novel Microbial Agent for Mites Control

Article ID: 32508

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Mites are small arthropods belonging to the class Arachnida and the subclass Acari. Although ticks and mites are closely related. Mites are distantly related to spiders and scorpions. The body of mites is divided in two sections, the cephalothorax or prosoma (there is no separate head), and an opisthosoma. The scientific discipline devoted to the study of ticks and mites is called acarology. Most mites are tiny, less than 1 mm (0.04 in) in length, and have a simple, unsegmented body plan. Their small size makes them easily overlooked; some species live in water, many live-in soils as decomposers, others live on plants, sometimes creating galls, while others again are predators or parasites. Most species are harmless to humans but a few are associated with allergies or may transmit diseases.

Mites pose a serious problem to plants worldwide, attacking crops and spreading disease. When mites damage crops of economic importance the impacts can be felt globally. Mites are among the most diverse and successful of invertebrates, with over 45,000 described species, with many more thousands to be discovered. They are responsible for a significant portion of the losses of crops for food, fiber, industry and other purposes, and require expensive and often controversial pest control measures. Understanding these mites is vital for entomologists, pest researchers, agronomists and food producers

The mites are of great economic importance as pests of crops, stored grains and animals; as biological control agents and also as agents of humus breakdown. It is estimated that about 15-16% of crop yields are reduced each year due to mite infestation alone, and therefore control of such pests is essential for greater and more successful crop production. Various methods for control such as physical, mechanical, biological, chemical methods are involved. Chemical disinfectants play a very important role in all of this as pesticides can be used to control pests very quickly and effectively. But the disadvantages outweigh the benefits of chemical pesticides. These include contamination and death of domestic animals, loss of natural competitors to pests, pesticide resistance, reduction of bee and pollination, damage to adjacent crops, damage to fishing and birds and contamination of groundwater. To date, chemical pesticides such as Propargite (Omite), Dicofol (Kelthene), Phenpyroximet (Pyromite), Spiromesifen (Oberon) have been used for the control of mites and some acaricides are still available in the market but some are banned by the government due to human hazards. Due to the overuse of pesticides, even mites have developed resistance to these acaricides, so that mites cannot be controlled effectively. The demand for chemical pesticides for this type of pest control is now declining. Recently, T. Stain & Company Limited, a leading agricultural product manufacturer, has developed a new biological pesticide with help of *Streptomyces* spp. (Actinomycetes) called as “Stanomyte” available in the market to protect crops against mites and increase yields.

Stanomyte- An Overview

Over the last few years, in some areas of India, various crops have been severely damaged due to the threat of mites. To control such incidents T. Stains & Co. Ltd. introduced a new biopesticide containing Streptomyces spp. (Market name: Stanomyte). Stanomyte is originally made to control mites in certain crops like cotton, fruits and vegetables, cucumbers, soybeans, etc.

Products

Composition

Stanomyte is a biologically selective Streptomyces (actinomycetes) based product to control a wide range of mites in agricultural crops. It contains spores and mycelial fragments of streptomyces @ 1 × 108 CFU/ml of the products.

Formulation	Liquid
Dosage	Spray @5ml/ lit of water
Shelf life	1 Year

Mode of Action

When the spores and mycelial fragments come in contact with the mites, they secrete the chitinase enzyme, which dissolves the cell wall of the mites and then begins to grow by taking nutrients from the mites, eventually targeting the whole mycelium. In this process the insects become paralyzed and eventually mummified.

It effectively controls mites in a wide range of crops. It is a good IPM molecule does not affect other beneficial organisms. It does not harm or infect beneficial predatory mites. It is eco-friendly and it helps maintain the balance of the environment.

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Effect of Edible and Non-Edible Oil Seed Treatment on Storability of Pulses

Article ID: 32509

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Introduction

Pulses are the ancient food crops with evidence of their cultivation for over 8000 years. They are biologically rich source of protein and essential minerals and complement well with cereal based diet because of high amount of lysine. Indian Council of Medical Research has recommended an average daily consumption of 40 grams of pulses. Hence there is an urgent need for increasing the pulses production to meet the growing demand for consumption. One of the major constraints in production of pulses are the insect pests which inflict severe losses both in the field and storage. In India over 200 species of insect have been recorded infesting various pulses. Among these, pulse beetle, C. maculatus is a major pest that causes serious damage and is a cosmopolitan. The pulse seed suffer a great damage during storage due to insect attack. Several bruchid species attack cereals and pulses in the store and causes a loss of 10- 15% with a germination loss ranging from 50- 92 %. Pulse beetle Callosobruchus species is serious one .this insect has been reported from the Philippines, Japan, Indonesia , Srilanka , Burma and India. It is a notorious pest of chickpea, mung , peas, cowpeas, lentil and arhar (Anujabhardwaj and verma, 2013).

Problems in Storage

1. Temperature: The general effect of temperature on longevity is that longevity increases as temperature decreases. This is true of “orthodox” seeds: that is, most seeds that follow some general “rules of thumb” regarding longevity during the storage life of the seeds. The relationship between temperature and seed longevity is that for each 10F (5.6 0C) decrease in temperature, longevity doubles (Harrington, 1972). This rule applies to seeds stored between temperatures of 32 0F (0 0C) and 122 0F (50 0C). This rule assumes that the moisture content is a constant.

2. Seed moisture and humidity: Seed moisture has a greater effect than temperature on seed longevity. Most seeds also follow some “rules of thumb” regarding moisture and longevity. The general relationship is that for each one percent increase in seed moisture, longevity decreases by half (Harrington, 1972). This rule applies to seed with moisture content between 5 and 13%. Above 13% moisture content, seed storage fungi and increased heating due to respiration cause longevity to decline at a faster rate. Once seed moisture reaches 18 to 20%, increased respiration, and the activity of microorganisms cause rapid deterioration of the seed (Bhardwaj et al., 2013).

3. Effects of fungi, bacteria and pests:

a. Fungi: Most seed storage fungi are inhibited when the relative humidity is kept below 65%. At this relative humidity the moisture content of starchy seeds is about 13%, and oily seeds about 7%. (The major effects of fungi are:

i. It decrease the seed viability.
ii. Produce toxins that affect seed viability and germination.
iii. Increase heat production in seed lots.
iv. It causes seed discoloration, mustiness and caking.

a. Bacteria: Bacteria do not have a significant role in seed deterioration because free water is required for bacterial growth and if the moisture content of the seed is high enough to support bacteria, the seed is more likely to succumb to deterioration due to other causes such as respiration, heating or premature sprouting.

c. Insects: In hot, humid climates such as the Mid-Atlantic and South, mites, weevils, flour beetles and borers can be a serious problem in stored seed but if the seed is dried to 8% moisture content and the temperature reduced to (64 to 68 °F (18 to 20 °C), insects should not be a problem. At a moisture content of 15% and a temperature of 86 to 95 °F (30 to 35 °C), they can become very destructive. Mites will not survive when the relative humidity is below 60 % (Ivania et al., 1995).

Seed Treatment

Seed treatment is a biological, chemical or physical process designed to mitigate externally or internally to the seed or soil borne microorganisms, resulting in the emergence of healthy seedling and subsequently healthy plants.

1. Until the second world war the only botanical pesticide used were pyrethrum, rotene, nicotine, sabadilla and quassin. Rotene is presently used only on a limited number of crops due to its high toxicity to fish.
2. Natural pyrethrum from chrysanthemum flowers is employed mainly as a rapid knockdown agent for crawling and flying insect which causes allergic to man and animals.
3. Nicotine, sabadilla and quassin are seldom used as pesticide today.
4. Seed treatment with chemical is the old practice, it is ignored in the recent past due to it causes environmental pollution.
5. Seed treatment with edible and non- edible oil gaining more importance.

Advantages of Edible and Non-Edible Oils Over Chemicals

1. Oil insecticides tend to have broad-spectrum activity and bio-degradable pesticides with greater selectivity.
2. Safe, relatively specific in their mode of action.
3. Easy to process and easy to use.
4. Safe for higher animals and natural enemies in environment.
5. Farmers and small-scale industries can often easily prepare botanical insecticides.
6. Formulated locally with indigenous materials available.
7. Thus aid in saving farmers money.

Scope for Oils

1. It repel the insects.
2. It affect feeding and oviposition on the seed and plants.
3. Disrupt behaviour and physiology of insect in various ways.
4. It toxic to different developmental stages of many insects and pathogens.

List of Edible and Non-Edible Oils Used for Seed Treatment in Pulses

1. Mustard.
2. Linseed.
3. Noug G. abyssinica (seed oil).
4. Sunflower oil.
5. Neem oil.
6. Eucalyptus.
7. Karanj.
8. Cedar.
9. Apricot.
10. Olive oil.
11. Groundnut.
12. Sesame.
13. Palm oil.

Applications of Edible and Non-Edible Oils

1. Oil as an additive:

a. Numerous vegetable oils can be used as a protective additive. An advantage is that they are easy to apply.

b. Oil can be used preventively as well as curatively.

2. Protective action: Because of the oily coating of the seeds, the insects are unable to reproduce. They fail to lay eggs in the kernel. Larvae outside the kernel are not able to enter the kernel either because of the slippery oil coating.

3. Curative action: Oil may also kill the insect eggs. When the egg is already present at the surface of the seed or inside the seed, the oil coating prevents gaseous exchanges. So, the larvae inside the egg or the kernel will die due to lack of oxygen (Tabu et al., 2012).

Disadvantages of the Use of Oil

1. Oil can have an adverse effect on the germination power of the oil treated seeds. Therefore, it is recommended that seed which is intended for sowing should not be treated with oil.
2. Oils can also be poisonous to human beings. Cereals that are intended for food should only be treated with vegetable oils.
3. Locally made oil may go rancid which will then make the product taste unpleasant.

Conclusion

Use of chemicals have given good results in increasing the storability of pulses by controlling various insects and fungi yet they are hazardous to environment and also for the consumers. Some of the oils have been reported to be equally effective as that of chemicals in increasing the storability of pulses and also, they are eco-friendly, consumer acceptance is also high as compared to chemicals.

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Effect of Mulching on Plant Growth and Soil Environment

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Introduction

Any material used (spread) at surface or vertically in soil to assist soil and water conservation and soil productivity is called mulch. The word mulch has been probably derived from the German word "molsch" means soft to decay, which apparently referred to the use of straw and leaves by gardeners as a spread over the ground as mulch (Jacks et al., 1955). It is defined as an application of layer of covering material on the soil surface. Mulches are either organic or inorganic. Organic mulches are those derived from plant and animal materials. Those most frequently used includes plant residues such as straw, hay, peanut hulls, leaf mold and compost, wood products such as sawdust, wood chips and shavings and animal manures. Organic mulch properly utilized can perform all the benefits of any mulch with the possible exception of early season soil warming. Inorganic mulch includes plastic mulch and accounts for the greatest volume of mulch use in commercial crop production. The plastic materials used as mulch are poly vinyl chloride or polyethylene films. Owing to its greater permeability to long wave radiation it can increase temperature around the plants during night in winter. Hence, polyethylene film mulch is preferred as mulching material for crop production.

To achieve optimum advantage from the mulch, the mulch should be applied immediately after germination of crop @ 5-ton ha-1 (organic mulch). The practice of applying mulches to soil is possibly as old as agriculture itself. Mulches are used for various reasons but water conservation and erosion control are the most important objective for its use in agriculture in dry regions. Other reason for high mulching use includes soil temperature modification, soil conservation, nutrient addition, improvement in soil structure, weed control and crop quality control. Mulching reduces the deterioration of soil by way of preventing the runoff and soil loss, minimizes the weed infestation and checks the water evaporation. Thus, it facilitates more retention of soil moisture and helps in control of temperature fluctuations, improves physical, chemical and biological properties of soil, as it adds nutrients to the soil and ultimately enhances the growth and yield of crops. (Kumar et al.1990).

Effect of Mulching on Plant Growth and Soil Environment

1. Effect of mulches on soil moisture: The conservation of soil moisture through mulching is one of the important purposes. The micro-climatic conditions are favourably affected by optimum degree of soil moisture. When soil surface is covered with mulch helps to prevent weed growth, reduce evaporation and increase infiltration of rain water during growing season. Plastic mulch helps prevent soil water loss during dry years and sheds excessive water away from the crop root zone during periods of excessive rain fall. This can reduce irrigation frequency and amount of water, it may help reduce the incidence of moisture related physiological disorders such as blossom end rot on tomato, fruit cracking in lime and pomegranate. Mulches conserved more soil moistures, enhances vegetative growth and yield contributing characters.

2. Reduce infiltration rate: Mulching increase the total intake of water due to formation of loose soil surface. The rain drops on mulched soil do not seal the particles as they do on un-mulched soil. This sealing effect of rain drops results in more loss of water through erosion. The water infiltrated in soil can be utilized by crops there-by crop yields are increased. Mulches obstruct the solar radiation reaching to soil. Infiltration and soil evaporation are among the key processes that determine soil water availability to crops in semi-arid agriculture. The presence of crop residue mulch at the soil-atmosphere interface has a direct influence on infiltration of rainwater into the soil and evaporation from the soil. Mulch cover reduces surface runoff and holds rainwater at the soil surface thereby giving it more time to infiltrate into the soil.

3. Maintain soil temperature: Mulching reduces soil temperature in summer and raises it in winter. It prevents the extremes of temperatures. During summer, mulching conserves the soil moisture due to reduced evaporation. The cooling effect of soil promotes root development. In general, the effect of mulching on the temperature regime of the soil varies according to the capacity of the mulching material to reflect and transmit solar energy. Mulches results in greater water content and lower the evaporation. However, effects on soil temperature are highly variable. White mulches decrease soil temperature while clear plastic mulches increase soil temperature.

4. Reduce run-off and soil erosion: Soils from dry region are highly susceptible to water erosion and wind erosion because rainfall occurrence is frequent during intense storms and surface is not adequately protected by vegetation which effectively retards runoff. Therefore, to reduce erosions by wind and water is an important reason for using mulches in dry regions. Crop residues when applied at adequate level increase infiltration rate. Decomposition of these residues results in improving soil aggregation and suitability for crop production. Mulching the soil surface reduce velocity of runoff, evaporation and increase the amount of water stored in the soil profile Mulch can effectively minimize water vapour loss, soil erosion, weed problems and nutrient.

5. Reduce weed growth and keep the crop clean: By providing a physical barrier, mulching reduces the germination and nourishment of many weeds. If somehow weeds are growing, they become pale and ultimately die. Mulching materials such as wheat straw, dry grasses and saw dust are good in this respect. The mulching favours the reduction of evaporation leading to higher soil moisture content, a reduction in weed growth and the decomposition of added mulches might have also contributed to increase the supply of nutrients and moisture for overall increase in crop yields. Covering or mulching the soil surface can prevent weed seed germination or physically suppress seedling emergence. Loose materials like straw, bark and composted municipal green waste can provide effective weed control. Saw dust is a wonderful soil improver and weed suppressor as it conserves soil moisture, decreases run-off, increases infiltration and percolation, decreases evaporation, etc. and weed growth can be substantial under clear mulch .

6. Promote earlier harvest: Mulch can be used effectively to modify soil temperature. Black or clear mulch intercept sunlight which warms the soil. White or aluminium mulch reflects the sun's heat and keeps the soil cooler. Black mulch applied to the planting bed prior to planting will warm the soil and promote faster growth in early season, which generally leads to earlier harvest.

7. Reduced fertilizer leaching: As excessive rainfall is shed from the root zone, fertilizer loss due to leaching is reduced. This is particularly true in sandy soils. This allows the grower to place more pre plant fertilizer in the row prior to planting the crop

8. Improved quality and yield: Mulch helps keep fruits such as tomato from contacting the ground. This reduces soil rot and helps keep the product clean. Fruit cracking and blossom end rot are reduced in many cases. Fruits tend to be smoother with fewer scars. Properly installed plastic mulch helps keep soil from splashing onto the plants during rainfall, which can reduce grading time. The yield and chemical composition to tomatoes, cucumbers, muskmelons, eggplant, etc. were found to be improved. The yield and keeping quality of early potatoes, cabbage and other vegetables may be improved by straw mulch.

9. Plant growth and development: The effects of mulches on plants are operative through the effects of mulches on soil water, soil temperature, structure and erosion. Reduced evaporation is major reason for the growth of the plants and there by high crop production due to mulch. Mulching provides a favourable environment for growth. A combination of the above and perhaps other factors, results in more vigorous, healthier plants which may be more resistant to pest injury. Therefore, mulched plants usually grow and mature more uniformly than un-mulched plants.

10. Stimulate soil micro-flora: Mulching stimulates soil micro-organisms such as algae, mosses, fungi, bacteria, actinomycetes and other organisms like earth worms etc., owing to lose, well aerated soil conditions, uniform moisture and temperatures thus resulting in a more rapid breakdown of organic matter in the soil and release of plant nutrients for crop growth. Under the mulch layer earth worms proliferate and help to improve the soil aggregate stability and infiltration etc. Mulching conserves moisture, suppresses weed growth, protects the upper fertile soil from erosion, minimize variation in soil temperature and affords winter protection. In addition, mulches are also reported to enhance soil microbial activity.

11. Add organic matter: Organic mulches return organic matter and plant nutrients to the soil and improve the physical, chemical and biological properties of the soil after decomposition, which in turn increases crop yield. Soil under the mulch remains loose and friable. Aeration and soil microbial activity are enhanced.

Conclusion

Mulching plays an important role in sustainable crop production to prevent loss of water by evaporation, prevention of soil erosion, reduce fertilizer leaching and its pronounced effects on soil health by improving the soil structure, soil fertility, biological activities, avoid soil degradation in addition to moisture conservation, regulating temperature, encouraging change in favourable micro-climate, check weed growth and ultimately increasing the productivity, quality, profitability and sustainability of crops.

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Effect of Environments on Pathogenesis

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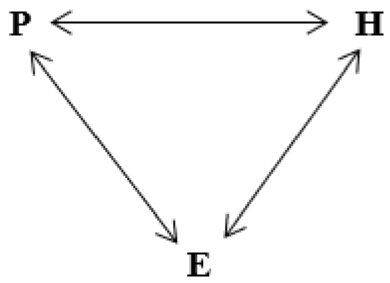
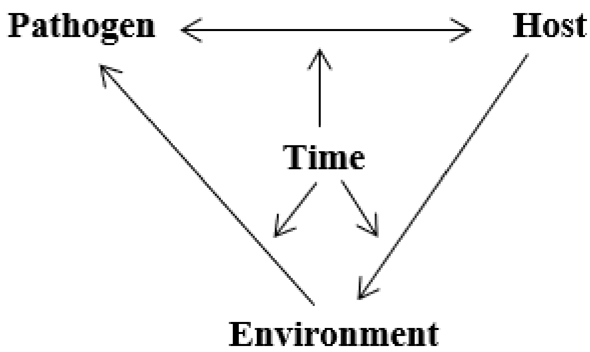
Plant disease results from the interaction of a pathogen with its host but the intensity and extent of this interaction is markedly affected by the environmental factors. Although these factors are not the causal agents of infectious diseases, they are the final determinants of almost all the events that constitute the infection chain leading to pathogenesis and also the events that follow, viz., spread of the disease in the population. The fact that most plant pathogens are often present in a geographic area but the diseases caused by them become serious only occasionally is one of the indications that the ever-changing environments influence the development of a disease. The role of environments in pathogenesis is as important as susceptibility of the host and pathogenicity of the causal agent. Any consideration of disease in the crop, therefore involves the "disease triangle".



P=Pathogen, H=Host, E= Environment

The pathogen interacts with the host and vice versa. Both influence each other, the host providing nutrition to the pathogen and the latter causing the disease in the former. The host also influences the environment through crop canopy, root and leaf exudates, withdrawal of nutrients and water from soil and other activities mediated through these effects. Environment affects the host through physical, chemical and biotic factors involved in plant growth and metabolism.

These interactions and their effects are not spontaneous. In epidemiology, time over which the interactions are taking place and the population, rather than the individual, is affected is the fourth component added to disease triangle which can be modified as:



The first step in the infection chain is the survival of the pathogen. While pathogen's own characters and presence, of suitable medium are basic determinants, the environment is equally important. Adverse physical, chemical and biotic environments can limit survival ability and reduce the density and capacity of the inoculum. The transport or dispersal of the inoculum in speed and distance is also dependent on environment. The germinability of spores, the number and flight range of insect vectors are directly influenced by prevailing weather.

At the time of penetration, the structural defence barriers of host, stability and germination of spores on the host surface, and their penetration are influenced by meteorological conditions. Invasion of tissues by the developing parasite after penetration may not be directly influenced by external environments but the effect the latter produces on the host may lead to favourable or unfavourable conditions for the pathogen in the tissues.

Resistant varieties may tend towards susceptibility under some temperature conditions. Also, the factors such as light, temperature and humidity on the host surface definitely determine the exit of the pathogen, its sporulation, number of generations, and amount of secondary inoculum produced for dispersal. Thus, is obvious that in spite of pathogen being virulent and the host being congenial, disease may not develop in a population unless environmental conditions are favourable for it.

The environment affecting the plant and the pathogen consists of two parts: the atmospheric environment and the soil environment. Although both are interrelated so far as physical parameters are concerned, the soil environment is chemically and biologically more complex but stable. Soil environments directly affect the soil-borne root pathogens and indirectly the pathogens of foliar parts. Atmospheric environment is mostly related to pathogens of aerial parts.

The atmospheric environments, and to some extent the soil environments too are determined by meteorological factors. Long term generalization of weather is climate. The climate of a region describes the annual progression of the weather and expresses the more or less permanent limits within which weather ranges over a period of time. The climate can be subdivided into macro, micro- and crop climate. Macroclimate is the general weather conditions over the field while microclimate is the outcome of macroclimate acting on limited environmental units, such as slopes or valleys, light or dark soil, or on units under different environmental management, e.g. tilled or untilled, irrigated or unirrigated fields, bare or cropped land, etc. The interaction of microclimate with the crop can be termed as crop climate.

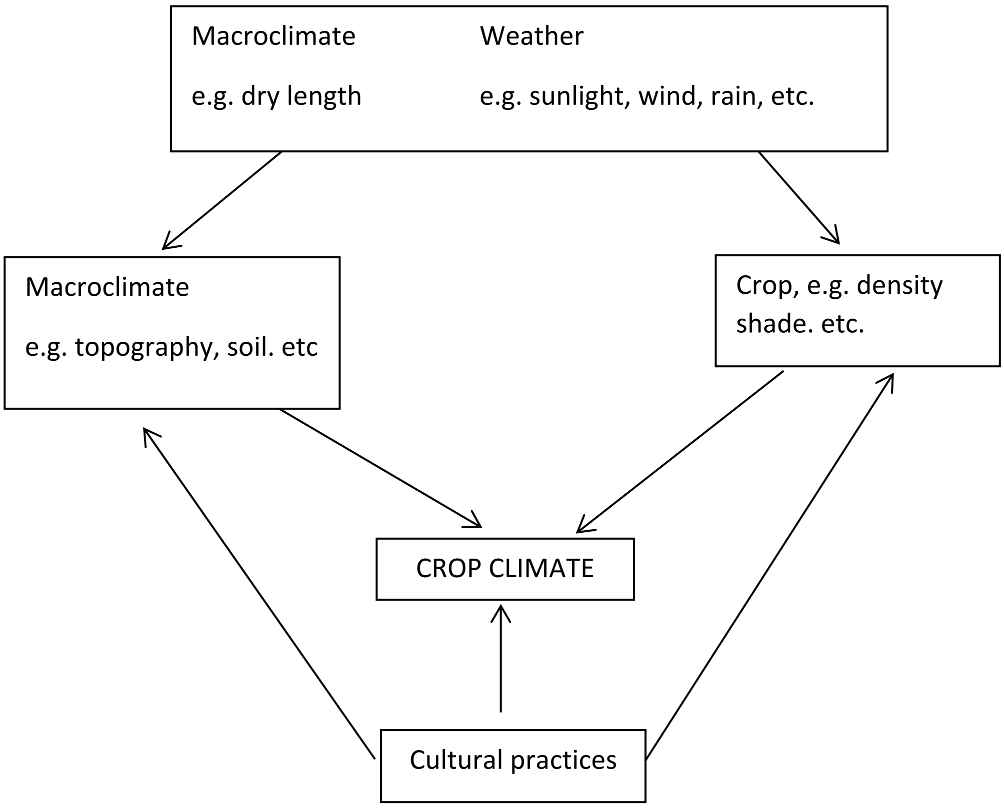


Figure: The Interaction of Macro, Micro and Crop Climate.

Although the crop climate is determined by macroclimate through microclimate and crop conditions and cultural practices, the nature of the crop growth and cultural practices may keep the conditions fairly stable-for longer periods as compared to the climate outside the crop. This is very important for pathogenesis of organisms flourishing under moderate temperature and high humidity conditions.

In the same manner as the atmospheric environments, the soil environments can also be divided into two parts, the environment of soil away from the plant root system and the soil environment in the root zone under the influence of biologically active roots (the rhizosphere). The conditions in these two zones are altogether different and can influence soil-borne plant pathogens differently.

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Manures for Vegetable Production and Soil Health

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Introduction

Soil fertility and crop production can be maintained only by efficient and judicious management of nutrients addition to the soil from external sources. Of the two sources most widely used all over the world, one is organic in nature- the organic manures, simply called manures, and the other comprises the synthetic or naturally occurring chemical fertilizers, simply called fertilizers.

The term manure originally meant that which was worked by hand, but gradually, came to apply to any process by which the soil properties could be improved. Prominent among such processes was that of directly applying manures to the land, manure in this sense being what is now called farmyard manure or dung, the excreta of farm animals mixed with straw or other litter. Ronald Fisher seems to have used the word manure systematically for what we would call fertilizer today.

Definition of Manure

The materials, which are organic in origin, bulky in nature and capable of supplying plant materials in available forms having no definite chemical composition with very low analytical value and generally produced from animal and plant waste products, are called manures.

Advantages of Manure

1. Improve soil structure, aeration, infiltration rate and water holding capacity of soil.
2. Provide all essential nutrient elements, which are available in the soil for longer periods.
3. Can be prepared locally and eco-friendly.

Disadvantages of Manure

1. Elemental content is low and nutrients availability is slow.

2. If applied when not fully decomposed, tend to induce nutritional deficiency.

Classification of Manure

Manures are evaluated mainly based on their nitrogen content and the amount of organic matter present in them. Based on nitrogen content, the manures may be arbitrarily grouped into bulky organic manures and concentrated organic manures, the former being comparatively lower and the latter higher in nitrogen.

Importance of Organic Matter / Wastes in Vegetable Production

1. Vegetable crops need soil with a high amount of organic matter (humus).
2. Application of compost, farmyard manure, night soil, oil cakes, or green manure increases organic matter in the soil.
3. Many microorganisms, such as bacteria, actinomycetes, fungi, moulds, yeast, protozoa, diatoms, worms and algae, decompose the organic matter.

Manure Management

Returning manure to crop fields recycles a large portion of the plant nutrients removed in harvested crops. On farms where livestock are fed large amounts of off-farm purchased feeds, manure applied to crop fields is a substantial source of nutrient inputs to the whole farming system, however, just as nutrients can be lost from the soil, nutrient losses from manure during storage, handling and application are both economically wasteful and a potential environmental problem.

Bulky Organic Manures

Farmyard Manure: This is the traditional manure and is mostly readily available to the farmers. Farmyard manure is a decomposed mixture of cattle dung and urine with straw and litter used as bedding material and residues from the fodder fed to the cattle. The waste material of cattle shed consisting of dung and urine soaked in the refuse of the shade is collected daily and placed in trenches about 6-7 m long, 1.5-2.0 m broad and 1.0 m deep. Each trench is filled up to a height of about 0.5 m above the ground level. The top of the heap is to be made dome shaped and plastered over with cow-dung earth slurry. It becomes ready to apply after 3-4 months. It is possible to prepare by this process 7.0-8.5 m3 of manure (5-6 tonnes or 10-12 cartloads) per year per head of cattle. Well rotten farmyard manure contains nitrogen 0.4 to 1.5%, phosphorus 0.3-0.9% and potassium 0.3-1.9%. Animal and cow dung from biogas are also used in similar manner.

Composting

It is the process of producing compost through aerobic decomposition of biodegradable organic matter. The decomposition is performed primarily by aerobes, although larger creatures suchas ants, nematodes and oligochaete worms also contribute. This decomposition occurs naturally in all but the most hostile environments, such as within landfills, extremely arid desert or cold weather such as boreal winters or polar regions, which prevent the microbes and other decomposers from thriving.

Vermiculture

Vermiculture means scientific method of breeding and raising earthworms in controlled conditions. It aims at creating improved conditions artificially so that earthworms multiply in shortest possible time and space. Earthworm is the worm of soil so its multiplication and growth will more in earthen pot. Commercially, the vermiculture is practiced in cemented or wooden box. A pot of 1x1x0.5 m dimension is sufficient to raise 20,000 earthworms. Firstly, entire bottom of the pot has to be covered with 5 cm depth sand. Above the sand layer, another layer of farmyard manure having 7.5 cm thickness to be constructed. Now, urine free 2-3 days pre-decomposed dung with live soil has to be spread above the farmyard manure layer up to the neck of the pot. Feeding materials like rice husk water hyacinth dust, wheat bran, gram-bran and pre-decomposed kitchen wastes can be mixed with the dung. This base material (medium) is to be watered so that moisture content should be around 50-60%. After watering, the medium earthworms are released and the whole surface is covered with moist gunny bag. About 25-30°C temperature of the medium favours the multiplication rate. Then, the pots are kept in undisturbed shady place. Occasional feeding and watering are practiced. Cocoons and earthworm are found on the surface of medium after a month or so.

Precautions to be Taken

1. Use right type of earthworms.
2. Maintain proper moisture.
3. Protect the earthworms from ants, rats and other birds.

Characteristics of Good Vermicompost

1. Fully decomposed and matured organic manure with C: N ratio about 15: 1.
2. Contains essential plant nutrients.
3. Rich in millions of beneficial bacteria, particularly N-fixer.

Benefits of Vermicompost

1. Increases growth, flowering and fruiting.
2. Develops soil structure for better root alteration.
3. Improves water retention capacity.

Quality Assurance and Making the Most of Vermicomposts

Maintaining a feed as uniform as possible and maintaining a population of worms as uniform as possible is the only way out to standardize the properties of a vermicompost. However, the fertilizer value is only slow-release (not immediate).

Sheep and Goat Droppings

It is also valuable organic manure, which is effective to all types of crop. It contains nitrogen about 0.5 to 0.7%, phosphorus 0.4 to 0.6% and potassium 0.3 to 1.0%.

Bone Meal

Bones from slaughterhouses, carcasses of all animals and from meat industry constitute bone meal, which is the oldest phosphatic fertilizer used.

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Storage Problems in India

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Introduction

India is one of the largest producers of food grains in the world, with a global share of 76% in production. Important food grains produced in India include cereals i.e. wheat, rice, maize, millets i.e. sorghum, pearl millet ,pulses i.e. chickpea, pigeon pea, soyabean and oilseeds including groundnut ,rapeseed and mustard. these grains are of utmost importance as they form the major portion of Indian diets. The importance of other grains especially minor millets i.e. fingers millets, kodo millets, barnyard millets etc. is also increasing largely because of their high nutritional significance and the increasing health consciousness of consumers.

food grains form the basis of almost every diet all over the world and we cannot even imagine our survival in the absence of food grains ,especially wheat and rice which are considered to be staple food grains of India. Nutritionally food grains are known to be significant with respect to their carbohydrates and protein contents, although the ratio vary considerably within different grains ad their varieties. This may be more clearly understood by considering that soyabean is a rich source of protein as well as at ,whereas, wheat is a rich source of carbohydrates and proteins.as far as storage of food grains is concerned ,emphasis has been laid to only major crops like wheat ,rice ,maize and some of the pulses. However, there are many food grains which are nutritionally very important but do not find priority in modern storage systems, due to lack of storage capacity.

Grain	World		India		India's Share
	Area	Production	Area	Production	In Production
Wheat	218.461	713.183	29.650	93.510	13.11
Rice	164.722	745.710	43.500	159.200	21.35
Maize	184.192	1016.736	9.500	23.290	2.29
Sorghum	42.120	61.385	6.180	5.280	8.60
Bajra	-	-	9.120	9.200	-
Soyabean	111.270	276.406	12.200	11.948	4.32

Indian Scenario

1. India produces about 250 mt of food grains.
2. Indian wheat production has jkyrocketed to 95 mt on the strength of govt buying.
3. Corn production has gone up to 21 MT, states like Karnataka ,Bihar have done wonder in crop production.

What are the Methods Used to Store the Food Grains?

With the increase in food grain procurement since 2008-09 ,the food corporation of India had to depend on space available through central warehousing corporation(cwc),state warehousing corporation (swc) and the private players .the methods used by their organization to store food grains include follow:

1. Covered storage: Most popular method used by CI,CWC and SWCS. It is the method where in a jute bag is used to store the grains. Grains packed in jute bags are piled inside warehouses or godowns.

2. Cover and plinth (CAD) method: In this method which the food grains are stored in the open with necessary precautions like rat and damp-proof plinths. This method also makes use of drainage and covering of stacks with special polyethylene covers etc.

3. Silos: These are tall tower like structures used to store grains .silos require 30% less land when compared to the conventional warehouses and can run round the clock ,making them more efficient.

4. Silo bag tech: Silos bag is hermetic type storage made with plastic bags in shape of a tube. These bags can protect the grains from UV rays, humidity ,dust etc. They are also but suited or short term, high volume grains to assist with harvest logistics.

Issues and Challenges

1. Poor Farm Storage Facilities: The storage facilities at farm levels are poor often leading to damage by pests and insects. The storage facilities are also not suitable for long time storage of grains.

2. Imbalances in availability of storage capacity: There has been an increasing in storage capacity of FCI over the past years. The CAG report 2013 revealed serious imbalances on availability of storage capacity and huge storage of storage space is consuming states according to the report out of the total storage, space available with FCI,641 was located in the large procurement states like Punjab, Haryana ,Andhra Pradesh, Uttar Pradesh, and Chhattisgarh.

3. Storage of grains in open space: During procurement season ,due to lack of proper CAD storage facilities, stocks are simply damaged open spaces are much of these stocks get damaged because of seepage of water from ground in the absence of proper plinth and height of ground or due to floods and rains.

4. Poor infrastructure and storage facilities: The warehouses back adequate ambience such as proper temp and moisture which greatly affects the quality of grains and leads to damage and wastage of the products i.e. the grains get infested with mould and insects due to lack of safe and scientific storage practices.

5. Associated health issues: According to WHO proper, disease any cotoxins are found in moldy grains/foods. These release aflatoxins which have serious health implications and are cancer causing.

6. Non-adherence to the principle of first in first out(IO): The proper estimates resulting in extra procurement is a major issue which strains storage capacity. Failure to ensure early disposal of damaged stock led to blockage of storage space and also cause damage to exciting stock.

7. Insufficient storage facilities: India currently lacks of necessary storage at the farm level, leading to the damage of grains by pests and insects. furthermore, the storage facilities in the country are unsuitable for long term storage of grains.

8. Imbalance in India's storage capacity: According to report published in 2013 showed a serious imbalance in the availability of storage capacity.it was found that there was a huge storage space in storage facilities in consuming states.as per the report ,out of the total FCI storage space, 64 was located in large procurement state such as Punjab, Haryana ,Andhra Pradesh, Uttar Pradesh, Chhattisgarh.

Food grains storage and management in India

What are the Initiatives Taken by the Govt. to Enhance Grain Storage Capacity?

1. National policy on handling and storage of food grains, 2000: Its objectives to reduce the losses that occurs during the storage and transit of food grains at arm and commercial levels.

a. It also aims to modernize the system of handling, storage and transportation of food grains.

b. Declare food grain storage as infrastructure. Transport grains from arm to silos in special trucks.

2. Gramin Bhandaran Yojana: It is a capital investment subsidy scheme or the construction /renovating of rural godowns.

a. Introduced in 2001-2002.

b. Under these schemes the project or the construction of godowns can be taken up by any individuals, farmer, group of farmers, NGOC, SHGS, companies, etc.

3. Private Entrepreneurs Guarantee Scheme:

a. These schemes was formulated in 2008.under these schemes ,the storage capacity is created by private players, central ware housing corporation or state govt agencies or guaranteed hiring by the food corporation of India.

b. Govt does not provide any funds or lands or the construction of godowns andull investments is done by private parties or CWC or state agencies.

c. After the godown is constructed and taken over by the FCI, storage charges are paid to the investor or a guaranteed period of (9-10yrs)irrespective of the quality of food grains stored.

Possible Solutions

1. Administrative and political unit: Few years back a question was asked in the Indian parliament, whether the government should continue support or undertaking research in various area of agricultural sciences or not? When this question through ministry of agriculture come to the author or comments, W.R.T. situation of post-harvest losses of grains, it was mentioned that we have done enormous research on storage of grains and related areas, but it is dehearting that a limited proportion of research has sought the attention of post governments. Thousands of tons of food grains washed of and spoilt every year in the month of April due to sudden heavy rains in the areas where FCI or government food grains collected and storage centres are located. Millions of grains are stored in open jute bags covered with polyethylene sheets. I personally think that a major proportion of this loss can be averted just by building permanent shed platforms are providing roof covers over them. I do not think that this requires any scientific intervention or research. The only thing which is required is government and administrative will. Therefore, a large no. of such covered structures is required to be built all over the country to reduce post-harvest losses of food grains.

2. Efficient and Affordable Storage Structures: In India storage of grains is done at many levels. The major production is stored at farmer level and is root cause of massive storage losses. Therefore, suitable food grain storage structures at affordable cost are required at minimized the losses.

3. Community Drying Cum Storage Complains: Considering the specific requirements of food grains moistures in various crops ,community drying cum storage complexes need to be developed .safe storage guidelines need to be developed or the crops or verities where there are not existing and the existing guidelines to be followed or all remaining common grains.

4. Handy Gadgets: Simpler, faster and handy gadgets or grain moist-your determination is required to be developed. This would enable farmers and the stakeholders at any level to ensure maintenance of moisture blow specific level or safe storage of grains.

5. Moisture temperature storage lie charts: At all possible moisture contents and temperature information on the no of days of safe storage of grains must be provided farmers and stake holders. Regular checking of moisture content of food grains should be practiced in order to reduce the fungal infestation. Hence it requires proper platforms tests before procurement of grains or storage.

6. Pest control: Proper maintenance and practices to control pests and rodents should be adopted to reduce the losses. Regular fumigation facility and hygiene practices, facility to regulate the temperature and relative humidity are important.

7. Better transportation: Proper transportation facility is one of the important points to provide in time transfer of food grains to well organized storage sectors.

8. Storage Protocols: Considering the future requirements emphasis should also be given or development of future protocols and infrastructural facilities or minor food grains as well.

9. Subsidies, loans and other support system: Government may also encourage private players or setting up storage facilities by encouraging through subsidized schemes and loans. Conclusively ,it may be said that if our intertime one good and efforts are honest, we can solve any problem. The problem and challenges of safe storage of agricultural commodities have also excited before us. Converging efforts and scientists ,stakeholders and government may provide effective, feasible and sustainable solution or the existing problem of grain storage .further ,the escalating production trends of grain should also be considered while planning or future storage requirements.

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Water Productivity in Integrated Farming System

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Introduction

In India, during recent past, the economic growth is comparatively very fast than the Agricultural growth rate. The growth rate of food grain production decreased to 1.2 % during 1990-2007, lower than the population growth of 1.9 % and the population is projected to touch 1370 million by 2030 and to 1600 million by 2050. As the demand to produce food grains for growing population is higher, 289 and 349 mt during the respective periods, more than 20 % of current cultivable area by 2030 will be converted for non-agricultural purposes.

Agriculture is the largest consumer of water. With increasing demand of water for industry and drinking, the availability of water for agriculture has decreased. However, the demand for food, fodder, fuel and fibre production has increased with increasing population. In present day situation, increasing water productivity through Integrated Farming system has been identified as one of the viable options, where the cropping activity alone in regular farms are integrated with allied enterprises like cropping systems (crop diversification), horticulture, livestock, fishery, sericulture, agroforestry, apiary, vermicompost, biogas, mushroom spawn production, mushroom unit etc. for effective utilization of farm resources along with maximum use of water.

Increasing Water Productivity through Integrated Farming System

Water productivity is defined as “crop production per cubic meter of water consumption”. In sustainable agriculture increasing the water productivity is an important element which paves way for food security and healthy ecosystem functioning. Water productivity can be improved by producing the same output with less water or by increasing output for the same amount of water.

1. Increasing Crop Water Productivity: Water productivity can be improved by appropriate crop selection that adapt to the ecosystem, reducing unproductive water losses and maintaining healthy, vigorously growing crops through optimized water use, nutrient and agronomic management practices. The agronomic measures made in healthy, vigorously growing crops favour transpiration and improves productive water losses. Enhancement in water productivity can be achieved only with proper nutrient management, soil management and pest management. The water productivity across cropping systems, under both irrigated and rainfed conditions has great variations. Scope for improvement is large only when the yield gaps are more. The yield gaps can be reduced with appropriate nutrient and water management done together. Gaps in crop water productivity are often associated with access to water along with access to other inputs like seeds and fertilizers, emphasizing the importance of markets and infrastructure. The canopy development associated with increasing yields limits the scope for reducing water losses, because doubling the yield requires almost twice the amount of transpiration.

2. Increasing Water Productivity in Agroforestry Systems: In the world, agroforestry area is estimated to be around 1023 million ha in 2009 and has possibilities to be increased by including unproductive area, grass and forest lands and degraded lands. Agroforestry enhances resource utilization by improving temporal and/or spatial complementarities in resource capture. Agroforestry provides numerous benefits, ranging from diversification of production to improved exploitation of natural resources and provision of environmental functions, such as soil conservation, improvement or maintenance of soil fertility, water conservation and more productive use of water. Trees regulate water flow and a small change in tree cover can have a large impact on reducing runoff and enhancing infiltration and transpiration. ‘Hydraulic lift’ is an interesting phenomenon in agroforestry systems, whereby the tree root system lifts water from moist deep soil layers to the upper soil layers, where it is accessible to crops. Agroforestry belts acts as riparian buffers to combat non-point source water pollution from agricultural fields and help to clean runoff water by reducing runoff velocity, thereby promoting infiltration, sediment deposition and nutrient retention. The management of riparian vegetation can improve the quality of water in the river and protect coastal ecosystems. In degraded areas, integrating multipurpose trees into farms helps to fight land degradation while increasing the productive use of water.

3. Increasing Livestock Water Productivity: Production of livestock products consume one third of the total water for agriculture and supplies one third of human protein needs. Most of the world's animal production comes from rainfed mixed crop–livestock systems in developing countries and from intensive industrialized production in developed countries. The demand for animal products and the global water scarcity is increasing along with increasing competition for water making it necessary to improve the livestock water productivity (LWP).

LWP was first defined by Peden et al. (2007) as the "ratio of livestock products and services to the water depleted and degraded in producing these; it can also include water depleted in slaughterhouses and milk processing facilities".

The livestock production in areas of low potential and in smallholder systems, would show that livestock are very efficient in making productive use of water that is of low value for other sectors. In small holder systems, livestock often provide multiple services, including farm power for cultivation and transport and manure for soil fertility management. Valuing manure as a beneficial output of livestock systems would result in a much higher value for LWP than when only meat and milk are accounted. The major water depletion in relation to livestock production is the evapotranspiration of water for feed production. The LWP depends mainly on the type, the growing conditions and the management of forage production.

4. Reducing postharvest losses: Approximately 1.3 billion t of food are lost or wasted annually, which is roughly one third of the human food produced. These losses occur mostly at the postharvest and processing levels in developing countries, and at the retail and consumer levels in industrialized countries. However, the per capita food losses in developing and industrialized countries are remarkably comparable. Therefore, to achieve higher productivity in agriculture including water productivity reducing postharvest losses like improved handling, storage methods and pest management.

Conclusions

The demand for food and energy, is the greatest challenge for today and this could be met by increasing the water productivity of crop, livestock, Agro forestry and aquatic food production, while reducing social inequities and preserving the functioning of water bodies. Here the various options and solutions that are available for increasing agricultural water productivity have been reviewed. Integrated farming system, includes a rational mix of cropping systems suited to different agroclimatic zones and improves the socio-economic status of the farmers and can generate additional employment, income for small and marginal farmers along with increasing the water productivity. IFS reduce environmental hazards occurring through mismanagement of farm wastes and resources. It improves farm productivity, quality of life of resource poor farmers along with sustainability.

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Soil Related Constraints and their Management

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A constraint free soil environment is very important for achieving higher food production. The major soil constraints affecting the crop production in Tamil Nadu are:
1. Chemical constraints: Salinity, sodicity, acidity and nutrient toxicities.
2. Physical constraints: High or low permeability, sub soil hard pan, surface crusting, fluffy paddy soils sandy soils etc.

Saline Soils

1. Saline soils are characterised by higher amount of water-soluble salt, due to which the crop growth is affected.
2. For these soils with electrical conductivity of more than 4 dS m-1, provision of lateral and main drainage channels of 60 cm deep and 45 cm wide and leaching of salts could reclaim the soils.
3. Application of farm yard manure at 5 t ha-1 at 10 - 15 days before transplanting in the case of paddy crop and before sowing in the case of garden land crops can alleviate the problems of salinity.

Sodic Soils

Sodic soils are characterised by the predominance of sodium in the complex with the exchangeable sodium percentage exceeding 15 per cent and the pH more than 8.5.

Reclamation of sodic soils:
1. Plough the soil at optimum soil moisture regime.
2. Gypsum requirement-based gypsum application.
3. Impound water.
4. Provision of drainage for leaching out the soluble salts.
5. In situ incorporation of green manure at 5 t ha-1.

Sandy Soils

1. Sandy soils are containing predominant amounts of sand resulting in higher percolation rates and nutrient losses.
2. Compacting the soil with 400 kg stone roller or oil drum with stones inside eight times at proper moisture level once in three years could reduce the percolation losses.
3. Addition of tank silt for coastal sandy soils is recommended for enhancing their productivity.

Fluffy Paddy Soils

1. They are characterised by low bulk density of the topsoil resulting in the sinking of farm animals and labourers as well as poor anchorage to paddy seedlings.
2. Such soils can be reclaimed by, passing of 400 kg stone roller or oil drum with sand inside eight times when the soil is in semi dry condition along with addition of lime @ 2t ha^{-1} once in three years.

Heavy Textured Clay Soils

The clay soils are containing major amounts of clay fraction resulting in the poor permeability and nutrient fixation.

Such soils can be reclaimed by:
1. Addition of river sand at 100 t ha $^{-1}$.

2. Managed by deep ploughing the field with mould board plough or disc plough during summer to enhance the infiltration and percolation.

Low Permeable Black Soils

1. Application of 100 cart loads of red loam soil.
2. Deep ploughing the field with mould board plough or disc plough during summer enhances the infiltration and percolation.
3. Application of FYM, composted coir pith or press mud at 25 t ha^{-1} per year will improve the physical properties and internal drainage of the soil.

High Permeable Red Soils

1. Application of tank silt or black soil at 25 t ha^{-1} per year along with FYM , composted coir pith or press mud at 25 t ha^{-1}.
2. Deep ploughing the field with mould board plough or disc plough during summer to improve the water holding capacity of the soil.

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Micro Climate Modification Using Crop Geometry

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Microclimate

Microclimate is the weather prevailing from the top of the crop canopy to the maximum depth of root penetration. It is also known as plant climate or eco climate or habitat climate. Scale of micro climate is <10 m in horizontal scale and <20 m in vertical scale and 6 to 12 min in time scale.

The microclimate is the environment within and close to the crop canopy and can be modified by crop training, covers, mulches etc.

The growth and development of the crop plants are largely influenced directly or indirectly by microclimate of the crops. Light interception is one among the important micrometeorological factor which mainly influences the function of photosynthesis. The canopy architecture of the crop manipulates the interception of solar radiation of the crops. Yield increases can be obtained by mechanically manipulating leaves to allow greater penetration of solar radiation. Crop geometry is also determining the yield potential of the crop through better utilization of moisture and nutrients from the soil by harvesting the maximum possible solar radiation. Maize, which is normally sown, has only random leaf orientation that often results in mutual shading owing to intra-row orientation. Hence, this study was carried out to identify the appropriate crop geometry and planting pattern for increasing the productivity of maize through creating favourable microclimate in maize. In this book methodologies adopted and the results derived from the study are discussed. I hope that this book will be highly useful resource material for modifying the microclimate to enhance the crop productivity.

Vegetation and Energy Reduction

The effectiveness with which trees provide shade and save energy according to this study depends on their density, shape (geometry) and placement (distance), the dimensions of the shading building, the position of the sun in the sky and whether a tree keeps its leaves all year round also determined overall energy savings. Gomez Monoz et al, (2010), observed that the effect of tree shadowing buildings is found to reduce heating loads and concluded that trees have beneficial effect in energy savings. The results demonstrated that large trees have potentials to provide 70% shade during hot or warm seasons. Pandit et al, (2010) opined that trees cast shades on homes and buildings thereby lowering the indoor temperatures and thus reducing demand for power to cool the buildings during hot times of the year. They developed a statistical model that indicated savings generated by shade-producing tree in a sub-urban environment. Escobedo et al, (2011), observed that Gainesville's urban trees reduce its energy use year-round by shading buildings and providing evaporative cooling effects, saving air conditioning costs during the warm months and block icy winter winds during cold months. It implies that the knowledge of the size of a given building and sizes and positions of the trees near it will enable a researcher to place economic value on the trees based on the amount of reduction and increases in energy use in the building.

Vegetation and Wind Control

Smart (2011), developed concepts of grapevine canopy microclimate by considering how solar heat levels are affected due to high absorption by wind. According to Scudo, (2002), vegetation influenced the direction of wind movement by means of obstruction and deflection, guidance and filtration depending on tree geometry, height, canopy permeability and crown cover. Thus, it is structural characteristics of the vegetation that is the controlling factor for air movement. The parameters typically associated with microclimate include conventional variables such as air temperature, atmospheric humidity, solar insulation fluxes, Wind speed and Wind direction.

Other factors affecting microclimate were also identified to include national environmental factors such as topography, sun angle exposure, latitude, soil type, vegetation cover and other meteorological factors such as cloud cover, regional precipitation, high altitude, wind characteristics.

Relationship to Climate Change

Temperature was identified as the fundamental parameter for assessing trends in climate change. The role of vegetation in urban microclimate control have positive effects such as shading effects, surface temperature reduction through absorption and reflection, ground temperature reduction by reflection and absorption of urban heat island especially during the night, and controlling wind effect through blockages and re-direction if properly positioned.

To provide proper shadow effect, the vegetation density needs to be high enough but not too high as to create wind obstruction. Shading by vegetation to be dependent on the vegetation density configuration that is its shape, height and canopy position, distance from the shaded structure, building relation to the position of the sun. Tree shading has the ability to reduce thermal heat through solar energy interception. Shading was observed in the study area to reduce afternoon temperature at both street and open space levels. Complete shading by trees eliminates about 70 % of solar energy falling on the canopy.

Effects of Windbreaks on Airflow, Microclimates

The mechanisms by which a porous windbreak modifies airflow and microclimate. It shows how a turbulent mixing layer initiated at the top of the windbreak dominates the airflow behind a windbreak. This mixing layer spreads vertically as it moves downwind, growing at a rate determined by the turbulence in the approach flow and the windbreak's 'permeability'. The roughness of the terrain and land-cover upwind, windbreak height and porosity are thus the main controls on the amount and extent of shelter provided by a windbreak. The changes in temperature, humidity, heat and evaporation fluxes given these changes in turbulence are then described. Based on the turbulent mixing layer model, the highly sheltered 'quiet zone' will be typically warmer and more humid while further downwind in the 'wake zone', cooler and drier conditions would be expected. Shade is also shown to modify the heating in the quiet zone and, depending on the orientation of the windbreak, can offset the warming in the quiet zone. Lastly, the mechanisms affecting plant productivity are described in light of these airflow and microclimate changes. A major effect of a windbreak is to reduce the incidence of low frequency, high magnitude damage events such as sandblasting or lodging. Microclimate effects, however, do not always improve productivity. For example, while shelter may improve water-use efficiency in irrigated crops by increasing yields and reducing water-use, this may not be the case in dry land agriculture.

Pests and Diseases

The survival of pests and plants diseases is affected significantly by microclimate conditions. There may be ways you can manage and manipulate the microclimate to provide less favourable conditions for pest and disease.

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What Do and Don't During Cold Waves

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A cold wave (known in some regions as cold snap and in Mongolia as a zud) is a weather phenomenon that is distinguished by a cooling of the air. Specifically, as used by the U.S. National Weather Service, a cold wave is a rapid fall in temperature within a 24-hour period requiring substantially increased protection to agriculture, industry, commerce, and social activities.

The precise criterion for a cold wave is determined by the rate at which the temperature falls, and the minimum to which it falls. This minimum temperature is dependent on the geographical region and time of year. In the United States, a cold spell is defined as the national average high temperature dropping below 18 °F (−8 °C).

Formation of Cold Waves

1. The core of a cold wave at the surface is a strong high-pressure centre that forms during winter in high latitudes.
2. Cold polar or Arctic air masses are relatively shallow, extending one to several km above the surface.

Effect of Cold Waves

1. Cause death and injury to livestock and wildlife.
2. Exposure to cold mandates greater caloric intake for all animals, including humans, and if a cold wave is accompanied by heavy and persistent snow, grazing animals may be unable to reach needed food and die of hypothermia or starvation.
3. The belief that more deaths are caused by cold weather in comparison to hot weather is true as a result of the after effects of these temperatures (i.e. cold, flu, pneumonia, etc.) all contributing factors to hypothermia.
4. Extreme winter cold often causes poorly insulated water pipelines and mains to freeze.
5. Even some poorly protected indoor plumbing ruptures as water expands within them, causing much damage to property and costly insurance claims
6. Motor vehicles may fail when antifreeze fails or motor oil gels, producing a failure of the transportation system.
7. The air during a cold wave is typically denser and thus contains more oxygen, so when air that a fire draws in becomes unusually cold it is likely to cause a more intense fire.
8. Cold waves that bring unexpected freezes and frosts during the growing season in mid-latitude zones can kill plants during the early and most vulnerable stages of growth, resulting in crop failure as plants are killed before they can be harvested economically.
9. Cold waves have caused famines.
10. At times as deadly to plants as drought, cold waves can leave a land in danger of later brush and forest fires that consume dead biomass.

What to do During a Cold Wave?

1. Stay indoors as much as possible
2. Eat to supply heat to the body and drink non-alcoholic beverages to avoid dehydration.
3. Dress properly if you must go outside.
4. Wear several layers of, lightweight; warm clothing rather than one layer of heavy clothing.
5. The outer garments should be tightly woven and water-repellent.
6. Mittens are warmer than gloves.
7. Cover your head as most body heat is lost through the top of the head.

8. Cover your mouth to protect your lungs.

More Do’s and Don’ts

1. Avoid over work.
2. Over exertion can bring on a heart attack, a major cause of death in the winter.
3. Watch for signs of frostbite; loss of feeling and white or pale appearance in extremities such as fingers, toes, ear lobes and the tip of the nose.
4. Watch for signs of hypothermia (subnormal body temperature); uncontrollable shivering, memory loss, disorientation, incoherence, slurred speech, drowsiness and apparent exhaustion.

Transportation Options During Cold Wave

1. Consider public transportation if you must travel. If you travel by car, travel in the day, don’t travel alone, and keep others informed of your schedule. Stay on main roads; avoid back-road shortcut.
2. Winterize your car. This includes a battery check, antifreeze, wipers and windshield washer fluid, ignition system, thermostat, lights, flashing hazard lights; exhaust system, heater, brakes, defroster, oil level, and tires. Consider snow tires and keep your car’s gas tank full.
3. Carry a “basic vehicle emergency kit” in the trunk of your vehicle.

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Mycotoxins: Hazard to Human and Animal Health

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The term mycotoxin was used for the first time in 1961 in the aftermath of an outbreak of an unknown disease which killed poultry birds. It was a major veterinary crisis in England, during which thousands of animals died and was named Turkey X disease. The disease was linked to a peanut meal, incorporated in the diet, contaminated with a toxin produced by the filamentous fungus *Aspergillus flavus*.

Mycotoxins are the metabolites having biological activity and it may be expressed by their inhibitory or lethal effects on human or animal health. Unlike bacterial toxins, fungal toxins (mycotoxins) are not proteins and therefore are not usually detectable by the immune systems of humans and animals. Toxins can remain in the organism after fungus has been removed as due to lack of visible appearance of fungus does not negate presence of mycotoxins.

Wide range of mycotoxins or metabolites is produced by certain fungi such as moulds. There are many species of moulds and hundreds of known mycotoxins. Species of mycotoxin-producing moulds include *Fusarium, Trichoderma,* and *Stachybotrys.* A single mould species may produce several different toxins, and a given mycotoxin may be produced by more than one species of mould.

Fungi	Substrate	Mycotoxin
Aspergillus flavus	Maize, groundnut, oilseed, cotton seed	Aflatoxin
Aspergillus parasiticus	Maize, groundnut, oilseed, cotton seed	Aflatoxin
Aspergillus nomius	Maize, groundnut, oilseed, cotton seed	Aflatoxin
Aspergillus carbonerius	Grapes wine, coffee	Ochratoxin
Aspergillus ochraceus	Barley, wheat	Ochratoxin
Fusarium oxysporum	Wheat, barley, maize	Fumonisins
Fusarium sp.	Wheat, barley, maize	T-2 toxin
Penicillium verrucosum	Wheat, barley, maize	Ochratoxin
Claviceps purpurea	Rye	Ergot alkaloids
Stachybotrys	Hay	Satratoxins

Furthermore, toxin-producing molds do not necessarily produce mycotoxins under all growth conditions, with production being dependent on the substrate, temperature, water content and humidity. The mycotoxins probably evolved as a kind of "chemical defense system" to protect the mold from insects, microorganisms, nematodes, grazing animals and human. Nearly 300 different types of mycotoxins formed by 350 species of microorganisms are known. The important among them are alfatoxins, stergmatocystin, ocharactoxin, zearalenone etc. the most widely occurring mycotoxin is alfatoxins. The major mycotoxin producing moulds include *Aspergillus paraticus* (producing B1, B2, G1 and G2 toxin), *Aspergillus flavus* (producing B1and B2 toxin), *Fisaroi serptracjopds* (producing T-2 toxin), *Fisaroi graminearum* (producing deoxynivalenol/zeralenone toxin), *Penicillin verrercosum* (producing ochratoxin-A).

In human and animal, mycotoxin is responsible for a number of diseases. The toxicities produced as a result of infestation of mycotoxins may be fatal or chronic. In mammals it may affect the central nervous system, cardiovascular or pulmonary systems. Some mycotoxins on prolonged consumption may prove to be carcinogenic. The most potent hepatocarcinogens known is alfatoxin B1. Prominent cases of Human mycotoxicosis include the one which was happened in Taiwan in the year 1967, where 26 members in a farming community became ill after eating contaminated rice; 3 children died. The cause of death was diagnosed to be the consumption of contaminated rice which showed >200 µg aflatoxin B1/kg. In 1974, an outbreak of hepatitis in India affected 400 people resulting in 100 deaths. The cause of death was consuming of aflatoxins in corn (>15 mg/kg).

The major reasons attributing to the growth of fungus and moulds on grain and production of mycotoxin is bio deterioration of grains coupled with conducive temperature and moisture content on and surrounding the grain.

Lethal toxicities in the sense of acute and chronic diseases are elicited by mycotoxins. The LD50 value for aflatoxins is 18.2 ppb (microorganisms per kg body weight) while, for most of the mycotoxins LD50 value ranges from 3 to 4 mg per kg body weight. So, mycotoxins are the most dangerous apart from hepatocarcinogenic in nature.

The problem arising can be addressed by controlling the cause that resulted in such effects i.e. temperature, moisture and pests. Which encourage spoilage and it's needed to be hampered. Bio-deterioration of grains caused by microorganisms, insects, rodents etc be prevented. Improved handling and quality control would have a significant effect on reducing the incidence of mycotoxins in food and feeds. While storing the grain it must be assured that moisture content in grain be reduced to 8% or otherwise hermetic storage i.e. at high CO_2 and low O2 levels in air tight containers is a sure way of preventing mycotoxin production. In case preventive methods are not applicable, then detoxification has to be attempted. For achieving detoxification ammonisation process is the best. In this process, ammonia gas at 2-3 atm is forced through the grain for 15-30 minutes at a temperature of 90°C.

Fungus that produces mycotoxins can grow on a variety of different crops and foodstuff and can penetrate deep into food and do not just grow on the surface. Fungus usually does not grow in properly dried and stored foods, so efficient drying of commodities and maintenance of the dry state, or proper storage, is an effective measure against mould growth and the production of mycotoxins. Every effort must be made to minimize the occurrence of mycotoxins in food and feeds otherwise, it's a silent threat to the humans and animals' health. As per the guidelines issued by WHO, in order to minimize the health risk from mycotoxins, care should be taken to inspect whole grains which are all regularly contaminated with aflatoxins for evidence of mould and those grains that look mouldy, discoloured, or shrivelled must be discarded. Mostly damage to the grains occurs before and during drying, and in storage. Avoid such damages of grains, as damaged grain is more prone to invasion of fungus and therefore mycotoxin contamination. Storage of food articles is of prime importance every care must be taken to store food articles properly – kept free of insects, dry and not too warm. Also, there is no need to keep foods for extended periods of time before being consumed. For healthy living ensure a diverse diet – this not only helps to reduce mycotoxins exposure, but also improves nutrition.

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Speed Breeding for Crop Improvement

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Introduction

The speed breeding concept was inspired by NASA's efforts to grow crops in space, using an enclosed chamber and an extended photoperiod. Perhaps, the most well-known strategy for increasing generation turnover is 'shuttle breeding introduced by Norman Borlaug in the 1950s at the International Centre for Maize and Wheat Improvement (CIMMYT), which enabled growing two generations per year by sowing wheat populations at two different field locations differing in altitude, latitude and climate in Mexico. To increase the productivity and stability of crops, there is pressure to fast-track research and hasten the development of new crop varieties. The relatively longer generation time of most crops represents a bottleneck in applied research programs and breeding, creating the need for technologies that accelerate plant growth and development and generation turnover.

Speed breeding is the rapid generation advancement technique of accelerating research by shortening the breeding cycle. The speed breeding platform developed at John Innes Centre, U.K. and University of Queensland Australia used supplementary lighting and temperature control for extending the photoperiod, enabling rapid generation advancement in glasshouses with sodium vapor lamps (SVL) or growth chambers fitted with a mixture of metal halide and light-emitting diode (LED) lighting. By adopting a 22 hours photoperiod and a controlled temperature regime, generation times were substantially shortened for spring bread wheat (*Triticum aestivum*), durum wheat (*T. durum*), barley (*Hordeum vulgare*), chickpea (*Cicer arietinum*), pea (*Pisum sativum*), canola (*Brassica napus*), model grass, *B. distachyon*, and the model legume, *Medicago truncatula*. Under the rapid growth conditions, plant development was normal, plants could be easily crossed (wheat and barley), and seed germination rates were high.

Speed Breeding Setup and Protocols

1. Lights: An appropriate spectral range can be achieved through LEDs, or a combination of LEDs and other lighting sources (e.g., halogen lamps), or in the case of a glasshouse, by simply supplementing the ambient lighting with LEDs or SVLs. In addition to controlling the light quality, a PPFD of ~450–500 µmol/m^2/s at plant canopy height is also recommended.

2. Photoperiod: A photoperiod of 22 h with 2 h of darkness in a 24-h diurnal cycle.

3. Temperature: The optimal temperature regime (maximum and minimum temperatures) should be applied for each crop. A higher temperature should be maintained during the photoperiod, whereas a fall in temperature during the dark period can aid in stress recovery.

4. Humidity: Most controlled-environment chambers have limited control over humidity, but a reasonable range of 60–70% is ideal.

Increasing the period of illumination through supplemental lighting sources greatly shortens crop generation time and accelerating the maturation of grains**.** Further, increasing plant density proved pretty efficient to help the plants grow faster. A glasshouse is often preferred for because plant populations can be grown year-round. This process involves a large investment in time as well as space within the glasshouse. Following the crossing of two homozygous lines, six generations of self-pollination are required to produce progeny that are 98.4% homozygous, which, at a rate of two generations per year, would take 3 years to complete. Although only one or two seeds are needed from each plant to begin the next generation, plant researchers and breeders seek to maximize the number of plants within a restricted space. Plant density can be scaled up under SB to enable concurrent rapid cycling of large plant populations.

Sr. No.	Crops	Normal generation time	Generation time due to speed breeding
1.	Bread Wheat	2-3 generations/year	6 generations/year
2.	Durum Wheat	“Do”	“Do”
3.	Chick pea	“Do”	“Do”
4.	Pea	“Do”	“Do”
5.	Grass pea	“Do”	“Do”
6.	Brassica rapa	“Do”	4 generations/year
7.	*Brassica oleracea*	“Do”	“Do”
8.	Canola *(Brassica napus)*	“Do”	“Do”
9.	Soybean	1-2 generations/year	5 generations/year

Advantages

1. The technique has a great potential to accelerate cereal research and cultivar improvement when combined with modern breeding technologies.
2. This technique has potential to works in conjunction with genetic transformation.
3. Speed breeding is likely to reduce generation time for other crop species, for example, sunflower (Helianthus annuus), pepper (Capsicum annuum), and radish (Raphanus sativus), which have been shown to respond well to extended photoperiod.
4. Speed breeding could be used to rapidly generate fixed populations through SSD, which in some species may be cheaper than generating double haploids, for subsequent field evaluation and selection, thus facilitating genetic gain and production of improved cultivars.
5. For genetically well-defined traits, speed breeding could be used to rapidly introgressive genes or haplotypes into elite lines using marker-assisted selection.
6. In a breeding context, rapid generation advance to homozygosity through SSD method following crossing will facilitate genetic gain for key traits and allow more rapid production of improved cultivars by breeding programs.
7. It accelerates the production of DH lines by speeding up the crossing, plant regeneration and seed multiplication steps.
8. Accelerate plant development for research purposes, extensive phenotyping, mutant studies and transformation studies.

UQ scientists, in partnership with Dow AgroSciences, have used the technique to develop and commercially release the wheat variety ‘DS Faraday’, increased yield, high protein, milling wheat with tolerance to pre-harvest sprouting. However, developing speed breeding protocols for crops is expensive and need a lot of investments.

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Bulk Segregant Analysis: Rapid Discovery of DNA Markers and Quantitative Trait Mapping

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Introduction

Quantitative trait analysis is usually associated with construction of mapping population and genotyping of each individual plant with genome wide markers as well as phenotyping for the traits of interest. But, genotyping of a large mapping population is tedious and relatively costly. So, by grouping plants from two extreme phenotypic classes or two extreme tails of quantitative trait variation and extracting and bulking DNA from these two bulks, the process of genotyping is reduced to only two DNA samples instead of analyzing DNA separately from each plants of a population. Two variants of the BSA technique are possible depending on whether these plants are derived from a cross between two contrasting parental lines or from a population of plants with diverse genetic backgrounds (e.g. variety mixes or composite populations). This was first described for use in plant genetics by Michelmore et al., 1991, he tagged disease resistance using contrasting bulks genotyped with random amplified polymorphic DNAs (RAPDs). They also described tagging of different traits using either RAPDs or RFLPs or SSRs markers through BSA over other genetical techniques for gene 'tagging', such as use of near isogenic lines which is produced by tedious and cumbersome process of the repeated back crossing (Michelmore et al., 1991).

Most of the economically important traits are genetically complex, which are affected by many genes, environments and their interactions. However, conventional analysis methods require assaying all the individuals for the target traits collected from a sample population. As a result, it is usually expensive and time-consuming (Zou et al., 2016). To maintain the robustness of data by reducing cost and simplifying analytical process, selective assay, such as selective genotyping, by which only individuals with extreme traits (usually the two tails selected from a sample population) are analysed, has been proposed (Sun et al., 2010). More recently, bulk segregant analysis has been modified to locate the target genes, by using large populations, increased tail sizes and high-density markers so that there is no need to validate the putative markers by genotyping the entire populations using the positive markers (Sun et al., 2010). As a consequence, it has dramatically reduced genotyping cost by using selective samples, while the statistical power in QTL mapping is comparable to the entire population analysis (Sun et al., 2010). Considering a population with 500 individuals where 25 extreme ones are selected to form two contrasting bulks, bulk segregant analysis will only cost 0.4% (=2/500) of the total cost required for entire population analysis (Zou et al., 2016). With the development of molecular breeding technologies in recent years, bulk segregant analysis has also witnessed many improvements. Apart from biparental segregating populations, the pooled DNA analysis can be used for two contrasting groups of individuals from any population as suggested by Xu et al., (2008) and Sun et al., (2010).

Bulk segregant analysis (BSA) was initially designed to target the traits controlled by major genes with large effect and less effected by environmental interaction (Zou et al., 2016). But, recent advances in BSA have increased the power of bulk segregant analysis in identifying minor causal alleles. as followings given below. Altinkut & Gozukirmizi (2003) used bulk segregant analysis (BSA) to identify microsatellite markers associated with water-stress tolerance in wheat. Microsatellite analysis was then performed on the established DNA pools, using 35 primer pairs from chromosome group 5 (5A, 5B, 5D), to detect microsatellite fragments that were present, absent, or both in the DNA pools and their parental lines. One microsatellite fragment was identified that was present in tolerant parent and the tolerant bulk but was absent in the sensitive parent wheat and sensitive bulk, and that marker was tagged for tolearance.

Bernier et al. (2007) used a population of 436 random F3 derived lines from a cross between the upland rice cultivars Vandana and Way Rarem for yield under reproductive stage drought stress. For QTL detection, a set of random lines and the highest and lowest yielding lines under both stress and nonstress conditions were genotyped by 126 SSR markers. A QTL (qtl12.1) with a large effect on grain yield under stress was detected on Chromosome 12. The whole population was genotyped for additional markers on Chromosome 12, allowing QTL localization to a 10.2 cM region between SSR markers RM28048 and RM511.

Venuprasad et al. 2009; investigated F4:5 population of 490 recombinant inbred lines (RILs) from the cross Apo/2*Swarna to detect quantitative trait loci (QTL) with large effects on grain yield under drought stress using bulk segregant analysis (BSA). Two rice microsatellite (RM) markers, RM324, and RM416, located on chromosomes 2 and 3, respectively, were shown to be strongly associated with yield under lowland drought stress. The QTL linked to RM416 (DTY 3.1) had a large effect on grain yield under severe lowland drought stress, explaining about 31% of genetic variance for the trait ($P < 0.0001$).

Kanagaraj et al. (2010) performed BSA to identify markers linked to drought resistance using 23 recombinant inbred lines of IR20/Nootripathu. The parents were screened for polymorphism using 1206 rice microsatellite primer pairs. Out of 134 SSR polymorphic primers between parents, three primers showed polymorphism between bulks. These three primers co-segregated among the individual RILs constituting the respective bulks. The genomic regions flanked by these markers have been reported to be associated with several drought resistance component traits in rice.

Kumar et al. (2019) carried out BSA to identify markers linked to high grain iron and zinc content in pearl millet using F2 population derived from cross of two contrasting parents J 2340 and 30291. Parental lines were screened for polymorphism using 275 SSRs primer pairs. Out of 99 SSR polymorphic primers between parents, two primers showed polymorphism between bulks. These two primers co-segregated among the individual F2s constituting the respective bulks. So, these markers were reported to be putatively linked to high grain Fe and Zn. The identified SSRs markers Xipes0027 and Xpsmp2263 might be useful to screen higher grain iron and zinc content genotypes in pearl millet in future crop improvement program.

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Package of Practices for Organic Seed Production

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Introduction

The term "organic seed" means seed produced under an organic system, ideally one that is certified. Seed, as a foundation and focus point for the development of agriculture (Kloppenburg 1988), is at the center of all principles of organic agriculture—health, ecology, fairness and care (IFOAM 2005;). The organic sector strives to apply organic standards to the entire life cycle of the plant, including the production and use of inputs such as seed (Henatsch 2000; Lammerts van Bueren et al., 2003).

Organic Seed Production Practices

1. Land selection: Land should be organically managed. Avoid the low-lying area to restrict the runoff water contamination from conventional farming system. To avoid contamination from wind, the organic farm shall be separated from conventional farm by live fence or manmade organically managed crop can be maintained as buffer zone. A buffer zone of at least 3 meters shall be maintained between conventional and organic management land. The equipment or implements used for organic management shall be cleaned before use. Crops should be rotated to reduce pest problems and any potential for seed contamination by open pollination with similar species types. The seed production field should not have known weed problems that are too difficult to control through organic means.

2. Soil fertilization: It is important that the fertility of the soil is improved when producing organically since chemical fertilizers cannot be used. To ensure good soil fertility and fewer soil borne diseases, crop rotation, use of a cover crop, green manure crops, mulch, animal compost, and plant material compost can be used.

There are many commercial organic fertilizers available for organic crops; the major ones are listed below:

a. Composted manure used to increase nitrogen content.
b. Inoculates of beneficial fungi, which work with the plant's roots to help them fix nitrogen from the air.
c. Crop residues and green manures
d. Bio fertilizer (Bacterial preparation)
e. Wood ashes to increase potassium.
f. Rock phosphate, often crushed rock that contains elevated levels of phosphate.
g. Seaweed extract, which is not a fertilizer, but aids plant growth and resistance to pests and diseases.
h. Plant preparation and botanicals extract.
i. Vermiculate and Peat.
j. Straw and other mulches.
k. Choice of crop and varieties: Any crop of variety/hybrid except genetically modified organisms/crop which suits to the location shall be used or grown. Pest and disease resistant.

3. Choice of crop and varieties: Any crop of variety/hybrid except genetically modified organisms/crop which suits to the location shall be used or grown. Pest and disease resistant varieties are mostly preferred.

4. Seeds and planting material: Seeds/ planting material shall be used from organically certified source. In case of unavailability of organic seed, untreated seeds from conventional farm shall be used for first year and for subsequent years organic seeds shall be used. In case of growing other varieties which are not grown in the first year, chemically untreated conventional material shall be used. Genetically engineered seeds, pollen, transgenic plants or plant materials shall not be allowed.

5. Planting techniques: Seeds are generally planted directly by drilling in the field or transplanting from a greenhouse-grown seedling. These seed transplants should be organically produced. The seeds must be planted in such a way that proper vegetative development occurs that will support fruit and seed development with proper spacing and depth in the bed.

6. Weed, pest and disease management: Management of weeds and pests is critical to ensure that organically produced seeds have high yield and quality. Weed can be managed through mulching with plant residues and other fully biodegradable materials, livestock grazing and hand weeding coupled with mechanical cultivation. The seed crop is in the field for a long period of time, there are many opportunities for multiple pathogens to interact with a single crop. To control these pathogens organically is complex and requires proper growing conditions.

a. Biological pest control: Biological control utilizes three sources of natural enemies that can be used to control harmful pests and reduce the use of organic pesticides they are parasitoid, predators and weed feeders.

i. Biocontrol agent like *Pseudomonas, Trichodorma*.
ii. Introduction of predators or parasites of the pest.
iii. Natural enemies like spiders, insects, mites, nematodes and birds
iv. Non-synthetics control such as lures, traps and repellant.

b. Physical method: In this method there is use of human effort to control insect pest and disease. The different physical method is listed below:

i. Regulation of temperature: applicable for stored place.
ii. Regulation of light: applicable for field crop.
iii. Regulation of moisture: Use for stored insect pest control.
iv. Use of sound waves.

c. Mechanical method: The mechanical method of insect pest management includes: Hand picking, Sieving and winnowing, Shaking and beating, Netting, Wrapping, Painting and Banding.

7. Harvesting, threshing and drying: Harvesting the male parents' line should be done first. Method of harvesting depends on the type of seed being produced. When harvesting dry-seeded crops, seed shattering must be prevented because seed harvest generally occurs after the crop reaches physiological maturity. To reduce shattering, the stalks of the plant need to be cut while still green and field dried, allowing for uniform seed maturation.

8. Cleaning and Storage: Once seeds are harvested, threshed and extracted. They should be evaluated to determine the physical purity. All seeds should be single units and all should be stored according to their individual temperature/humidity requirements. Generally, moisture content should be below 12% for storage.

9. Seed treatment: The organic seed are treated normally with materials from organic sources. They are:

Botanicals	Biofertilizers	Cow's product	Biocontrol agent	other
Neem leaf extract	*Rhizobium*	Panchagavya	*Pseudomonas* spp.	Coconut milk
Mint leaf extract	*Azatobactor*	Cow milk	*Trichoderma* spp.	Tender coconut
Sarani leaf extract	*Azospirillum*	Curd		Vermicompost
Prosopis leaf extract	*Phosphobacteria*	Cow urine		Vermiwash
Arappu leaf extract		Cowdung		

The various tested treatments can be classified in several categories:

a. Thermal treatment.

b. Use of antagonists: Several antagonists have been tested and the list is long. Some nonexhaustive results are as follows:

i. Trichoderma spp against collar rot *(Aspergillus niger)* on groundnut.
ii. *Pseudomonas chlororaphis, Bacillus subtilis, Fusarium oxyporum, Streptomyces* spp.

c. Natural compounds: Essential oils, sometimes with chelator and natural detergent have been tested. Thyme and oregano oils are reported to give good results.

d. Other products: Organic acids (lactic, acetic, citric, propionic and ascorbic) and antiseptic products such as KMnO4 and CuSO4 are also under tests at the moment.

Organic Seed Certification

In simplified terms, the National Organic Program Standards require for crop farms:

1. 3 years (36 months prior to harvest) with no application of prohibited materials (no synthetic fertilizers, pesticides, or GMOs) prior to certification.
2. Distinct, defined boundaries for the operation.
3. Proactive steps to prevent contamination from adjoining land uses.
4. Implementation of an organic system plan, with proactive fertility management systems; conservation measures; and environmentally sound manure, weed, disease, and pest management practices.
5. Monitoring of the operation's management practices to assure compliance.
6. Use of natural inputs and/or approved synthetic substances on the National List, provided that proactive management practices are implemented prior to use of approved inputs.
7. No use of prohibited substances.
8. No use of genetically engineered organisms (GMOs), defined in the rule as "excluded methods".
9. No use of sewage sludge or irradiation Use of organic seeds, when commercially available (must not use seeds treated with prohibited synthetic materials, such as fungicides).
10. Use of organic seedlings for annual crops.
11. Restrictions on the use of raw manure and compost.
12. Must maintain or improve the physical, chemical, and biological condition of the soil, minimize soil erosion, and implement soil building crop rotations.
13. Fertility management must not contaminate crops, soil or water with plant nutrients, pathogens, heavy metals or prohibited substances.
14. Maintenance of buffer zones depending on risk of contamination.
15. Prevent commingling on split operations (the entire farm does not have to be converted to organic production, provided that sufficient measures are in place to segregate organic from non-organic crops and production inputs).
16. No field burning to dispose of crop residues (may only burn to suppress disease or stimulate seed germination flame weeding is allowed).
17. No residues of prohibited substances exceeding 5% of the EPA tolerance (certifier may require residue analysis if there is reason to believe that a crop has come in contact with prohibited substances or was produced using GMOs).

Conclusion

Organic agriculture with organic seed includes growing of crops by a set of guidelines that prohibit the use of synthetic products/ chemicals such as fertilizer, pesticides and herbicides. Therefore, soil fertility and pest management are achieved through cropping patterns (rotations, inter/mix-crops, pest and disease-resistant genotypes), manure (green manure, organic manures and compost), biofertilizers, cultural practices (weeding, planting, conventional tillage) and biopesticides, including plant derived products.

At present this system seems to be an ideal and valid solution to produce seeds aside with the agriculture production. The overuse of plant growth regulator, pesticides and fertilizer for faster growth of agriculture produce is detrimental to human health and environment as a whole. Further, consumers are becoming conscious and critical about the quality of food and by-product that affect their health though the toxicity depends to some extent of the type of food consumed.

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Climate-Smart Actions in Agriculture for Ensuring Zero Hunger

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Introduction

Among the population dependent on agriculture, it is the rural poor comprising a significant proportion of small- and marginal-farmers as well as landless labourers facing the serious consequence of climate change impacts. In the milieu, increasing the resilience of food production system to climate change and food supply/access in general and to rural poor in particular becomes imperative. Nevertheless, it cannot be done without preparing the agriculture sector to adapt for climate change. Of them, management of dwindling natural resources for climate resilience in Indian agriculture takes the top priority to ensure food and nutritional security to millions of people.

Understanding the Complex Challenge in Agriculture System

The challenges in crop production are many in the context of food security and hunger reduction. To cite a few, burgeoning population visa-vis increasing demand for food; competition for land, water and energy; increasing cropping intensity particularly in the Indo-Gangetic plains leading to irrational resource use; changing pest complex; degradation of natural resources like land and water; declining total factor productivity; and stagnating yield (Fig. 1). Indian agriculture not only faces the above routine challenges as it gets transformed but their intensity gets magnified in lieu of climate change. Agriculture not only affected by climate change but serve as a panacea as well by playing a major role through green economy. The production challenges are interdependent having the confluence at different magnitudes across regions which finally gets reflected at macrolevel with negative impact. Hence, framing adaptation and mitigation strategies for climate change becomes utmost priority in Indian agriculture.

The complexity in addressing the production challenges embraced by the negative impact of climate change as shown in Fig. 1 needs an in-depth understanding of the local situation management strategies. Further, the implementation strategies to be successful at micro-level, it need the synergy between the local communities and authorities apart from the support from government in policies and investment. Clearly, participatory mode is the need of the hour to tackle the situation in the scenario of climate change.

Fig. 1. Interdependent production challenges in agriculture system

Climate-Smart Actions for Enhancing Food Production

Agriculture being the most vulnerable sector, management of resources like land, water, energy and other crucial inputs helps to build synergy in adapting as well as mitigating to the negative impacts of climate change. Strategic management addresses the prime issues and reduce the potential negative trade-offs posed by climate change apart from enhancing the capacity to produce more food on sustainable basis. However, it requires the knowledge on the past, current and future scenario to develop climate-smart strategies for the system resilience. Several options like conservation agriculture, climate smart villages and smart technologies are available in the current scenario but its implementation requires the local knowledge. This section briefly highlights the options for climate smart action: -

1. Intervention by conservation agriculture practices: Conservation agriculture, an approach to farming that seeks to increase food security, alleviate poverty, conserve biodiversity and safeguard ecosystem services, can also contribute to making the agricultural system more resilient to climate change. The conservation agriculture principles comprise of minimum soil disturbances, maximum soil cover and diversified cropping system (Fig. 2). The conservation agriculture is based on the integration of management of soil, water and agricultural resources that can assure more sustainable agricultural production. The conservation agriculture is aimed to conserve, improve and make more efficient use of natural resources through integrated management of available soil, water, and biological resources combined with external inputs. Conservation agriculture practices exists like zero tillage, laser-land levelling, crop rotation and residue management which facilitate to increase the soil carbon sequestration and water-holding capacity. The conservation agriculture techniques result in drought resilience as well as reduce the crop damage from floods. It is one of popular techniques gaining momentum in India particularly in the Indo-Gangetic plains.

Fig. 2. Principles of conservation agriculture

2. Intervention by fostering resource smart farms: Resource smart farms are sites wherein researchers and local communities as well as institutions come together to identify the resource smart agriculture interventions to address the ongoing challenge. The rationale behind fostering resource smart farms is to integrate smart farming practices under participatory approach involving experts and local communities/organizations which will be later incorporated into village development plans. The resource smart farm has a range of adaptation strategies or interventions which entails almost all farm operations (Fig. 3) like land smart practices (zero tillage, rotary tillage, laser land levelling, furrow irrigated raised bed system etc.), water smart practices (aquifer recharge, farm pond, rainwater harvesting, laser land levelling, micro-irrigation, alternate wetting and drying as well as direct seeding in rice etc.), nitrogen smart practices (site specific application, precision dose, legume cropping, green manuring etc.), carbon smart practices (application of organic manures, conservation agriculture, livestock rearing, bio-fertilizer application etc.) and energy smart activities (utilization of biofuels, use of fuel efficient machines, crop residue management, zero tillage etc.) to work in an integrated manner towards building climate resilience. However, if the resource smart practices have to be ranked, it can be based on the scores obtained for contribution to food production, climate risk adaptation and mitigation.

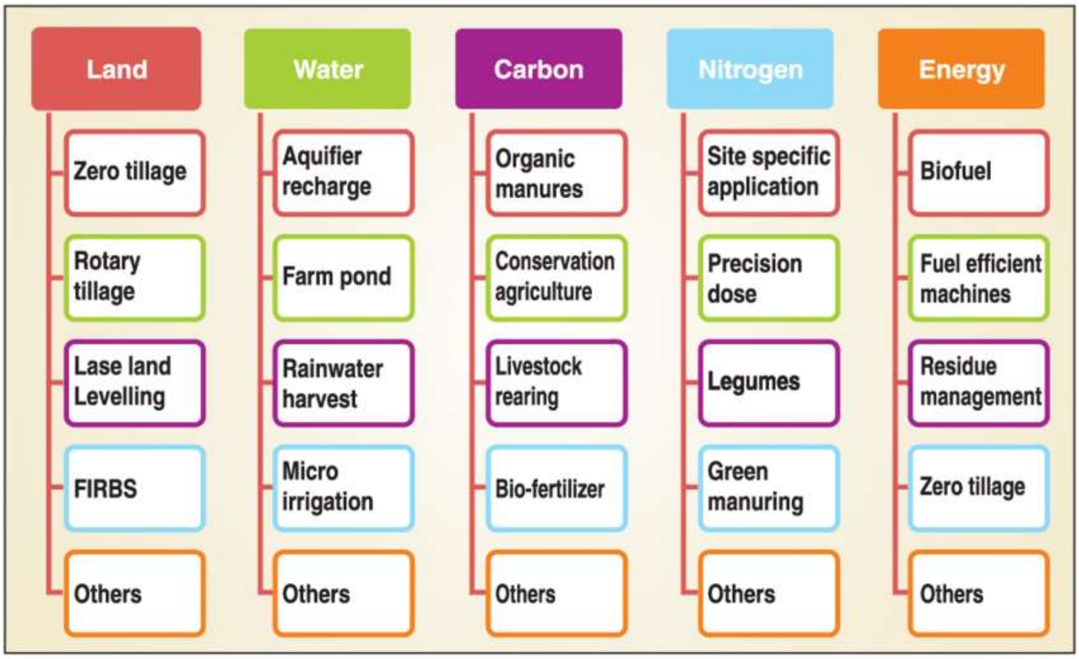

Fig. 3. Smart resource management techniques for climate resilience

3. Intervention by climate smart technologies: Climate-smart technologies have evolved in due course of time with the advancement of communication and technology and it helps the farmer to make aware of himself/ herself regarding the smart resource management options for climate resilience.

4. Information and Communication Technology (ICT) services: ICT provides climate services or advisories for smart resource management like season and crop bound voice and text messages in their local language. Further, crop advisories in the form of weather forecasts, new varieties, tips on adaptation strategies are also provided at regular intervals.

5. Precision nutrient management: Smart nutrient management tools like Nutrient Expert Decision Support, Leaf Colour Chart and Green Seeker sensors are widely used to determine the optimum dose of fertilizers.

6. Other Interventions: Apart from the above highlighted options, the following interventions also help to manage the depleting resources at the farm level:

a. Crop diversification: In the context of smart resource management, appropriate crop diversification (for instance, legumes as a part of portfolio will fix nitrogen in the soil) in a piece of land with facilitate for sustainable intensification.

b. Agroforestry: In this intervention, planting trees with the usual crops helps in carbon sequestration of the soil as well as prevent soil erosion.

c. Direct seeding: It is a popular practice in rice cultivation. Direct seeding comprises the process of sowing the rice seeds directly in dry seedbed against the usual transplantation which significantly reduce the crop water requirement and improve the soil physical conditions in the content of resource management.

d. Alternate wetting and drying: This strategy is also practised in rice crop wherein the farm is alternately flooded and drained. The climate smart method reduces the methane emissions to the tune of 48% relative to flooding irrigation. The technique when combined with precision fertilizer application tools, it further reduces the greenhouse gas emissions significantly. For a farmer, the immediate benefit when adopting this strategy is high reduction in the quantum of irrigation water used in the farm.

e. Community management of resources: Local communities shall be involved in managing the depleting resources like water through establishment of community pond apart from building seed and fodder banks for providing quality inputs to the local farmers.

Conclusion

Alleviating hunger is a top priority for most of the countries, especially developing countries owing to climate change affecting food production. Among sectors, agriculture is the most vulnerable and challenges posed by climate change at the forefront have to be viewed at the grassroots level and it has to be addressed holistically rather than devising or formulating stand-alone strategies. To meet the future population food demand, especially by 2030, agriculture has to undergo a rapid transformation which itself will increase the resource damage under the existing agricultural production system. Hence, integrating climate resilience into Indian agriculture and natural resource management gains the focus at the moment. To be effective, the implementation of the initiatives for 'climate smart actions' should be done in participatory approach with the local partners, government authorities and community-based organizations viz., self-help groups, village cooperatives and farmer producer organizations. The current situation requires an immediate attention and abrupt local knowledge to design the framework for 'climate-smart actions' at all levels to achieve the target of 'zero hunger' by 2030.

Agricultural Waste into Wealth

Article ID: 32523

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Abstract

India is an agrarian economy. It is a source of livelihood for majority of the rural population living in the country. Agriculture involves different type of activities and operations. Unfortunately, most of the activities and operations are crude and not scientific which result in production of huge quantities of agricultural waste. Agricultural waste refers to any unwanted or unsalable materials produced wholly from agricultural operations directly related to the growing of crops or raising of animals for the primary purpose of making a profit or for a livelihood. According to an estimate, around 800 to 1000 Mt of agricultural wastes is available in India every year, but most of it is not used properly. The agricultural waste can be managed properly by using the 3 R approach and converted into useful products that can be used for human welfare and sustainable environment. We need to convert this agricultural waste into wealth.

Keywords: Agricultural waste, 3 R approach, Fuel, Organic manure.

Introduction

Waste is a natural by-product of the phenomena of life and growth of societies. It is viewed as unwanted or unusable material that has been disposed or discarded after primary use. Humans in their day to day life create a boundless heap of waste of countless variety. Efficient handling of waste is an important factor in the developmental progress of any nation and the health of its people. Effective management of waste is now a national priority as seen through the Swachch Bharat Mission. Waste management that leads to generation of substances and products that can be put to primary use is an emerging major sector for employment to meet the livelihood needs of the vast majority of India's rapidly growing population. Given the magnitude of waste generated, innovative waste conversion processes can create micro-entrepreneurship opportunities on a massive scale. In India, the potential of waste to wealth enterprise is very high. Currently not enough has been done. Increasing opportunities for this enterprise can have manifold advantages.

It can bring back useless, discarded waste products into economic use and lead to:
1. Reduction of pressure induced by waste on the environment.
2. Creation of opportunities for income and employment generation in a relatively new area thereby enhance economic activity.
3. Impact quality of life.

What is Agricultural Waste?

Expanding agricultural production has naturally resulted in increased quantities of livestock waste, agricultural crop residues and agro-industrial by products. Agricultural waste is collective term which is use for all the non-economical substance produce by agricultural operations such as roots, crop residues, livestock waste etc.

Classification of Agricultural Waste

Field Waste: Weeds, Straws, Leaves, Bagasses, Roots.
Animal Waste: Animal excreta, Urine, Litter, Waste Feed, Poultry Waste, Fishery Waste.
Agro-industrial waste: Sugarcane- molasses, peals, processing plant waste.

The Ways How We Can Convert this Agriculture Waste into Wealth are as

Animal feed: Most of us are unaware of the fact that most of the agricultural wastes which we thought of having useless are in fact having some economic value. Due to our ignorance, we dispose them in the open leading to serious environmental catastrophe. The waste products generated from threshing, dehusking and the milling process can be used directly on the farm for the feeding of various animals. Similarly rice and wheat bran can be served directly to some animals such as goat, cattle and even pigs. While corn bran, groundnut cake, sesame cake can be blended with other ingredients and served to poultry birds as feeds. Dead birds can be served to catfish as a good source of food. These are just a few examples of how we can use the farm waste as feed for your animals instead of disposing them off indiscriminately which often leads to environmental pollution and hazard.

Fuel: In recent years Bio fuels have emerged as an important class of fuels mainly because of their pollution free nature. Similarly, bio gas is relatively pollution free. The generation of bio-gas from food, farm and animal waste help in a considerable reduction in pollution besides cutting down the monthly costs of the households. Biogas is very easy and cheap to produce. Many other products related to human use such as briquette, soap etc. can be made from agricultural waste.

Organic manure: Farm waste can be successfully converted to organic manure. There has been strong research evidence that organic manure is a better option than the inorganic manure for optimum crop production. The use of organic manure besides boosting crop yields also lowers the input costs of the farmers ultimately resulting in the increase in their net income.

Here it is pertinent to mention that only dead decaying and properly decompose material should be used because the application of raw animal waste on farm land could lead land pollution. Some of the animal wastes are acidic in nature and can prove fatal for the crop.

So, the waste products should be allowed to decompose first. Decomposition helps to breakdown the acidic content of the waste and makes it less harmful to the soil and the plants which it is meant to nourish. Composting is another method of utilizing the farm waste beneficially. The farm waste products like straw and stubble, urine, cow dung, leaves and other farm wastes can be used to produce compost.

The benefits of compost in addition to, nitrogen, phosphorous, and potassium also include certain other micronutrients viz. manganese, copper, iron, and zinc. Compost improves the quality of soil, and for this reason it is considered as a soil conditioner. It also improves the structure and texture of the soil enable the soil to retain nutrients, moisture, and air for the betterment of growth of plants.

Cash: Most of the agricultural waste products can be sold out to people for other purposes. Let me take the case of poultry waste. In the country there are many vegetable farms and mushroom growers which use poultry waste as manure in their farms. Agricultural waste such as rice bran, corn husk can be used for as feed or as fuel in factories. Many of us do not know that from paddy besides rice, we can get twenty-seven different types of products many of which can be used for human consumption and can be sold for cash.

Ethyl alcohol: It is the main component of the power alcohol and its main advantage is that it can also be prepared from the agricultural waste. Power alcohol is the mixture of ethyl alcohol and petrol in the ratio of 20:80 + Small quantity of Benzene. The raw material used for its manufacture include saccharine materials like Sugarcane, molasses, starchy materials like potatoes, cereal grain etc, cellulose materials, and hydrocarbons.

3R Approach for Reducing Agricultural Waste

The principle of reducing waste, reusing and recycling resources and products is often called the "3Rs." Approach.

1. Reducing means choosing to use items with care to reduce the amount of waste generated.
2. Reusing involves the repeated use of items or parts of items which still have usable aspects.
3. Recycling means the use of waste itself as resources.

Waste minimization can be achieved in an efficient way by focusing primarily on the first of the 3Rs, "reduce," followed by "reuse" and then "recycle."

Conclusion

Today, country is facing serious problem of crop residue management, stubble burning, soil degradation, loss of bio diversity. Proper agriculture waste disposal can reduce indiscriminate disposal or burning of waste products which cause both soil, water and air pollution. It will also help in maintaining the fertility of the soil. Conversion of all forms of vegetable and animal waste into organic matter suitable for the needs of the growing crop will also reduce our dependence on chemicals enabling us to move towards more natural and healthier methods of food production. This also will reduce the cost of cultivation and can lift the socio-economic status of the farmers. Agricultural waste is generated from various cultivation practices and these practices may have the potential to generate valuable products that are beneficial for human beings. The agricultural waste can be managed properly by using the 3 R approach and converted into useful products that can be used for human welfare and sustainable environment.

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Mushroom: Pathogens and Pests

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Mushroom

Mushroom is a fungal fruiting body, grow wild in fields, meadows and forest like the common cultivated types. The earliest world in Sanskrit appear to be “Krumpa” and in vernacular or “Khumbi”, “Chhatra”, Kukurmutta”, “Bhumi kavak”, “Kritryachi chhatri” etc. Today more than 10,000 types of fleshy mushrooms stand recorded and classified, out of which about 50 are pleasing to taste.

Chinese were the first to do the artificial cultivation of the tropical & subtropical mushroom about thousand years ago. Mushrooms are a source of good quality protein and are rich in vitamins of B-complex including folic acid, low fat (rich in linoleic acid and devoid of cholesterol) make mushroom to cure the obesity, hypertension and atherosclerosis. All these attributes make mushroom “THE ULTIMATE HEALTH FOOD". Fresh mushrooms contain about 85-95% moisture content, 3% protein, 4% carbohydrate, 0.3-0.4% fat and 1% minerals and vitamins.

Pests and Pathogens of Mushroom

1. Pathogens.
2. Competitors.
3. Pests.
4. Nematodes.
5. Abnormalities.

Pathogens

1. Cobwebs *(Dactylium dendroides)*: The fungus grows rapidly over the surface of the easing soil and envelops the fruiting bodies in a cropping bed. The mushroom appears like cotton balls on the surface but underneath the mushrooms are reduced to a soft rotting mass. Soil and air are common source of infection and wet surface and high humidity are the predisposing factors. Reduce humidity to 20% and operate the fan soon after watering as a preventive measure. It can be best controlled by application of Dithane-Z-78 (0.25%) sprayed 3 times at an interval of 10 days.

2. Dry bubble *(Verticillium fungicola)*: Spots in caps start sinking and centre is covered with a heavy spore mass of dark brown colour with age. In case of sever attack, downward splitting of the stem and the cap to remain small, little and misshapen. Temperature above 18°C and relative humidity above 90% are predisposing factors. Three sprays at 10 days interval with 0.25% Diathane Z-78.

3. Bacterial Blotch *(Pseudomonas tolaasii)*: Circular yellowish spots develop on the cap or near the margin and coalesce to form chocolate brown spots which penetrate into the fleshy tissues. The pathogen spreads through splashing of water drops from infected to healthy sporophores and high humidity (above 80%). Sprays the beds with 100 ppm bleaching powder.

4. Viral diseases: This disease commonly known as La France, Watery stipe, die back, X-disease or brown disease and which may result into slight or total failure of the crop. The most common symptoms are the elongation of the stalk with a small, tilted cap (drumstick) Deterioration of the mycelium (dieback) to control the disease use of filtered air inside the peak heating, spawn running and cropping rooms.

Competitors

Competitors which reduce the available food and retard the growth.

1. Brown plaster mould *(Papulaspora byssina)*: The mycelium is initially white while changes later to cinnamon brawn colour. It extends outwards from the centre on exposed compost surface and also on casing soil. Good hygiene, treatment with 4% formalin solution can check the spread of the competitor.

2. Green mould *(Trichoderma viride)*: The fungal mycelial starts disappearing on patches where the mould grows and a dark grey brown patch with white margin result from the reaction. Maintain 7.0 to 7.5 pH and 70 to 72% moisture in the compost beds. Spray infected beds with 0.05% Bavistin.

3. Olive Green mould (*Chaetomium* spp.): Greyish white mycelium with small, round, olive green pin head like bodies (petrithecia) are attached to the finished straw pieces of the compost. Compost pasteurized at a temperature exceeding 60°C.

4. White Mould *(Cephalothecium roserum)*: Whitish layer of the mould grows on the casing soil. Control consists in spraying casing soil twice at 10 days interval with 0.004% Thiram.

5. False truffle *(Diethiomyces microsporus)*: Small truft of white to cream coloured mycelium appear on the compost or beneath the casing soil. Subsequently white, wrinkled, round to irregular masses resembling to brain like structures are formed. A characteristic sulphur like smell is present in infected room. Temperature of the mushroom beds should range between 14-15°C in order to prevent disease incidence.

6. Ink caps (*Coprinus* spp.): Long slender, white stalks with small thin caps often appear on the compost beds before casing. The development is rapid and caps decay into a black liquid.

Pests

1. Mushroom fly: Larval stage is the most damaging. The larvae feed on the spawn or mycelium, pierce the hyphae and suck the contents. They also enter the fruiting bodies and make tunnels and honey comb the pileus. Proper pasteurization/sterilization of compost and casing soil, mixing of Diazinon/Lindane in the compost.

2. Mite- *Tyrophagus putresentiue*: The harmful mites damage the crop directly by feeding on the spawn and mycelium or puncture holes in mushroom cap and stalks and also cause stunting of fruit bodies as well as brown spots on the caps and stems. Spray Diazinon (Ditaf) @ 1.5-2.0 ml/10 lit water outside the mushroom house premises.

3. Spring tails: This tiny insect feed on the mycelium and the caps and stems of fruit bodies and causes serious damage. Spraying with Malathion or Nuvan @ 0.05% on affected beds during cropping is very effective.

Nematodes

Myceliophagus nematodes (which feed on mycelium) are known to be most damaging. beds show various types of symptoms like mycelium disappearance, browning and stunting of water-soaked pinheads and the fruit bodies appear in patches. The peak heat temperature during pasteurization must be maintained 60°C for 3-4 hours.

Abnormalities

1. Stroma formation.
2. Rose comb: Long stemmed mushroom, Cracked mushroom, Hard gilled mushrooms, Early opening of mushroom.

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Drones for Hi-Tech Agriculture and Uses

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Drones

An agricultural drone is an unmanned aerial vehicle used to help optimize agriculture operations increase crop production, and monitor crop growth. Sensors and digital imaging capabilities can give farmers a richer picture of their fields. Using an agriculture drone and gathering information from it may prove useful in improving crop yields and farm efficiency.

Benefits of Drones

Currently, the drones are being used more-importantly in agriculture, forestry and fisheries at an extended pace.

1. Agriculture: In agriculture, to scan the soil health; monitoring the crop health status round the clock; planning better schedules for field irrigation; fertilizers and pesticides foliar spray; observing the weather and providing datasheets for next-year weather-based planning analysis; yield/Losses data estimation and insuring the forensic claims.

2. Soil and Field Analysis: Drones are often instrumental at the beginning of the crop cycle. They turn out precise three-D maps for early soil analysis, helpful in coming up with seed planting patterns. When planting, drone - driven soil analysis provides information for irrigation and nitrogen-level management. Also used for planting.

Crop Spraying from Sky: In industrial farming, it's typically necessary to require to the skies to spray pesticides, drop seeds, or spot dying crops. Drones will drop a way a lot of targeted load of chemical than a conventional heavier-than-air craft might. Drones will scan the bottom and spray the right quantity of liquid, modulating distance from the bottom and spraying in real time for even coverage. Consultants estimate that aerial spraying are often completed up to 5 times quicker with drones than with ancient machinery.

3. Crop and Field Observation: Immense fields and low potency in crop observation along produce farming's largest obstacle. Observation challenges square measure exacerbated by progressively unpredictable atmospheric condition that drive risk and field maintenance prices. Antecedent, satellite imagination offered the foremost advanced variety of observation. However there have been drawbacks. Pictures had to be ordered ahead, can be taken just once each day, and were inaccurate. Further, services were extraordinarily expensive and therefore the images quality usually suffered on bound days. Today, time-series animations will show the precise development of a crop and reveal production inefficiencies, enabling higher crop management.

4. Irrigation: Drones with hyper spectral, multispectral, or thermal sensors will establish that components of a field square measure dry or want enhancements. Once the crop is growing, drones enable the calculation of the vegetation index, that describes the density and health of the crop, and show the warmth signature, the number of energy or heat the crop emits.

5. Health Assessment: It's essential to assess crop health and spot microorganism or plant life infections on trees. By scanning crop exploitation each visible and near-infrared lightweight, drone-carried device will establish that plants mirror completely different amounts of inexperienced lightweight and NIR lightweight. This info will turn out multispectral pictures that track changes in plants and indicate their health.

6. Forestry: To know the carbon sequestration; tree canopy analysis; monitoring/ Tracking the whole biodiversity especially native species and ecological landscaping.

7. Fisheries: In fisheries sector, to detect illegal fishing; prosecution the international water-law offenders; enforcement of fisheries-related rules and regulations; in-channel habitat mapping during low water.

Barriers

On the far side the barriers to widespread drone adoption altogether industries, safety of drone operations, privacy problems, and insurance, coverage queries. the largest agricultural concern is that the sort and quality of information that may be captured. Lack of quality and refined sensors and cameras.

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Effect of Chitosan Nano Coating on Post Harvest Losses in Tomato (*Solanum lycopersicum* L.)

Article ID: 32526

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Summary

Tomato (*Solanum lycopersicum* L.) is one of the common vegetable crops throughout world and is available in the market throughout year. Globally reported, 25-42% loss in tomato during post-harvest period indicating that almost half of the total produce never reaches the consumers. Biodegradable Nano-formulations are effective as compared to other compounds due to high surface-to-volume ratio, small size of the particles (1nm) and high charge density. Chitosan based nano-materials have been explored in agriculture for plant protection and growth. They are preferably used worldwide for their biodegradability, high permeability, eco-friendly, non-toxicity to human and cost effectiveness. Currently the application of nanomaterials seems to be very attractive in preventing post-harvest losses in fruits and vegetable. Nanoparticles are more effective against microbes at very low dose. It also extends the shelf life of tomato by controlling growth and developments of microorganisms. Nanoparticle at very low concentration effectively prevent the microbial decay, weight loss, maintained the firmness, reduced the respiration rate, significantly decreased the loss of titratable acidity, retained the TSS, lycopene, ascorbic acid, inhibit PPO activity, effectively preserved L*, a*, b* value, maintained organoleptic score in tomatoes. Therefore, nano formulation has potential to further explore in post-harvest technology for further validation at large scale experiments for translation of technology.

Introduction

Horticulture crops play important role in economic development of the country and it contributes 30.4 per cent to GDP of agriculture. But the post-harvest loss reduced the quality of commodities, in India the estimated loss ranges from 14-36% in fruits and 10-25% in vegetables (Arah et. al., 2015). Every year we lost approx 1 lakh crore Rs due to post harvest losses in horticulture crops. Ripened fruits are terribly spoiling and prone to transport harm which consequently leads to loss of quality and quantity. This is particularly common in developing countries because of poor post-harvest handling systems, storage facilities and transportation. Various factors responsible for post-harvest losses can be categorized into two major categories. First, pre harvest losses because of farmers' poor agricultural techniques (i.e. varieties with low shelf life, imbalanced use of nutrients, abiotic stresses, insects, pests and disease infestation), old harvesting procedures, non-utilization of pre-harvest suggested methods. Second, harvest losses due to careless harvesting, harvesting at inappropriate stage, dumping produce without pre-cooling, moisture strengthening that causes pathogen infestation, bulk packaging without grading of produce and reprehensible transportation and storage to distant market distribution. These losses return low profits to growers and processors (Xing et, al., 2010).

Traditionally, post-harvest management practices/techniques like pre-cooling after harvest, refrigeration storage, post-harvest uniform heat treatment of tomatoes, modified atmosphere packaging and use of agrochemicals calcium chloride (CaCl2), 1-methylcyclopropene, nitric oxide, H2O2, salicylic acid and sodium selenate are followed to protect/uphold the quality of fresh fruits and vegetables (Dominguez et, al., 2012). Treatments with synthetic fungicides namely fenhexamid, pyraclostrobin, boscalid etc. has also been the major practice to overcome the postharvest diseases. But, simultaneously, international worries have also been rising over the indiscriminate use of synthetic fungicides on crops because of their harmful effects on human health and the emergence of pathogen resistance against fungicides. Chemical residues easily distributed in the edible portion of commodities that is responsible for reduced the quality. Toxic organic and inorganic compounds are entering the environment. Long term adverse effects on living organisms (Nehar et, al., 2018).

Why Nano Formulation to be Used in Horticulture

Biodegradable nano formulations are effective as compared to other compounds due to high surface-to-volume ratio, small size of the particles (1nm) and high charge density. Chitosan based nano-materials have been explored in agriculture for plant protection and growth. They are preferably used worldwide for their biodegradability, high permeability, eco-friendly, non-toxicity to human and cost effectiveness (Badawy and Rabea, 2009; Sucharitha et, al., 2018). Currently the application of nanomaterials seems to be very attractive in preventing post-harvest losses in fruits and vegetable. Nanoparticles are more effective against microbes at very low dose. It also extends the shelf life of fruits and vegetables by controlling growth and developments of micro-organisms. That's why we need to explore newer alternatives to reduce the use of synthetic fungicides (Saharan et, al., 2015).

Effect of Nanoparticles on Post-Harvest Fungal Decay on Tomato Fruit

In agriculture, application of nano-based products such as nano-fungicides, nano-bactericides, nano-fertilizers and slow release of macro/micro-nutrients are being endorsed from laboratory to field level for crop protection and higher yield. Because of the efficacy of nano-based materials in crop protection and yield, various nanomaterials have been applied as coating agent, nanolamination, spray, or as enforcement compounds in various fruits and vegetables. Microbial decay contributes up to ~70% losses in fruits and vegetables and is, therefore, very crucial to control it during storage. Nano materials are more potent in degrading microbial cell wall and inhibiting transcription-and translation by binding with microbial DNA and anionic proteins (Candir et, al., 2018). Nanoparticles have also been reported as plant immune booster and enhance the activities of defence antioxidant enzymes. Therefore, nanoparticles more elegantly prevent the microbial infection and act as nano-shield on tomato surface (Hajji et, al., 2018).

Effect of Nanoparticle on Physiological Parameters on Tomato Fruit

Physiological parameters of tomato (physiological loss in weight, texture, colour, firmness and respiration rate) change during storage. These changes have severe impact on the quality, nutritional value and subsequent marketability of fruits. During post-harvest storage, environmental factors adversely affect the cellular homeostasis which crumples the texture and induces quality degradation in tomato fruits. Physiological loss in weight is a primary concern during post-harvest storage of horticulture crops. It is known as a great indicator of fruit freshness and mainly occurs as a result of water loss by transpiration and reserve carbon loss by respiration (Sogvar *et, al*., 2016). The nanoparticle acts as a semi-permeable barrier for oxygen, carbon dioxide, moisture and other solutes which in turn reduces respiration, moisture loss and oxidation reactions. Firmness is also an important attribute in post-harvest life of fruit and affects the acceptance by the consumers. Firmness retention by nanoparticles to inhibitory activity against pectate lyase, polygalacturonase and cellulase which are responsible for degradation of cell wall and subsequent loss of firmness. Similarly, respiration rate increase during storage (Reddy *et, al*., 2000). Respiration rate in fruits is crucial and affects the overall metabolic activities. Its higher rate severely decreases the shelf-life of fruits. This suppression of respiration rate by nanoparticles due to partial blockage of pores on the surface of fruit. Previous studies have revealed that nonmaterials acts as a barrier film that creates a modified internal atmosphere by selectively permeating C_2H_4, CO_2 and O_2 in and out of fruit leading to a reduced rate of respiration and transpiration (Ali *et, al*., 2011).

Effect of Nanoparticle on Quality Attributes on Tomato Fruit

Bioactive compounds (titrable acidity, ascorbic acid, lycopene, phenol compounds) are very essential component of fruits and vegetables. Titrable acidity (TA) is one of the important quality parameters to evaluate the sour taste of fruits. Generally, level of acidity uniformly decreases during storage due to the consumption of organic acids in respiratory processes to maintain the normal activity of fruits. Nanomaterials slow down the physiological processes in fruits by reducing ethylene production, respiration and hence abbreviates the consumption of organic acids (Hajji *et, al*., 2018). Ascorbic acid is one of the most important nutritional components in fruits and acts as an antioxidant molecule to resist senescence. Its content decreased with the advancement of fruit ripening. Variability in ascorbic acid content is related to the ripening stage where a green fruit exhibits higher content of ascorbic acid than a ripened fruit. Nanoparticles have the potential to create a semipermeable film on fruit surface which limits fruit respiratory metabolism and thereby slows the decline of ascorbic acid. Lycopene is principally responsible for the characteristic deep-red colour of tomato, watermelon and papaya fruits. Lycopene content in tomato remarkably increased during storage. Nanoparticle reduces the availability of O_2 in fruit which in turn inhibits the development of lycopene (Helyes *et, al*., 2011). Phenolic compounds are responsible for changes in colour and flavour, loss of nutritional value and shelf-life of a fruit. The inhibition of phenol compounds by nanosilica polymer which adsorbs polyphenol oxidase or its substrates and also chelates metal ions at active site and reduces its activity (Badawy and Rabea, 2009).

Conclusion

Biodegradable Nano formulation efficiently used to reduce post-harvest losses because of their higher surface to volume ratio that helps to increase the activity of nanoparticles which enhance the quality and shelf life of fruits and vegetables. Due to the small particle size facilitates its penetration to the plant cells, better absorption, and high reactivity by plant cells. Nanoparticle has charge density, which effectively interact with the negatively charged surfaces of bacterial cells. It reduces the oxidation reaction as the result it reduces the respiratory activity taking place in fruits and vegetables after harvest, thereby increasing the shelf life of fruits and vegetables. Nanomaterials effectively prevented microbial decay, physiological loss in weight, maintained fruit firmness and reduced the respiration rate in fruits and vegetables during stored. It also delayed the loss of titratable acidity, retained the TSS, total sugars, reducing sugars, ascorbic acid, lycopene and phenol content. Nanoparticles are very effective at less concentration and thus exert minimum chemical load on the treated horticulture crops. The cost can decrease as well as increasing profit by using nano formulations are eco-friendly. Therefore, nanoparticles have potential to be further explored in post-harvest technology. It may be validated in large scale experiments for translation of technology.

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Artificial Intelligence: A Tool for Transforming Agriculture

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Artificial Intelligence

Artificial intelligence (AI) is an area of computer science that emphasizes the creation of intelligent machines that work and react like humans. Some of the activities in artificial intelligence using computers incudes are:

1. Speech recognition.
2. Learning.
3. Planning.
4. Problem solving.

What is Artificial Intelligence?

Humans have always been working to improve and achieve the next level in every domain of life and the next big thing whose stepping stone has already been laid is going to be the field of artificial intelligence.

In 1956, John McCarthy, an American scientist, coined the term Artificial intelligence and defined it as “the science and engineering of making intelligent machines.” He is also known as the father of AI.

A lot of work has been done in the field of computer sciences and great efforts have been made to improve the efficiencies and speed of computing machines through development of both hardware and software. Now computer came perform tasks which are not humanly possible. Recent development in advanced computing and enhancement in computing power has resulted in the growth of normal computing devices in to super computers.

Now we are even exploring the possibilities of exascale computing and exascale computer can perform one quintillion operations per second i.e. 1018 operations per second. Such a super computing devices will contribute towards the future of AI. AI and machine learning are going to transform the world and will bring significant change to every aspect of human life.

Top 10 Major Applications of AI

1. AI in Marketing.
2. AI in Banking.
3. AI in Finance.
4. AI in Agriculture.
5. AI in Healthcare.
6. AI in Gaming.
7. AI in Space Exploration.
8. AI in Autonomous Vehicles.
9. AI in Chatbots.
10. AI in Artificial Creativity.

Artificial Intelligence in Agriculture

Agriculture and farming are one of the oldest and most important professions in the world. Humanity has come a long way over the millennia in how we farm and grow crops with the introduction of various technologies. As the world population continues to grow and land becomes scarcer, people have needed to get creative and become more efficient about how we farm, using less land to produce more crops and increasing the productivity and yield of those farmed acres. AI in agriculture is helping farmers to improve their efficiency and reduce environmental hostile impacts. The agriculture industry strongly and openly embraced AI into their practice to change the overall outcome. AI is shifting the way our food is produced where the agricultural sector's emissions have decreased by 20%. Adapting AI technology is helping to control and manage any uninvited natural condition. Today, the majority of start-ups in agriculture are adapting AI-enabled approach to increase the efficiency of agricultural production. Implementing AI-empowered approaches could detect diseases or climate changes sooner and respond smartly. The businesses in agriculture with the help of AI are processing the agricultural data to reduce the adverse outcomes.

(https://www.edureka.co/blog/artificial-intelligence-applications/)

Advantage of Implementing AI in Agriculture

The use of Artificial intelligence in agriculture helps the farmers to understand the data insights such as temperature, precipitation, wind speed, and solar radiation. The best part of implementing AI in agriculture that it won't eliminate the jobs of human farmers rather it will improve their processes.

1. AI provides more efficient ways to produce, harvest and sell essential crops.
2. AI implementation emphasis on checking defective crops and improving the potential for healthy crop production.
3. The growth in Artificial Intelligence technology has strengthened agro-based businesses to run more efficiently.
4. AI is being used in applications such as automated machine adjustments for weather forecasting and disease or pest identification.
5. Artificial intelligence can improve crop management practices thus, helping many tech businesses invest in algorithms that are becoming useful in agriculture.
6. AI solutions have the potential to solve the challenges farmers face such as climate variation, an infestation of pests and weeds that reduces yields.

Impact of Artificial Intelligence in Agriculture.

Artificial Intelligence in the Agricultural Industry – Insights Up Front

The most popular applications of AI in agriculture appear to fall into three major categories:

1. Agricultural Robots: Companies are developing and programming autonomous robots to handle essential agricultural tasks such as harvesting crops at a higher volume and faster pace than human laborers.
2. Crop and Soil Monitoring: Companies are leveraging computer vision and deep-learning algorithms to process data captured by drones and/or software-based technology to monitor crop and soil health.
3. Predictive Analytics: Machine learning models are being developed to track and predict various environmental impacts on crop yield such as weather changes.

AI technology is rapidly rectifying the problems while recommending specific action that is required to overcome the problem. AI is efficient in monitoring the information to find solutions quickly. Let's see how AI is being used in agriculture to improve results with a minimal environmental cost. By implementing AI can identify a disease with 98% accuracy. Thus, AI helps farmers monitor the fruit and vegetable by adjusting the light to accelerate production.

Forecasted Weather Data

AI in an advanced way is helping the farmer to remain updated with the data related to weather forecasting. The forecasted/ predicted data help farmers increase yields and profits without risking the crop. The analysis of the data generated helps the farmer to take the precaution by understanding and learning with AI. By implementing such practice helps to make a smart decision on time. Seasonal forecasting is particularly valuable for small farms in developing countries as their data and knowledge can be limited.

AI Helping Analyse Farm Data

Farmers can use AI to manage weeds by implementing computer vision, robotics, and machine learning. With the help of the AI, data are gathered to keep a check on the weed which helps the farmers to spray chemicals only where the weeds are. This directly reduced the usage of the chemical spraying an entire field. Farmers can also analyse a variety of things in real time such as weather conditions, temperature, water usage or soil conditions collected from their farm to better inform their decisions. For example, AI technologies help farmers optimize planning to generate more bountiful yields by determining crop choices, the best hybrid seed choices and resource utilization.

Precision Agriculture

AI systems are also helping to improve harvest quality and accuracy -- what is known as precision agriculture. Precision agriculture uses AI technology to aid in detecting diseases in plants, pests, and poor plant nutrition on farms. AI sensors can detect and target weeds and then decide which herbicides to apply within the right buffer zone. This helps to prevent over application of herbicides and excessive toxins that find their way in our food.

Monitoring Crop and Soil Health

Utilizing AI is an efficient way to conduct or monitor identifies possible defects and nutrient deficiencies in the soil. With the image recognition approach, AI identifies possible defects through images captured by the camera. Computer vision and deep learning algorithms process data captured from drones flying over their fields. From drones, AI enabled cameras can capture images of the entire farm and analyze the images in near-real time to understand soil defects, plant pests, and diseases problem areas and potential improvements. Unmanned drones are able to cover far more land in much less time than humans on foot allowing for large farms to be monitored more frequently.

AI Tackles the Labour Challenge

With less people entering the farming profession, most farms are facing the challenge of a workforce shortage. Traditionally farms have needed many workers, mostly seasonal, to harvest crops and keep farms productive. However, as we have moved away from being an agrarian society with large quantities of people living on farms to now large quantities of people living in cities less people are able and willing to tend to the land. One solution to help with this shortage of workers is AI agriculture bots. These bots augment the human labour workforce and are used in various forms. These bots can harvest crops at a higher volume and faster pace than human labourers, more accurately identify and eliminate weeds, and reduce costs for farms by having a round the clock labour force. Thus, Artificial Intelligence is helping farmers find more efficient ways to protect their crops from weeds.

Concluding Thoughts

AI is being utilized in sectors such as finance, transport, healthcare, and now in agriculture. Through the use of AI and cognitive technologies farms across the world are able to run more efficiently, with less workers than before while still meeting the world's food needs. There is no more fundamental need than the need of food, and this will never go away. Fortunately, the use of AI will allow farms of all sizes to operate and function keeping our world fed. Through the use of agricultural AI and cognitive technologies, farms across the world are able to run more efficiently to produce the fundamental staples of our dietary lifestyles. AI is redefining the traditional pattern of agriculture. The future of AI in agriculture is way ahead in offering radical transformation with advanced approaches.

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Spread of Veganism – A Trending Dietary Habit

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Introduction

Vegan diet is a very strict form of diet that restricts people from having animal-based foods and products. It is concept fast spreading in western countries and has step foot in India also. At present the population being vegan is little but the growth rate is found to be drastic. The reason triggering the inclination of vegan population are to rise against exploitation of animal rights, harming animals, religious or spiritual believes, concern for environment and being health cautious. This paper explores the nutritional aspects of Veganism.

Classification of Vegan Diet

There are four types of vegan diet namely Rastafarian, raw vegan, standard vegan and natural vegan. Rastafarian vegan people use only natural products other than processes or value-added foods and stringently follows religious and spiritual believes. Food materials are consumed as such without cooking and processing even gluten containing foods like wheat products are not included in the diet. Standard vegan persons intakes supplements in addition to the vegan diet. Natural Vegan are found to be the combination of Rastafarian and raw vegan types.

Spread of Veganism

This modern concept is taking off well among the younger generation. The concern for environment, animals and health, and peer influence has made them to choose vegan option over any other diets. Many of the upper-class people have withdrawn their spending over meat and have shifted to vegan foods. They feel it to be an identity and pride. Moreover, this trend is on race in the urban areas because of the greater accessibility of people towards vegan options. People in the urban areas also tend to taste, enjoy and explore new food. With the growth of mass media and social media the spread of vegan foods has was irresistible. Several vegan influencers, environmental activists, animal protection activists etc are on a serious run to promote veganism through their various posts, events, challenges, programs and campaigns.

Impact of Veganism

Vegan is often found to be synonymous with healthy foods in turn demanding for organic foods to be healthy. Thus, the demand for organic foods is found to be on an increasing track. The major shift to plant-based farming could be beneficial to the environment as it reduces GHG emission proportion from livestock, prevents pollution from animal wastes, reduces exploitation of natural resources for animal rearing, etc. This could affect the major population depending on livestock sector. Thus, it could affect the GDP, employability, export and food processing sectors of India. But this could open new vistas like production and processing units for producing alternatives for animal-based products from plant-based commodities. Production of plant-based products are found to be exhaustive making them costlier to afford.

Vegan diet includes low total energy intake, low sodium intake, better intake of good fat, low protein and high dietary fibre. It helps in prevention of type-2 diabetes, cancer, cholesterol and overweight. Even though the veganism is considered to be health it also has certain drawbacks. The studies show that vegan diet is not nutritionally self-sufficient. Vegan adopters are found to be deficient in Cobalamin, Calcium, Vitamin D, and Iodine. The iron intake is highly satisfactory however it will not automatically result in optimal iron status since absorption of non-haem iron is less efficient. Children under vegan diet are found comparatively smaller with higher risk of fracture compared to children under omnivorous diet. Thus, the diet will not be holistic or complete without external supplements.

Conclusion

The benefits of veganism could be enjoyed only on proper planning. For an economy or environment or eco-system or food chain to be stable the balance between plant, animal and human has to be maintained. Veganism has its own pros and cons; it has to be studied beforehand as the change is in-evitable.

Types of vegetarian	*Fruit*	*Veggies*	*Dairy*	*Eggs*	*Seafood*
Raw food vegan	✓	✓			
Vegan	✓	✓			
Lacto vegetarian	✓	✓	✓		
Ovo vegetarian	✓	✓		✓	
Lacto-ovo vegetarian	✓	✓	✓	✓	
Pescatarian	✓	✓	✓	✓	✓
Flexitarian	✓	✓	✓	✓	✓

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Need of Synthetic Seed Production in Fruit Crops

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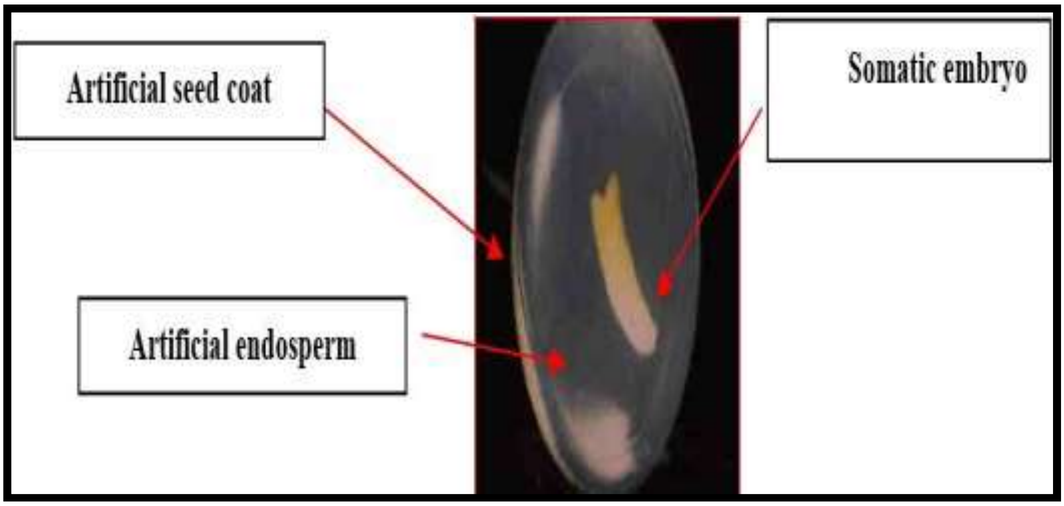
Introduction

Artificial seeds are artificially encapsulated somatic embryos (usually) or other vegetative parts such as shoot buds, cell aggregates, auxiliary buds, or any other micro propagules which can be sown as a seed and converted into a plant under in vitro or in vivo conditions. An improved artificial seed production technique is considered a valuable alternate technology of propagation in many commercially important crops and a significant method for mass propagation of elite plant genotypes. The production of plant clones multiplied by tissue culture and distributed as artificial seeds could be a useful alternative to the costly F1 hybrids for different plant crops (Hail et al., 2017).



Comparison Between Natural and Artificial Seed

Synthetic seeds	Artificial seeds
Produced from the sexual process	Produced from asexual process
Doesn't involve the fusion of gametes	Involve the fusion of male and female gametes
Produced from vegetative cells	Produced from germ cells
Contains genetic constituent from single parent	Contains genetic constituent from both the parents
Genetic recombination does not take place	Genetic recombination takes place
Contains only endosperm and embryo, seed coat is absent	Contains embryo, endosperm and seed coat

(Khushbhoo et al., 2018)

Need of Artificial Seed

Artificial seed is needed as most of recalcitrant seed cannot be preserved in slow growth cultures or under cryopreservation, can be only propagated as synthetic seed and many fruit crops are difficult to multiply by conventional propagation methods. Seed propagated hybrids can be multiplied through tissue culture and propagated by using synthetic seeds rapidly.

Production of Synthetic Seed

The preserved embryoids without seed coat are termed as synthetic seeds. In vitro embryoid develops from callus tissue callus tissue and their induction is initiated by somatic embryogenesis supplementing the medium with auxin and cytokinin's in proper ratio. Seeds are contaminated with microbes and desiccated are encapsulated by protective gel like calcium alginate.

The Following Steps are Needed for Commercial Synthetic Seed Production:
1. Production of embryogenic tissue from transformed cells or tissue.
2. Large – scale production of synchronous somatic embryo.
3. Maturation of somatic embryo.
4. Non – toxic encapsulation/coating process.
5. Artificial endosperm/ mega gametophyte, depending on species.
6. Storage capability of artificial seeds.
7. High frequency, direct greenhouse/ nursery field for conversion to plant, depending on production requirements.

Standard Methods Used for Encapsulation of Somatic Embryos

1. Gel Complexation Via a Dropping Procedure: This is the most useful encapsulation system. Drip 2-3 % sodium alginate drops from at the tip of the funnel and the somatic embryos are inserted. Keep the encapsulated embryos complex in calcium salt for 20 min. Rinsed the capsules in water and then stored in air tight container.

2. Automate Encapsulation Process: This is the quick method of artificial seed production. Alginate solution with embryo is feed from supply tank. Alginate capsules were planted in speeding trays using a vacuum seeder. The capsules are planted in the field using a stan hay planter. A hydrophobic coating is required for mechanical handling for the rapid drying and the thickness of the alginate capsules. For coating, an Elvax 4260 copolymer is suitable for producing a slow drying, non-tacky coating which allows embryo conversion (Hail et al., 2017).

Advantages of Synthetic Seeds

1. Direct delivery of somatic embryos will save many subcultures to obtain plantlets from regenerated embryo.
2. Reduced costs of transplants.
3. Production of large numbers of identical embryo.
4. Determine role of endosperm in embryo development and germination.
5. Study of seed coat formation.
6. Synthetic seeds are true breed.
7. Potential advantages of artificial seed technology for tree genetic engineering.
8. Propagation with low cost, high volume capabilities of seed propagation.
9. Seeds are produced within a short time.
10. Seeds can be produced at any time and in any season of a year.
11. Dormancy of artificial seed can be shortened by reducing the life cycle of plant.
12. These are useful in germplasm preservation.
13. Synthetic seeds are applicable for large scale mono culturing.
14. Seeds give protection of meiotically unstable, elite genotype.
15. The synthetic seeds provide us knowledge to understand the development, anatomical characteristics of endosperm and seed coat formation (Hail et al., 2017).

Disadvantages of Synthetic Seeds

1. The major challenges that need to be solved to improve the protocols are in storage caused by lack of dormancy, synchrony in somatic embryo development, improper maturation, slow conversion into plantlets, low production of viable mature somatic embryos, proper acclimatization into field because of their tenderness due to the absence of lignification and low cuticle formation and the reduction in viability and plant recovery when the artificial seeds are stored at low temperature can be overcome if the process and regulation of somatic embryogenesis and origin of soma clonal variation.

2. In recalcitrant species, somatic embryogenesis, the possibility of using non-embryogenic propagules for artificial seed production was reported to be a promising such as the difficulties of achieving one rooting step.

3. The difficulties of sowing artificial seeds directly in soil or under non-sterile conditions are considered to be one of the main limitations of this technique (Michel and Standardi, 2016).

Examples of Plant Parts Encapsulated and Converted to Artificial Seeds in Fruits

Explant material	Fruit crops
Somatic embryos	Mango, Papaya, Guava, Grape
Auxiliary buds/ Adventitious buds	Citrus, Pineapple
Nodal segments	Pomegranate
Shoot tips	Banana, Apple, Kiwi

(Keith, 1990)

Conclusion

The technique has great advantages such as: a cheapest delivery system, minimize cost of plantlets, offers tremendous potential in micro propagation, a promising technique for the direct use of artificial seedlings in vivo i.e. germplasm conservation through cryopreservation.

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Use of Hydroponics in Vegetable Cultivation

Article ID: 32530

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What is Hydroponics?

Translated directly, hydroponics means plants working (growing) in water. The word 'hydroponics' is derived from two Greek words: 'hydro' – meaning water, and 'ponos' – meaning labour.

A modern definition of hydroponics: A system where plants are grown in growth media other than natural soil. All the nutrients are dissolved in the irrigation water and are supplied at a regular basis to plants. In South Africa, hydroponic vegetable production is almost always done under protection.

Advantages of Hydroponic Vegetable Production

1. Hydroponically produced vegetables can be of high quality and need little washing.
2. Soil preparation and weeding is reduced or eliminated.
3. It is possible to produce very high yields of vegetables on a small area because an environment optimal for plant growth is created. All the nutrients and water that the plants need, are available at all times.
4. One does not need good soil to grow vegetables.
5. Water is used efficiently.
6. Pollution of soil with unused nutrients is greatly reduced.

Disadvantages of Hydroponics

1. Hydroponic production is management, capital and labour intensive.
2. A high level of expertise is required.
3. Daily attention is necessary.
4. Specially formulated, soluble nutrients must always be used.
5. Pests and diseases remain a big risk.
6. Finding a market can be a problem.

What do I Need to Start a Hydroponic Production Unit?

Garden units	Commercial
Source of clean water	Water is the most important consideration. Quality, quantity and reliability
The right location	A market. Know what, where and when to market your crop
Specially formulated fertilizer	Hydroponics is labour intensive. During peak season, labour must be available for 7 days a week

Time to attend to the system daily	Management skills: Production, labour, marketing, infra-structure
A little knowledge of plants or gardening	Expertise in crop production, fertilization & irrigation, pests and disease management
A commercial or homemade unit	Location: Infra-structure, labour, market, etc
	Financing: The amount needed depends on the size, type of greenhouse, labour cost and your market
	Dedication

Know the Basics

To be able to produce vegetables successfully year after year, one needs to be familiar with the basics of hydroponics viz: the plant, growth medium, water & nutrients. By relying on recipes only, one will not be able to identify the cause of a problem and you may not be able to correct them.

How do Plants Function?

Plants have only three types of organs: Leaves, roots and stems. Know what the organs look like and how they function so that you can deal with their needs.

Growth Medium

Growth medium is the substitute for soil in hydroponic systems.

The functions of growth medium are:

1. To provide the roots with O_2
2. Bring the water and dissolved nutrients in contact with roots.
3. Anchor the plants so that they do not fall over.

Many different materials can be used as long as they provide the roots with O_2, water and nutrients. In South Africa, gravel is popular in re-circulating systems, sawdust is the most popular for the open bag system / drain to waste system.

Water and Nutrients

All the nutrients plants need is dissolved in water and they are supplied to plants every day.

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Macro elements (N; P; K; S; Ca) are needed in substantial amounts, whereas plants need very small amounts of micro elements (Fe; Zn; Mn; Mg; Cu; Co, Mg).

It is necessary to use was specially formulated fertilizers. Fertilizers used for hydroponics are purer (and expensive) than other fertilizers to prevent precipitation and blockages of the system.

Symptoms of nutrient deficiency can easily be mistaken for disease symptoms

Symptoms of nutrient deficiency are normally seen on leaves

Different Hydroponic Systems

Two different hydroponic systems are used to produce vegetables: the gravel flow, or re-circulating system, and the open bag, or drain to waste system.

In the drain to waste (open bag) system, plants are grown in containers and nutrient solution is supplied to plants by means of a dripper, for up to 12 times per day. The number of irrigation cycles per day depends on temperature and the growth stage of plants. The crops in the drain to waste system grow tall and need to be trained and pruned so that they grow upwards as a single stem.

Gravel Flow System

In the gravel flow system, the nutrient solution is re-circulated and the roots of the plants stand in a thin film of nutrient solution all the time. Gravel or sand is used most often as growth medium.

Which Crops can be Grown in A Hydroponic System?

Basically, all high value crops. Popular in South Africa are tomatoes, cucumbers and peppers in drain to waste systems and lettuce and herbs in gravel flow systems.

Which Crop should I Grow?

Garden units: Depends on the choice of the family and the type of unit.

Commercial units: The most important consideration is the market and the climate. Nobody can make this decision for you. Every situation, every crop and every market have its own advantages, disadvantages and requirements.

Which Variety do I Choose?

There are many vegetable varieties available.

Some were developed specifically for commercial hydroponic production in greenhouses. Local seed companies are able to recommend varieties that are widely adapted and easy to grow.

For house hold units common garden varieties are recommended.

Seedlings

1. Seedlings can be purchased at nurseries, or you can produce them yourself.
2. When buying seedlings, look for young plants, the roots must not be stuck to the walls of the seedling tray and must be white, not brown.
3. Soil- and water-borne diseases can be transmitted through seedlings.
4. Transplant only the strongest seedlings.
5. Do not use seedlings that are too old and 'pot bound'.

To produce seedlings, follow instructions on seed packages.

Taking Care of Plants

Different crops are planted at different spacing. Small plants can be planted close to each other.

Large plants need more space to grow and must be spaced further apart.

Water flow must be checked every day and adjusted when necessary.

If plants turn yellow, it is normally a symptom of nutrient deficiency, too little light or a disease.

Inspect the leaves every day for disease symptoms and insects. Act immediately if a problem occurs.

Tall plants need to be trained and pruned to make optimal use of the expensive greenhouse space.

Harvesting

Vegetables are perishable. The shelf life and quality depend on a chain of actions:

1. Pick at the right stage without damage to the plant.
2. Pick early in the morning or when it is cool.
3. Keep picked vegetables out of the sun.
4. Handle carefully.
5. Store them at the right temperature (depends on crop).
6. Use the right packaging (depends on crop and market).
7. Transport with care.

Commercial Scale Hydroponic Vegetable Production

Hydroponics is becoming a very important way to produce vegetables in South Africa because of the production potential, the high quality of the produce and the efficient water usage.

If produced in a climate-controlled greenhouse, the producer can supply vegetables out of season when the price is good.

Commercial scale hydroponics production is capital, labour and management intensive.

High quality Sorrel

Greenhouses

Why in a greenhouse?

The purpose of greenhouses is to create an environment more favourable to plant growth than the environment outside.

In South Africa plants are grown in greenhouses to protect plants against the strong UV radiation, to increase the humidity around plants, and to decrease to some extent the extreme minimum and maximum temperatures that can occur in one single day.

Most greenhouses in South Africa are covered with polyethylene sheeting or shade netting.

Greenhouses come in many forms and vary from simple and relatively cheap to very sophisticated and expensive.

Tips to Prevent Spread of Disease

The most important tools are knowledge and dedication:
1. Several cultivation practices can prevent the spread of disease.
2. Sanitation.

Use of Pesticides - Where do I Buy Suitable Pesticides?

Small scale/house hold hydroponic producers can buy pesticides in small packages available at nurseries and certain retail stores.

Commercial producers can obtain bigger quantities from agrochemical companies.

Which Pesticide to Use?

Pesticides can be effective only if:
1. The pest has been identified correctly. (This can be tricky!).
2. The pesticide is applied correctly. This includes mixing, spray technique, time of day, etc.

Contact an expert such as the Roodeplaat Diagnostic Centre (tel: +27 (0) 12 808 8000) if you are uncertain about the identification of the disease or pest.

Only registered pesticides may be recommended.

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Interactions Between Host and Pathogen & Classification

Article ID: 32531

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Introduction

The term 'has pathogen cooperation' alludes to the manners by which a pathogen (infection, microorganisms, prion, organism and viroid) communicates with its host. Pathogens adjust to the changes, and elective approaches to endure and contaminate a host. They are irresistible operators which cause infections in a host body, when the host insusceptible framework falls flat against them. Questions like how the pathogens work, how their entrance point into the host is encouraged through the natural obstructions and how they get by inside a host that is regularly under treatment or vaccinated for a similar pathogen, can be replied by investigating host-pathogen communications. Host-pathogen associations can be depicted on the populace level (infection contaminations in a human populace), on the organism level (pathogens tainting host), 27 or on the atomic level (pathogen protein official to a receptor on human cell). Be that as it may, before venturing into methodological subtleties of host-pathogen cooperation forms, a short look into history of this exploration field is incorporated here to summarize the how(s) and why(s) of ongoing headways of this field.

Plant infection presents a consistent danger to agribusiness around the globe. Seeing how plant and pathogen connect with one another is pivotal for building up a feasible horticulture. During the long history of co-development among host and pathogens, plant insusceptible reaction has finished in an exceptionally protection framework that can oppose potential assault by microbial pathogens .As plants need portable protector cells and substantial versatile frameworks, they should depend on the natural insusceptibility of every phone and on fundamental sign radiating from contamination locales. The impression of the pathogen is accomplished through receptors, a reconnaissance framework fit for perceiving both preserved sub-atomic examples and explicit impact or proteins and initiation of the comparing protections.

The utilization of transgenic plants in late endeavours, incorporating advancement of freaks with adjusted R qualities, has provided new experiences into the instruments engaged with pathogen discernment, signal transduction and ensuing protection from illness in plants. Particularity of the associations among plants and pathogens is as yet an unlimited wonder with a confused pecking order of natural association.

Clarification of this wonder speaks to a significant undertaking of contemporary plant pathology. Be that as it may, gigantic open doors for crop improvement are probably going to emerge, as the total sequencing of Arabidopsis plant genome, which is a sub-atomic research model, become a reality. Numerous R qualities, which give protection from different plant species against a wide scope of pathogens, have been disconnected.

In any case, they have created exceptional methodologies to adjust to natural changes by utilizing a scope of constitutive or inducible biochemical and sub-atomic components. They show both long-and momentary guard reactions to quick difficulties, for example, pathogen assaults. A synergic impact of numerous burdens speaks to the essential driver of yield misfortune. The suitable reaction of plant rises up out of the view of an extracellular sign and its transduction between and inside plant cells. Associations between malady opposition (R) qualities in plants and their comparing pathogen avirulence (Avr) qualities are the key determinants of whether a plant is vulnerable or protection from a pathogen assault.

Materials and Methods

Some ongoing examination works have concentrated on the essential idea of harmfulness and pathogenicity which characterized and proposes a Classification framework for microbial pathogens dependent on their ability to cause harm as a result of the host's resistant reaction.

Every one of these examinations by implication show us the pattern of improvement of the host-pathogen associations Research field. The field has begun with irregular research works of a pathogen and its cooperation with a host. Most punctual research has been done on have pathogen collaborations as for natural components, similar to light, temperature, season, and pathogen/have populace among others.

Research works have characterized and provided guidance to the host-pathogen cooperation's investigate field. Disclosure of particular discharge frameworks has given the essential foundation of host-pathogen communication examine.

Results

1. Interactions between host and pathogen: Obstruction is the most widely recognized reaction of plants to pathogens and helplessness is the uncommon occasion. Plants have advanced to create viable systems of safeguard and oppose the assault of microorganisms that are continually in contact with their latent capacity have. To set up illness, pathogens need to confront and kill various obstructions on their way into the plant tissue.

The main obstruction is the plant cell surface. Infiltration could happen through normal openings like stomata, through injuries, or by direct entrance utilizing catalysts as well as mechanical powers. When pathogens obtain entrance by entering the plant fingernail skin, they face the subsequent hindrance, the plant cell divider. After cell divider infiltration, the pathogen is isolated from plant cytoplasm just by the plasma layer . Plasma films contain particular proteins, extracellular surface receptors, which are engaged with the location of pathogen related atomic examples (PAMPs) to trigger invulnerable reactions. Chitin is a part of cell dividers that is viewed as one of the major contagious PAMPs. Plants are outfitted with both constitutive and inducible guard system. The previous incorporates constitutive properties, for example, the quality and thickness of cell dividers and the nearness of pre-framed antimicrobial mixes, for example, polyphenol. Then again, actuated opposition included recently harmful synthetic compounds and physical obstructions. On pathogen acknowledgment, administrative qualities start a multicomponent barrier reaction whose components are actuated in a profoundly controlled worldly and spatial way. Run of the mill segments of such reactions incorporate the creation of phytoalexins, gathering of (hydrolytic) pathogenesis-related (PR) proteins, enlistment of sign pathways, fortification of the phone divider, creation of receptive oxygen species, lastly modified cell passing and fundamental obtained obstruction (SAR). In perfect cooperation's, these resistance reactions are not started or are initiated distinctly at later stage and permitting the pathogen to apply its negative effect on development and improvement of the plant.

2. Classification of Host-Pathogen Interactions: The parts of a host-pathogen association can be extensively grouped into 4 phases, i.e., intrusion of host through essential obstructions, avoidance of host protections by pathogens, pathogen replication in have and a host's immunological capacity to control/wipe out the pathogen. A pathogen can attack a host simply subsequent to breaking the essential host guards. Pathogens contain harmfulness factors which advance and cause illness. The more noteworthy the destructiveness, the more probable the malady will happen.

Conclusion

In agriculture today, the tireless danger of loss of yield and quality from sicknesses is one of the most disruptive components. At present it is being defeated for the most part by methods for agrochemicals. The separation and starter portrayal of R qualities give chances to delivering plant assortments with sickness opposition. To decide the atomic premise of infection protection from a wide scope of phytopathogens, and to decide the instruments with which R quality items perceive pathogen elicitors and the plant barrier squares pathogen development will be future research objectives in the field of plant pathology. The information got from future research will without a doubt help to create solid illness opposition, and will assist with diminishing the utilization of ecologically harming agrochemicals. In nutshell, adornment of plant world with best sub-atomic weapons stores who can guard themselves from pathogen assault is conceivable just by analysing the sub-atomic premise of plant pathogen connection.

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Apiculture: A Profitable Business Venture and a Tool for Controlling Rising Inflation

Article ID: 32532

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Introduction

Apiculture is the scientific method of rearing honey bees. The word apiculture comes from latin word "Apis" meaning Bee. Thus, it is the rearing, caring and management of honeybees for the production of honey and its by-products (Bee pollen, Bee venom, Propolis, Bee wax, Royal Jelly). Main honey producing bees belong to family Apidae of Hymenoptera and comes in the genus Apis and has following species i.e.:

1. *Apis mellifera* (European honey bee) responsible for revolution in bee keeping in India.
2. *Apis dorsata.*
3. *Apis cerena*.
4. *Apis florae.*

Why to Go for Apiculture?

Bee Keeping plays an important role in providing an alternative source of income generation for rural youths and farmers beside playing crucial role in pollination of major crops . According to a survey, an individual can earn around Rs 50,000/- per month during major honey flow period in a particular season. Also, for setting up the beekeeping venture one does not needs high capital investment nor requires big lands. The main product which is the honey and its by-products has a tremendous commercial and nutritional significance. Honey is very delicious and a highly nutritious food. It is produced from nectar of plants through enzymatic activity, regurgitation and water evaporation. Honey contains simple sugars which are readily absorbed by the body, providing an instant source of energy plus it contains valuable vitamins and minerals. From medicinal point of view, it contains anti-bacterial, anti-inflammatory, anti-cancer, anti-septic properties. It is used for treating cold, cough and fever. Thus, honey has high demand for not only domestic market but even for export purpose because of its nutritional and medicinal uses. India is the fifth largest producer of honey and India has exported 38177.08 MT of natural honey for the worth of Rs 705.87 crore during 2015-16. Recently, in May 2020, the Central government has also announced a package of Rs 500 crore for beekeeping under Atma Nirbhar Abhiyan for promoting beekeeping among small and marginal farmers. Such financial support and farmer friendly policies will give impetus to the Beekeeping and Honey Mission to bring about Sweet Revolution in the country. It is not only the honey that is the outcome of apiculture. Beside honey we get many by products which are of tremendous commercial value and these products fetches healthy returns and helps in increasing the profit of the farmers.

Following are the useful by products of beekeeping other than honey:

1. Bees wax: They are very useful in cosmetic industries for making creams, lotions, lipsticks and in making candles.

2. Propolis: They have anti-bacterial, anti-allergic qualities and used to treat cough and throat irritations.

3. Royal Jelly: It is used in treatment of osteoporosis, diabetes etc. it also aids in healing wounds and boost immunity.

4. Bee venom: It is given as shot for rheumatoid arthritis, nerve pains, multiple sclerosis etc. according to studies, bee venom contains a mixture of proteins which can potentially be used as a prophylactic to destroy the HIV that causes AIDS in human. Bee venom can fetch around Rs 7000/ gm depending upon the quality.

5. Bee Pollen: It is a rich source of essential nutrients, minerals , vitamins and anti-oxidants. It contains more than 250 active substances. In Europe it is considered as food supplement. It is incredibly healthy, lower heart diseases, boost liver function and improves nutrient metabolism and its utilization. It is safe for people and easy to add to diet.

Apiculture as a Tool for Controlling Inflation and their Role in Pollination

Bees play an important role in pollination of crops. About 80 % of all pollination is done by bees which includes more than 100 important crops, fruit trees, vegetables etc. For understanding apiculture's roles in controlling inflation we must know what is inflation. Inflation is the Average rise in prices of goods i.e. Food, clothing and services. Among various reasons, one of the reasons that accounts for inflation is high demand and low supply of goods. Therefore, apiculture can play important role indirectly in reducing the demand-supply gap by increasing the production and yield of crops through increased pollination which in turn provides high supply of goods to market thereby reducing the pressure for availability of raw resources or goods in the market. Therefore ,technically people involving in beekeeping may play big role then economists in tackling the problem of inflation in the country.

Conclusion

Apiculture is a profitable business one can choose for along with doing the conventional agri farming. It provides honey which is the most nutritional food along with few other by products which is used in many industries including cosmetic, polishing and pharmaceutical industries. The honey bees are best pollinating agents which helps in increasing the crop yield and thus plays a crucial role in pollination. Lastly, the people involving in apiculture can indirectly play important role in checking the inflation of the country by reducing the demand–supply gap.

" EAT HONEY, SAVE EARTH , STAY HAPPY" - (Zahid Abass Wazir).

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Precision Agriculture: A Modern Breakthrough

Article ID: 32533

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Introduction

Agriculture had passed through numerous experiments and agitations in past few decades as the green revolution enforced its entire concentration on increased productivity at the cost of indiscriminate utilization of harmful agrochemicals and over exploitation of natural resource base. The escalating requirement of food and deteriorating resources has been a ceaseless point of argument or concern for applied scientists and policy constructors. In this context, precision agriculture, a developmental epitome/paradigm, first emerged in the United States in early 1980s that envisaged the maximization of efficacy of resources like land, water, manpower, energy and other vital production inputs and has been progressed as a feasible replacement to augment profitability on financial basis and production and productivity as well by the means of sagacious/judicious administration of accessible assets without imposing any hazardous influence on environment. Precision agriculture, the breakthrough in conventional farming system, is considered to be in the most recent stage of development of a product by incorporating newest ideas and features that are employed for achieving a sustained production level along with amplification of resource use efficiencies through information oriented management practices and proper techniques appropriate for production variables like soil, water, seed, varietal characteristics of crop, agrochemicals, climate and so on. The production efficacy is enhanced by contributing inputs to the crops in precise/right quantities at right time in right place in a right manner or in right composition. Robert et al. (1994) proposed three 'R's i.e. the 'Right time', the 'Right amount' and the 'Right place'. Thereafter, the International Plant Nutrition Institute added another 'R' to that list, the 'Right Source', and more recently, Khosla (2008) suggested an additional 'R', the 'Right manner'.

The principles and technologies are equally effective in both open farming and protected systems such as poly house/glass house / greenhouse among which protected environmental situation can implement additional benefits of regulated weather parameters on production. Probably the most effortless approach for determining precision farming is to consider it as everything which establishes the fact that the agrarian package of practices becomes more and more accurate and restrained at the time of cultivating agricultural crops and raising livestock. The key components which are actively involved in this system are information technology, GPS and GIS guidance, control systems, sensors, robotics, drones, autonomous vehicles, variable rate technology, GPS based soil sampling, automated hardware, telematics, and software.

What is Precision Agriculture?

Precision agriculture or site-specific crop management or smart farming is referred to as a management concept established on observation, measurement and response to the inter and intra field variability in crops with an objective to delineate a decision support system for entire farm administration for optimizing economic returns on inputs while conserving natural resources. It is an approach to effective farm management that utilizes information technology to guarantee that the crops and soil receive accurately what is needed by them for optimum growth and productivity and to secure better profitability, sustainability and protection of environment. The methodologies of precision farming have been empowered by the introduction of Global Positioning System or GPS, Geographic Information System or GIS and Global Navigation Satellite system or GNSS.

Advantages

Precision agriculture is designed to advance field level management with respect to:
1. Crop science: Farming practices are matched closely with crop requirements of various inputs.

2. Environmental protection: It aims to reduce ecological hazards and footmark of farming.
3. Economics: Competitiveness is boosted through more efficient practices.

Precision agriculture furnishes an abundance of information to the farmers:
1. Build up a record of their farm
2. Improve decision making
3. Foster greater traceability
4. Enhance marketing of farm products
5. Improve lease arrangements and relationship with landlords
6. Enhance the inherent quality of farm products

The major benefits from agronomical, technical, environmental and economic perspective obtained from this GPS based technology are listed below:
1. Enhances agricultural production and productivity
2. Prevents soil degradation
3. Reduces chemical application in crop production
4. Efficiently utilizes water resources
5. Disseminates modern farm practices to improve quality and quantity and reduces cost of cultivation
6. Develops favourable attitudes
7. Changes the socio-economic status of farmers
8. Reduces the burden on agriculture and the environment by improving the efficacy of machineries and putting it into utilization
9. Application of right amount of chemicals in right place and at right time gives benefits to the crops, soils and groundwater, thereby improving the whole crop cycle
10. It has become a cornerstone of sustainable agriculture as it takes into consideration the crops, soils and the conditions of the farmers
11. The management practices can considerably reduce the quantity of nutrients and other inputs required for production while increasing yield levels
12. Farmers may obtain a good financial return on their investment by saving water, pesticide and fertilizer related expenditures.

Challenges

1. It is suggested that educational and economical aspects are the two most significant constraints in wider acceptance of smart farming.
2. Lack of local experts, funds, knowledgeable research and extension personnel influence more in comparison with other factors of educational challenges.
3. Higher initial expenditures impose greater hindrance.
4. Lack of technical expertise, knowledge and technology are important issues.
5. This approach is not applicable or quite difficult and costly or not affordable for small and marginal land holdings.
6. Heterogeneity of cropping systems and market imperfections are observed.

Emerging Technologies

Smart farming employs several modern technologies on agricultural equipment's such as tractors, sprayers, harvesters etc.
1. Positioning system or GPS receives satellite signals to definitely ascertain a position on earth
2. Geographic information systems or GIS software makes sense of all the accessible information
3. Variable rate farming equipment viz. seeder, spreader etc.

Precision agriculture is an engagement of some digital farming technologies.
1. Robots
2. Drones and satellite imagery.
3. The Internet of things.

4. Smartphone applications.
5. Machine Learning.
6. Sensors.
7. VRA or variable rate application seeding.
8. Weather modelling.
9. Nitrogen modelling.

Conclusion

Precision farming had emerged with the commencement of GPS oriented supervision for tractors in early 1990s, and the embracement of this technique is now-a-days so much extensive throughout the globe that it is apparently the most customarily utilized example of precision agriculture methodology at the moment. John Deere was the first to acquaint this approach of employing GPS location data obtained from satellites. The fundamental intention of precision agriculture is to guarantee profitability, effectiveness and sustainability while safeguarding our environment by using the big information collected to conduct both proximate and forthcoming conclusions on each and everything starting from place, where to apply inputs at a specific rate to the time, when to allot chemicals, fertilizers or seed with best efficacy. Whilst the principles have been in use almost for more than 25 years, they have become more accepted due to technical improvements and the recognition of added and widespread technologies in the past decade only. The endorsement of mobile devices, accession to high speed internet facility, low expenditure and dependable instruments for positioning and imagery as well as farm equipment’s optimized by the manufacturer, are few elementary approaches that characterize the movement of precision agriculture and besides, some experienced personnel have indicated that more than 50% of today’s farmers use at least one precise technique which can lead to a more effective farming system in the long run by utilizing the energy minimally for unit area of production with maximum yield of food crops. The spotlight of precision agriculture is described in such way that it adequately assimilates the benchmarks of internationally acknowledged quality assurance programs viz. good agriculture practice or GAP protocols, sustainability standards and fair-trade principles that impact the producers and consumers communities where quality of the food is secured for a healthful nation.

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Contingency Crop Planning Under Aberrant Weather

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Introduction

Agriculture acts as the fountainhead of livelihood for approximately two third of population inhabiting in India where the adverse effect of rapid climate change and uncertainty and weather aberrations such as drought, flood, extravagant circumstances viz. higher intensity and excessive precipitation, frost, hail storm, heat wave, cold wave etc. on crop production and productivity is quite conspicuous in current years and all these factors are emerging as recurring phenomena in most parts of our country especially in crop growing seasons. In essence, the South West monsoon accounts for almost 75 per cent of total rainfall in India and it also exerts a crucial impact on performance of agriculture in kharif season mainly and on economy as well in terms of yield and overall monetary income. Although in rainfed regions, with the occurrence of rainfall early sowing becomes the best approach for achieving higher production, crop yield is hampered a lot due to delayed onset of monsoon or prolonged breaks during cropping season as well as early withdrawal or continuation of monsoon for longer periods which frequently result in inferior performance or total failures of major crops. Consequently, there is a dire requirement to formulate certain efficacious strategies with the objective of confronting such type of weather abnormalities. Keeping all these eventualities in consideration, Central Research Institute for Dryland Agriculture (CRIDA) developed some approaches and package of practices depending upon the characteristics of soil, precipitation and micro farming conditions to combat the divergence of weather which are generally designated as 'Contingency crop planning'.

Overview

Rainfed areas possess a distinguished position in Indian economy and rural livelihoods which is distributed over 55% of net sown area, providing more than 40% to the national crop production while also sustaining almost 40% of population and carry out a remarkable responsibility in achieving food security. Although the resource deficient cultivators, the backbone of rainfed agriculture, were predominantly circumnavigated from the advantages of green revolution, more than 87% of coarse cereals and pulses, 55% of upland rice, 77% of oilseeds and 65% of cotton are successfully cultivated under rainfed situations. Even after obtaining the full irrigation potential, approximately 45 to 50% of total cultivated area will rely upon monsoon completely, henceforth; rainfed farming is aspired to hold a significant place in agrarian economy of our country (Venkateswarlu et al., 2011). In spite of all the advancements auspiciously produced so far, it engages several challenges and hazards associated with biophysical and socio-economic conditions. Crop productivity proceeds to be quite low and uncertain by the virtue of weather fluctuations, nutrient deficiencies and poor socio-economic status of small and marginal farmers. Rainfed agriculture suffering from recurrent droughts or moisture shortages has to assimilate the modern techniques to sustain livelihood, environmental as income security of rural mass thereby preventing them from migration to urban areas in search of assured employment and to conserve soil and water efficiently. As the climatic alterations are compelled to jeopardize the spatial and temporal scenario of production systems, strategic and anticipated analysis or exploration for apprehension of the momentous role of climate change on rainfed farming is being conducted at an outstanding strength which is demanding an urgent need to manifest suitable methodologies to make it economically viable, socially acceptable and environmentally sustainable.

What is Contingency Crop Planning?

Contingency crop planning is defined as the implementation of technology related (land, water, soil, crop), institutional and policy dependent plans or interventions for making a choice of cultivating alternate crops or cultivars in adjustment with the actual rainfall situation and soil properties in a specific location during length of the crop growing season on the basis of real time weather pattern including extreme events that can contribute to domestic and rural food and fodder security, if executed in time and with efficiency (Srinivasarao et al., 2010). Real time contingency cropping refers to the highly location specific cultivation of an appropriate crop depending upon the date of receipt of rainfall in place of normally sown highly profitable crop of the region due to aberrant weather conditions.

Types of Contingent Crop Plans

1. Inadequate and uneven distribution of rainfall:

a. Cultivation of crops with low water requirement.
b. Cultivation of short duration crops.
c. Providing live saving or supplemental irrigation.

2.Long gap in rainfall:

a. Increased seed rate for obtaining higher plant population.
b. Spraying of urea solution.
c. Providing live saving or supplemental irrigation at critical crop growth stages.
d. Weeding and other intercultural operations.

3. Early onset of monsoon: Cultivate pearl millet, sorghum etc.

4. Late onset of monsoon:

a. Pre sowing irrigation, dry sowing or Kurra sowing.
b. Alternate crops and varieties like castor (Aruna), green gram, cowpea, sunflower etc.
c. Seed treatment and complete weed control.
d. Transplanting of one-month old bajra seedlings.
e. Grow pulses or oilseed crops in place of staple cereals.

5. Early cessation of rain:

a. Cultivation of short duration crops.
b. Mulching and decrease in plant population.
c. Providing live saving or supplemental irrigation.

6. Prolonged dry spells during crop period:

a. Resowing if dry spell occurs in 10 days of sowing.
b. Thinning of alternate rows of sorghum and pearl millet if mild moisture stress is seen at 30-35 days after sowing.
c. Cutting of sorghum and pearl millet and ratooning if severe moisture stress is encountered at 30-35 days after sowing.
d. Cutting of sorghum and pearl millet and ratooning if moisture stress occurs at blooming stage
e. Shallow inter-cultivation for eradication of weeds or for mulching purpose if there is a break in monsoon for short while
f. Adoption of wider spacing for moisture conservation and live saving irrigation
g. Proper weed management to save inputs (water, nutrients, CO_2, light, space etc.)
h. In situ rain water harvesting and recycling and soil mulching to reduce evaporation losses
i. Spraying of 2% urea solution after drought period which is beneficial for indeterminate crops like castor, pigeon pea, groundnut etc.
j. Stripping of crop leaves, intercropping and risk distribution.

General Technological to be Implemented on Real Time Basis

1. Stress tolerant genotypes (drought, flood, heat and cold); development of new crop varieties including types, cultivars and hybrids; short duration cultivars
2. Resilient crops and cropping systems and addressing new crops such as cotton and maize in non-traditional regions
3. Agronomic management such as crop calendars in the system, plant time adjustment, plant population, thinning etc.

4. In-situ moisture conservation, water harvesting and recycling, farm ponds, catchment and command relationships, lining, silt traps and monitoring ground waters
5. Soil management, conservation agriculture, moisture stress management with improved soil carbon stocks, mulch cum manuring, on-farm generation of organic matter, cover crops etc.
6. Balanced nutrition and foliar nutrition towards drought and flood tolerance
7. Integrated farming systems in drought prone regions and organic farming
8. Efficient land use system, agri silviculture, silvipasture, dryland horticulture etc.
9. Livestock and vaccinations in various weather aberrations and Innovations in Village Level Institutions
10. Integrated Nutrient Management (INM), zero tillage (ZT), Balanced and Site-Specific Nutrient Management (SSNM) along with foliar sprays of K and Zn
11. Improved crop management through crop rotations and intercropping, integrated pest management, supplemented with agroforestry and afforestation schemes
12. Efficient use of irrigation water, energy efficiency in crop production and use of poor-quality water, integrated watershed development, developing strategies for improving rainwater use efficiency through rainwater harvesting, storage, and reuse.

Conclusion

The investigation on influence of rapid modification and susceptibility of climate on agrarian sector is progressively appreciating the beneficial role of adaptation strategies to combat the weather aberrations throughout the world and our country is no exception in this context also as India experiences several vulnerabilities such as late onset and early cessation of monsoon, mid-season drought, prolonged dry spell and many others. Accordingly, an ever-increasing exigency to impose an intensified concentration on adaptation and mitigation strategies to extravagant weather hazards should be properly forecasted. In this matter, short term responses to safeguard farm productivity and ensure food security at household and national level and the long-term strategies to mitigate the impacts of rapid climate change thereby affecting the livelihoods of rural populations should go hand in hand in spatial, temporal, and sectoral scale. Moreover, implementation of real time contingency plans and programmes requires some sort of preparations for specific anticipated weather abnormalities depending on the long-term experiences or trends along with actual response to the prevailing condition in an indispensable approach, so that the negative effects of such type of weather events could be diminished.

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The Aroma Mission - For Boosting Medicinal Aromatic Plant Cultivation in India

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Introduction

The farming community of the country is facing challenging times with conventional agricultural and cropping systems to gain adequate economic returns. Aromatic crops are some of the most lucrative but underutilized crops that have tremendous potential for small and marginal farmers to alleviate socio-economic conditions. In the national and foreign markets, the essential oils of these aromatic crops are in very high demand. The growth opportunities in this market, however, have not been completely exploited yet. In order to bring about a decisive and disruptive shift in the rural economy, business dynamics and growth opportunities, the CSIR-Aroma Mission project has been designed to deliver end-to - end technology and value-added solutions across the country on a significant scale. CSIR-Aroma Mission will bring about a transformational shift in the aromatic sector through scientific interventions in the fields of agriculture, processing and product production in order to stimulate the growth of the aromatic and rural industries.

Aromatic Plants and their Essential Oils

Aromatic plants contain odorous, volatile, hydrophobic and highly concentrated compounds called essential oils (volatile or ethereal oils). These are obtained from various parts of the plant such as flowers, buds, seeds, leaves, twigs, bark, wood, fruits and roots (Brenes and Roura, 2010; Negi,2012). The essential oils are complex mixtures of secondary metabolites consisting of low-boiling-point phenylpropenes and terpenes (Greathead, 2003). The most important families from the point of essential oils are: *Asteraceae* or *Compositae*, *Lamiaceae* or *Labiateae* and *Apiaceae* or *Umbelliferae* (Bernath, 2009). It was found that there are valuable mixtures of mainly terpenoids like linalool, geraniol, borneol, menthol, thujanol, citronnillol, α-terpineol and a variety of low molecular weight aliphatic hydrocarbons like phenols (thymol, carvacrol, eugenol, gaiacol) and aromatic aldehydes (cinnamaldehyde, cuminal and phellandral) (Bakkali *et al.*, 2008). The oils are usually extracted by steam distillation, while currently the use of supercritical carbon dioxide extraction has become increasingly popular (Lubbe and Verpoorte, 2011).

There are more than 3000 plants used for their essential oils of which about 300 are used commercially as flavours and fragrances (Van de Braak *et al.*, 1999). The food industry uses the oils in soft drinks, food confectionary, *etc*., and the cosmetic industry uses them in perfumes, skin and hair care products, aromatotherapy, *etc.*, while the pharmaceutical industry utilizes them for their functional properties (Lubbe and Verpoorte, 2011).

Over the last six decades, the Council of Science and Industrial Research (CSIR) has worked tremendously to establish the essential oil-based aroma industry in India, which has greatly helped Indian industry, farmers, progressive growers and entrepreneurs to build jobs and increase their incomes. After intensive R&D and field trials, CSIR institutes have developed a variety of aromatic crops that can play a game-changing role for the flavouring industry in India.

CSIR-Aroma Mission

The Council of Scientific and Industrial Research (CSIR), Govt. of India has launched a project called "Aroma mission" which is an 'Aroma and Phyto-Pharmaceutical Mission' that is expected to help the farmers in boosting their income through cultivation of aromatic crops and medicinal plant keeping in view plight of farmers involved in traditional agriculture and their flight from rural areas due to climate change. In this initiative, CSIR, with its dedicated laboratories operating in the field of aromatic crops, is operating with other public and private enterprises to explore the implementation of technologies already established for the benefit of farmers and industry. The project was implemented with a view to doubling the income of farmers from their production using the available infrastructure.

The CSIR-CIMAP has also entered into collaborations with leading fragrance manufacturers and industries with the aim of benefiting farmers. Under the mission of the Central Institute of Medicinal and Aromatic Plants (CIMAP) cultivation of these crops will be promoted, in particular, in unproductive, marginal waste lands, including those affected by water scarcity, drought , salinity or flooding in Uttar Pradesh, Uttarakhand, J&K, AP, HP, MP, Odisha, Rajasthan , Gujarat, Karnatakaa, Karnataka, Chhattisgarh, Tamil Nadu, Maharashtra and North Eastern states.

To this end, taking into account the market demand for aromatic crops and their ability to increase the income of small and marginal farmers, awareness programmes are being conducted in different parts of the country.

Aim of the Mission

The aim of this mission is to improve the cultivation and value-addition of medicinal and aromatic plants for supply to the aroma-business industries and to the traditional Indian medicine system. For this reason, several CSIR institutes, including CIMAP, CDRI, NBRI and IITR (Lucknow), IIIM (Jammu), IHBT (Palampur), URDIP (Pune) and NEIST (Jorhat) have joined forces to develop and popularise technologies for the production , processing, value-addition, product creation and marketing of medicinal products.

In order to achieve the following outcomes, this mission aims:
1. To bring about 5550 ha of additional area under captive cultivation of aromatic cash crops in 18 states particularly targeting rainfed or degraded land across the country.
2. To provide technical and infrastructural support for distillation and values-addition to farmers all over the country.
3. To enable effective buy-back mechanisms to assure remunerative prices to the farmers.
4. Value-addition to essential oils and aroma ingredients for their integration in global trade and economy.
5. To conduct awareness and skill development programmes on cultivation and processing of aromatic crops.

Crops Selected in the Project

In this project, nine high-value aromatic cash crops have been selected by CSIR-IIIM so that unemployed young people can use the technological know-how supported by CSIR laboratories to add value to the essential oils produced by farmers in their particular area. Crops include lemongrass hybrids, rosagrass/himrosa, lavender, rosemary, Jammu monarda, clay sage, *Mentha* spp., *Ocimum* spp. and rose scented *Geranium*. The experts from industry have suggested the farmers to choose aromatic crop varieties developed by the CSIR-laboratories due its established acceptability in the existing market. These crops are selected on the basis of natural aromatic sources appropriate to the industry and have an enormous potential to give the aroma sector a quantum leap.

Scientists from CSIR-IHBT (Palampur) and CSIR-IIIM (Jammu) have addressed the cultivation practices and economy of high-altitude aromatic crops such as rose, rosemary, scented geranium and lavender that can be replicated in the north-eastern region's farming fields that can lead to doubling the income of farmers with small land holdings. Experts from CSIR-NEIST Jorhat have discussed the various activities undertaken by NEIST under the mission and the superior varieties of lemongrass (L8), citronella (C-5) and patchouli (P1) and its yield and oil content in the farmer's field of Northeast India.

Similarly, many economically significant medicinal plants, including kalmegh, ashwagandha, shatavari, senna, silybum, curcuma and swertia, have been targeted by the Phyto-Pharmaceutical Mission.

Future Prospects and Conclusion

Aroma mission will play a dominant role in the manufacture and processing of aroma products for the domestic and foreign markets. An additional 700 tonnes of essential oil worth Rs. 110 crores will be produced annually for the perfumery, cosmetics and pharmaceutical industries. The mission will set up a framework for timely farm advisory and integration with scientists and industry representatives to ensure maximum productivity and a fair price to the produce, which will help raise farmers' incomes by Rs. 30,000 to 60,000 per year. Approximately 45,000 professional human resources capable of multiplying, distilling, fractionating and testing the quality of essential oils and commercial herbal products will be created. In addition, more than 25,000 farming families will benefit and more than 15-20 lakhs will be working in rural areas on a daily basis.

Finally, it can be concluded that the CSIR-Aroma mission is capable of reducing imports of essential oils and enabling India to become the leading exporter of at least some essential oils.

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Carbon and Nitrogen Metabolism in Plants Under Drought Stress

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Introduction

Abiotic stress is the primary cause of crop loss worldwide, reducing average yields for most major crop plants by more than 50%. Drought is the most economically important abiotic constraint to crop production in the world (Anjum et al., 2011) and it is the most important limiting factor for crop production, becoming an increasingly severe problem in many regions of the world. Cellular carbon and nitrogen metabolism must be correlated to sustain optimal growth and development for plants and other cellular organisms. Furthermore, C/N balance is also critical for the ecosystem response to elevated atmospheric CO_2.

Carbon Metabolism and Drought Stress

Abiotic stresses, such as drought, salinity, extreme temperatures, chemical toxicity and oxidative stress are serious threats to agriculture and result in the deterioration of the environment. A major perturbation of plant protection under drought stress is ascribed to carbon metabolism which is manifested in premature cessation of starch deposition in endosperm. Supply of assimilates is never the limiting factor rather its utilization within the grain is the controlling factor of sink activity. In plants, grain-filling rate depends on the remobilizing capacity of the carbohydrate reserves from the vegetative organs to the grains. Under drought stress there is limited availability and supply of photoassimilate from source to sink tissues limiting grain filling rate. So, reserve mobilization from stem to grain might rise to 40–60 % under stressful conditions which otherwise could contribute 5–20 % of the final grain yield under normal conditions. Carbohydrate reserve in the form of water-soluble carbohydrate may account for more than 80 % of the total carbon content of plant (Cuellar-Ortiz et. al., 2008).

Fructans, the major constituents of water-soluble carbohydrates are the principal and long-term stored forms of carbohydrates in plants and serve as supplement for grain filling. Fructans are believed to be synthesized from sucrose when the current photosynthate supply exceeds the demand of the plants (Van den Ende, 2013). Under non-stress conditions, fructans are synthesised in the stem and accumulated to the highest amount at mid-grain-filling stage; thereafter, they are decomposed and partially remobilized into the grains for starch synthesis at later grain-filling stage. However, under abiotic stresses such as drought conditions, fructans can be decomposed into sucrose even during early grain-filling stage and so that can effectively compensate the lowered current photosynthate supply thereby sustaining grain-filling rate, consequently the grain yield may be largely maintained under moderate stress (Joudi et. al., 2012).

The central role of sugars depends not only on direct involvement in the synthesis of other compounds, production of energy but also on the stabilization of membranes by operating as compatible osmolytes which include proline, polyamines and polyols. In water scarcity, e.g. the diversion of carbon to polyol biosynthesis that are non-reducing sugars may also store excess carbon that decreases the activity of carbon metabolizing enzymes like invertase and sucrose synthase.

Water soluble carbohydrates can accumulate in plant stems and during later phase of grain filling these become an important source of assimilates for grain yield in plant. Starch constitutes the major carbohydrate in the endosperm of rice grains; it is composed of two types of polysaccharide molecules, amylose and amylopectin. Both amylose and amylopectin are synthesized from ADP-glucose, which is synthesized from glucose-1-phosphate in a reaction catalysed by ADP-glucose pyrophosphorylase (AGPase).

Starch is the major storage metabolite in many plants. Starch accumulation is correlated with the sucrose content of the kernels, activity of sucrose synthase and other enzymes which plays important role in starch synthesis (Yan et. al., 2008). This suggests that low sucrose content and a decline in the enzymatic activity involved in starch synthesis are responsible for the reduction of starch accumulation.

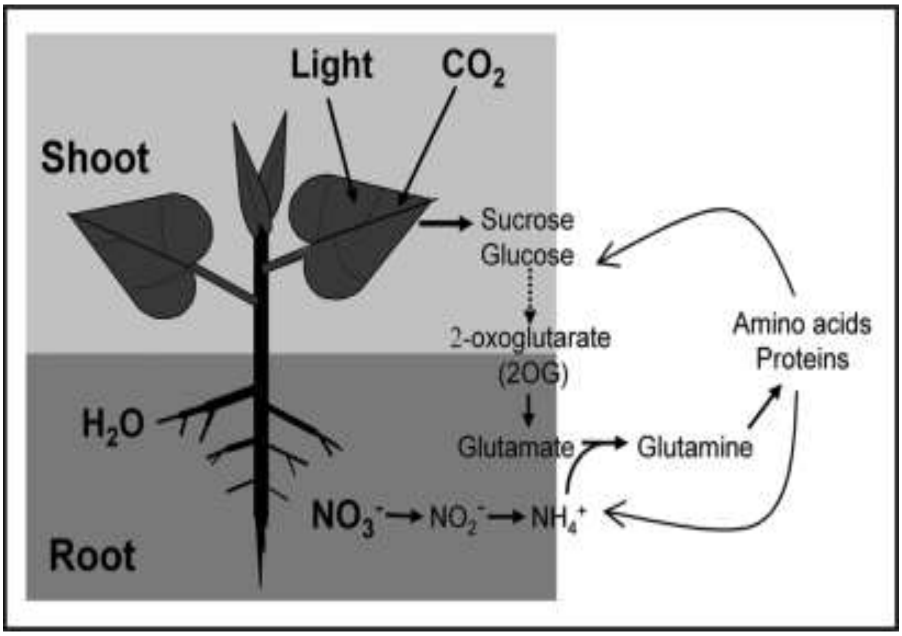

Fig 1: C to N metabolism in plants (Zheng, 2009)

Grain filling in cereals is mainly determined by sink strength. The sink strength can be described as the product of sink size and sink activity. Sink activity is a physiological restraint that includes multiple factors and key enzymes involved in carbohydrate utilization and storage. Enhanced sink activity under water scarcity may be attributed to increased carbon remobilization from the stems to grains or accelerated grain filling. Since starch is mainly synthesized from sucrose, which is the major translocator form of carbon in the phloem from source to sink tissues, and its catabolism leads to carbon formation for starch synthesis.

Drought Stress and Nitrogen Metabolism in Plants

Plants remobilizes a significant proportion of the nitrogen (N) accumulated by the vegetative tissues of the plant to the grain, and the majority of N transport during the grain filling period is the result of this redistribution of N. N assimilation is a vital process controlling plant growth and development through inorganic N which is assimilated into amino-acids and thus serve as important N.

The enzymes such as gultamate oxaloacetate transaminase and gultamate pyruvate transaminase are responsible for biosynthesis of these N carrying amino-acids and proteins (Lawlor, 2002). Storage proteins account for about 50% of the total protein in mature cereal grains and have important impacts on their nutritional quality for humans and livestock and on their functional properties in food processing. Globulins are an important source of protein in seed plants and are found in minute amounts in cereals. In rice, these proteins form the major endosperm storage protein fraction, accounting for about 70- 80% of the total protein. The high content of globulin storage proteins in grain may contribute to the high nutritional value when compared with other cereals, such as barley and wheat (Shewry and Halford, 2002).

Globulin was down-regulated showing a 58% decrease in abundance under drought stress conditions; the nutritional quality of rice grains under drought stress conditions may have been affected. During drought stress, removal of water from the membrane disrupts the normal bilayer structure and results in the membrane becoming exceptionally porous when desiccated. Stress within the lipid bilayer may also result in displacement of membrane proteins and this contributes to loss of membrane integrity, selectivity, disruption of cellular compartmentalization and a loss of activity of enzymes, which are primarily membrane based.

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Fall Army Worm: A Deadliest Epidemic Pest in India

Article ID: 32537

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Fall armyworm *(Spodoptera frugiperda)* is native to tropical and subtropical regions of the Americas. In 2016, it was reported for the first time in Africa where it caused significant damage to maize crops and has great potential for further spread and economic damage. In 2019, the pest spread in India as far as Mizoram in the northeast, Uttar Pradesh in the north, Gujarat in the west, Chhattisgarh in central India, and several states in the south.

Description and Life Cycle

The adult moth is able to move over 100 km per night. Due to the strong flying ability, it has spread to most of the tropical countries and entered India.

1. Egg: It lays eggs on plants, from which larvae hatch and begin feeding. The female moth can lay up to a total of 1000 eggs during its lifetime. Initially eggs are white in colour and later turns into brown with presence of greyish scales over the egg mass. Egg period is about 2-3 days.

2. Larva: Initially larvae are brown and later changes into green. Four characteristic raised round spots on the last abdominal second segment forming a square and the head has an inverted "Y" shaped mark.

3. Pupa: Pupation normally occurs in the soil, sometimes it may also pupate in maize cob. Pupal period may extend more in winter compare to summer.

4. Adult male: In the male moth, the forewing generally is shaded grey and brown, with triangular white spots at the tip and near the centre of the wing.

5. Adult female: The forewings of females are less distinctly marked, ranging from a uniform greyish brown to a fine mottling of grey and brown.

Host Plants

A polyphagous pest shows definite preference for the Poaceae family. It affects maize, rice, sorghum and sugarcane.

Damage Symptoms

The caterpillars mainly feed on leaves, making Parallel holes, giving them a ragged and torn appearance. If the larvae are numerous, they can completely defoliate the plants. Small larvae prefer feeding sites close to the ground. In corn, the caterpillars feed in the whorl, often concealed under their own frass. If the growing point is destroyed, dead heart symptoms appear. The larvae frequently feed on the immature kernels inside the developing ear.

Control Measures

1. Apply neem cake @ 250 kg/ha to reduce the adult emergence from pupae
2. Use light trap @ one/ha during night hours to monitor activity in and around maize fields
3. Avoid growing maize after maize crop
4. Collect and destroy egg masses
5. The following botanical and synthetic insecticides recommended as per IRAC Modes of Action are promising.

Insecticide	Knapsack sprayer (500 L/ha)	Power sprayer
Azadirachtin 1 EC (10000 ppm)	20 mL/10 L	60 mL/10 L
Thiodicarb 75 WP (AchE Inhibitors)	20 g/10 lit.	60 g/10 L
Flubendiamide 480 SC (Ryanodine receptor modulator)	3 mL/10 L	9 mL/10 L
Chlorantraniliprole 18.5 SC (Ryanodine receptor modulator)	3 mL/10 L	9 mL/10 L
Chlorpyriphos 20 EC	(AchE inhibitors)	20 mL/10 L
Emamectin benzoate 5 SG (Chloride channel activator)	4g/10 L	12 g/10 lit.
Spinosad 45 SC (nAchR allosteric modulator)	3 mL/10 L	9 mL/10 L

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Automation in Protected Cultivation

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Lakshmi Poojitha Challa

A greenhouse is a structure that is built of walls and a transparent roof and is designed to maintain regulated climatic conditions. These structures are used for cultivation of plants, fruits, and vegetables which require a particular level of sunlight, temperature, humidity and soil moisture.

Description and Life Cycle

Greenhouse technologies are being commercially utilized all over the world since last few decades. However, the level and extent of their use is different in different countries. These structures may be of different types according to the prevailing climate and its use. It includes high technology (fully and automatically controlled), medium- technology (partially and manually controlled), low- technology (naturally controlled), and plastic tunnel greenhouses.

There has been tremendous increase in area under greenhouse cultivation in most of the countries. In cool climates greenhouse cultivation has spread more and despite having a lot of potential, the medium and low technology greenhouses have not spread properly. However, the area under plastic tunnels, including walk in tunnels, are increasing with great pace. Countries like China, Japan, Spain, Italy, Turkey, Morocco are showing very good growth.

In Asia, China, Japan and recently South Korea are the leading users of greenhouse technology of the world. They use greenhouse primarily to extend the growing season, both in spring and fall. Japan has about 11000 ha greenhouse for cultivation of fruits like grapes, cherries, Japanese pear, fig, lemon etc.

Greenhouse technology in India is in its infancy. In nineties, several large high-technology greenhouse units came up, copying the foreign technology collaborating with foreign agencies, to produce flowers for export. In recent past medium-technology or low-technology naturally ventilated greenhouse and walk-in-plastic tunnels of smaller size are being used in many parts of India. As on today, Leh of Jammu and Kashmir alone boasts of more than 20000 small units of greenhouses. Mostly fresh vegetables are grown in these greenhouses and these low- technology structures have permitted the extension of growing season by four to six months. Nursery and production of seedling are other fields where the greenhouse technology is utilized in India.(Ghosh, 2009)

Automation of greenhouse system refers to operation of the greenhouse with minimum or without manual intervention. A well-maintained greenhouse structure is one which controls the spatial and temporal distribution of the parameters to achieve maximum crop yield and benefit cost ratio. The adoption of automation makes possible to grow advanced high value cropping system with new technologies which are difficult to grow by conventional means. Using automation one can control the irrigation valves, pump and fertigation equipment, sensors.

Some of the specific features of automation are stated below:

1. Can accommodate both overhead (misting,) and root zone (drip, NFT, flood tables) watering systems.
2. Greatly reduce or eliminate labour and the potential for human error in mixing feed formulas.
3. Water and fertilizer use can be minimized as these systems can more readily accommodate recycling of water.
4. Saves time as similar plants can be grouped together and watered in single or multiple zones.
5. Sensors can monitor how much water and fertilizer your plants are getting/needing.
6. Growers can program the control based on easy settings such as (time, moisture, EC, etc.) and/or make decisions based on outside weather conditions.
7. Grower can remotely monitor control crop based on individual zone watering needs while managing the entire cycle of the crop.

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8. Even, consistent watering cycles to produce a more consistent crop with better crop yields.
9. Can create a zero-runoff system. As in Europe, we're seeing more stringent water use restrictions in Canada where it is now law not to discard of waste water.
10. Extreme ROI: payback can be achieved for all sizes of greenhouse projects but generally speaking, the larger the project, the more economically feasible.
11. It eliminates the manual opening and closing of valves.
12. Possibility to change frequency of parameters as per the crop need.
13. Providing timely intervention.
14. We can control from remote areas.
15. Eliminating the need of hardware connections.

Need for Automation in Greenhouse

The United Nations has predicted that by 2050, more than two-thirds of the nine billion world population will live in the cities. Securing the supply chain of fresh fruits and vegetables in this new scenario will be an overwhelming challenge. For such a system to operate successfully and to achieve its production objectives, attention needs to be paid to the technical aspects of automation, culture, environment and system. In greenhouse, interaction of offline monitoring system on real time basis was inefficient. Therefore offline systems were shifted to wireless and cloud-based data collection architectures. Various data acquisition platforms either prototype or commercial have been used for improving the efficiency of greenhouse production. Some of the most recent automations include web-based, cloud-based, IoT communication and control, wireless sensor networks.

Types of Automations Used in Green House

1. Time based monitoring system.
2. Sensor based monitoring system.
3. Computer-based monitoring systems.
4. Wireless sensor network.
5. Internet of things.
6. Artificial intelligence.

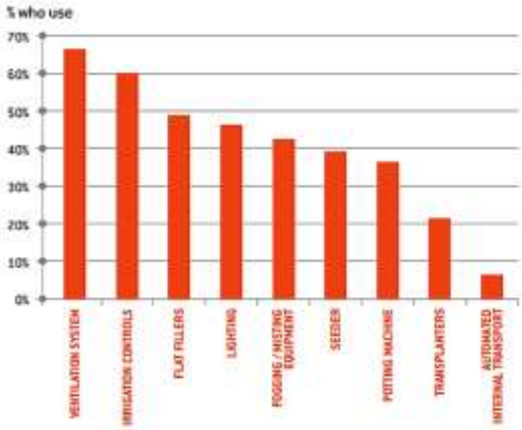

Fig 1: State of Equipment and Automation in Indoor Farming (Source: Survey of 100 Growers in Late 2011, Greenhouse Growe)

Root Media Used in Greenhouse

Farming Method	Key Characteristics	Major Benefits
Hydroponics	Soilless based, uses water as the growing medium	Fosters rapid plant growth; Reduces, even eliminates soil-related cultivation problems; decreases the use of fertilizers or pesticides.

Aeroponics	A variant of hydroponics; it involves spraying the roots of plants with mist or nutrient solutions.	In addition to benefits mentioned above, aeroponics requires less water.
Aquaponics	It integrates aquaculture (fish farming) with hydroponics.	Creates symbiotic relationships between the plants and the fish; it uses the nutrient-rich waste from fish tanks to “fertigate” hydroponics production beds; and hydroponic bed cleans water for fish habitat.

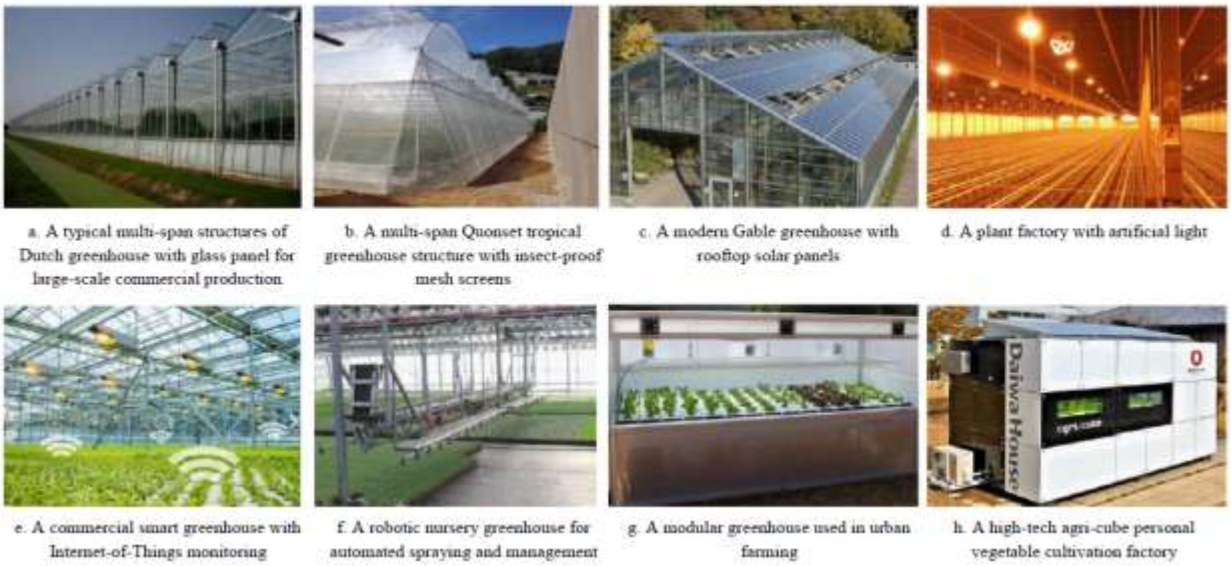

Fig 2: Views of some of the most popular modern greenhouses and controlled environmental agriculture (Shamshiri et al, 2018).

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Foot Printing: Carbon, Ecological and Water

Article ID: 32539

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Basic Concepts of Foot Printing

What is a common measure of the impact of an individual, institution, region or nation? This can be done by measuring the "footprint" of that entity. When discussing climate change and sustainability the concepts of carbon footprint and ecological footprint are often used. Understanding how these footprints are derived is important to the discourse as not all calculations are equal. These footprints can be calculated at the individual or household level, the institutional level (corporation, university, and agency), municipal level, sub-national, national or global. They are derived from the consumption of natural resources such as raw materials, fuel, water, and power expressed in quantities or economic value. The quantity consumed is translated into the footprint by using conversion factors generally based in scientific or economic values.

Carbon Footprint

A carbon footprint is the amount of greenhouse gases—primarily carbon dioxide—released into the atmosphere by a particular human activity. A carbon footprint can be a broad measure or be applied to the actions of an individual, a family, an event, an organization, or even an entire nation. It is usually measured as tons of CO_2 emitted per year, a number that can be supplemented by tons of CO_2-equivalent gases, including methane, nitrous oxide, and other greenhouse gases.

Since climate change is one of the major focuses of the sustainability movement, measurement of greenhouse gases or carbon footprint is a key metric when addressing this problem. A greenhouse gas emissions (GHG) inventory is a type of carbon footprint. Such an inventory evaluates the emissions generated from the direct and indirect activities of the entity as expressed in carbon dioxide equivalents. Since you cannot manage what you cannot measure, GHG reductions cannot occur without establishing baseline metrics.

Ecological Footprint

Similarly, the ecological footprint (EF) represents the area of land on earth that provides for resources consumed and that assimilates the waste produced by a given entity or region. It is a composite index that represents the amount of biologically productive land and water area required to support the demands of the population in that entity or region The EF is beneficial because it provides a single value (equal to land area required) that reflects resource use patterns (Costanza, 2000). The use of EF in combination with a social and economic impact assessment can provide a measure of sustainability's triple bottom line (Dawe, et al., 2004). It can help find some of the "hidden" environmental costs of consumption that are not captured by techniques such as cost-benefit analysis and environmental impact (Venetoulis, 2001). Using the ecological footprint, an assessment can be made of from where the largest impact comes (Flint, 2001).

Water Footprint

The water footprint of production is the volume of freshwater used by people to produce goods, measured over the full supply chain, as well as the water used in households and industry, specified geographically and temporally. This is slightly different from the hydro print described above which simply compares the consumption of water by a geographic entity to the water that falls within its watershed. The water footprint considers the source of the water as three components:

1. Green water footprint: The volume of rainwater that evaporates during the production of goods; for agricultural products, this is the rainwater stored in soil that evaporates from crop fields.

2. Blue water footprint: The volume of freshwater withdrawn from surface or groundwater sources that is used by people and not returned; in agricultural products this is mainly accounted for by evaporation of irrigation water from fields, if freshwater is being drawn.

3. Grey water footprint: the volume of water required to dilute pollutants released in production processes to such an extent that the quality of the ambient water remains above agreed water quality standards.
The water footprint of an individual is based on the direct and indirect water use of a consumer. Direct water use is from consumption at home for drinking, washing, and watering. Indirect water use results from the freshwater that is used to produce goods and services purchased by the consumer. Similarly, the water footprint of a business or institution is calculated from the direct and indirect water consumption.

Summary

Foot printing tools can be useful ways to present and compare environmental impact. They are useful because they can combine impacts from various activities into one measure. However, they have limitations. For instance, in a carbon footprint or greenhouse gas emissions inventory, many of the “conventional” environmental impacts such as hazardous waste, wastewater, water consumption, stormwater, and toxic emissions are not accounted for, nor are the impacts of resource consumption such as paper, food, and water generally measured. Perhaps most importantly, certain low-carbon fuel sources (e.g. nuclear power) that have other environmental impacts (e.g. nuclear waste) are neglected. Finally, the scope of the emissions inventory does not include upstream emissions from the manufacture or transport of energy or materials. This suggests that there is a need to go beyond just GHG emissions analyses when evaluating sustainability and include all forms of energy and their consequences.

The ecological footprint can be misleading when it is looked at in isolation, for instance with an urban area, the resources needed to support it will not be provided by the actual geographic area since food must be “imported” and carbon offset by natural growth that does not “fit” in a city. However, cities have many other efficiencies and advantages that are not recognized in an ecological footprint. When looked at on a national level it can represent the inequities that exist between countries.

It is interesting to contrast the water and ecological footprints, as well. The water footprint explicitly considers the actual location of the water use, whereas the ecological footprint does not consider the place of land use. Therefore, it measures the volumes of water use at the various locations where the water is appropriated, while the ecological footprint is calculated based on a global average land requirement per consumption category. When the connection is made between place of consumption and locations of resource use, the consumer’s responsibility for the impacts of production at distant locations is made evident.

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An Overview of Application of Remote Sensing to Asses Impact of Changes in Land Use on Runoff Using SWAT Model

Article ID: 32540

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Abstract

In last decade, land use and land cover changing very rapidly which culminating into disturbance of the different natural process. Alteration land use and land cover should be assessed properly to estimate the impact of it on different hydrological process. There are numerous methods to find out the different hydrological component using empirical relationships, statistical methods or using different hydrological and hydrodynamic models. Remote sensing and Hydrological models emerged as a robust technique to understand these processes. In this study a brief review has been done on use of remote sensing and modelling to assess land use land cover impact on runoff. It was found that SWAT model and different satellite data such as Digital Elevation Model (DEM), Images were very helpful and showed the potential to assess theses impacts. These brief summarized studies will help reader to understand the modelling and use of remote sensing particular in context of land use and land cover change assessment.

Keywords: Land use, Land Cover, Runoff, SWAT and Model.

Introduction

Runoff is part of rainfall, snow melt and irrigation water this is flow on the surface of the earth. And in other word it is the part of water which is not infiltrated in the ground and flow on the surface of the earth according to gravitation low. Runoff water finely meet with the water body. Runoff is the depends on metrological factors and physical characteristics of field. Physical characteristics it is like land use, vegetation, soil properties, catchment shape, drainage network, slope percentage of basin and topography of the basin.

Only 65 % of rainfall water absorbed by the soil and it contribute on the ground water recharge remaining 35% or rainfall water is run way on the surface of the earth and lastly meet in the water body. Runoff water is the major source of the none point pollution and runoff water is major factor of the soil erosion. In present time agricultural field use more chemicals this chemicals' flow by the runoff water and create the pollution in the water source. In the present time of the world population growth rate is high and also peoples want live with standard life. Peoples are changed the land cover and land use for fulfil our requirements. According to world bank in 1990s total forest area of the world is 31.801% and in 2015s its remaining only 30.825%. Land cover change had a larger impact on runoff. Change in runoff increase or decrease both are harmful for environment. Land cover management is more important for safety from natural disaster. Consequent impacts of land cover change on flood or runoff hydrographs study are important for humans.

Review of Literature

Increasing of the impervious surface created by the urbanization and reduce the infiltration rate of the rainfall water, and increase the runoff volume and peak discharge of the river. This is the one factor of the flood disaster. And runoff water also caring the sediments this is one type of the water pollution sources. In present time developed and developing country use the more fertilizer in agriculture field. Runoff water is the one of the nonpoint sources of pollution. NPS pollution has become the leading cause of degraded water quality in the U.S (Bhaduri et al., 2000).

Over the last some years we more use the computer and over more research is done on the computer. In present time we also use some models for estimation of land use land cover change impact on the runoff. This type of study is major limitation is lack of long term and high accurate availability of metrological and physical data of the area, it is difficult to find the LULC change impact on the runoff character with the accurately (Defries & Eshleman, 2004).

China is the most industries country. Shenzhen area is the special economic zones by the industries in China. In Shenzhen for development of the industries land cover and land use highly changed since the mid-1980s. The scs method use for simulation of the hydrological parameters in the Buji River Basin. Buji river basin is higher urbanization because of it is area under the Shenzhen city. This basin leads to higher runoff, greater flood peak discharge and shorter runoff peak times, and thus create higher risk of flood disasters. Land use land cover data were taken from LANDSAT images in 1980, 1988, 1994 and 2000. At 1%, 2% and 5% rainfall probability, the increase of the maximum flood peak was 20.2%, 23.0% and 28.9% respectively, under relatively dry soil moisture condition. At 10%, 50% and 90% rainfall probability (the rainfall probability of 10% means 10-year return period of moist year, 2-year return period of normal year and 10-year return period of dry year), the increase of runoff coefficient was 12.6%, 20.7% and 33.5% respectively under relatively dry soil moisture condition, however, and the value was 2.5%, 4.3% and 6.9% respectively under relatively wet soil moisture condition (Shi P.J. et al., 2007).

SWAT model was useful for analysis of land cover change impact on runoff characteristics River Nzoia catchment. This is found the agricultural land cover is increased in year by year from 39.6 to 64.3% between 1973s and 2001s but forest area was decreased by the 12.3% to 7.0%. The changes in land use land cover in the period 1973–2001, have effectively and have increase in runoff. The SWAT model-generated runoff increased about 119% between 1970 and 1985. With climatic inputs held constant, land-cover changes accounted for a difference in runoff of 55– 68% (GITHUI F. et.al ,2009).

In the world day by day increase the number of populations. Humans change the land cover and land use for done our requirements fulfill. As the Yom catchment has been highly changed in urbanization along the river bank over the last decade and the potential for increased runoff volume, peak of flow and urban flooding is probable. In this paper provided information is more useful for planning emergency urban floods, and find the flood effected area, and also useful in public sector for future planning and managements in the northern central watershed of Thailand (Petchprayoon et al., 2010).

Land use and land cover change create major impact on the over land flow generation in the souther pacific area of the costa rica. In this area secondary forest which is developed over 12-15 year which is generate very low runoff volume in the normal and high rainfall intensity. Grassland 10 time and oil palm 20 time more generate the runoff with respect to the secondary forest land in the normal rainfall intensity. In higher rainfall intensity (384 mm/h) oil palm field generate the 75 % runoff of the rainfall volume (Abarquero A. N. et al., 2015).

land cover land use change analysis at manali and kurumali river basin in kerala. Land use land cover impact on runoff characteristics of small area and large area. Which is affect the availability of ground water and surface water and also affect the future land cover because change in water availability. In this basin forest area decreased 60% to 32% it is very large amount of changes but runoff increased only 15% because of forest changed in agricultural field, agricultural fields create more evapotranspiration (N. SAJIKUMAR and R. S. REMYA, 2015).

Vegetation deterioration on more gentle slopes will produce a greater impact on flood risk than the same deterioration on steeper slopes. The size of patches of change in vegetation cover does not seen to affect their impact on river discharge. The hilltop and near-stream zone are the most sensitive area for land-cover change in blanket peatland basins. The revegetation is highly beneficial for flood management. (Gao J. et al., 2016).

Methodology: Runoff Calculation Methods

The following methods provide the peak flow of the runoff from a design storm. According to Peak flow of runoff we design some hydrological structure. Peak flow study is more important for safety purpose of structure.

1. Rational Method:

Qp = CIA (in m3/s) where
Qp = peak runoff rate, m3/sec
C= runoff coefficient, it is the based on the land surface
I= rainfall intensity, m/sec and
A=watershed area, m^2

The peak flow is accursing at design storm time equal to the time of concentration, tc. Runoff coefficients is varying from 0 to 1.

2. Curve Number Method: The Curve Number Equation is actually giving relationship between runoff volume and rain volume. The equation used in this method.

Q =(P-Ia)2 / (P-Ia+S) (depth)
Where,
Q= runoff depth,
Qp (peak flow) = Q*A,
P= rainfall depth,
Ia = initial abstraction, and
S= watershed storage.

All units are in depth. The initial abstraction is amount of rain that falls before runoff is initiated; generally, Ia value is used to be 0.2S and equation is written as:

Q = (P-.2S)2/(P-.8S) (depth).

The S value find by the help of this equation

S=(25400/CN)-254(mm).

Where CN is the curve number its value varying from 0-100. It is depending on the soil type and land use land cover.

3. SWAT model: It is a physically-based, distributed, agro-hydrological model. That operates on a daily time step at watershed scale. It is designed for predict the impact of management on runoff water, sediment yield and also in agricultural field find the chemical content on the runoff water in ungauged basin. The model is useful for continuous simulation of dissolved and particulate elements in large basin. It is use for analyzing small or large catchments by dividing into sub-basins, which are then further subdivided into HRUs with same land use, land cover, soil type and slope. The surface runoff simulation in SWAT was brought out using various input data such as topography, land use, soil properties and weather data in the watersheds. The basin was initially divided into HRUs on the basis of unique combinations of land use, soil type, and percentage slope of basin. These HRUs are again divided into sub-basins. The use of sub- basins in a simulation is particularly beneficial when different areas of the watershed are classified by land use or soil type enough in properties to impact hydrology. SWAT convert the hydrologic cycle into two phases: first is the land phase and another is the routing phase. The land phase keeps track the runoff movement from the field to the main stream in the basin. The routing phase create outlines how the runoff water moves through the stream network. SWAT include the hydrology components like canopy storage, infiltration, evapotranspiration, lateral subsurface flow, surface flow, ponds, small channels and back flow. HRUs calculate the runoff flow by the water budget equation.

$$SW_t = SW_O + \sum_{t=0}^{t}(RT - Qt - ETt - Pt - QRt), \text{ where}$$

SWo= soil water content at beginning,
SWt= soil water content at end of a time period of storm,
Rt=rainfall,
Qt= surface runoff,
ETt, = evapotranspiration,
Pt= percolation, and
QRt= lateral flow.

The SCS curve number method estimates surface runoff from daily rainfall. It is computation at the HRU level. The sizes of the HRUs are smaller than watershed. The surface runoff is calculated with the curve number method. Peak runoff rate calculated by Rational method. Penman method to calculate PET. MUSLE for calculating the sediment yield from sheet erosion for each HRU.

4. Model inputs: Topography, Soil data, Land use and Metrological data.

Distributed TOPMODEL

TOPMODEL has been used worldwide as a standard model. It is use for hydrological analysis. It was a continuous lumped or semi distributed deterministic hydrological model was firstly developed. Recently, fully distributed topmodel has developed, tested and evaluated by Gao et al., 2016. The distributed model uses for grid(20m*20m) cell. Distributed topmodel represents the movement of runoff water across and between cells. In distributed topmodel module for runoff calculation uses the multiple-direction flow theory. In this model runoff calculated by the darcy weisbach equation.

$$V2=8gds/f$$

Overland flow velocities depending on slope, water depth and surface roughness.

According to Darcy-Weisbach equation velocity depends on the surface roughness. When distributed topmodel run for the different spatial configurations of land cover in a basin, the velocity parameter for the cells in the model are varied depending on the land cover land use type in the grid cell.

Current Status and Future Scope: In the present time land use land cover is heavily changing by anthropogenic activities. According to the previous study land cover land use change affects the ecosystem and climate change is very fast accelerated by land use land cover change. Water is the involve in the all activities of nature. The change of water balance at any were like basin, sun basin, and small grid cell this all affected by the water unbalancing.

The use of remote sensing-based GIS analyses in mountain areas has still many challenges to overcome. The accuracy of image classification methods could be tested more rigorously using ancillary and ground data. We are all use for research purpose many types of the data this data availability with excellent accuracy is major problem and for future research present data with highly accurately storing and finding is the major challenge.

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Wireless Sensor Network (WSN) for Precision Irrigation

Article ID: 32541

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Introduction

Agriculture is an important sector which drives the economy and food security of many nations. Due to the increased demand for food, people are trying to put extra efforts and modernize conventional agricultural practices for better productivity (Aqeel-ur-Rehman et al., 2009).

The agriculture in India needs more assistance for farms and farmers, more advanced research in recent available agricultural technologies, more automation, and more testing and applying new methods of study, analysis, and mechanization. Irrigation is one of the essential factors which regulate the level of crop production. The agricultural sector uses maximum water globally (Munoth et al., 2016). Water is a depleting resource; hence judicious use of water is the need of the hour (Garg et al., 2016).

Precision irrigation means water application in the root-zone of the crop at the right time, in exact quantity, at the right place through the accurate methods. The goal of precision irrigation is improving crop productivity and water use efficiency (WUE), so that energy cost per irrigation is minimized.

A real-time automation irrigation system in the field for delivering the precise and accurate amount of water for the crop at each stage of its growing period is used (Sakthipriya, 2014 & Li et al., 2010). In another study, an information on field parameters (soil moisture, temperature, leaf wetness, water logging) and environmental parameters (wind directions, air relative humidity) have been recorded in a real time for precise irrigation.

With this information, the users can adjust their strategies to achieve the desired objective to the efficient management of all agricultural inputs like water and fertilizers, etc. (Aqueel et al., 2014; Santiago et al., 2012).

Role of Sensors in Agriculture

A sensor is a device that has capabilities to measure physical attributes and convert them into signals for the observer. They are used for collecting information about physical and environmental attributes, whereas actuators are employed to react to the feedback to have control over the situations. Sensors are the part of nature and many of the sensing capabilities are available in living organism in the form of bio-sensors. The context acquisition provides a valuable contribution to modelling situations of domains with a variety of time-variant attributes. Agriculture is one such domain.

The agriculture domain poses several requirements that are the following:
1. Collection of weather, crop and soil information.
2. Monitoring of distributed land.
3. Multiple crops on a single piece of land.
4. Different fertilizer and water requirement to various parts of uneven land.
5. Diverse needs of crops for different weather and soil conditions.
6. Proactive solutions rather than reactive solutions.

1. Soil Moisture Sensor: The utilization of sensors is becoming possible in almost every field of life due to the advancement of technology and its size reduction. The soil moisture plays a vital role in precision irrigation. Soil moisture improves soil fertility, provides proper irrigation timing, depicts the water requirement, and saves the water; hence soil moisture sensor plays import role in sensor-based irrigation system.

Fig 1. Soil moisture sensor

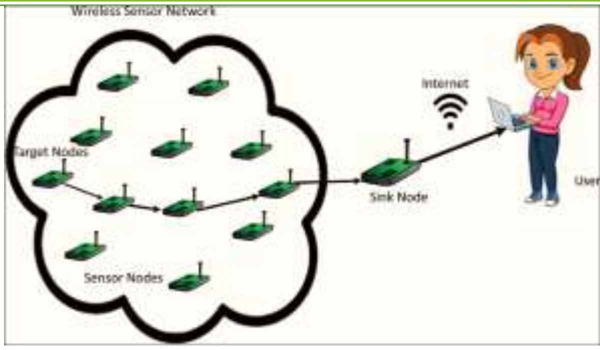

Fig 2. Wireless Sensor Network (WSN).

Working Principle of Soil Moisture Sensor: The following methods provide the peak flow of the runoff from a design storm. According to Peak flow of runoff we design some hydrological structure. Peak flow study is more important for safety purpose of structure.

Wireless Sensor Technology and Networks

Wireless Sensor Network (WSN) comprises over several components called 'nodes' (refer to Fig. 2). The nodes are smart devices that are used to collect the application-oriented data requirements. A sensor network performs three basic functions:

1. Sensing.
2. Communication.
3. Computation by using hardware, software and algorithm.

Need for Automatic Irrigation

1. Saving energy and resources for utilizing in a precise way.
2. Easily installation of the system on the field.
3. To apply the right amount of water at the right time for the sake of farmer's easiness to control farm Irrigation and nursery.
4. Valves are used in automated irrigation systems to turn on/off the motor.
5. Pump or motor can be easily operated with a sensor-based controller and no need for any labour to manage or monitor irrigation systems.

Conclusion and Future Work

The automated irrigation system (AIS) is feasible and cost-effective solution for optimizing water resources for agriculture production. Such system is viable solution in places where water scarcity problem existed, thereby improving sustainability. The AIS helps the farmer by making his work smarter. The development of sensor-based applications in agriculture makes it possible to increase the productivity, efficiency, and profitability through precision irrigation farming. The water conservation practices for irrigation need to be effective and affordable because the demand for water requirement is increasing day by day and there is also need to provide fresh and surplus amount of water to the aquatic habitats.

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Different Bagging Techniques in Guava (*Psidium guajava* L.) Fruit

Article ID: 32542

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Botanical name: *Psidium guajava* L.
Family: Myrtaceae.
Chromosome no: 2n= 22
Origin: Peru.

Introduction

Guava is one of the important fruits cultivated in several tropical and subtropical countries of the world (Pathak, et al., 2007). It is also known as 'Apple of the tropics' or 'Poor man's apple'. Due to hardy nature of plant, it can withstand adverse climatic conditions and grows under a wide range of soil types from sandy loam to clay loam (Dhaliwal and Singla, 2002).

Bagging is a physical protection technique used extensively in several fruit crops to improve skin colour and to reduce the incidence of disease, insect pests, mechanical damage, sunburn of the skin, agrochemical residues on the fruit, and bird damage (Bentley and Viveros, 1992; Kitagawa et al., 1992; Hofman et al., 1997; Xu et al., 2010).

General Information

In India, Guava is the fourth most important fruit crop in area and production after mango, banana and citrus with production of 42.36 lakhtonnes from an area of 2.76 lakh ha (NHB Database, 2018). It is an important fruit crop cultivated all over India, especially in the regions of Uttar Pradesh, Madhya Pradesh, Bihar, Maharashtra, West Bengal, Punjab, Chhattisgarh, Haryana, Karnataka, and Gujarat.

Allahabad of Uttar Pradesh has the reputation of growing best quality guava fruits in the world (Maji, 2010). In Madhya Pradesh major guava producing areas are Sagar, Shahdol, Sehore, Sheopur, Indore, Hoshangabad and Mandsaur. In Madhya Pradesh, the area covered is around 35.08 thousand ha with a production of 686.70 thousand MT of guava crop (Anonymous, 2018).

Properties

Its roots, bark, leaves and fruits have a great medicinal value. The fruit is an excellent source of vitamin C, pectin, calcium and phosphorus. Guava is the most important protective fruit in India because of highest vitamin C (299 mg/100g) among table fruits (Bal et al., 2014). It is normally consumed fresh as a dessert fruit, or processed into puree, juice, concentrate, jam, jelly, nectar or syrup (Jagtiani et al., 1988). It has been observed that pectin content is higher in winter guava than the monsoon fruits (Salunke and Kadam, 1995).

Improved Varieties

Lucknow-49 (Sardar), Allahabad Safeda, Apple Colour, Hafsi, Harija, Arka Mridula, Chittidar, Arka Amulya, Lalit, Shwetha, etc. are some of the improved cultivars of guava fruit. Bagging can be implemented on any of the varieties to increase the physical as well as chemical quality of the fruit with least percentage of damage or defects.

Main Problem and Solution

The production of poor-quality fruits is a matter of common experience. It would be therefore worthwhile to improve the quality of guava by bagging of fruits with different bagging materials. It may be comprised of newspaper bagging, polythene bagging, butter paper bagging, etc.

Fruit bagging decreases the defects caused by diseases and insects, and increased flesh firmness and flavour. The most important role of fruit bagging was to effectively protect fruits from physiological factors which led to the significant decrease of the total damaged and defective fruits (13.7-33.3%), as compared with non-bagged control.

Bagging, protects fruit from pests and diseases but also affects the quality of the produce by changing micro-environment of fruit during development (Son and Lee, 2008) and yields high quality fruit.

However negligible research works have been conducted on safe guava production techniques and handlings. Therefore, this study can be used to explore the effects of different bagging materials on physical and chemical quality of guava in a view to judge the potential of fruit bagging technology for safe guava production. This investigation is helpful to evaluate the use of bagging techniques to protect the winter grown guava fruit quality from the adverse effects of fruit fly attack.

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COVID 2019 – Effect on Agricultural Economy

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If we see the current status of the economy, we would realize how a single virus has created a havoc in the lives of millions. Some consider it as the conspiracy of china while for some it is accidental outpour from the foreign lab where scientist was working on bats, bats who are considered to be the inhabitants of deadly virus. Biggest problem of the scientist, while dealing with virus is their property to be mutable therefore it's too difficult to find any vaccine which can control the high reproductivity rate of virus once they are inside the living cell. A virus infects your body by entering healthy cells. There, the invader makes copies of itself and multiplies throughout your body. The new coronavirus latches its spiky surface proteins to receptors on healthy cells, especially those in your lungs. Specifically, the viral proteins bust into cells through ACE2 receptors. Once inside, the coronavirus hijacks healthy cells and takes command. Eventually, it kills some of the healthy cells. Now coming to the symptoms which people have gone through mostly found in elderly people as their immunity is too weak to deal with COVID disease.

COVID-19, the illness caused by the coronavirus, starts with droplets from an infected person's cough, sneeze, or breath. They could be in the air or on a surface that you touch before touching your eyes, nose, or mouth. That gives the virus a passage to the mucous membranes in your throat. Within 2 to 14 days, your immune system may respond with symptoms including:

a. Fever, A cough, Shortness of breath or trouble breathing, Fatigue, Chills, sometimes with shaking, Body aches, Headache, A sore throat, Congestion or a runny nose, Loss of taste, Loss of smell, Nausea or vomiting, Diarrhoea.

The virus moves down your respiratory tract. That's the airway that includes your mouth, nose, throat, and lungs. Your lower airways have more ACE2 receptors than the rest of your respiratory tract. So COVID-19 is more likely to go deeper than viruses like the common cold Lungs might become inflamed, making it tough for you to breathe. This can lead to pneumonia, an infection of the tiny air sacs (called alveoli) inside your lungs where your blood exchanges oxygen and carbon dioxide. A simple CT scan of infected chest, you can find shadows or patchy areas called "ground-glass opacity."

For most people, the symptoms end with a cough and a fever. More than 8 in 10 cases are mild. But for some, the infection gets more severe. About 5 to 8 days after symptoms begin, they have shortness of breath (known as dyspnea). Acute respiratory distress syndrome (ARDS) begins a few days later. While placement in a hospital's ICU can be lifesaving for patients with severe illness, it can also come with significant health consequences. Generally, people requiring intensive care are at increased risk for mental health issues like post-traumatic stress disorder (PTSD), anxiety, and depression when they're released from treatment, according to Weill Cornell Medicine in New York City. They may also have significant cognitive impairment and limited physical ability.

Now coming to the effects of this deadly virus on the economy. It has impacted the economy in such a challenging way that it is difficult for the common people to come out of its trap. In lay man language, how can we describe the economy, especially for a country like India, where majority of people are dependent on the agriculture. In fact, govt is also turning blind eye to farmers by introducing three farm bills whose main aim is to give upper hand to the traders and businessmen. If farmers don't get the free will to sell their crop in the market, how can we ensure the availability of basic crops and all the essential commodities. "Agricultural economics is an applied phase of the social science of economics in which attention is given to all aspects of problems related to agriculture." Agricultural Economics, as its title implies is that branch of economics which deals with all aspects of problems related to agriculture. " It is only one of the many branches of applied economics such as Industrial Economics, Labour Economics, Monetary Economics, Transport Economics, Public Economics, International Economics, Household Economics, etc. Agriculture is the basic source of food supply of all the countries of the world—whether underdeveloped, developing or even developed. Due to heavy pressure of population in underdeveloped and developing countries and its rapid increase, the demand for food is increasing at a fast rate. If agriculture fails to meet the rising demand of food products, it is found to affect adversely the growth rate of the economy. Raising supply of food by agricultural sector has, therefore, great importance for economic growth of a country.

Agricultural advancement is necessary for improving the supply of raw materials for the agro-based industries especially in developing countries. The shortage of agricultural goods has its impact upon on industrial production and a consequent increase in the general price level. It will impede the growth of the country's economy. The flour mills, rice shellers, oil & dal mills, bread, meat, milk products sugar factories, wineries, jute mills, textile mills and numerous other industries are based on agricultural products.As a result of agricultural progress, there will be extension of market for industrial products. Increase in agricultural productivity leads to increase in the income of rural population which is turn leads to more demand for industrial products, thus development of industrial sector.

"Increase in agricultural production and the rise in the per-capita income of the rural community, together with the industrialisation and urbanisation, lead to an increased demand in industrial production." In this way, agricultural sector helps promote economic growth by securing as a supplement to industrial sector.

Even developed countries lay emphasis on agricultural development. "Agricultural progress is essential to provide food for growing non-agricultural labour force, raw materials for industrial production and saving and tax revenue to support development of the rest of the economy, to earn foreign exchange and to provide a growing market for domestic manufactures. Agricultural economics only a phase of an immense field called economics in which primary attention is paid to the analysis of the economic problems associated with agriculture, Prof. Hubbard has defined agricultural economics as, "the study of relationship arising from the wealth-getting and wealth-using activity of man in agriculture". "Agricultural economics treats of the selection of land, labour, and equipment for a farm, the choice of crops to be grown, the selection of livestock enterprises to be carried on and the whole question of the proportions in which all these agencies should be combined. These questions are treated primarily from the point of view of costs and prices."

"Agricultural Economics is that branch of agricultural science which treats of the manner of regulating the relations of the different elements comprising the resources of the former whether it be the relation to each other or to human beings in order to secure the greatest degree of prosperity".

"Agricultural economics is concerned with the allocation of resources in the agricultural industry, with the alternatives in production, marketing or public policy." Agricultural economists are concerned with the study of efficiency in farm production, with the returns that will result from employing various quantities and combinations of inputs in farming, and with determining the best farm production alternatives under given physical and economic conditions. They are concerned with the economics of agricultural markets, with the costs of marketing various farm products, and with the alternative steps or changes that may made in the marketing structure to serve the objectives of society more efficiently. They are interested in analysis of the alternatives in public policy and the economic effects of carrying out a particular programme, such as price support law or a soil conservation programme. Agricultural economists make use of the tools of economic analysis in studying.

All the tools of analysis used in general economics are employed in agricultural economics as well. We have the same branches of agricultural economics i.e. economics of production, consumption, distribution, marketing, financing and planning and policy making as in case of general economics. A study at the micro and macro level for the agricultural sector is also generally made. Static and dynamic analyses are also relevant for the agricultural sector of the economy.

To be more specific, Agricultural economics examines how a farmer chooses various enterprises e.g., production of crops or rising of cattle and how he chooses various activities in the same enterprise. e.g., which crop to grow and which crop to drop; how the costs are to be minimized; what combination of inputs for an activity are to be selected; but amount of each crop is to be produced but type of commercial relation the farmer have to have with people from whom they purchase their input or to whom they sail their product.Agricultural economics does not study only the behaviour of a farmer at the farm level. That is, in a way, the micro analysis. Agricultural problems have a macro aspect as well. Instability of agriculture and agricultural unemployment are the problems which have to be dealt with, mainly at the macro level.

And then, there are the general problems of agricultural growth and the problems like those concerning tenurial systems and tenurial arrangements, research and extension services which are again predominantly macro in character. Such problems their origin, their impact and their solutions are all the subject matter of agricultural economics. Again, 'agricultural economics' as at present does not confine itself to the principles concerning 'economising of resource in agriculture' only whether at the micro or macro level or from the 'static' a 'dynamic' point of view. The scope of agricultural economics is larger than 'mere economizing of resources'. Agriculture is, as we know an important sector, of the overall economy. The mutual dependence of the various sectors of the economy on each other is well established. Growth of one sector is necessary for the growth of the other sector. As such, in agricultural economics, we also study how development of agriculture helps the development of the other sectors of the economy; how can labour and capital flow into the non-agricultural sectors; how agricultural development initiates and sustains the development of other sectors of the economy.

What this implies is that agricultural economics not only develops concerning the use of scarce resources in agriculture proper but also examines the principles:
1. Regarding the out flow of scare resources to other sectors of the economy.
2. About the flow of these resources from other sectors into the agricultural sector itself.

Agricultural economics makes use of the principles of general economics. The first point to be noted with regard to the nature of agricultural economics is that, in general, it borrows most of its principle from its parent body of knowledge i.e., the general economics. Even the main branches of agricultural economics are similar to those of general economics. But than a question arises. If the principles of general economics are not different from the principal of agricultural economics, why is there a need for separate study of agricultural economics?

The answer lies in the fact that agricultural economics does not merely imply a direct application of principles of economics to the field of agriculture. The principles of economics are too general in nature and the general theory of economics has been considered as an abstraction from reality.

Before this theory is applied to agriculture which includes, besides crop production, forestry and animal husbandry for the purpose of economic analysis, its principles have to be modified so that their postulates totally tally with the main features of the situation of obtaining in the agricultural sector. A few examples will make it clear. We study in economic theory, price formation under various market structures e.g., monopoly, perfect competition and oligopoly. So far as agriculture is concerned, it is presumed that as the number of farms is very large and at the same time, their size is relatively small and the crops produced are undifferentiated (homogeneous), perfect competition is likely to prevail is the agricultural produce market. In other words, we shall almost be completely ignoring the study of price formation of agricultural produce under condition of oligopoly or monopolistic competition or monopoly. Then, there is the system of tenancy or crop sharing in agriculture – a problem particular to agriculture only. Study of this problem will necessitate modification of the principle of resource allocation as propounded in general economics.

The modification of the economic principles, required to be made before being applied to agriculture are so large and varied that there is a complete justification for studying agricultural economics as a separate body of knowledge. According to Forster and Leoger, "Agricultural Economics is an applied science and as such is concerned with the identification, description and classification of economic problems of agriculture to the end that these problems may be solved." Also, according to Gray, 'Agricultural Economics may be defined as the science in which the principles and methods of Economics are applied to the special conditions of agricultural industry.'

However, Black does not agree with this view. Applied science, as we know involves the use of the principles of a pure science to a particular situation. For example, engineering is an applied science. It suggests how to apply the principles of physics & other sciences to certain situations. The principles of physics themselves are not modified. These stay intact. In agricultural economics, general principles of economics themselves are modified. According to Black principles of agricultural economics can be compared to mechanics and not physics. If mechanics deserves to be called a specialised form of pure science, we can use the same term for agricultural economics i.e., specialized form of pure science, rather than an applied science. Agricultural economics is both a science as well as art. We have earlier pointed out that agricultural economics should not be called as an applied science but as a specialised form of pure science.

As such a science, it explains the cause and effect relationships between various economics variables operating in agriculture. And relationship as found to exist, can be used for solving various problems affecting agriculture. As such Agricultural economics is also an art. Further, as is the case with 'General Economics', Agricultural Economics is a normative science also.

Agriculture Makes its Contribution to Economic Development in Several Ways, Viz.

1. By providing food and raw material to non-agricultural sectors of the economy.
2. By creating demand for goods produced in non-agricultural sectors, by the rural people on the strength of the purchasing power, earned by them on selling the marketable surplus.
3. By providing investable surplus in the form of savings and taxes to be invested in non-agricultural sector.
4. By earning valuable foreign exchange through the export of agricultural products.
5. Providing employment to a vast army of uneducated, backward and unskilled labour. As a matter of fact, if the process of economic development is to be initiated and made self-sustaining, it must begin for agricultural sector.

Agriculture sector is the backbone of an economy which provides the basic ingredients to mankind and now raw material for industrialisation.

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Low Cost Polyhouse Technology for Propagation and Multiplication of Walnut

Article ID: 32544

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Walnut is the most important cash crop of the country and is grown in U.P., Himachal Pradesh and the UT of Jammu and Kashmir. There are no regular orchards for walnuts in the country as the existing plantings are of seedling origin. The seedling trees attain giant size and start bearing nuts of variable size and shape after 10-15 years. Thus, the higher biological value of the walnut kernel makes it an indispensable food product and that is why the walnut is on the FAO priority plants list. Also, Walnut is a rich source of proteins, fats and minerals and is a concentrated source of energy. Walnuts contain important phytochemicals as well as high amount of poly-unsaturated fats (Omega-3) which offer potential benefits for brain health as well as brain function. Therefore, crops with proven high nutritive value and good agro-economical indexes have to be propagated. The propagation of walnut is more difficult as compared to the most of the fruit crops. It is due to the low rate of callus formation and the presence of higher concentration of the phenolic compounds. Traditionally walnut in India is propagated by seed. Though the seed propagation being most efficient and economic but not satisfactory because of the walnut heterozygosity, the propagation by seeds does not lead to the inheritance of the characteristics of a certain variety. Hence, different new ways of walnut propagation have been investigated throughout the world the most popular of which include grafting (bench grafting, cleft grafting, tongue grafting), budding (patch budding, chip budding) and stooling. The new methods for the production of the inoculated walnut trees include hot callus and hypocotyl grafting.

Budding in walnut is mainly done by the technique of patch budding which is generally practiced from May-June. This is one of the oldest methods for the propagation in the nursery in open. The success of this method depends on the climatic conditions of a particular region. Winter colds and spring frosts reduce the successful inoculation percentage and the post inoculation temperature also are the limiting factors which might impede with the good callus formation. Budding can be practiced not only during the vegetation but also during the dormant winter period of the trees, budded plants being left in controlled temperature conditions. In such a case, patch budding is not recommended due to the difficult separation of the buds from the scion and this problem does not exists in chip budding. Successful inoculation percentage in chip budding was 89% during first week of June and in patch budding was 30-35% during md June. Removal of leaf blades 15 days before budding operation enhanced bud take. In Kashmir, the methods of patch budding and crown grafting have been found fairly successful. Walnut can also be propagated though annular budding and chip budding. Annular budding gives a very high percentage of bud take in walnut when performed during the month of July. Chip budding during may give good performance in walnut.

Grafting in walnut is less successful compared to most fruit trees, especially in natural climatic conditions. Therefore, different methods are used for the production of transplants in controlled temperature, relative humidity, method and time of grafting and bleeding etc. For the success of the callus formation the most popular and widely accepted method is to place the plants in the woody boxes in a room with controlled temperature. Grafting takes place during winter dormancy with one-year old root stock and grafts. This method is known as bench grafting which has a number of advantages. First of all, the period for grafting is longer and much more work can be done. Secondly, grafting takes place in winter i.e. a period with less job opportunities. Third, bench grafting can be mechanized and thus increase labour efficiency.

Stooling is another method of vegetative propagation which can be performed in walnut. To obtain good rooting and better establishment of stool layer, the growth regulators like IBA, IAA and NAA can be used. The mother stools of the commercial cultivars will have to be raised by cutting or layers in the first instance.

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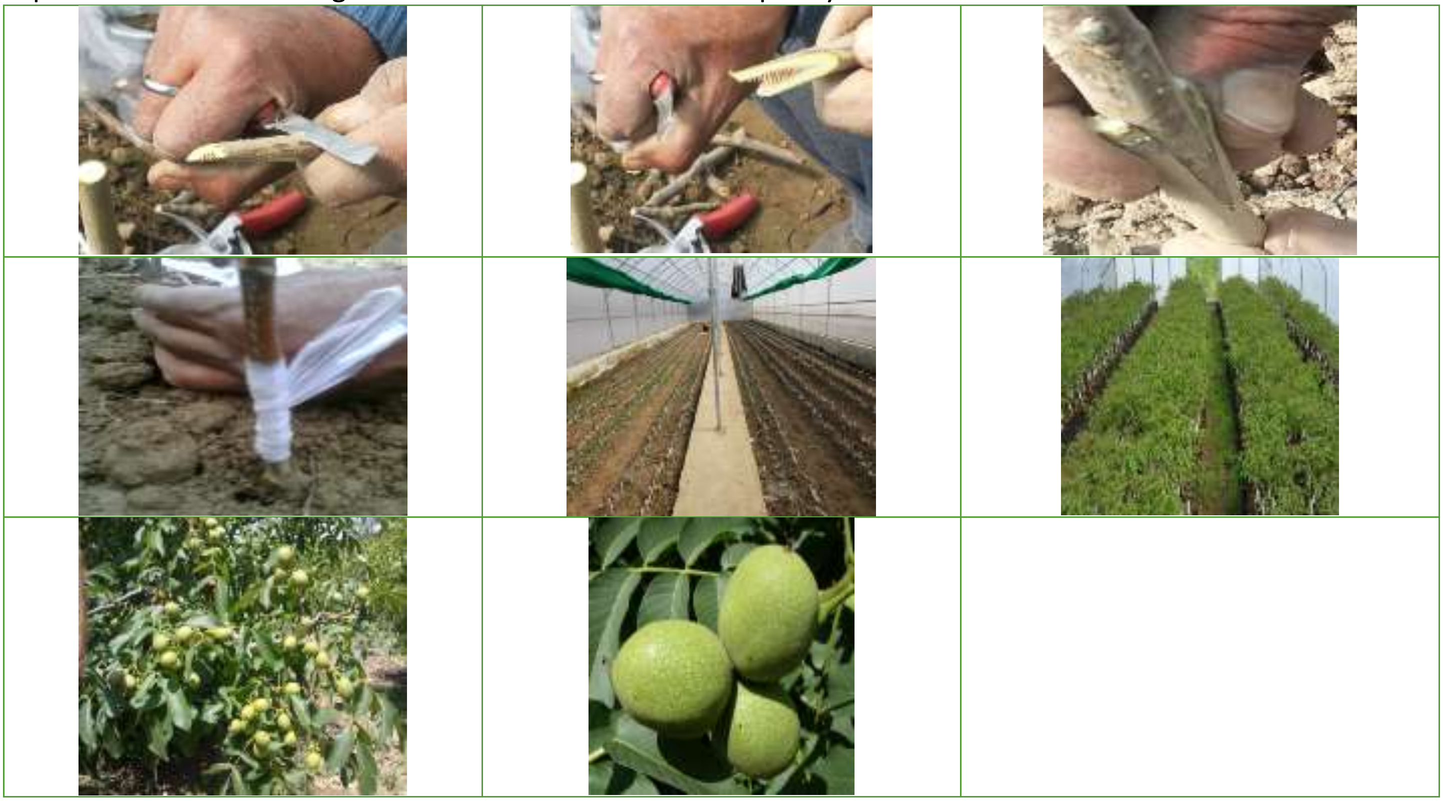
Despite all these methods, though the success percentage is yet not much as compared to those employed under the low cost zero energy poly-house conditions viz, hot callusing cable system and hypocotyls grafting. This is a wooden structure covered with white polythene. To provide the suitable relative humidity for the success of walnut grafts, water is sprayed one or two times in a day. However, to increase the temperature no additional aid is fitted. Budding/grafting success is appreciably high under these polyhouses. It has been reported by Eedogan (2006) that the method hot callusing cable is used for the annual production of about 20,000 plants in Turkey with an average graft survival of 82%. The callus proliferation occurs most readily during the late winter and at the time of the year just before or during bud break in the spring. This is due to the reduction in the auxin gradient through the summer and into autumn, and its increase in late winter and through the spring. While as in hypocotyls grafting method, grafting takes place during vegetation with growing tip of soft wood cutting on cleft. Grafted plants should be kept in about 80-90% relative humidity and temperature of 26-270C. Hence, the new techniques practiced under the controlled polyhouse conditions result in high graft survival percentage which is stable throughout the separate years and independent of ambient climatic conditions. The success in propagation is known to be influenced by the method, time and environment conditions to which the plants are subjected to grow before and after propagation. Thus, there is urgent need to standardize the environment and time for clonal multiplication of walnut in order to ensure supply of quality plant material for expansion of area, there by facilitating manifold increase in production and productivity of superior nuts and meeting the international standards of quality characters of nut and kernel.



Low cost polyhouse technology for propagation and multiplication of Walnut

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DNA Fingerprinting

Article ID: 32545

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The technique was discovered by Sir Alec Jeffreys in 1985.

Why it is Used?

1. Identification of criminals from blood stain, semen.
2. Establishing parentage.
3. Many other purposes like forensic science etc.

Advantages

1. Data is more reliable over conventional analyses of serum protein and erythrocyte antigens and proteins.
2. DNA fingerprinting is essentially the southern blotting of DNA.

Southern Blotting

1. Name follows the name of the scientist E.M. Southern.
2. DNA: DNA hybridization is the basis.

Procedure of Southern Blotting

1. The limitation parts of DNA after electrophoresis are denatured into ss DNA structure by soluble base.
2. Then transferred onto a nitrocellulose membrane ; done by placing nitrocellulose filter membrane on the gel and the main principle behind this is capillary action.
3. The DNA becomes trapped in the nitrocellulose membrane as buffer passes through it. This process is known as blotting.
4. DNA is permanently immobilized on the membrane by heating at 180 degree centigrade.
5. Baked membrane is treated with a solution of 0.2% each of Ficoll, PVP, Bovine serum albumin.
6. This treatment prevents non-specific binding of primers to the membrane.
7. The pre-treated membrane is placed in a solution of radioactive ss DNA or an oligonucleotide called a probe. The conditions are so maintained that the probes will hybridize with their complementary DNA sequences.
8. This step is known as hybridization reaction.
9. After hybridization the membrane is washed to remove the unbound probes.
10. The layer is put in close contact with a X ray film and incubated for an ideal period to permit pictures because of radioactive tests to be framed on
11. The film is then developed to several distinct bands corresponding to the positions in the gel of the DNA fragments that are complementary to the radioactive probe used in the study.

The Procedure for DNA Fingerprinting

1. The first step is to obtain a sample of DNA of individual in question.
2. The DNA is usually obtained from blood samples, may be from several years old blood or semen staining on clothing.
3. The amount of DNA needed for fingerprinting is very small.
4. The DNA is digested with a suitable restriction endonuclease, and the digest is subjected to gel electrophoresis.
5. The DNA is denatured and then transferred from the gel onto nitrocellulose filter membrane , where it is fixed by baking the filter at 80 degree.
6. The DNA bands on the filter paper are hybridized are detected through autoradiography.

Probes Used for DNA Fingerprinting

1. Generally developed from mini-satellite DNA.
2. These probes hybridize under conditions of low stringency.
3. A simple universal probe , a tandem repeat of GATA , has been developed from sex chromosomes of banded krait.

Applications

1. The bands appearing in the DNA fingerprint of the suspected criminal are compared with those obtained from the test DNA recovered from the evidence for crime. e.g., semen stains or sperm nucleus in vaginal swabs from assault casualties.

2. In case of disputed parentage, the DNA fingerprint of the child, the mother and the father are compared. As a rule, the bands present in a child's fingerprint must be accounted for those in the mother's and father's fingerprint. Along these lines, the youngster's finger impression is contrasted and that of mother and their normal groups are checked.

Case Studies

Burned skeletal survives from a youngster were found on the top of a house. There was no other piece of information accessible to demonstrate the personality of the expired. Face and body were found to be burnt only teeth and few bones were seen. A cautious specialist who inspected the remaining parts painstakingly protected after death blood, consumed tissue, femur bone and a couple of teeth which were alluded to our lab for examination. The referral blood samples of an elderly couple (who could not identify the remains but suspected the remains to be of their missing son) were also sent to the lab. All the samples received here yielded amplifiable DNA. Comparative analytical studies on the DNA profile obtained from the blood samples of the couple and the profile generated from burnt forensic samples confirmed the remains to be those of the son of the couple (Table 1).

Table

Genetic Markers	Profile of DNA from Fathers blood sample	Profile of DNA from femur bone	Profile of DNA from Mothers blood sample
D8S1179	14, 15	14,16	15,16
D21S11	30, 30	30, 33.2	30, 33.2
D7S820	8, 12	9, 12	9,12
CSF1PO	9, 10	10, 10	10,12
D3S1358	16,16	17,16	17,17
THO1	8, 9	9, 9	9, 9.3
D13S317	10, 12	8, 10	8,12
D16S539	12,13	13, 12	11,12
D2S1338	20, 23	23, 18	18, 18
D19S433	13, 14	14, 15.2	15.2,15.2
vWA	14, 14	14, 16	16,17
TPOX	8, 11	8, 8	8, 8
D18S51	13,17	17, 15	15,19
D5S818	11,12	11, 12	10,12
FGA	24, 25.2	24, 25.2	22.2 , 24

What is Paternity?

1. Paternity is set up when a lab utilizes hereditary fingerprinting to decide if two people have an organic parent-kid relationship.

2. DNA testing is the standard these days, polymerase chain response (PCR) and STR (Short Tandem rehashes) are right now utilized.
3. Older techniques additionally exist, including ABO blood bunch composing, catalysts, or human leukocyte antigens (HLA).

When do We Need Paternity Testing?

1. For peace of mind; when a man wants to confirm that a child is his own.
2. Sexual crimes resulting in illegal pregnancy.
3. Illegal marriage for child support.
4. Hidden marriage with inheritance claims of the offspring.
5. Immigration cases.
6. Reverse paternity testing in missing person & mass disaster investigations.
7. Interchange of infants in maternity hospitals.

Mendelian Inheritance (Con)

Rules of inheritance:
1. A child has two set of copies of alleles for each autosomal marker (one from mother and one from father).
2. A child will have mother mitochondrial DNA haplotype (baring mutation).
3. A male child will have father's Y chromosome haplotype (baring mutation).

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Rose Apple: Choicest Melody for Dry Zones of Karnataka

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Introduction

The term “rose apple” (in French, pomme rose, pommier rose; in Spanish, *poma rosa, pomarrosa, manzana rosa*, or manzanita de rosa) is so widely employed that the species has few alternate names apart from those in the many local dialects of Africa, India, Malaya, southeastern Asia, the East Indies and Oceania. It is sometimes called *jambosier* by French-speaking people, plum rose or malabar plum in the English-speaking West Indies, *pommeroos* or *appelroos* in Surinam, and *jambeiro* or *jambo amarelo* in Brazil; *jaman* in India, and *yambo* in the Philippines. Commonly available Rose Apple types in India are, Common Rose apple (*Syzygium jambose*), Watery Rose Apple (*S. aqueum*) and Malayan Apple (*S. malaccense*), which all comes under the common family i.e. Myrataceae.

Plant Morphology and Taxonomy

The rose apple tree a shrub but is generally a tree reaching 25 or even 40 ft (7.5-12 m) in height, and has a dense crown of slender, wide-spreading branches, often the overall width exceeding the height. The evergreen leaves are opposite, lanceolate or narrow-elliptic, tapering to a point; 4 to 9 in (10-22 cm) long, and from 1 to 2 1/2 in (2.5-6.25 cm) wide; somewhat leathery, glossy, dark-green when mature, rosy when young.

The flowers are creamy-white or greenish-white, 2 to 4 in (5-10 cm) wide, consisting mostly of about 300 conspicuous stamens to 1 1/2 in (4 cm) long, a 4-lobed calyx, and 4 greenish-white, concave petals. There are usually 4 or 5 flowers together in terminal clusters. Capped with the prominent, green, tough calyx, the fruit is nearly round, oval, or slightly pear-shaped, 1 1/2 to 2 in (4-5 cm) long, with smooth, thin, pale-yellow or whitish skin, sometimes pink-blushed, covering a crisp, mealy, dry to juicy layer of yellowish flesh, sweet and resembling the scent of a rose in flavor. In the hollow center, there are 1 to 4 brown, rough-coated, medium-hard, more or less rounded seeds, 3/8 to 5/8 in (1-1.6 cm) thick, which loosen from the inner wall and rattle when the fruit is shaken. Fragments of the seed coat may be found in the cavity.

Origin and Distribution

The rose apple is native to the East Indies and Malaya. It was introduced into Jamaica in 1762. In Guatemala, the tree may be planted as a living fencepost or in hedgerows around coffee plantations. For this purpose, it is drastically pruned to promote dense growth.

Climate

The rose apple flourishes in the tropical and semi tropical climates only. In India, it ranges up to 4,400 ft (1,350 m). It does best on the banks of canals and streams and yet tolerates semi-arid conditions. Prolonged dry spells, however, are detrimental.

Soil

A deep, red loamy soil is considered ideal for the rose apple.

Propagation

Most rose apple trees are grown from seeds, which are polyembryonic (producing 1 to 3 sprouts), but the seedlings are not uniform in character nor behavior. In India, vegetative propagation has been undertaken with a view to standardizing the crop and also to select and perpetuate dwarf types. Using cuttings, it was found that hardwood does not root even with chemical growth promoters. Treated semi hard wood gave 20% success. Air-layers taken in the spring and treated with 1,000 ppm NAA gave 60% success. Air-layers did not root in the rainy season. In budding experiments, neither chip nor "T" buds would take. Veneer grafting in July of spring-flush scions on 1-year-old rootstocks was satisfactory in 31% of the plants. Fruiting can be expected within 4 years.

Planting

Prior to planting, the field is properly cleared and ploughed. Pits of 1 x 1 x 1 m size are dug at the distance of 5 to 6 m both ways. Usually, work of digging of pits is completed before the onset of monsoon. The pit is filled with mixture of 75% top soil and 25% well rotten farmyard manure or compost.

Spacing

1. 5×5 mt, 2. 6 x 5 mt, 3. 10 x10 mt.

Fertilizer Application

The rose apple trees are generally not manured. This is not because they do not require manuring or fail to respond to it but because they can stand a good deal of neglect. An annual dose of about 20 kg FYM during the pre-beating period and 50 kg per tree bearing trees is considered.

Normally, seedling rose apple trees start bearing at the age of 5 to 6 years while grafted or budded trees come into bearing in 4 to 5 years. On very rich soils, the trees have a tendency to put on more vegetative growth with the result that fruiting is delayed. When the trees show such a tendency, they should not be supplied with any manure and fertilizer and irrigation should be given sparingly and withheld in September-October and again in February-March.

This helps in fruit bud formation, blossoming and in fruit setting. Sometimes this may not prove effective and even more drastic treatments such as ringing and root pruning may have to be resorted. A fruit grower has, therefore, to be cautious in manuring and fertilizing rose apple trees and hence, has to adjust the doses according to the growth and fruiting of trees.

4-5 Years Old Plantation

FYM	50 kg per plant /year
Nitrogen	500 gm per plant/year
Phosphorus	200 gm per plant/year
Postash	200 gm per plant/year

Irrigation

In early stages, the roseapple tree requires frequent irrigations but after the trees gets established, the interval between irrigations can be greatly decreased. Young trees require 8 to 10 irrigations in a year. The mature trees require only about half the number, which should be applied during May and June when the fruit is ripening. During autumn and winter months, just an occasional irrigation may be applied when the soil is dry. This will also save the trees from the ill effects of frost in winter.

Training and Pruning

Regular pruning in rose apple is not required. However, in later years the dry twigs and crossed branches are removed. While training the plants, the framework of branches is allowed to develop above 60 to 100 cm from the ground level.

Yield

The average yield of fruits from a full-grown seedling tree is about 3-5 kg and from a grafted one 6-8 kg per year.

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Rose Apple (S. jambose)

Malayan Apple (S. malaccense)

Watery Rose Apple (S. aqueum)

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Regulation of Flowering in Vegetable Crops Under Protected Cultivation

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Summary
For the setting of fruits inside greenhouse or protected cultivation various techniques are used. From forgoing discussion, mostly in tomato at high humidity condition mostly use the blowers and PGRs for setting of fruits. And these situations 95-100 % results were taken on our university farm. Generally, in cucumber used the gynodioecious / parthenocarpy hybrids. But, sometimes by hand emasculation pollination of flowers was done; it's less chance to set a uniform fruits and time consuming.

Why Protected Cultivation?
1. Better quality produce.
2. Higher productivity.
3. Off-season cultivation.
4. Better insect-pest and disease management.
5. Efficient use of resources.
6. Reduced used in pesticides.
7. Higher profitability.

Regulation of Flowering and Fruiting in Tomato

1. Flowers:

a. Normally the flower clusters are not pruned until 3 to 4 well-formed fruit appears on that cluster.
b. However, abnormal flowers (the large fascinated flower) have to be removed as soon as recognized. This flower will produce a cat-faced fruit.

2. Terminal points:

a. Remove the terminal growing point above the top flower cluster (last cluster to pollinate) approximately forty-five days before the intended date of terminating the tomato crop to stop plants from continuing to grow.
b. Leave 2-3 leaves above the top cluster to shade and feed the top fruits.
c. During hot summer months and leaving as many leaves on the plant can provide good shade for the growing fruit and cool the greenhouse.
d. It is estimated that each plant will transpire close to 1-1.5 lit. of water a day and a house full of plants can lower the temperature of the greenhouse by at least 10 °F.

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3. Pollination:

a. The female organs of the tomato flower are enclosed inside the male organs (five anthers attached together to form a cone around the female organ). Anthers open to the inside releasing pollen as soon as they mature.

b. At maturity, the anthers will have a bright yellow colour and the flower will be receptive to pollination for about 48 hours.

c. Pollen released without vibrating the flower will not be sufficient to produce high yield of good quality fruit. Field tomatoes are pollinated (vibrated) by natural wind.

d. Because natural wind is absent in the greenhouse, tomato growers must pollinate their crop by several means including battery operated vibrators, air blowers, and bumblebees.

e. Growers should also make every effort to transfer the maximum number of pollens to the stigma of the flower.

f. The size and weight of the tomato fruit is positively correlated with the number of pollens transferred to the female part of the flower.

4. Battery operated vibrators:

a. Vibrators are small devices which can be purchased from any greenhouse supply store and operated by a weak electrical current from a battery.

b. Vibrate the flowers by touching the stem of the flower cluster for few seconds. The strong vibration created by this tool will release more than enough pollen to fertilize the majority of the eggs in the ovary.

c. Pollinate the flowers every-other-day on sunny days when humidity in the greenhouse is between 60 and 80%.

d. Touch the cluster stem and do not touch the flower itself otherwise a hole will be created in the developing fruit. It takes approximately 30 minutes three times a week to pollinate 700 plants in one greenhouse of size 30X96 feet.

e. This method of pollination is good for a small-size operation and the best method to guarantee pollinating every flower you want to pollinate and produce maximum-size fruit.

f. Some of the drawback includes the fact that a grower has to be in the greenhouse at a certain time three times a week, it is a boring job, and the possibility of producing fruit with holes if you touch the flower.

5. Air blowers:

a. Greenhouse tomatoes can be pollinated by using a household leaf blower operated at normal speed with the air flow directed to the flower clusters.

b. Use this device three times a week.
c. It takes half the time to pollinate the same number of plants compared to the electric vibrator.
d. However, the number of seed per fruit was less and fruit size and weight were smaller than fruit produced by using the vibrator for pollination.
e. In general, anticipate five percent reduction in yield if you use this device.

6. Bumblebees:

a. Using bees to pollinate one or two greenhouses will save you time to do something else but it will not save money.
b. Bumblebees are excellent pollinators for greenhouse tomatoes. Each bee will visit and vibrate the flower for few seconds to collect pollen for feeding. As a by-product of this process, the stigma of the flower is showered with a large number of pollens leading to good pollination and fertilization of almost all the eggs in the ovary.
c. Larger size and a heavier fruit is expected from bee pollination. Bees are active from sunrise to sunset; they do not take a long break or a day off.
d. It is estimated that each bee can pollinate up to 350 flowers.
e. Using a hive (even the smallest mini-hive) can lead to over pollination and injuring many flowers in a small greenhouse.
f. Bumble bee box in polyhouse.

7. Using of growth regulators:

a. The growth regulators can be used to increase fruit set at high and low temperature to reduce the leaf curl incidence.
b. The flower dipping in PCPA (Parachloro-Phenoxy acetic acid) 30 ppm at the fully open stage to increase the fruit set at low and high temperature.
c. The application of Cycocel (500ppm) on the plants in nursery 3-4 days before transplanting another spray of it 25-30 days after transplanting.
d. It reduces the leaf curl incidence.

Chemicals which Used for Fruit Development

Chemicals	Common name	Dose (mg/l)	Effective
2-Chloroethylphosponic acid	Ethephon	200-500 whole plant spray	Flowering induction, better rooting and setting of plants
2, 4 Dichlorophenoxy acetic acid	2,4-D	2-5 as seed treatment or whole plant spray	Increase fruit set, earliness and parthenocarpy
3- Indole Butyric acid	IBA	50-100	Increase fruit set
3 Indole acetic acid	IAA	Foliage spray	For good fruit size and yield

Regulation of Flowering and Fruiting in Capsicum

1. Flowering:

a. A young capsicum plant starts flowering about two to six weeks after planting, when it has 7 to 13 leaves.
b. The optimal temperature during flowering should be 20 - 21oC on average both day and night.
c. A low night temperature decrease pollen viability in capsicum flowers and modify flower structure and makes self-pollination less effective.
d. Flowers developed at a night temperature below 18°C usually produce a fruit with a ‘tail’ (elongated, pointing blossom-end).
e. A lower temperature during flowering results in less four-loculed fruit, and more three loculed fruit, or even two-loculed fruit, which is not desired.
f. A flower grown under very low temperature (below 10oC at night) would produce a small flattened fruit.
g. Too high temperature (> 28 °C) stimulates blossom end rot.

2. Pollination:

a. To ensure the set of high-quality fruits use pollinators like bumble bees or honey bees inside the greenhouse.

b. Bees make that less fruit are deformed, and that fruit set and first harvest are better and a bit earlier.

3. Fruit set:

a. High light and low day temperature are beneficial for setting and first growth of the new fruit.

b. The total period from blossom to full-colour ripe fruit is 7 - 12 weeks. When fruit set is difficult)

c. Drop the night temperature to 18°C. The day temperature can stay at 20-22°C.

d. Increase the CO_2 concentration (to 700-1000 ppm).

e. For setting of the second flush of capsicum fruit, dropping the temperature is not advised, as it will slow down the ripening of the first flush.

f. Generally the later fruits will set by themselves after harvest of older fruits.

4. Controlling fruit load:

a. Young plants can support about four to eight fruit per plant at a time.

b. An older crop can have over 10 fruits per plant at a time.

c. Fruit load must be controlled by the grower, in order to achieve a reasonable fruit weight (e.g. minimal 150 gram per fruit) and quality.

d. The best method to correct the number of fruits is by removing excess.

Regulation of Flowering and Fruiting in Cucumber

1. A fruit may develop at each node and more than one may begin to develop at some nodes.
2. It is usually best to thin these multiple-fruit clusters to a single fruit; however, vigorous plants can sometimes have more than one cucumber at a node and any distorted fruit should be removed immediately.
3. The greatest growth of the fruit occurs between day 6 and 14 after the bloom opens (anthesis). Maximum fruit length occurs at day 14 followed by diameter increase.
4. The shape of the fruit is somewhat tapering at the stem end prior to day 10 after the bloom, however, the fruit becomes uniformly cylindrical by day 14.
5. During the spring season, commercially acceptable fruit size is usually reached by the 11th day after the bloom opens.

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Role of Cropping System in Sustainable Vegetable Production

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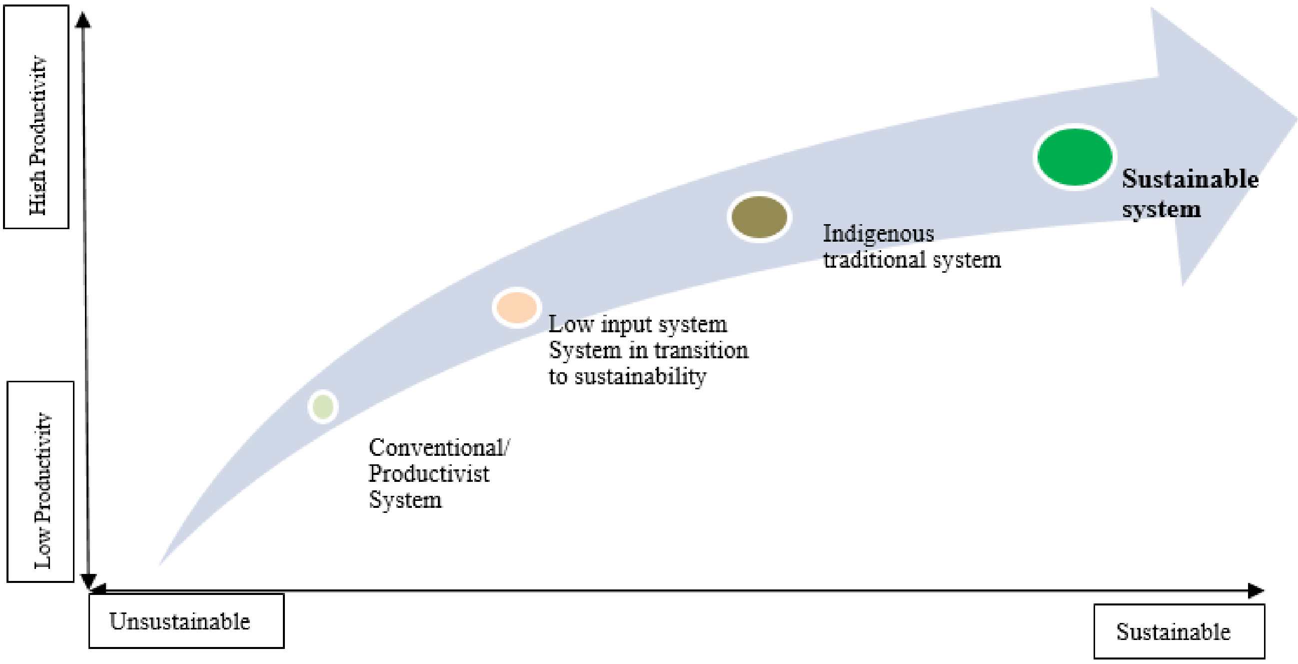
What is Sustainability?

The idea of a sustainable has gained prominence since the publication of the Brundtland Report in 1987. According to Brundtland "The Sustainable development is development that meets the needs of the present without compromising the needs of future generations to meet their own needs".

Transition Process of Unsustainable System to Sustainable System



Sustainable Agriculture

Sustainable agriculture is an "integrated system of plant and animal production practices having a site-specific application that will, over the long term:

1. Satisfy human food and fiber needs.
2. Enhance environmental quality.
3. Make efficient use of non-renewable resources and on-farm resources and integrate appropriate natural biological cycles and controls.
4. Sustain the economic viability of farm operations.
5. Enhance the quality of life for farmers and society as a whole." (Farm Bill 1990).

Why do We Need Sustainable Agriculture?

Recent statistics indicates increase in productivity levels of vegetables, though ample quantities of vegetables are still required to feed the highly increasing population. For ensuring a healthy and prosperous nation, we have to increase our production by modify our cropping pattern and dietetic habits. Cereals are India's mainstay and cereal production is essential for sustaining the livelihood of the rural poor. But a key step to the economic development of Indian farmer's will be to diversify their cereal based production system. Diversified agriculture is profitable, it generates additional employment for rural masses and conserves natural resources. Inclusion of horticultural cash crops in cropping sequence is a good option to achieve the above requisites. Vegetables are an excellent choice of cash crops as they can be grown easily, produce good yields and generate higher price in market compared to cereals. Most of the vegetables, if properly grown, can give higher yield than many cereal crops. The available resources, if properly managed, can not only help in the food self-sufficiency drive but will also provide means to earn foreign exchange by exporting fresh vegetables and vegetable seeds. Moreover, these vegetable crops are suitable for production on small pieces of land and their inclusion in traditional cropping systems can improve the nutritional potential of the system as vegetables are rich in vitamins, minerals and other health factors.

Objectives of Sustainable Vegetable

1. Integrated system of plant and animal production practices.
2. Satisfy human food and fibre needs.
3. Enhance environmental quality and the natural resource.
4. Sustain the economic viability of farm operations.
5. Enhance the quality of life for farmers and society as a whole.

Components of Sustainable Vegetable

1. Soil and water conservation to prevent degradation of soil productivity.
2. Efficient use of limited irrigation water to avoids problems of soil.
3. Appropriate crop rotations.
4. Integrated nutrient management that reduces the need for inorganic fertilizers, improves the soil health and minimize the environmental pollution by conjunctive use of organics, in-organics and bio-fertilizers.
5. Integrated plant protection that reduces the need for agrochemicals through crop rotation, weather monitoring, use of resistant varieties, timely planting of crops and biological plant protection.
6. Management systems to control weeds by preventive measures, tillage, timely cultivation and crop rotation which improve plant health.

Design of Sustainable Vegetable System

1. Optimizing the use of locally available resources.
2. Reducing the use of off-farm.
3. Relying mainly on resources within the agro-ecosystem by improving the match between cropping patterns and the productive potential.
4. Working to value and conserve biological diversity.
5. Taking full advantage of local knowledge and practices.

What is Cropping System?

1. System: A system is a group of interacting components, operating together for a common purpose, capable of reacting as a whole to external stimuli.

2. Crop system: An arrangement of crop populations that transform solar energy, nutrients, water and other inputs into useful biomass i.e. food, feed, fuel and fibre.

3. Cropping systems: Cropping systems, an important component of a farming system, represents a cropping pattern used on a farm and their interaction with farm resources other farm enterprises and available technology, which determine their makeup.

4. Cropping pattern: It is the pattern of crops for a given piece of land or cropping pattern means the proportion of area under various crops at a point of time in a unit area.

Benefits of Cropping System

1. Maximum utilization of land.
2. Maximum utilization of inputs.
3. Better harvest of solar radiation.

4. Yield continuum.
5. Regular income.
6. Sustainable production.
7. Maintain and enhance soil fertility.
8. Enhance crop growth.
9. Minimize spread of disease.
10. Control weeds.
11. Inhibit insect and pest growth.
12. Increase soil cover.
13. Reduce risk for crop failure.
14. Use resources more efficiently.

Classification of Cropping Systems

1. Monoculture: Under monoculture system, one crop is grown on a piece of land year after year or repetitive growing of the same sole crop in the same land. In a monoculture system the cropping intensity is always 100%.

2. Multiple cropping: In this system, more than two crops are cultivated in a year in succession on the same field.

a. Why we need for intensive cropping:

i. Cropping systems has to be evolved based on climate, soil and water availability for efficient use of available natural resources.

ii. The increase in population has put pressure on land to increase productivity per unit area, unit time and for unit resource used.

b. Strategy for multiple cropping:

i. For raising crops, an advanced schedule must be prepared.

ii. Laboratory tests should be conducted to predict initial fertility status of soil.

iii. Recommended dose of manure and fertilizers should be applied to each crop.

iv. Micronutrients should be applied to crops, if needed.

v. Legume crops must be included in the system for the fixation of elemental nitrogen.

vi. Early maturing and high yielding varieties of crops must be selected.

c. Types of multiple cropping:

i. Sequential cropping: It is growing of two or more crops in quick succession on the same piece of land in a farming year.

ii. Intercropping: Intercropping is the growing of two or more dissimilar crops simultaneously on the same piece of land.

d. The intercropping can be classified into following:

i. Row intercropping: In this intercropping system at least one crop is planted in rows.

ii. Mixed intercropping: There is no distinct row arrangement in such types of intercropping.

iii. Stripe intercropping: Rising of two or more crops simultaneously in different stripes e.g., growing of one stripe of sweet corn and one strip of potato.

iv. Relay cropping: In a relay cropping system, planting of succeeding crop is done before the harvest of preceding crop.

e. Other important intercropping systems are:

i. Parallel intercropping. Under such cropping system both crops have different growth habit but zero competitiveness. e.g., Cowpea + Sweet corn.

ii. Companion Cropping. In this cropping system the production of both the intercrops is equal to the production of both the crops grown individually. e.g., Potato/onion + Sugarcane.

iii. Multi-storeyed/multitier cropping : As the name indicates, under this system two or more crops of different heights grown simultaneously on a certain piece of land in any certain period.

iv. Synergetic cropping. In such type of cropping system, the yield of one crop has the synergetic effect on second crop therefore both the crops produce higher yield than when they grow as a single crop on unit area basis. e.g., Sugarcane + Potato.

v. Mixed cropping. Mixed cropping deals with growing two or more than two crops simultaneously on the same piece of land without define row pattern or fixed ratio by mixing the seeds of crops intended to be grown mixed or sowing alternate rows in various ratios.

3. Crop rotation: Crop rotation is the practice of growing crops on a particular piece of land in a systematic sequence in order to maintain the soil fertility. The rotation of crop may be for one year, two year, three or more years.

Basic Principles of Crop Rotation

1. A heavy nutrient feeder crop is followed by a crop that requires less nutrients. Doing so the soil will not be depleted of its nutrients.

2. A crop having high water requirement is followed by the crop with low water requirement. In this way residual soil moisture is used by the next crop, and hence saving energy as well as water.

3. Deep rooted crop is followed by shallow rooted crop. Thus, various layers of the soil may be tapped for the essential nutrients for growth and development of plants.

4. A crop requiring more tillage operations is followed by a crop with less tillage. This results in reduction of the cost of field preparation because in some cases harvesting of previous crop takes care of field preparation for the next crop like digging of potato/ sweet potato tuber tilled the field sufficiently for the next crop like cucurbits, onion or potato.

5. Legume crop is followed by non-legume crop. This pattern will maintain soil fertility status. Moreover, investment on fertilizer application in legume crop is very less.

6. Crops which return very little organic matter (viz., lettuce, green onions, radish, spinach etc.) should alternate with crops which return considerable amounts of humus forming residues (cabbage, garden peas, beans etc.) Thus, physical condition of the soil does not deteriorate.

Merits of Crop Rotation

1. Crop rotation makes vegetable farming systematic.
2. It is a potent way of controlling weeds, insect-pests and diseases.
3. It adds nitrogen and organic matter in the soil, and helps in maintaining balance between soil nutrients.
4. It utilizes farm resources (land, labour, equipment etc.) efficiently and effectively
5. It regulates the use of plant nutrients from the soil due to an appropriate alternation of crops.
6. It increases overall yield and quality of the produce.

Conclusion

The objective of any cropping is to maximize the resource use (soil, water, sunlight, vegetation, humans and animals). This can be achieved through identification of crop adaptation zones for maximum productivity, based on soil, climate and management strategy. As food crops, vegetables constitute a very important role because of higher productivity in a short time along with year-round availability. We immediately need to add sustainability dimension to our agriculture production system to improve the productivity of vegetables at the maximum. Adopting suitable cropping systems is one of the best possible options to improve the resource use efficiency under changing climate scenario.

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Fertigation - A Way of Enhancing Fertilizer Use Efficiency and Crop Productivity

Article ID: 32549

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Introduction

Fertigation is defined as the application of fertilizer through irrigation water. Fertigation is the coined term used for application of fertilizers together with water applied through irrigation system. This method of fertilizer application can be used with any of the micro irrigation system such as sprinklers, drip system etc., to increase the use efficiency of both fertilizer and irrigation water.

Objectives

Fertilizer, the key input in crop production is normally applied in bulk and most part of it goes as waste due to leaching and deep percolation. Besides fertilizers get transmitted beyond the active root zone and effective utilisation by the plant in many cases is less than 50 per cent of the fertilizer applied.

Application of fertilizer through drip and similar micro irrigation system is the latest technology wherein water and the soluble fertilizers are applied simultaneously in the dissolved form to the root zone of the crop resulting in minimal loss of nutrients and water.

This system provides the right amount of water with dissolved oxygen and nutrients to the root zone of the plant at the right time in order to produce quality crops of uniform size and maturity. Fertigation through micro irrigation system is the effective means of delivering water and nutrients to the plants, which is the most important component of successful crop production.

Advantages of Fertigation

1. Uniform application of fertilizer - Fertigation ensures uniform and regular flow of both water and nutrients, resulting in increased growth, yield and quality of crops.
2. Placement in root zone - Through fertigation the major nutrients are supplied in one solution to the active root zone resulting greater absorption.
3. Frequent application is possible - Fertigation provides an opportunity to apply fertilizer more frequently than conventional methods. Small quantities can be applied at close intervals.
4. Quick and convenient method - Fertigation is quick and convenient method compared to conventional fertilizer application methods.
5. Most efficient method - Fertigation increases the availability and uptake of nutrients and consequently improves fertilizer use efficiency
6. Possibility of application in different grades to suit the stage of crop - The soil and plant system requires different nutrients during the growth cycle, can be supplied more effectively.
7. Large savings on labour and energy - This technique can reduce fertilizer application costs by eliminating an operation.
8. Reduction in nutrient losses - Fertigation reduces nutrient losses from leaching, volatilization and / or fixation.
9. Micro nutrients application along with NPK - Micronutrients can be applied effectively by mixing with major nutrients.
10. Fertigation maximizes water and nutrient productivity
11. Luxury consumption of nutrients by plants can be lowered
12. Each irrigated plant receives the same proportion of nutrients.
13. It is an eco-friendly technology as it minimizes ground water pollution.

Suitability of Nutrients for Fertigation

A rule of thumb is that nutrients that are absorbed by soil (anion forms) and those moves with soil water are best suitable for application through micro irrigation system. The most common nutrient applied by fertigation is nitrogen. Elements applied less often include P, K, Sulphur, Zinc and Iron.

Phosphorus, Potassium and inorganic forms of micro nutrient cations may be soluble in water. However, because of immobilization in the soil they may accumulate in the top 1 to 2 inches of the soil surface and not be distributed throughout the root zone.

Application of Nitrogen (N)

Nitrogen, the plant nutrient most commonly deficient for crop production is often applied through micro irrigation system. Nitrogen availability is usually limited in the soil compared with other plant nutrients because its various forms can be leached, volatilized, denitrified, or fixed in the organic fraction of the soil.

Fertigation allows nitrogen supply to be matched with plant demand. Plants take up nitrogen continuously throughout the growing season. If too much nitrogen is applied at any one-time, excess vegetative growth may occur and this may affect yield and quality in some crops. Fertigation also reduces the potential for nitrogen to be lost through leaching or denitrification.

Nitrate nitrogen moves readily in soil with irrigation water and can be applied separately or in mixture with such compound as ammonium sulphate, urea, calcium ammonium nitrate and ammonium nitrate. Calcium nitrate can also be used when bicarbonates are low.

Nitrogen injected in the form of ammonium phosphate can cause serious clogging of the system. If calcium and magnesium are present in the irrigation water, the phosphate can form complex precipitates.

One of the favoured forms of N for use in mirco irrigation system is urea, because it is highly soluble nitrogen fertilizer. Urea dissolves in non-ionic form so that it does not react with other substances in the water. Also, urea does not cause any precipitation problems.

Phosphorus (P) Application

Injection of phosphorus into irrigation water is less common than injection of nitrogen. It is not recommended for fertigation in most crops. Problems related to application of phosphorus in irrigation water are:

1. Precipitation may be encountered when inorganic phosphate is injected into irrigation water containing high amount of calcium and magnesium. This may result in the clogging of the system with insoluble calcium and magnesium phosphate.

2. Phosphorus is mostly taken up early in the life of a crop, and is important in stimulating root growth and early development. Hence phosphorus is best applied with or near the seed at the time of planting in most crops. There is usually no need to apply additional phosphorus after planting.

3. Phosphorus applied through irrigation water will remain on or near the soil surface, if not incorporated by a tillage operation. Unlike nitrogen, phosphorus is high immobile and does not move far from the site of application.

Potassium (K) Application

Like nitrogen, potassium is particularly suited to fertigation. It is taken up in large quantities, second to nitrogen, and is particularly important in the late growing seasons in fruit and flower formation. In various crops, fertigation allows nitrogen and potassium application rates to be manipulated during the growing season, with the amount of potassium relative to that of nitrogen being increased late in the growing season.

Crop utilization of applied nutrients and quality of produce are often enhanced with fertigation of potassium. Common K sources are potassium sulphate and potassium chloride which are readily soluble in water. These fertilizers move freely in soil and research evidences have shown lateral and downward mobility of potassium applied through drip irrigation. Further the distribution of potassium was more uniform than that of either nitrate or phosphate.

Application of Micronutrients

1. Sulphur (S): Like nitrogen, sulphur is an important constituent of protein, but sulphur is only required in limited quantity and is less commonly limiting. If there is need to apply sulphur, this can be achieved by choosing ammonium sulphate or potassium sulphate to apply all or part of the nitrogen or potassium requirements.

2. Calcium (Ca): Calcium nitrate is more soluble and can be used where a quick response is required in high value crops. Calcium is required for healthy root growth and strong cell walls.

3. Magnesium (Mg): Magnesium sulphate and magnesium nitrate are water soluble magnesium products and can be applied as fertigation.

4. Boron (B): The crop requirements for boron can be met through soil application and foliar sprays. Boron can be applied with care through fertigation system.

5. Copper (Cu), Iron (Fe), Manganese (Mn) and Zinc (Zn): The metallic trace elements can be applied through fertigation systems under certain circumstances, but foliar sprays of iron and manganese will be more effective. In the case of copper and zinc, there is no need for split applications.

Fertilizer Use Efficiency

The fertilizer use efficiency of major plant nutrients under conventional soil application and fertigation is given in the table.

Nutrient	Fertilizer use efficiency (%)	
	Soil application	**Fertigation**
Nitrogen	30 - 50	95
Phosphorus	20	45
Potassium	50	80

Fertigation Appliances

Fertilizer injection equipment is to be provided at the head of the micro irrigation system for applying fertilizers in solution directly to the field along with the irrigation water. The equipment for fertigation is available in different types and models differing in their properties. Three main groups of equipment, with different types and models in each group is available.

1. Venturi injector: This operates on the venture principle, where a flow constriction with specific entrance and exit conditions in the pipeline creates pressure because of the increased velocity of flow through the constriction. This creates a suction effect which is sufficient to suck fertilizer solution from an open container into the water flow. The rate of flow is depending on the pressure difference created. This is a simple and inexpensive method of fertilizer application. But it had some disadvantages. The pressure loss across a venture valve is high, about 1/3 of the operating pressure and precise regulation of flow is difficult because the rate of injection is very sensitive to the pressure and the rate of flow in the system.

2. Pressure differential by – pass tank: The fertilizer tank is connected to the main line by means a bypass arrangement and operates on the principle of pressure differential created by regulating the control valves. This allow certain quantity of flow to by pass through the tank and then difference in pressure forces the water to enter into the tank and to go out again, carrying a varying amount of dissolved fertilizer. The rate of flow is determined by the pressure head difference between the inlet and outlet.

3. Fertigation pumps: In direct injection pump, pumps of piston type or diaphragm pumps are most commonly used due to their reliability and accuracy of application pumps can be adjusted over a scope of different ranges to provide a continuous and uniform concentration of nutrients in the irrigation water. There is no pressure loss in the system. Injection devices allow central fertilization; the whole process may be controlled from one central point.

Fertilizers Used for Fertigation

Fertigation can be achieved by using single or multiple nutrient fertilizers in their solid or liquid form. An essential prerequisite for the use of solid fertilizer in fertigation is its complete and fast dissolution in the irrigation water.

Nutrients	Fertilizers	Grade	Formula	Other nutrients
Nitrogen (N)	Urea	46:0:0	$CO(NH_2)_2$	-
	Ammonium sulphate	21:0:0	$(NH_4)_2SO_4$	22 % S
	Urea Ammonium nitrate	32:0:0	$CO(NH_2)_2$ $(NH_4)_2NO_3$	-
	Ammonium nitrate	34:0:0	NH_4NO_3	-
Nitrogen (N) and phosphorus (P)	Mono ammonium phosphate (MAP)	12:61:0	$NH_4H_2PO_4$	-
Phosphorus (P)	Phosphoric acid	0:52:0	H_3PO_4	-
Phosphorus and Potassium (K)	Mono potassium phosphate (MKP)	0:52:34	KH_2PO_4	-
Potassium (K)	Potassium chloride	0:0:60	KCl	-
	Potassium sulphate (SoP)	0:0:50	K_2SO_4	18% S
	Potassium nitrate (Multi K)	13:0:46	KNO_3	-
	Potassium thiosulfate	0:0:25	$K_2S_2O_3$	17 % S
Magnesium (Mg) and Calcium (Ca)	Magnesium sulfate	0:0:0:17 (MgO)	$MgSO_4$	13 % S
	Magnesium nitrate	11:0:0:16 (MgO)	$Mg(NO_3)$	-
	Calcium nitrate	15:0:0:27 (CaO)	$Ca(NO_3)_2$	
Others	Poly feed	19: 19: 19		
	Poly feed	20: 20: 20		
	Poly feed	11: 42: 11		
	Poly feed	16: 8: 24		

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Vegetable Cultivation in DPR Korea: Impact of Humanitarian Assistance from UN's Central Emergency Response Fund

Article ID: 32550

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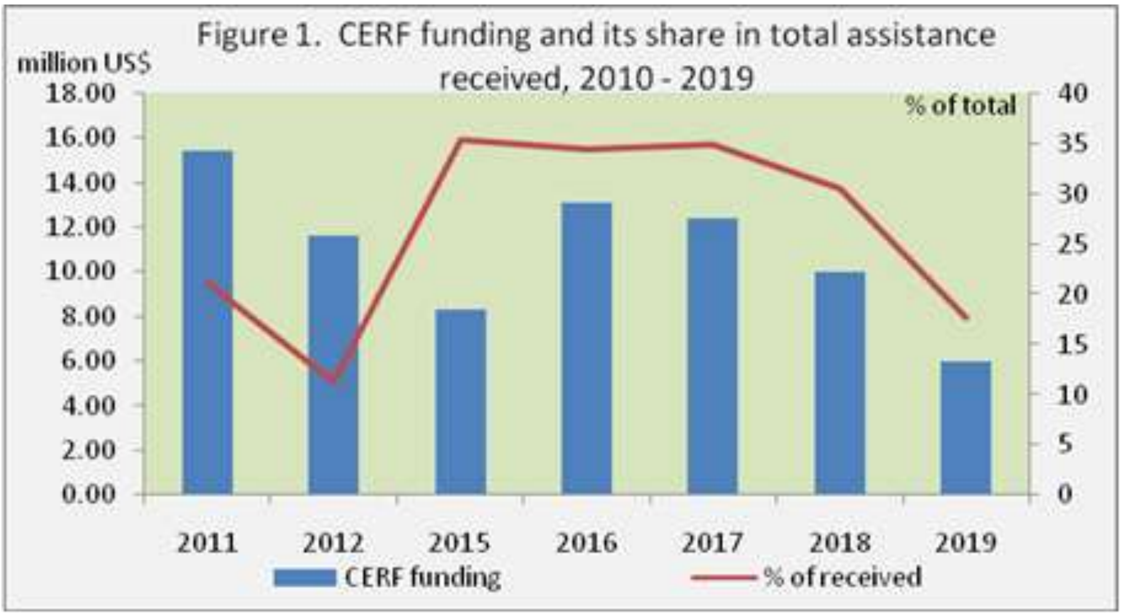
Introduction

United Nation's Central Emergency Response Fund (CERF) is a major donor of the Democratic People's Republic of Korea (DPRK). It was the largest donor of DPRK for most years over the period 2010-2019. Since 2017, its relative share in total assistance is declining (Figure 1). In 2020, CERF funding to DPRK amounted to US$5.9 million, which constituted 18.4 percent of the total US$32.1 million received funded through humanitarian response plans as of 23 September 2020.A part of annual CERF funding to DPRK is allocated to FAO for supporting the food security sector through promotion of cultivation of nutritious foods such as soybean and vegetables.



Vegetable is an important item in the food basket of DPRK people given the persistence of malnutrition as a significant public health concern, particularly affecting women and under-five children. Increasing production and consumption of vegetables can be a highly cost-effective approach in reducing existing malnutrition. Accordingly, the DPRK Government has given high priority to increasing vegetable production in the country. One of the goals for the agriculture sector set in DPRK's five-year strategy for national economic development (2016–2020) is to increase production of fruits, vegetables and mushrooms through promotion of modern cultivation techniques including greenhouse cultivation of vegetables and mushrooms.

In DPRK, annual production of vegetables, estimated at 1.50 million tonnes from 0.05 million hectares (ha), falls short of the demand by 1.0 million tonnes based on per day per capita requirement of 300 g excluding potato. A wide variety of vegetables are grown in DPR Korea in cooperative farms and household kitchen gardens both in field conditions and in protected environment - greenhouses and plastic tunnels. On-farm production is concentrated in the main summer season (May/June to August/September) while in protected environment vegetables are grown in both winter and summer. Common vegetable crops grown include spinach, Chinese cabbage, red pepper, tomato, cucumber, radish, onion, lettuce, eggplant, and mushroom. Vegetables grown in greenhouses include mainly cucumber, tomato, red pepper and cabbage.

Snapshot of vegetable production, Mangyongdae Vegetable Farm, Pyongyang

Recently, vegetable growing in hydroponic culture is spreading in DPRK. The Pyongyang Vegetable Research Institute under the Academy of Agricultural Sciences has developed appropriate methods for growing vegetables in hydroponic greenhouses. These include supplying liquid nutrients and environmental management, a nutrient early-diagnosis technology, and a nutrient liquid irrigating technology to maximize productivity.

Harvesting of vegetables in Jungphyong Vegetable Greenhouse Farm, North Hamgyong province

FAO Assistance to Supporting Greenhouse Vegetable Cultivation

FAO assisted the DPRK Government in expansion of greenhouse vegetable cultivation through emergency assistance projects in the wake of 2016 floods – Emergency assistance to support food and nutrition security in flood affected areas (TCP/DRK/3605, October 2016 – September 2017); Emergency support to increase vegetable, soybean, and small livestock production to improve Nutrition Security (OSRO/DRK/701/CHA, March 2017 – December 2017). Under these two projects, a total of 58 greenhouses were constructed for cultivation of vegetables. Emergency assistance was provided to 46 cooperative farms in six provinces – Ryanggang, North Hamgyong, South Hamgyong, Kangwon, North Hwangh and South Hwanghae in 2018 through CERF-funded project OSRO/DRK/802/CHA project. The farms were provided with the following inputs: 10 tonnes of soybean, 0.6 tonne of cabbage, 0.5 tonne of cucumber, 0.1 tonne of tomato seeds and 5 428 rolls (each 500 m2) of plastic sheet. With these inputs the cooperative farms produced 7 590 tonnes of soybean and 3 737 tonnes of vegetables benefitting a total of 45 539 people (male 22 314 and female 23 225).

CERF Assistance to Vegetable Production in DPRK in 2019

In 2019, FAO received US$1 499 890 from CERF-Rapid Response window for the project “Post-disaster assistance to reduce post-harvest loss and replant vegetable crops in Typhoon-affected areas of DPR Korea (OSRO/DRK/901/CHA)”. The project provided assistance to 100 cooperative farms most damaged by the Typhoon Lingling selected from the following provinces and counties: South Hwanghae, (Haeju,Pyoksong, Kangryong, Paechon, Yonan, Chongdan, Unchon, Anak, Sinchon, Thaetan, Samchon, Unryul, Sinwon, Pongchon, Ongjin); North Hwanghae(Sariwon, Sohung, Unpha, Rinsan, Phyongsan, Pomsan, Kumchon); South Hamgyong (Hongwon, Yonggwang, Hamju, Jongphyong, Kumya); Nampho(Onchon, Kangso), South Phyongan (Jungsan); and North Phyongan (Pakchon, Unjon).

The inputs provided under the project included4 000 rolls of plastic for greenhouse repairs,50 000 square meter of clear greenhouse film, 29 000 plastic trays, 2 000 tonnes of Portland cement, 150 000 PVC pipes, 600 kg of seeds distributed, and 60 000 m2 tarpaulin. The project benefitted a total of 85 000 farm households, 375 000 direct beneficiaries, a total of 35,000 people in schools, hospitals and orphanages were also directly benefited. The direct beneficiaries included a total of 195,000 female beneficiaries and 180 000 male beneficiaries.

Status of Vegetable Production with CERF Assistance in 2019-2020

The total sown area of the selected 100 farms amounted to 69 651 hectares (ha), of which 3 962 ha (5.7 percent of the total sown area) was allocated to cultivation of vegetables. Total production of vegetables – cabbage, red pepper, tomato, and others – in the beneficiary farms was estimated at

82 904 tonnes. Yields varied within a wide range between 11.6 and 38.2 tonnes/ha with an average of 19.9 tonnes/ha. A significant part of this production was grown in greenhouses and tunnel houses.

Conclusion

Humanitarian assistance provided to DPRK in the food security and agriculture sector with CERF-funding plays an important role in supporting production of nutritious foods such as vegetables and soybean. Such assistance is extremely critical in the aftermath of natural disasters, such as droughts, floods and storms to help cooperative farms in affected areas to restore crop production.

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Baibing *(Alocasia fornicata)*-An Underutilized Vegetable Crop in Mizoram having Potential Source for Traditional Medicine

Article ID: 32551

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Introduction

Alocasia fornicata is a plant species of many nerved, broad leaved, rhizomatous or tuberous perennials from the family Araceae. It is originated from Indo-china and Indian Sub-continent. The plant is 2 inches to 3 inches in height with triangular wide shaped leaves and horizontally growing stolon (Govaerts and Frodin, 2002).

The male flower (spadix) is used as cooking purpose in North East Indian State of Mizoram, Manipur and Tripura; and the plant is locally known as Baibing in Mizo. Baibing is used like any other vegetable in preparation of food. It is relished by the people of Mizoram; when the spadix is boiled with any other vegetables to form a local cuisine. It is also used in preparation of stews, chutneys, fries etc. The plant has antioxidant properties (Mandal et al, 2010).The other phyto-constituents are triglochinin and calcium oxalate (Horborne, 1980).

The plant including spadix contains needle-shaped crystals of calcium oxalate known as raphides that are believed to be a defence mechanism against predators (Arnott and Webb, 2000).

Fig 1: Vegetative, spadix development and harvesting stage of Baibing *(Alocasia fornicata)*

Table 1: Medicinal Properties of Baibing *(Alocasia fornicata)*

Sl. No.	Medicinal Property	Plant Organ Used	References
1.	Antibacterial	Leaves and stolon (Roots)	Hague et al, 2014
2.	Antioxidant	Leaves, Rhizomes & Stolons (Roots)	Mandal et al, 2010

Baibing *(Alocasia fornicata)* grows from rhizomes in the ground and the best method of propagation involves splitting up of these rhizomes. Propagation should be done in spring or early summer, when the plant is just coming out of dormancy from the winter. Harvesting of spadix started from 3 to 4 months after planting. Picking is done 1-week interval.

Conclusion

The crop is easier to grow, resistance to pests and diseases producing good crop even under adverse conditions. However, negligence and meagre efforts on research and conservation renders the hidden. This has resulted in loss of valuable genetic resources of the crop. Popularization of this crop is required to generate awareness for its cultivation and conservation at farm and community level.

Baibing (Alocasia fornicata) has potential source for the development of traditional medicine, such as, a safer antibiotic and also as an anticancer agent.

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Suicidal Germination: As a Control Strategy for Parasitic Weed

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What is Suicidal Germination?

The ability to stimulate Parasitic weed germination through use of naturally occurring chemical signals are strigolactones (SLs) e.g. strigol and orobanchol; as suicidal germination agents, where germination take place in the absence of a host. Owing to the lack of nutrients, the germinated seeds will die. The structures of natural SLs is too complex to allow multigram synthesis.

Parasitic weeds of the genera Striga and Orobanche spp. cause severe yield losses in agriculture, especially in developing countries and the Mediterranean. Seeds of these weeds germinate by a chemical signal exuded by the roots of host plants. The radical thus produced attaches to the root of the host plant, which can then supply nutrients to the parasite weed. There is an urgent need to control these weeds to ensure better agricultural production.

Introduction: Striga and Orobanche

The total root parasitic plants *Striga hermonthica* (Purple witchweed) and Striga asiatica (Asiatic witchweed) are the most economically important weeds in the rain-fed agriculture, infecting pearl millet, sorghum, maize and other cereal crops. A single plant can produce 10,000-20,000 seeds under optimal conditions. The Semi-root parasitic weed *Orobanche aegyptiaca* produce more than 500 seeds per plant, infecting tomato, potato, tobacco, eggplant, mustard, pea, peppers, carrot, celery etc. by different seven species of broomrape. SLs are a novel group of carotenoid derived plant hormones that regulate different development processes. Strigol was the first natural SL isolated from roots of cotton, a non-host of striga. Today, more than 25 known natural SLs characterized by a common structure.

Control Strategies for Parasitic Weed

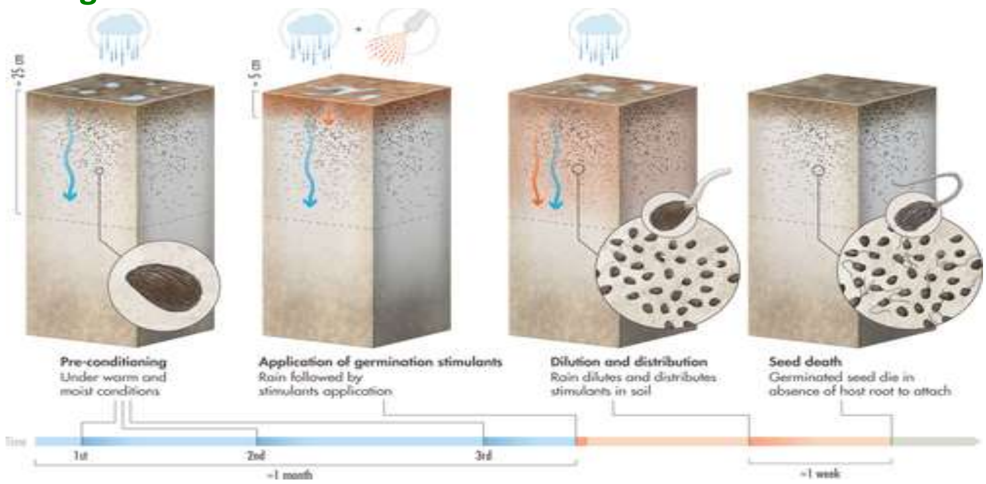
A diverse array of control approaches has been pursued to address the challenge presented by parasitic weed. These approaches aim to improve soil fertility or directly target the parasite by chemical or mechanical means and include the use of resistant varieties as well as cultural measures. Although these methods have helped in reducing the impact of this pernicious weed, they have not addressed the weed seed problem effectively. Thus, the extensive seedbank of weed in infected fields remains an impediment. As long as the weed seedbank is not controlled adequately, the need to apply means to control the parasite will persist. But suicidal germination is a promising option in combating weed.

The suicidal germination approach was proposed as far back as 1976. The use of natural SLs for this is not realistic alternative because chemical synthesis of these compounds is very laborious. In addition, plants produce and release SLs in very low amounts. A series of SLs analogs can be used to develop a protocol for implementing the suicidal germination strategy for combating parasitic weed. The synthetic germination stimulants viz; Nijmegen-1, MP 1, MP 3, T-010 and GR 24 etc. Structure modification of artificial germination stimulants resulted in an improvement in the germination inducing activities.

The best performing stimulant, which derived from 1-tetralone, induced 98.0% germination for *S. hermanthica* seeds (Kgosi, *et al*. 2012). Furthermore, a formulated SL mimic, T-010 and formulate SL analogue, Nijmegen-1 reduced the emergence of *S. hermonthica* in sorghum and *P. Ramosa* in tobacco fields. Both T-010 and Nijmegem-1 are hydrolysed faster than SL analogue, GR 24 which had been reported as an unstable compound in soil (Kannan, *et al*., 2014).

Sequiterpene lactones, heliolectones etc were isolated from sunflower root exudates as germination stimulants for *O. Cumana*. Some new polyphenols isolated from pea root exudates were found to strongly stimulate seed germination of several orobanche spp.

Mechanism of Killing Weed Seed



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Growing Strawberry in Hanging System: A Smart Way to Grow Strawberry in Small Area's

Article ID: 32553

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Introduction

Strawberry (*Fragaria x ananassa* Duch.) is a hybrid of two Native American species; Fragaria chiloensis and Fragaria virginiana, and one of the popular soft fruits of the world. It grows well in temperate climate however it can also grown successfully in tropical and sub tropical climate. Day neutral varieties like Selva and Fern, and Pajaro suitable for summer are also available. This soft fruit is having a distinct tantalizing aroma (Sharma and Yamdagni, 2000). It is highly nutritious with abundant source of vitamins A, B, C and niacin, minerals like phosphorus, potassium, calcium and iron (Karkara and Dwivedi, 2002). The fruits are highly perishable in nature consumed as fresh or utilized for the production of purees, juice concentrate, jams, preserves and rose red wine. Medicinally, strawberries have been known for its anti viral properties against polio, these may block the formation of nitosamines, which can cause cancer; furthermore these contain relatively high quantities of ellagic acid, which has a wide range of biological activities (Rieger, 2006). Strawberry is a highly remunerative crop with quickest return in shortest possible time.

Propagation

Strawberry is commercially propagated through runners. Although runner propagated produces true to type plant, but are prone to viral diseases. Therefore, for large scale production tissue culture virus free plants can be used.

Growing Method

Figure 1: Strawberry cultivation in hanging system under open condition

Planting of runners in the month of October and November is best. Growing strawberries in hanging system is a simple way to grow strawberries by utilizing vertical space by farmer having small land holdings, expensive land areas or in a city where space is a problem. It consists of soil or soil-less cultivation of strawberries on hanging polyethylene bags supporting with ropes under open condition. Its setup involves the use of bamboo for construction of post and supporting structure of convenient size with rope to support the hanging polyethylene bags containing growing media 1.5m above ground as shown in the Figure 1. The structure can also be made of concrete post and G.I wire trellis and others depending upon the capital of the farmer and availability of materials.

Sharma and Godara, (2017) found that container size also had significant effect on strawberry growth; plants grown in larger container produced better growth than the smaller containers. However, contrary the pot size used by Phala et al., (2012), the smallest pot may be sufficient for the maximum root growth attainable by the genotype. The large size pot increases the amount of substrate required and increase the costs of cultivation.

Growing Media

Strawberry being a shallow rooted plant needs effective nutrient management. For greater survival, the runners are planted in polyethylene bags containing soil, sand and FYM (1:1:2). However, Soilless media has more advantages where soil is contaminated and lack of suitable soil for strawberry cultivation. Soilless culture characteristics of substrates include holding water and nutrient, providing good aeration to root system, light weight, free of pathogenic organisms and substances that are toxic to plants (Johnson et al., 2010). The use of different organic and inorganic substrates allows the plants better nutrient uptake, sufficient growth and development to optimize water and oxygen holding (Verdonck et al., 1982; Albaho et al., 2009). Sharma and Godara, (2017) found that all combinations of substrates significantly improved the plant growth in strawberry compared to the soil and also reported that the substrate combination of cocopeat + perlite + vermicompost (3:1:1) was superior among all the treatments under Green house.

Crop Management

Avoid excess watering, which results in rotting of plants and also results in excessive growth and production of leaves and stolons at the expense of fruit production. Frequent irrigation rather than heavy irrigation favours the crop. For nutrient management the standard and uniform fertilizer solution may be given as per recommendation.

Advantages of Hanging System

1. Easy to harvest and can be done standing.
2. The presence of fungi is better controlled as the leaves and fruit keep dry and clean.
3. Less weed hence management is easier resulting in reduce cost.
4. Better utilization of vertical space; accommodate high number of plants per unit area.
5. Fruits remain clean due to non-contact with surface hence resulting in less damaged fruit.
6. Polyethylene bags can be recycled.

Conclusion

Strawberry is among the most widely consumed fruits in the world and its cultivation is increasing worldwide day by day. Strawberry as a whole plant and its fruit is very attractive even in cities people love to grow few plants in a pot or hanging baskets. The farmers are currently predominantly growing strawberries in open condition, in pots or polyethylene bags using different substrates or under highly automated greenhouse which requires large initial investment and to make it a profitable venture, plant must produce quality fruits and achieve high market prices. The following conditions may not be conducive for the farmers with small land holding and also lack of capital being one of the majors constrains, the farmer cannot afford these investments. The hanging system may serve as a simple solution to grow strawberries successfully and to earn monetary benefits as strawberries are highly remunerative crop. It is also suitable for roof tops with vertical arrangement of bags in a stand tied with ropes to support the weight of polyethylene bags.

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Drought and Agriculture: Estimation through ARID Tool

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Droughts are a natural part of the climate system and affect most parts of the world. This natural hazard is the main cause of losses in agriculture around the globe. Droughtis defined as insufficient soil moisture. It can be caused by a lack of significant rainfall, increased water losses (by evaporation or evapotranspiration) due to abnormally elevated temperatures, or a combination of the two. The beginning (drought onset) and end of a drought are often difficult to determine. Several weeks, months, or even years may pass before people know that a drought is occurring. As drought is part of the climate system and has a diverse geographical and temporal distribution, it is difficult to quantify and to determine its onset. One way to quantify drought is by using drought indices. Drought indices produce a number from the integration of several components of a drought, such as precipitation, streamflow, temperature, evaporation, etc. Through this integration, a bigger picture of the problem can be seen. Drought indices can be used to quantify drought intensity, compare drought in different regions, compare current conditions to previous ones, and provide a regional overview of the potential impacts of droughts. As there are several types of drought with complex interactions between components, there is no drought index that is suitable for all situations. Commonly used indices include the Agricultural Reference Index for Drought (ARID), the Keetch-Byram Drought Index (KBDI), the Lawn/Garden Moisture Index (LGMI), the Palmer Drought Severity Index (PDSI), and the Standardized Precipitation Index (SPI). It is crucial to compare current drought conditions with historical ones to determine if what is currently observed is above or below the expected. Drought indices allow this comparison because they are calculated using weather information.

Agricultural Reference Index for Drought (ARID)

For agricultural purposes, ARID is a more valuable index because it takes into account the soil-plant-atmosphere relationship. ARID is a simple index that indicates how dry the soil is, and it is used to monitor and predict agricultural drought. ARID uses a simple water balance for a soil profile assumed to be 40 cm (16 in) deep with evenly distributed roots. The soil water is calculated based on how much water is added into the system by rainfall and how much water is lost by through transpiration, runoff, and drainage (fig 1).

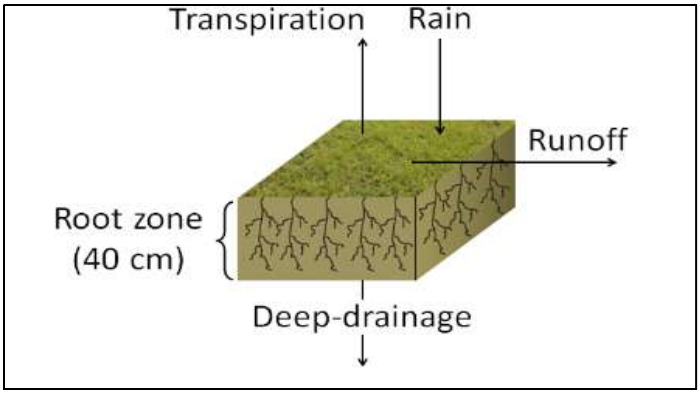


Fig 1 : Soil water balance components

A plant water deficit occurs when there is insufficient water in the soil profile to meet the needs of plants. When the amount of water available in the soil satisfies plant needs, transpiration reaches maximum values (the same of potential evapotranspiration). If water available in the soil does not satisfy plant needs, plants cannot have the normal transpiration. Therefore, transpiration is smaller than potential evapotranspiration. ARID can be defined as the ratio of actual transpiration (T) to potential evapotranspiration (ETo):

$$\mathbf{ARID = 1 - (T/ET0)}$$

ARID values range from 0 to 1. When no transpiration occurs (T = 0), ARID takes a maximum value of 1, indicating a full water deficit, whereas ARID is 0 when transpiration occurs at potential rate (T = ETo), indicating no deficit at all. ARID values increase gradually during dry spells and decrease rapidly with rainfall events. As the index represents cumulative days under water stress conditions, it can be associated with yield losses and compared to historical typical values for the same period in the same location, allowing users to track and quantify drought conditions.

The ARID Monitoring and Forecast tool monitor ARID values during the last 90 days based on data collected. Moreover, this tool provides average ARID values for each month and for each phase of ENSO, as well as the probability of ARID exceeding certain values. It is done for most counties in the south-eastern U.S., based on data obtained from National Weather Service COOP (Cooperative Observer Program) weather stations. The user can select among three soil types (sand, sandy loam, and loam) and the ENSO phase of interest. The tabs "Current" and "Tabular Data" are available only on locations with current weather data. Under the tab "Current", the user can monitor ARID values up to the last 90 days. Moreover, the user can compare ARID from the selected period with historical values for the same period to verify how current conditions differ from the expected ones. Under "Tabular Data", the user can see daily weather data, ETo, ETa (actual evapotranpiration) and ARID values for the selected period. Under "Average/Deviation", the user can see monthly average ARID or monthly deviation from historical values. Under "Probability of Exceedance", the user can see the probability of ARID exceeding certain values.

The different colors indicate different classes of ARID values and soil conditions:
1. Green: ARID values between 0.0 and 0.3 – Little or no stress
2. Yellow: ARID between 0.3 and 0.6 – Stress watch or moderate stress
3. Red: ARID between 0.6 and 1.0 – Stress warning or high stress.

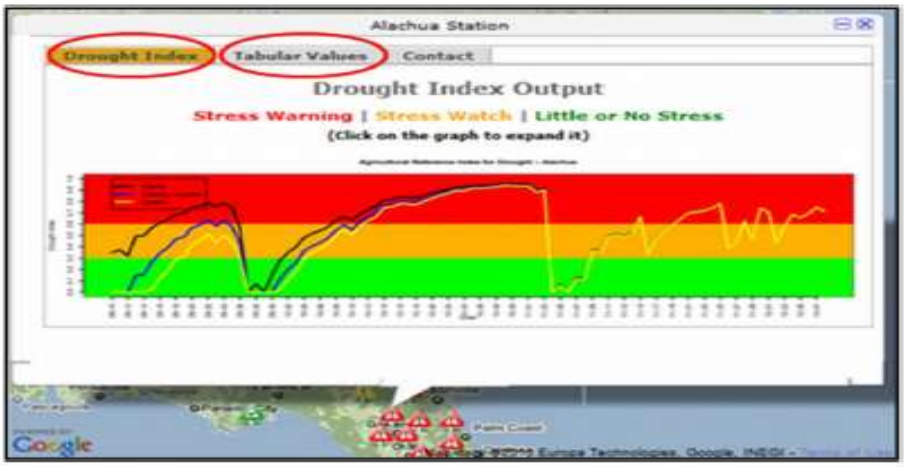
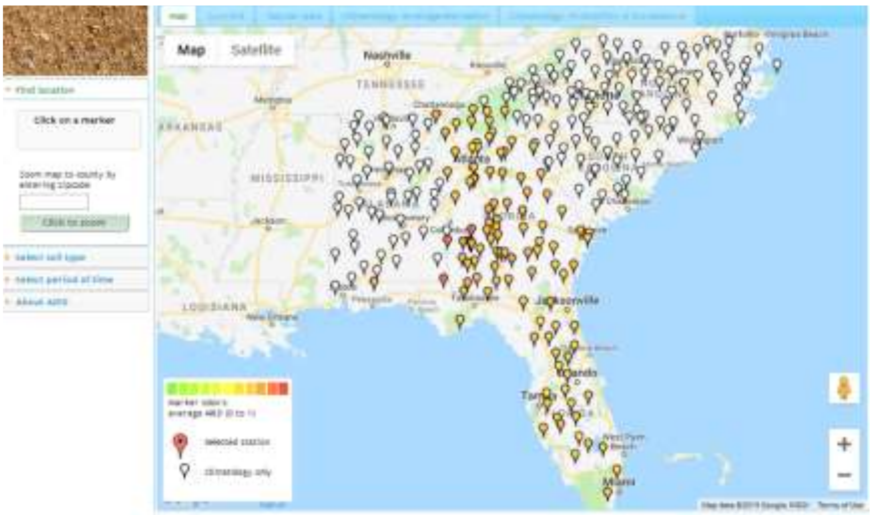


Fig 2 : Graph showing ARID values for the past 90 days for three types of soil: sand, sandy-loam, and loam



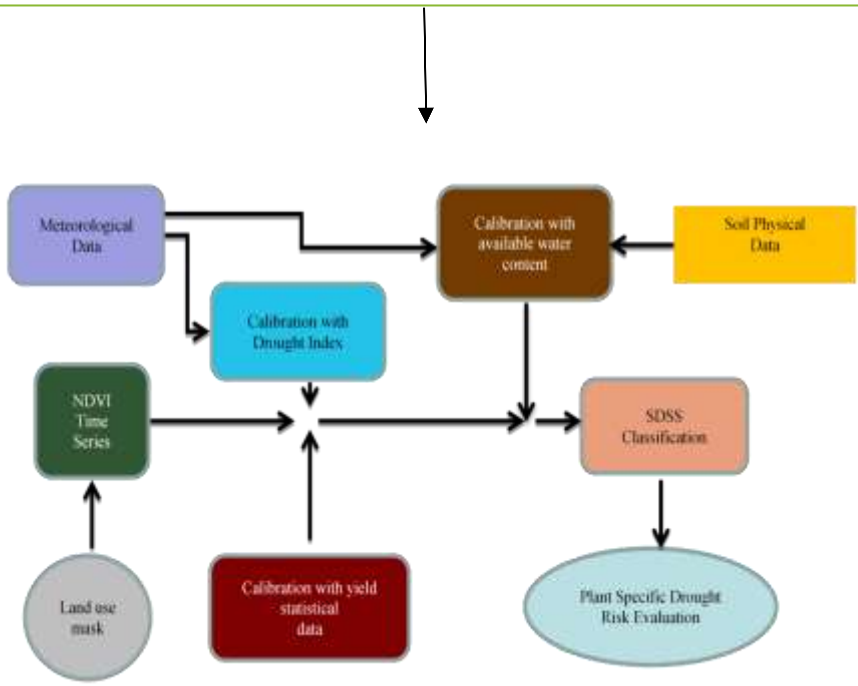


Fig 3: The main web page for the ARID Tool

ARID indicates how dry the soil is. Also, ARID increases gradually during dry spells or longer periods without rainfall and decreases rapidly with rainfall events. As the index represents cumulative days under water stress conditions, it can be associated to yield losses and compared to historical typical values for the same period of time in the same location, allowing users to track and quantify drought conditions.

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Agronomic Biofortification: Current Need

Article ID: 32555

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Summary of Article

The population of world is continuously increasing and demand for quality food is also increasing parallels. But the agricultural productive land continuously decreasing day by day due to industrialization and urbanization. So that intensifying good quality food production across the globe to feed this population is actually one of the most significant obstacles to achieve food security. Biofortification is one of the options to solve this type of problem by increasing nutrition value of food. However genetic biofortification is difficult and more resource intensive so that agronomic biofortification is currently an appropriate option to solve this problem.

Introduction

Current plant population of world is 7.8 billion, which should have reached up to 9.1 billion by 2050 (FAO, 2009), 17 percent higher than today. This increasing population requires a land to live and survive. But the area on earth is remain constant, so that this land is either come from agricultural of forest. This indicated that productive agricultural land is continuously decreasing but the need of food increasing day by day. In agriculture, most efforts have been concentrated on crop production. These studies do not, take into account the yield quality over time or the variability and reliability of the production of crops over the years. As global population is continually growing, the increase in agricultural produce at a rate proportional to parallel increase in population stands to be a major pre-requisite.

Agriculture has excellent significance in developing countries to provide food security. From the total population, 75% of the below poverty line people in the world live in rural areas and they depend on agriculture, on average, more than 20% of people living in these areas are struggles with quality food resources (FAO, 2019). The demand for quality food crops with high nutrient, minerals and fibber content is constantly increasing. So, there is a burden rising on already underprivileged arable land and water resources. The majority of people in developing countries, however, especially in rural regions, rely on cereal based foods as the major source of energy and minerals because of widespread poverty, high food prices and cultural preferences. Therefore, the contribution of animal-based foods to the daily quality food intake is much less in developing countries than in high income countries. At present, mainly three cereals (wheat, rice and maize) supplying up to 60% of the daily food intake of human populations and bread wheat in itself is the main food for 35% of the world's population. For under development countries, these figures are often higher (FAO, 2016).

Need for Biofortification

There are numerous reasons that force us to research and develop biofortified quality food for people.

1. Roles of micronutrient in human physiology and health: One of the big group of nutrients that our body requires is micronutrients. Because they are used to building vitamins and minerals. Vitamins are essential for the development of energy, immune functions, coagulation of the blood and other functions. Meanwhile, in formation of bone health, fluid balance and many other processes, minerals play a significant role.

2. Contribution of cereals to daily intake: Micronutrient and minerals deficiency is often caused by low dietary intake that is associated with a large consumption of cereal based foods and they have very small micronutrient and minerals contents. Also, these peoples are depending mainly on rice and wheat crops which are already categorized as very poor sources of micronutrients and minerals in terms of both content and bioavailability.

3. Dilution of micronutrients and minerals in cereals grain because of increases in yield: Over the past 100 years, there have been substantial increases in the grain yield of major cereal crops, especially during the Green Revolution, which started most noticeably in the 1960s. In the past, plant breeders were almost exclusively interested in the development of new cereal varieties with larger grain yield. With breeding efforts and improved soil and crop management practices, the average yields of major crops have increased more than twofold during the past 50–60 years. These large increases in yield, however, have caused considerable decreases in the concentrations of essential nutrients because of the so called 'dilution effect'.

Table 1: Micronutrients content in cereal grains:

Cereals	Fe (mg/100g)	Zn (mg/100g)
Rice	4.31	1.09
Wheat	4.56	3.33
Oats	4.72	3.97
Maize	2.71	2.21

USDA Food Composition Databases (2017)

4. Adverse soil conditions that affect grain qualities: Most of cultivated soil in the world is considered poor in plant available nutrients. Under such conditions, crop varieties cannot realize their full potential in nutrient absorption and accumulation, and therefore, grain nutrient concentrations are reduced further. The availability of nutrient to plant roots is very low in alkaline soils, which cover at least 30% of the arable land globally. The major types of soils that are mostly associated with micronutrient deficiency are sandy soil, weathered tropical soil, calcareous soil, saline soil, waterlogged soil and clay soil. The potentially availability of plant micronutrients in the soil comprises the exchangeable, soluble and organically bound pools, and plant roots take up these nutrients mostly from the soil solution. In the soil solution, Consequently, the capacity of roots to uptake nutrients are hampered, leading to low nutrient accumulation in plants. This causes losses of yield, depending on the severity of nutrient deficiency. Under such soil chemical conditions, additional fertilizer application to soil is of great importance to ensure a sufficient uptake of nutrients by roots.

Agronomic Biofortification Approaches

In order to strengthen the nutritional status of food crops, biofortification by agronomic methods involves physical application of nutrients to such crops that are highly consumed by peoples and ultimately enhances human nutritional status. Organic forms of mineral nutrients are more readily bio-available to humans as they can be absorbed more easily compared to inorganic forms of mineral nutrients, organic forms are less excreted and less intense toxicity. It often depends on the application and/or improvement in the solubilization and/or mobilization of mineral fertilizers from the soil.

In the late 1960s, agricultural production improved in many countries around the world with the use of NPK-containing fertilizers, contributing to the Green Revolution and saving them from famine. These fertilizers are critical and essential in the current scenario to increase crop yield and save the human population from famine, as low-input agriculture is insufficient to feed the existing world population of seven billion. In the edible portion of some plants, micronutrients such as Fe, Zn, Cu, Mn, I, Se, Mo, Co, and Ni are present to various degrees and are often absorbed from the soil by plant. Improving the status of soil micronutrients by their use as fertilizers can lead to a reduction in human micronutrient deficiency.

Agronomic biofortification is easy and affordable, but requires careful consideration in terms of nutrient supplies, methods of implementation and environmental impacts. These should be applied regularly in every crop season and thus are less cost-effective in some cases. In addition to fertilizers, soil microorganisms that encourage plant growth can be used to increase the movement of nutrients from the soil to edible sections of plants and increase their nutritional status. It is also possible to use soil microorganisms such as various species of the Azotobacter, Bacillus, Rhizobium and Pseudomonas genera to improve the abundance of mineral elements in plants. In minimal nitrogen conditions, N2-fixing bacteria play a major role in rising crop production.

Some plants are connected with mycorrhizal fungi, which in edible products can release enzymes, organic acids and siderophores capable of destroying organic compounds and increasing mineral levels.

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West Indian Cherry: Natural Source of Vit. C for Economic and Nutritional Security

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Introduction

Barbados Cherry is a wild under-utilized tropical and subtropical fruit crop, bearing shrub or small fruit crop grown mainly in the regions with humid climate, as an ornamental plant and for its edible and nutritive fruits. Common names of this fruit include Acerola Cherry, Barbados Cherry, West Indian Cherry, Wild Crepe Myrtle, Native Cherry, Garden Cherry, French Cherry. *Malpighia emarginata* is belong to the family Malpighiaceae. Fruit is a good source of vitamins, minerals, antioxidants, phenolic acids, especially the Vitamin C (richest source).

Origin and Distribution

The plant is native to the Yucatán, West Indies and southern Texas southward to northern South America, but is now also being grown as far north as Texas and in subtropical areas of Asia. It can be found in the tropics and subtropics throughout the world, including the Mexico, Central America, the Caribbean, South America as far south as Peru, and the southeast region of Brazil, southernmost parts of the contiguous United States (southern Florida and the Lower Rio Grande Valley of Texas , Canary Islands, Ghana, Ethiopia, Madagascar, Zanzibar, Sri Lanka, Taiwan, India, Java, Hawaii, and Australia.

Floral Biology

1. Tree: Acerola is an evergreen shrub or small tree with spreading branches on a short trunk. It is usually 2–3 m (6.6–9.8 ft) tall, but sometimes reaches 6 m (20 ft) in height.

2. Leaves: The leaves are simple ovate-lanceolate, 2–8 cm (0.79–3.15 in) long, 1–4 cm (0.39–1.57 in), and are attached to short petioles. They are opposite, ovate to elliptic-lanceolate, and have entire or undulating margins with small hairs, which can irritate skin.

3. Flowers: Flowers are borne in sessile or short-peduncle axillary cymes in cluster of 3 - 5 flowers on new terminal and on lateral spurs. Flowers are bisexual, 1 - 2 cm in diameter. There are five pink or lavender, and fringed petals. Flowers consist of calyx with 6-10 large sessile glands, 5 petals, fringed, slender-clawed or spoon-shaped, 10 stamens and filaments united below.

4. Flowering: Flowers usually appear after periods of rain fall or irrigation, thus flowering may occur any time during the year depending on local rainfall and climate pattern. Flowering may last a year-round. Flowering and fruit set occur almost continuously from April through November in Florida, and fruits mature in approximately 30 days.

5. Pollination and Fruit Set: In Florida, bees visit Barbados Cherry flowers in great numbers and are the principal pollinators. Maintenance of hives near Barbados Cherry trees substantially improves fruit set. In Hawaii, there was found to be very little transport of pollen by wind, and insect pollination is inadequate. Consequently, fruits are often seedless. Investigations have shown that growth regulators (IBA at 100 ppm; PCA at 50 ppm) induce much higher fruit set but these chemicals may be too costly to buy and apply.

6. Fruit: The Barbados cherry plant is an evergreen and grows about 3.6 metres (12 feet) tall. The flowers, which appear throughout the summer, are pink or rosy, 2 cm (nearly one inch) in diameter, and grow from the leaf axils in clusters of three to five. The red fruit is a drupe the size of a cherry. After three years, trees produce significant numbers of bright red drupes 1–3 cm (0.39–1.18 in) in diameter with a mass of 3–5 g (0.11–0.18 oz). Drupes are in pairs or groups of three, and each contains three triangular seeds.

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Biochemical Importance of Fruit and its Utilization

The drupes are juicy and very high in vitamin C (300-4600 mg/100g) and other nutrients. It is known for being extremely rich in vitamin C and are used in preserves and commercial vitamin production. Fruits also contains vitamins A, B1, B2, and B3, as well as carotenoids and bioflavonoids, which provide important nutritive value and have antioxidant uses. They are divided into three obscure lobes and are usually acidic to sub acidic, giving them a sour taste, but may be sweet if grown well.

The proximate composition of ripe fruit (based on 100 g edible portion) includes- energy 32 kcal, moisture 91.41%; protein 0.40 g, total lipid 0.30 g, ash 0.20 g, carbohydrate 7.69 g, total dietary fibre 1.1 g. Among several mineral contents- phosphorus 11 mg, calcium 12 mg, magnesium 18 mg, iron 0.20 mg, sodium 7 mg, zinc 0.1 mg, copper 0.086 mg and selenium 0.60 g., water (906-920 g), and dietary fibre (30 g). Mature ripe fruits also contain a number of important vitamins which include- thiamine 0.020 mg), riboflavin 0.060 mg, niacin 0.400 mg, pantothenic acid 0.309 mg, vitamin B-6 0.009 mg, folate food 14 g and vitamin A 767 g. Besides this, most important composition of the fruit is vitamin C content, varies from 3097-4515 (mg/100 g of edible part). The recovery of fruit juice, pulp and seed is 36.11%, 82.56% and 17.44%, respectively with 5.44o Brix total soluble solids and 1.18 % acidity in ripe fruit.

Climate

It is basically grown under tropical and subtropical humid climates. A temperature of 26˚C is optimum for its successful cultivation. It prefers penetration of sufficient amount of sunlight for better fruiting. This fruit production is hampered under shady condition. Besides, it can also survive at a temperature closed to 0°C or lower. A mature plant can bear a briefly exposure to -2.22°C, while young plants are killed if exposed even for a considerable period of time to at temperature below -1.11°C. Its smaller and shallow root system allows the plant to be grown as intercrop with other crops. It produces well when annual rainfall distribution is in between 1200-1600 mm. Besides, heavy rainfall ranging from 1000-3000 mm can be tolerated by these plants. It is naturally adapted to both medium- and low-rainfall regions; can tolerate long periods of drought, though it may not fruit until the coming of rain.

Soil

Though the plant does not possess any soil specificity but performs well in sandy or sandy-loam to clay, lime stone and others heavy type soil as it drains well. An average soil with a complete mixture of both clay and sand is optimal for its better performance since they hold more humidity. However, water-logging condition is very detrimental to the crop. A soil pH of 6.5-7.5 is ideal, as acidic soil do not encourage vigorous growth of the plant. The tree does well on limestone, marl and clay, as long as they are well drained. Acid soils require the addition of lime to avoid calcium deficiency and increase yield. The lime should be worked into the soil to a depth of 8 in (20 cm) or more.

Propagation

If seeds are used for planting, they should be selected from desirable clones not exposed to cross-pollination by inferior types. They should be cleaned, dried, and dusted with a fungicide. It should also be realized that the seeds in an individual fruit develop unevenly and only those that are fully developed when the fruit is ripe will germinate satisfactorily. Germination rates may be only 50% or as low as 5%. Seedlings should be transferred from flats to containers when 2 to 3 in (5-7.5 cm) high. But the viability of seeds is very poor. However, high variability was found in fruits, when propagated by seeds. Therefore, to achieve true to the type genotypes several asexual means of propagation also practiced viz. - cutting, layering, grafting and other standard methods. Among them, the former is currently favoured as easiest method. Hardwood cutting of Cherry plants treated with 1500 ppm IBA results prolific rooting with good survival rate. Cuttings of branches 1/4 to 1/2 in (6-12.5 mm) thick and 8 to 10 in (20-25 cm) long, with 2 or 3 leaves attached, hormone-treated and set in sand or other suitable media under constant or intermittent mist, will root in 60 days. They are then transplanted to nursery rows or containers and held in shade for 6 months or a year before being set out in the field. Air-layering (in summer) and side-veneer, cleft, or modified crown grafting are feasible but not popular because it is so much easier to raise the tree from cuttings. Grafting is generally practiced only when cuttings of a desired clone are scarce or if a nematode-resistant rootstock is available on which to graft a preferred cultivar; or when top-working a tree that bears fruits of low quality. Among several rootstocks, *Byrsonima crassifolia*. found superior for better vigour of the plant. In-vitro cultivation of this Cherry through micro-propagation has been also reported with satisfying results.

Intercultural Operations

Plant needs a balanced fertilized schedule with FYM10-15 kg/pit; nitrogen 35 g/plant; phosphorus 15 g/plant and potassium 30 g/plant at the time of planting. During second year, doses of NPK and FYM should be doubled and apply before the onset of monsoon. As, the plants bears normally on current season flashes, pruning is essential for emergence of new growth but it should be done after harvesting of the crop specially during October to November. Irrigation can be used for regulation of flowering cycles as under well irrigated condition it can produce up to 1-5 flowering peaks in a year.

Pests and Diseases

There are no such serious pest diseases are recorded except few minor insects like mealy bug and aphid. Also, one of the major obstacles to successful cultivation of the Barbados Cherry is the tree's susceptibility to the root-knot nematode, *Meloidogyne incognita* var. *acrita*, especially in sandy acid soils. Soil fumigation, mulching and regular irrigation will help to keep this problem under control. The burrowing nematode, *Radopholus similis*, is also a cause of decline in otherwise healthy trees.

Harvesting and Yield

When the time comes to do the fruit harvest, there is a great concern about the correct time, frequency, procedures and forms of storage. The fruits can be harvested after 3rd year of planting. But it takes 7-8 years to come into full bearing stage. The productivity of the plant increases up to 15-20 years and after that it may be stabilized or reduced, though, the plant from mature green up to deep red fully ripe mature depending upon the utility of the fruits. There is a lapse of only 22 days between flowering and complete fruit maturity.

For home use, as dessert, the fruits are picked when fully ripe. For processing or preserving, they can be harvested when slightly immature, when they are turning from yellow to red. As there is continuous fruiting over long periods, picking is done every day, every other day, or every 3 days to avoid loss by falling. The fruits are usually picked manually in the cool of the early morning, and must be handled with care. For immediate processing, some growers shake the tree and allow the ripe fruits to fall onto sheets spread on the ground.

In Barbados Cherry, a series of alterations occurs during the process of maturation, ripening and senescence, the main ones being the degradation of chlorophyll, the presence of carotenoids, decrease in acidity, increase in reducing sugars and mainly the acute decrease in ascorbic acid during these stages.

Harvested fruits should be kept in the shade until transferred from the field, which ought to be done within 3 hours, and collecting lugs are best covered with heavy canvas to retard loss of ascorbic acid. It should be harvested at green stages for pickle purpose; at green mature stage for murabba preserve; and for candy, syrup, concentrated juice, wine preparation it needs to pluck at deep red ripe stage. Fruit need to be cropped 2-3 times in a week or daily, according to the productivity of the plant, in order to prevent the losses by falling on the ground. The shelf life of Barbados Cherry is very poor, it deteriorates rapidly after removing from the plant. Changes in sensory attributes starts within 4 hours of harvest and fermentation will starts within 3-4 days. Therefore, it is necessary to avoid any physical injury during harvest and better to store in cool places or in refrigerator to avoid the mould growth. A well-managed tree yielding about 1.5-2.0 kg fruits/ plant and 4-5 kg fruits /plant at 3 years and 5th years after planting. Plants grown in dry areas in irrigated fields presented production between 2.01 and 27.11 kg per tree in four crops a year.

Keeping Quality

Ripe Barbados cherries bruise easily and are highly perishable. Processors store them for no more than 3 days at 7.22º C. Half-ripe fruits can be maintained for a few more days. If longer storage is necessary, the fruits must be frozen and kept at -12.22º C and later thawed for use. At one time it was believed that the fruits could be transported to processing plants in water tanks (as is done with true cherries) but it was discovered that they lose their colour and ascorbic acid content in water.

Food Uses and Processed Products

Barbados cherries are eaten out-of-hand, mainly by children. For dessert use, they are delicious merely stewed with whatever amount of sugar is desired to modify the acidity of the particular type available. The seeds must be separated from the pulp in the mouth and returned by spoon to the dish. Many may feel that the nuisance is compensated for by the pleasure of enjoying the flavourful pulp and juice. Other-wise, the cooked fruits must be strained to remove the seeds and the resulting sauce or puree can be utilized as a topping on cake, pudding, ice cream or sliced bananas, or used in other culinary products. Commercially prepared puree may be dried or frozen for future use. The fresh juice will prevent darkening of bananas sliced for fruit cups or salads. It can be used for gelatine desserts, punch or sherbet, and has been added as an ascorbic acid supplement to other fruit juices. The juice was dried and powdered commercially in Puerto Rico for a decade until the cost of production caused the factory to be closed down. The fruits may be made into syrup or, with added pectin, excellent jelly, jam, and other preserves. Cooking causes the bright-red colour to change to brownish-red. The pasteurization process in the canning of the juice changes the colour to orange-red or yellow, and packing in tin cans brings on further colour deterioration. Enamel-lined cans preserve the colour better.

Nutritional and Economical Food Security

Barbados Cherry is one of such underutilized fruit crops having many advantages like easier to grow and hardy in nature, producing a crop even under adverse soil and climatic conditions. So, exploitation of this crop can become a solution to the social problem of health and nutrition insecurity, poverty, and unemployment. The consumption of Cherry fruit can provide nutrition to the poor and needy tribals by meeting the nutrient requirements of vulnerable groups. Besides, being a rich of source of carbohydrates, proteins, energy, vitamins-C (highest among the fruits), A, B-6, thiamine, riboflavin, niacin, pantothenic acid, and minerals (Ca, Mg, P, Fe, Zn, Cu, selenium) and dietary fiber. These nutritional and anti-oxidant properties of the fruit prevent and cure various serious diseases like cancer, kwashiorkor, marasmus, night blindness, anemia, diabetes, hypertension, liver problems and hidden hungers which are threatened the modern world.

Being a good source of pectin, a number of processed products are prepared from it likes syrup, juices (concentrated, integral, lyophilised), candy, murabbas, pickles, ice-cream, gelatine, soft drinks, nectar, puree, jelly, gum, fruit conserve, nutraceutics, yogurts and sodas. Its juice helps in prevent the darkening of banana sliced for fruit cups or salads. They are also used for making of baby food and recipe items as source of vitamin C. A concentrate prepared from this fruit is very helpful for liver, gall bladder, blood circulation and in case of viral hepatitis. It is also one of three ingredients in a proprietary herbal medicine for allergic rhinitis and herpes. Because, of all these reasons crop is having potential to give economic security to tribals by giving employment and by fetching good returns from their sale in raw form as well as such value-added products.

Apart from this, the Cherry fruit has also used in commercial scale. Barbados Cherry is the richest source of vitamin C, which isused in the preservation of dry and frozen fruits as an antioxidant. If used along with citric acid, it is effective in the prevention of the oxidation process that occurs during the dehydration and freezing of many fruits such as papayas, pears, apples, passion fruits and pineapples. Besides, a large number of value added products can be prepared from the raw fruits, fruits residues after juice extraction or mixing with other fruits viz. Frozen Acerola, Hot-pressed Acerola Juice, Cold-pressed acerola juice, Frozen acerola juice, Bottled acerola juice, fortify other fruit juices (Passion fruit juice, pineapple juice, apple juice, grape juice, pear and apricot nectar, and some other fruit juices and nectar) with acerola juice, Acerola sherbet etc. By preparing these products rural people can earn a good income round the year and more employment and improves the socio-economic status of the rural people. So, if proper training can be given with proper recepies and procedures of these value-added products to the rural people from any research institutes, Agril. Universities or then it would be a good alternative source of by fetching these products year the round.

Conclusion

Health benefits, value addition, market access, and education about propagation and cultivation aspects of Barbados Cherry are very much essential for its proper utilization for food and nutrition security. The global production of this fruit is very low as compared to the fruit crops. It is very important to popularize the crop within suitable location. There is a need to develop and refine technology for higher production, productivity and improved post-harvest as well as value addition aspects of the fruit. As this fruit crop is perennial in nature and having almost year-round production more research is needed for curbing the future challenges of food and nutrition security by the way of exploiting the hidden potential of this fruit crop.

West Indian Cherry- Growing @ College of Horticulture, Hiriyur

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India's Scenario in Soil Testing

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Introduction

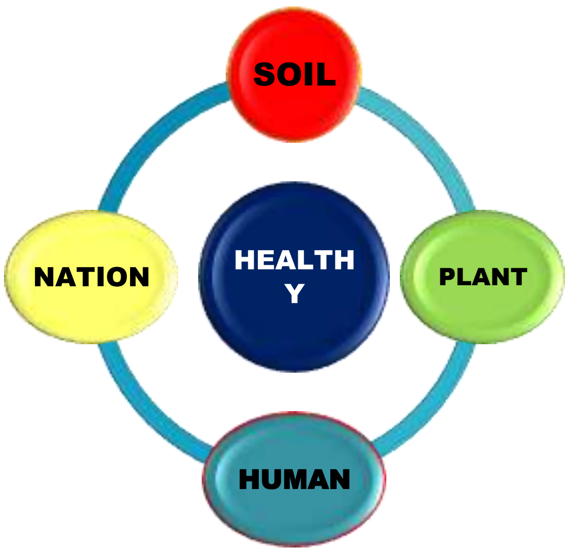
Soil testing refers to the chemical analysis of soils for characterization of the fertility status of soils and other properties like texture, structure, pH, Cation Exchange Capacity, water holding capacity, electrical conductivity and other parameters for amelioration of chemically deteriorated soils. One of the objectives of soil tests is to sort out the nutrient deficient areas from non-deficient ones.

Historical Background of Soil Testing in India

The soil testing programme was started in India during the year 1955-56 with the setting-up of 16 soil testing laboratories under the Indo-US Operational Agreement for "Determination of Soil Fertility and Fertilizer Use". In 1965, five of the existing laboratories were strengthened and nine new laboratories were established with a view to serve the Intensive Agricultural District Programme (IADP) in selected districts. To meet the increasing requirement of soil testing facilities, 25 new soil-testing laboratories were added in 1970. In addition to this, 34 mobile soil testing vans were established under the joint auspices of the Technical Cooperation Mission of USA (TCM). The installed capacity of the laboratories varied from 1000 samples/yr./lab (some cases in UP) to 30,000 to 70,000 samples/year in Tamil Nadu. A laboratory with 30,000 samples/year capacity used to be called as a standard laboratory. As of now there are around 4000 soil testing labs in India.

Soil Testing and its Relation with Farmers Welfare, Self-Sufficiency and Human Health

Nutrient imbalance is a silent killer if unchecked leads to misery (e.g. a convinced and a balanced diet is one which contain a big banana leaf with rice, sambar and curry at a ratio 4:2:1. Think what if the combo gets altered , it sounds pathetic right, then think how plant will be if they are fed with an imperfect combo. Here comes our hero 'soil testing' in order to rescue those innocent plants. The current consumption ratio of nitrogen, phosphorus and potassium (NPK) is 6.7:2.4:1 against their desirable ratio of 4:2:1. Thus with a proper soil testing we can recommend a perfect combo which the plant desires. So, question may arise, what if a balanced nutrient to plant? Once if plant gets what they desired, they will be happier, as a result they will produce more to his master (farmer). There by master too becomes happy due to the bumper production. This leads markets to have more inflow of goods, which enables us for self-sufficient nation which intern implies the nation is healthy and also more exports thus enhancing our forex reserves making our economy self-sufficient.



"If soil is healthy, plant will be healthy, if plant is healthy, human who consumes these plants will be healthy, therefore if the human is healthy our nation will be healthy, so even hundreds of corona comes it will be done and dusted."

Soil Health Card - The Key for Developed India

Soil Health Card (SHC) is a Government of India's scheme promoted by the Department of Agriculture & Co-operation under the Ministry of Agriculture and Farmers' Welfare. SHC is a printed report that a farmer will be handed over for each of his holdings. It will contain the status of his soil with respect to 12 parameters, namely N,P,K (Macro-nutrients); S (Secondary- nutrient); Zn, Fe, Cu, Mn, B (Micro - nutrients); and pH, EC, OC. Based on this, the SHC will also indicate fertilizer recommendations and soil amendment required for the farm. It is being implemented through the Department of Agriculture of all the State and Union Territory Governments. Soil Health Card Scheme is a very beneficial scheme for farmers. There are many farmers in India and they do not know which types of crops they should grow to get maximum yield. Basically, they do not know the quality and the type of their soil. They might know by experience what crops grow and what crops fail. But they don't know what they can do to improve the condition of the soil.

Our Alarming Situation

It is estimated that with the present availabilities, it is possible to distribute soil health card only to half the population of the whole farming community of our nation. As doubling the farmer's income by 2022, being an ambitious and most welcomed project by all of us is nearing, it is the need of the hour to strengthen our soil testing rates to achieve a fruitful outcome.
"As is the blood testing for corona so should be the soil testing for agriculture."

Conclusion

As soil testing has shown how important it is , we should be active from now to enhance its rate. How can we do it? Here are some possible ways which we can opt to have an optimistic result.

1. As we know how mandatory the ration cards are for purchasing goods through public distribution system, so should be the soil health card to be mandated for purchasing any inputs for agriculture (thereby we can reduce the nutrient loss , can reduce our cost of cultivation and also the environmental concern like eutrophication can be curtailed).

2. Policy makers can frame policy by diverting a divisible pool of money from subsidies and diverting them to purchase testing kits like ICP (Inductively Coupled Plasma) can make the testing result with more quantity and better quality.

Save soil safe nation.

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Modern Strategies for Crop Residue Management

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Introduction

Every year a large quantity of agricultural wastes is generated. India produced about 501.73 million tonnes (Mt) crop residue out of which 93.51 Mt of wheat, 105.24 Mt of rice, 22.26 Mt of maize, 16.03 Mt of millets (jowar, bajra, ragi and small millet), 341.20 Mt of sugarcane, 7.79 Mt of fibre crops (jute, mesta, cotton), 18.34 Mt of pulses and 30.94 Mt of oilseed crops. Out of various crops grown, rice, wheat and sugarcane are prone to crop residue burning. Some of these residues are used as animal feed, industrial fuel, residential cooking fuel and thatching for rural homes. With the introduction of combine harvesters, more than 75% of the rice area is harvested mechanically. Most farmers remove wheat straw for animals feeding. However, management of the rice straw is a major challenge as it is considered to be a poor feed for the animals because of high silica content. Combine harvester leaves behind a swath of loose rice residues, which interfere with operations of the seed drill used for planting wheat. To avoid these problem farmers burns this crop residue 90-140 Mt annually. From the farmers' point of view, burning may be seen as the most suitable method of disposing of rice straw. It is not only a cost-effective method but it acts as an effective weed and pest control procedure and preparing the fields for the next crop rapidly and inexpensively. By burning residue in the field, farmers derive specific benefits such as cost- and time-savings.

Burning of crop stubble causes the air pollution and lead to loss of huge biomass and plant nutrients, the entire amount of C, approximately 80–90% N, 25% of P, 20% of K and 50% of S present in crop residues are lost in the form of various gaseous and particulate matters, resulting in atmospheric pollution and global warming, but also cause adverse effect on soil properties as well as soil flora and fauna. Stubble burning also impacts human and animal health both medically and by traumatic road accidents due to restricted visibility. So, there is a need to adopt ways and options to manage this valuable resource.

Crop residue management means managing the amount and distribution of crop and other plant residues on a soil surface and use as raw material in production of other useful product. According to CARB (1997), the most environmentally acceptable solution to the crop residue management problem is to remove and collect the straw from the fields and use it for other purposes.

Types of Residues

Crop residues are parts of the plants left in the field after crops have been harvested and threshed. These are of two types:

1. Field residues: Are materials left in an agricultural field or orchard after the crop has been harvested. These residues include stalks, stubble (stems), leaves, and seed pods.

2. Process residues: are materials left after the crop is processed into a usable resource. These residues include seeds, bagasse, roots, husks and molasses. They can be used as animal fodder and soil amendment, fertilizers and in manufacturing.

Objectives of Crop Residues Management (CRM)

1. To increase the quantity of nutrients available to crops from organic sources.
2. For more effective recycling of nutrients, to enhance the efficiency of nutrients.

3. To Use of crop residues in sustainable crop production; nutrient source for next crop.
4. Control of burning of crop residue to prevent environmental degradation and loss of soil nutrients and minerals by promotion of in-situ management of crop residue.
5. Diversified use of crop residue for various purposes like power generation, charcoal gasification, packing material, production of bio-ethanol, paper/board/panel industry, composting and mushroom cultivation, etc.
6. Building and awareness about ill-effects of crop residue burning and its effective utilization and management and formulation and implementation of suitable law and legislative/policy measures to curb the burning of crop residue.

Adverse Effects of Crop Residue Burning

1. Loss of nutrients: It is estimated that the burning of one tonnes of rice straw accounts for the loss of 5.5 kg Nitrogen, 2.3 kg phosphorus, 25 kg potassium and 1.2 kg Sulphur besides, organic carbon. The burning of straw raises the temperature of the top soil that the carbon- nitrogen equilibrium in soil changes rapidly. This leads to a loss of huge NPK from the soil.

2. Impact on soil properties: Heat from burning residues elevates soil temperature causing the death of beneficial soil organisms. Frequent residue burning leads to complete loss of microbial population.

3. Emission of greenhouse and other gases: Crop residues burning is a potential source of Green House Gases (GHGs) and other chemically and radiative important trace gases and aerosols such as CH_4, CO, N_2O, NOX, and other hydrocarbons. Open burning of rice straw in fields leads to release of atmospheric pollutants like SO_2, NO_2 & CO_2 and other GHG. These gases interact with nitrogen dioxide in the presence of sunlight producing photochemical oxidants which are responsible for formation of photochemical smog.

Strategies for Residues Management

1. Residue incorporation: Unlike removal or burning of crop residue put the adverse effect on soil climate and micro-organisms. Straw incorporation is one of the best options for utilization of major part of the left-over rice straw in fields. It increases soil organic matter and N, P and K contents in soil. Crop residues incorporation increases crop yield from 15%-35% compared to control treatment. Ploughing is the most efficient residue incorporation method. The incorporation of Crop Residues in the field is beneficial in recycling nutrients, but leads to temporary immobilization of nutrients (e.g., Nitrogen) and extra nitrogenous fertilizer needs to be added to correct the high C:N ratio at the time of residue incorporation. This will not only help in reducing air pollution but would improve soil health characteristics and fertility. It would also reduce dependence on chemical fertilizers on one hand and prevent soil pollution from agro chemicals on the other.

2. Surface retention and mulching: Mulch is natural or artificially spread layer of plant residues or other material on the surface of the soil for conserve soil by low bulk-density and low energy yield per unit weight basis. The logistics for transporting large volumes of straw required for efficient energy generation represents a major cost factor irrespective of the bio-energy technology.

3. Livestock feed: In India, the crop residues are traditionally utilized as animal feed as such or by supplementing with some additives. However, crop residues, being unpalatable and low in digestibility, cannot form a sole ration for livestock. Crop residues are low-density fibrous materials, low in nitrogen, soluble carbohydrates, minerals and vitamins with varying 10 amounts of lignin which acts as a physical barrier and impedes the process of microbial breakdown. To meet the nutritional requirements of animals, the residues need processing and enriching with urea and molasses, and supplementing with green fodders (leguminous/non-leguminous) and legume (sunhemp, horse gram, cowpea and gram) straws.

4. Energy and bio fuel: Biomass can be efficiently utilized as a source of energy and is of interest worldwide because of its environmental advantages. In recent years, there has been an increase in the usage of crop residues for energy generation and as substitute for fossil fuels. In comparison with other renewable energy sources such as solar and wind, biomass source is storable, inexpensive, energy-efficient and environment-friendly.

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Bio-oil is a high-density liquid obtained from biomass through rapid pyrolysis technology. Conversion of crop residue ligno-cellulosic biomass into alcohol is of immense importance as ethanol can either be blended with gasoline as a fuel extender and octane-enhancing agent or used as a neat fuel in internal combustion engines. However, straw is characterized by low bulk-density and low energy yield per unit weight basis. The logistics for transporting large volumes of straw required for efficient energy generation represents a major cost factor irrespective of the bio-energy technology.

5. Biochar: Biochar is a high carbon material produced through slow pyrolysis of biomass such as wood, manure, or leaves, is heated at relatively low temperatures (<700°C) in a closed container with little or no available air.

It is a fine-grained charcoal and can potentially play a major role in the long-term storage of carbon in soil, i.e., C sequestration and GHG mitigation. However, with the current level of technology, it is not economically viable and cannot be popularized among the farmers. However, once all the valuable products and co-products such as heat energy, gas like H2 and bio-oil are captured and used in the biochar generation process, it would become economically-viable.

Contents	Amount
Ash	29%
Carbon	88%
Hydrogen	3.3%
Nitrogen	1.6%
Oxygen	1.4%
Volatile matter	22.3%
Phosphorus	529 mg/kg

6. As mushroom cultivation: Use of residues in mushroom production represents a valuable conversion of inedible crop residues into valuable food, which despite their high moisture content has two to three times as much protein as common vegetables and an amino acid composition similar to that of milk or meat. Wheat and rice straws are excellent substrates for the cultivation of *Agaricus bisporus* (white button mushroom) and *Volvariella volvacea* (straw mushroom), two of the most commonly grown fungi. Straw for Agaricus cultivation is usually mixed with horse manure and hay and a very high conversion efficiency of the substrate into fungal bodies is possible.

7. Crop Residue as animal bedding and compost: For preparing compost, crop residues are used as animal bedding and then heaped in dung pits. The use of paddy straw bedding during winter helped in improving the quality and quantity of milk as it contributed to animals' comfort, udder health and leg health. Paddy straw bedding helped the animals keep themselves warm and maintain reasonable rates of heat loss from the body. In the animal shed each kilogram of straw absorbs about 2-3 kg of urine, which enriches it with N. The residues of rice crop from one-hectare land, on composting give about 3 tons of manure as rich in nutrients as farmyard manure (FYM). The rice straw compost can be fortified with P using indigenous source of low-grade rock phosphate to make it value added compost with 1.5% N, 2.3% P2O5 and 2.5% K_2O.

Machinery for Crop Residue Management

The machines developed for residue management of different crops in India and other countries are:

1. Flail mower.
2. Straw chopper cum spreader.
3. Tractor operated cross conveyor paddy straw thrower.
4. Crop residue crushing machine.
5. Forage chopper.
6. Tractor operated shredder.
7. Stalk stubble breaking and mulching machine.
8. Tractor mounted sugar cane shredder.
9. Sugarcane trash chopper cum spreader.
10. Modified wheat straw chopper.
11. Rotary mulcher.

12. IISR Plant residue shredder
13. Stubble harvester cum chopper and happy seeder etc.

Key Initiatives by Government

1. Agriculture Ministry issued an advisory to the state governments to create awareness among the farmers about the harmful effect of straw burning.

2. Facilitate farmers residue management machines and equipment such as Zero till Seed Drill, Happy Seeder, Straw Baler, Rotavator, Paddy Straw Chopper/ Mulcher, Gyro Rake, Straw Reaper, Shredder, etc., to through Custom Hiring Centres or village level Farm Machinery Banks.

3. State Governments have also been directed that Rs. 4000/ hectare shall be used from the funds available for demonstration of machines under Sub-Mission on Agricultural Mechanization for demonstration of straw management machinery at farmers' fields.

4. Crop residue management, under Sub-Mission on Agriculture Mechanization, the Department of Agriculture Cooperation and Farmers Welfare have allocated funds to the four states.

Strategy for Residue Management

1. Promotion of technologies for optimum utilization and in-situ management of crop residue to prevent loss of invaluable soil nutrients, minerals and improvement of general soil health.

2. Promotion of diversified uses of crop residue for various purposes viz. power generation, as industrial raw material for the production of bioethanol, packing material for fruits & vegetables and glassware, utilization for paper/board/panel industry, biogas generation/composting and mushroom cultivation in Public-Private Partnership (PPP) mode.

3. Capacity building of various stakeholders including farmers and extension functionaries under crop development programs and organization of field level demonstrations on the management of crop residues in all programs/schemes

4. Promotion of adaptive research for the management of crop residue and development of machineries for effective utilization of such residues; and Formulation and implementation of necessary policy measures for control of crop residue burning through suitable laws/ legislation/ executive orders etc.

5. New legislation that has been introduced to ban the on-site burning of crop residues necessitates the introduction of innovative residue-management strategies.

Conclusion

Crop residues are of great economic values as livestock feed, fuel and industrial raw material, and in conservation agriculture for which it is a pre-requisite. Crop residue is a dynamic material improves physical, chemical and biological properties of the soil and ultimately maintain soil health. Crop residues, either partly or entirely must be used for conservation agriculture for ensuring the country's food security, making agriculture sustainable and the soil resource base healthy. All stakeholders viz., farmers, supply and value chain service providers, researchers, extension agents, policy makers, civil servants and consumers need to be engaged in understanding and harnessing the full potential of these valuable resources for sustainability and resilience of Indian agriculture. We believe that the research, policy and development programs as outlined in this bulletin will serve a great deal in managing crop residues at local and regional scales.

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Citrus Greening (Huanglongbing) Disease and their Effective Management Practices

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Common Name

Citrus greening, citrus huanglongbing (greening) disease.

Disease Status

Greening disease is known to happen in Andhra Pradesh, Karnataka, Punjab, Uttar Pradesh, Himachal Pradesh, Rajasthan, Maharashtra, Jammu, Bihar, Bengal and Sikkim. The disease is more extreme on sweet oranges than on corrosive lime, mandarin and grapefruits. This infection influences practically all citrus assortments independent of root stock. In India Mosambi sweet orange and Darjeeling orange *(Citrus reticulata)* are acceptable pointer plants for greening.

Causal Organism

Citrus greening disease (Yellow dragon disease or HLB) is a sickness of citrus brought about by a vector-transmitted microbe (1). The causative specialists are motile microbes, *Liberibacter* spp. The disease is vectored and transmitted by the Asian citrus psyllid, *Diaphorina citri,* and the African citrus psyllid, *Trioza erytreae,* otherwise called the two-spotted citrus psyllid (2). It has additionally been demonstrated to be joining transmissible. *Candidatus Liberibacter asiaticus* (Fastidious Phloem restricted Bacterium), commit gram negative bacterium.

Hosts

All species and varieties of citrus are affected, such as orange, grapefruit, mandarin, tangelo, kumquat, lemon, lime, pomelo, trifoliate orange and tangelo. Mock orange or orange jasmine *(Murraya paniculata)*, and the curry tree *(Bergera koenigii)* are also hosting.

Symptoms

(Source: researchgate.net)

Affected trees are stunted with pronounced leaf and fruit drop. Varied chlorotic patterns on leaves are noticed which are persistent and cannot be corrected by zinc sprays. Reduction in leaf size is common. Many affected leaves show small circular green islands within the chlorotic areas. Heavy leaf fall occurs with the onset of summer.

Often new flush may come out and leaves formed are short, upright and chlorotic with green veins or with green blotches on the leaves. Twig die-back occurs. Some branches in a tree exhibit severe symptoms whereas others in the same tree are apparently normal. Fruits show reduction in size, lopsided growth and oblique columella. The rind surface exposed to sun appears yellow whereas the remaining portion remains dull green. Diseased fruits are valueless owing to small size, distortion, low in juice and soluble solids, high in acid and insipid taste. Seeds are poorly developed, dark coloured and aborted.

Predisposing Factors

1. Mode of spread: The disease is transmitted through tainted bud wood and citrus psylla, *Diaphorina citri*. The infection likewise transmits from citrus to Periwinkle *(Catharanthus roseus)* through dodder.

2. Management:

a. Certain antibiotics, specifically streptomycin and oxytetracycline, may be effective in the fight against citrus greening disease and have been used in the United States but have been banned in Brazil and the European Union (3).

b. Natural Enemies: The nymphs are killed by parasitic wasps and predators including ladybeetles - larvae and adults - syrphid fly larvae, and pirate bugs. In California, the eulophid wasp, Tamarixia radiata, has been imported from the Punjab of Pakistan and released. Introduction of Tamarixia radiata has to be done with care, as there are hyperparasites that attack it. Research on Tamarixia radiata has also been done in Reunion and Mauritius.

c. Cultural Control: Cultural controls are important. Citrus should be monitored for huanglongbing and psyllids. It should be done to confirm that they are not present, or if they are present whether they are spreading. It is usual for the psyllid to be found first, and then 1-2 years later the disease appears. An IPM program against this disease requires (i) disease-free nursery plants, (ii) monitoring, and (iii) removal of infected trees (i.e., those with symptoms).

d. Check that plants supplied by commercial or government nurseries have been tested for huanglongbing bacteria and important viruses. The use of certified healthy trees is important in the management of the disease. It is also important that as part of the certified healthy tree program the nursery stocks are grown under psyllid-proof screenhouses.

e. Do not allow ornamental plants that are hosts of huanglongbing and psyllid, for instance, orange jasmine *(Murraya paniculata)* and curry leaf *(Bergera koenigii)*, to be moved from areas where the disease and/or insects occur.

f. It is important to monitor citrus for disease symptoms and for the presence of the psyllid. Monitoring should be done by farmers (preferably monthly if in a disease area, otherwise every 3 months), and also by quarantine authorities using yellow sticky traps placed in the tree canopy. Citrus growers should be trained how to do this. Early detection of the disease and the psyllid is very important. If diseased trees are found they should be removed, and burnt, but before removal they should be sprayed with the chemicals listed below to prevent spread of the psyllids.

3. Chemical Control: Mostly two insecticides are applied in areas where the psyllid is found:

a. Spray trees with a pyrethroid (e.g., lambda-cyhalothrin) insecticide to kill the adults and nymphs. Malathion can also be used.

b. Spray the ground around trees with a systemic product (e.g., imidacloprid) so that it is taken up by the roots to kill nymphs in the folds of leaves in the canopy. Note, do not use imidacloprid when trees are flowering as it is toxic to bees.

c. As an alternative to synthetic products, use "soft" insecticides, e.g., horticultural spray oil, neem or insecticidal soap

d. These treatments give protection for 9-12 months.

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The Wonder Creature - Insect camouflage

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Insects are one of the most dominant living forms. It constitutes over 90% of the animal life forms on Earth are insects. They may be found in nearly all environments. Insects are the wonderful creature and have evolved a number adaptations that help them survive and thrive under extreme conditions. Because of their physiological, behavioural and morphological adaptations these insects dominate another living organism in the world. Insect camouflage is one the morphological adaptations help this wonder creature as successful survivor.

Camouflage

Many insects can be camouflaged. Insects have the tendency to blend with their surroundings (insects look like stick, leaves and thorns etc) so that they can be escape from their predators or natural enemies. Some of the insect camouflage are:

1. Dead Leaf Mantis: The dorsal part of dead leaf mantis *Deroplatys desiccata* looks like dried dead leaves. This camouflage helps them to hide from predators, but it also gives added advantage to act as predator on other insects.

2. Dead leaf butterfly: This butterfly in otherwise called orange oakleaf or Indian oakleaf butterfly *Kallima inachus* belongs to nymphalid family. It is mostly found in tropical parts of Asia from India to Japan. The underside of the wings is look like a dead leaf, with pale brown and uneven edges. The upper side of the wings have bright colours similar that of typical butterflies. During mating the butterfly flash their wings and shows bright colours but if the butterfly wants to hide from predators, they simply close their wings.

	
Upper side of wing	**Lower side of wing**

3. Leaf katydid: Katydids are also called as "bush crickets". Many katydids resemble a green leaf, even like leaf veins. Katydids will remain motionless when on alert, but will quickly fly away when in danger, or disturbed. They belong to the family Tettigoniidae. They are primarily nocturnal in habit with loud mating calls.

4. Stick insect or walking stick & Walking leaf or leaf insect: These insects belonging to the order Phasmida. The stick insects are known as stick-bugs, walking sticks, or bug sticks coming under the family of Phasmidae. The body of the insect is long, slender, cylindrical and cryptically colored to resemble the twigs and branches on which they live. When resting, the insects are still on a mound of twigs or at the end of a tree branch, and it is almost impossible to spot. Walking sticks are clever enough at confusing predators into thinking they're sticks rather than prey.

Some of the phasmids are flat having leaf like shapes commonly called as walking leaf or leaf insect belonging to the family Phylliidae. The leaf insects camouflaged to mimic leaves rather than sticks. Hence, the predators of leaf insect often not able to distinguish them from real leaves. To further confuse the predators, when the leaf insect walks, it moves back and forward, to mimic a real leaf being blown by the wind.

5. Orchid mantis: The walking legs of this insect resembles like flower petals. These flowery predators look like lurid or colourful insects, but they're actually merciless killers. They use their camouflage, which mimics a flower petal, to hide from their prey. When flies and other pollinators approach the flowers for nectar collection, the orchid mantis strikes and kills them. The *Hymenopus coronatus*, also called *H. bicornis*, is a common orchid mantis found in tropical forest of Southeast Asia.

6. Sand grasshopper / Mottled sand grasshopper: The mottled sand grasshopper *Spharagemon collare* found at Northern United States and Southern Canada. They used to habituate in the sandy soiled grassy areas. They are minor pest of wheat. The mottled sand grasshopper relies greatly on its camouflaging colours for protection against predators.

7. Peppered Moth: The peppered moth *Biston betularia* is prevalent in Britain and Ireland. These moths have white with black speckles across the wings, giving it its name. This pattern makes the moth well camouflaged against lichen-covered tree trunks when it rests on them during day time.

8. Thorn Bug: The thorn bug *Umbonia crassicornis* is a sporadic pest of ornamentals and fruit trees in Western countries. The species of thorn bugs vary in size and colour, but they all have a developed enlarged thorn-shaped horn (spike) on their back or pronotum, which resemble like thorns on a branch. These bugs use the spike as camouflage mechanism, which discourages birds and other predators from eating it, if only by mistakenly confusing it with a thorn of the plant.

Conclusion

Insects are often neglected and overlooked organism. Being a necessary part of ecosystems and they provide incalculable benefits to humankind. By learning more about their incredible adaptations, uniqueness and behaviours, we can help protect them and ensure they continue to do their vital jobs.

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Nanotechnological Approaches for Synthesis of Sulphur Nanoparticles

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Introduction

Nanotechnology is the science that deals with matter at the scale of 1 billionth of a meter (i.e., 10^{-9} m = 1 nm) and is also the study of manipulating matter at the atomic and molecular scale. Nanotechnology as a new powerful technology has the ability to create massive changes in food and agricultural systems. Use of nanotechnology has assisted in revolutionizing the agriculture sector with new tools for disease detection, targeted treatment, enhancing the ability of plants to absorb nutrients, fight diseases and withstand environmental pressures and effective systems for processing, storage and packaging.

Sulphur (S) is regarded as the fourth most important and essential macronutrient after Nitrogen (N), Phosphorus (P) and Potassium (K) for plants (Choudhury et al., 2010; Teng et al., 2019). It is an essential element in determining the productivity and quality of agricultural products. It is required for synthesis of amino acids such as methionine, cystine and cysteine. It is also associated with tolerance to biotic and abiotic stress in plants. It has broad use in the form of sulphate fertilizers and, to a lesser extent, as sulphite biostimulants. 'S' is an important nutrient for oilseeds (groundnut, mustard, soyabean, safflower etc.) due to its association with increase in oil content and also a range of quality factors. Moreover, 'S' is one of the conventional pesticides used in agriculture with good efficiency against a wide range of powdery mildew diseases as well as black spot diseases (Turganbay et al. 2013). It is used as a fungicide to combat the apple scab disease under colder conditions, in conventional culture of grapes, strawberry, many vegetables, and several other crops.

Fig. 1. Various applications of sulphur in agriculture

Sulphur has multipronged applications in many fields, such as the production of sulphuric acid, agriculture, plastics, antimicrobial agents, rubber, pharmaceutical industry, bioleaching processes, pulp and paper industries, and different other agrochemical industries (Ober 2003; Chaudhuri and Paria 2010).

Synthesis Approaches Adopted for Nano Sulphur

Synthesis of nanomaterials by a simple, low cost and in high yield has been a great challenge since the very early development of nanoscience. There are various preparation techniques for synthesis of nanoparticles, among them two approaches (top-down and bottom up) are mainly used. The first is the breakdown (top-down) method in which an external force is applied to a solid that leads to break-up into smaller particles and another one is the build-up (bottom-up) method that produces nanoparticles starting from atoms of gas or liquids based on atomic transformations or molecular condensations. Various bottom and top down approaches have been developed so far, for the commercial production of nanomaterials. There are basically two approaches i.e. top down and bottom up followed for the synthesis of nanoparticles. Researchers have reported several approaches for synthesis of nano sulphur and the same are discussed in the following section.

Top Down Approach

1. Mechanical: In mechanical method dry and wet grinding methods are there. In the dry grinding method, the solid substance is ground as a result of compression, or by friction, using such popular methods as a jet mill, a hammer mill, a shearing mill, a roller mill, a shock shearing mill, a ball mill, and a tumbling mill.

2. Mechanochemical: The mechanochemical techniques like ball-milling or hand grinding are considered to be promising practices in solvent-free synthesis. Mechanochemical methods deal with chemical transformations induced by mechanical energy, such as compression, shear, or friction (Bhutia et al. 2017).

Bottom-Up Approach

1. Chemical reduction method: This method carries out the chemical reduction of metal ions using suitable reducing agent. The process uses non-complicated equipment or instruments, and can yield large quantities of nanoparticles at lower cost in a short time. The process involves the usage of a precursor, an acid and surfactant. The preparation of sulphur nanoparticles by an acid catalysed precipitation of sodium thiosulphate in presence of different surfactants (TX-100, CTAB, SDBS, and SDS) is reported in the literature.

2. Micro emulsion method: Microemulsion is a technique for the synthesis of nanoparticles in which two immiscible fluids such as water in oil or oil in water or water in supercritical carbon dioxide become a thermodynamically stable dispersion with the aid of a surfactant.

3. Sonochemical method: In the Sonochemical process, powerful ultrasound radiations (20 kHz to 10 MHz) were applied to molecules to enhance the chemical reaction. Acoustic cavitation is a physical phenomenon which is responsible for sonochemical reaction.

4. Green Synthesis: In green synthesis of nanoparticles different extracts viz. Albizia julibrissin fruit extract, Azadirachta Indica (neem leave) extract were used as reducing agent for metal salts into metal nanoparticles. Salem et al. (2016) synthesized sulphur nanoparticles by a simple green procedure using Melia azedarach leaves aqueous extract and citric acid. The below figure 2 shows the flowchart of different synthesis approach of nanosulphur.

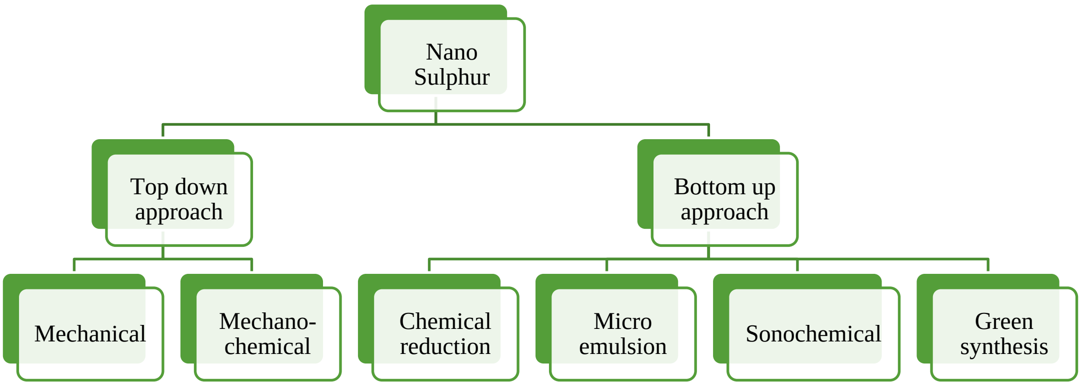

Fig. 2: Classification of approaches for synthesis of nano sulphur

Conclusion

Among the above-mentioned techniques, chemical synthesis method was widely used for sulphur nanoparticle. With respect to sulphur nanoparticles, “green” synthesis has also gained extensive attention as a reliable, sustainable, and eco-friendly protocol for synthesizing a wide range of materials/nanomaterials including metal/metal oxides nanomaterials and bioinspired materials. Mechanical methods reduce the destructive effects associated with the traditional methods of synthesis for nanoparticles commonly utilized in laboratory and industry. However, any information about the process standardization using mechanical approach is lacking in the literature.

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Automatic Irrigation Scheduling Techniques

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Introduction

The availability of freshwater in irrigated agriculture has become a major problem in the world. United Nations projected that nearly 3.4 billion people would be residing in "water scarce" countries by the year 2025, and India would be at the centre of it. In India, about 80 per cent of total water use is in the agriculture sector. Agriculture consumes approximately 90 per cent of 7, 61,000 billion litres of annual freshwater withdrawals in the country (Anon 2017). Irrigation to be given to crops as per crop water requirement of each crop. Otherwise, negative results encounter. Due to pressurized irrigation, there is a saving of irrigation water, and also this method ensures maximum water use efficiency. Many farmers are adopting this pressurized irrigation, especially in widely spaced field crops like cotton, sugarcane, tomato, groundnut, maize, coffee, tea and horticultural crops. The habit of farmers is irrigating field crops through manual control on regular interval irrespective of soil moisture information (Giri et al., 2013). These lead to wastage of fresh water. The current trend has been switching from a manual system to automatic operations in the irrigation system (Josi and Gokhale, 2006). In an automated irrigation system, all the operation is done by automatically without the need for human interference. Automated irrigation system comments are sensing unite, decision making unit and irrigation pipeline system. Automatic irrigation can be done by various methods like sensors network and GPRS module, computer vision, solar panel and circuit, using the embedded system, volume-based and time-based method. Smart irrigation practice utilizes sensors, tunnels, GPRS system and wireless network. The system will send a message to the farmer about the information and change in the operation of the farm field (Jondhale et al., 2017).

Different Type of Automation

1. Time based system: These systems operate based on timing. The main element in the implementation of time-based irrigation system is time clock controllers or timers. In this method, the amount of water will be regulated based on predefined timing, and it can be changed as per the requirement. The timers must be programmed to avoid an under-or over-irrigation according to the volume of water. A timer may also be used to start or stop the irrigation process.

2. Volume-Based System: In this irrigation system volume of water to be discharged to the field is fixed using automatic volume-controlled metering valves, and it is shown in Fig. 1.

Fig. 1 Volume-based irrigation system

3. Open Loop Systems: This system integrates both the time and volume-based activities as an integral part (Fig. 2a). In this system, irrigation duration and the volume of water will be the main parameter to control irrigation. The farmer will decide about the timing and amount of water to be discharged during the operation. A flow meter is engaged in measuring the amount of water discharged in a given period.

Fig. 2 (a) Open loop control system (b) Closed loop system

4. Closed Loop Systems: Unlike an open loop, a closed-loop system (Fig. 2b) works with the feedback. In this system, the starting and stopping of the irrigation process will be controlled based on the feedback taken from the field. The control system designed in this will decide about the timing and amount of water to be applied. This control system takes the control signals from sensors spread across the field. Thus, continuous feedback and control are made in this type of systems. The feedback signal may be obtained from soil moisture, temperature, radiation, wind-speed sensors, etc.

5. Real-Time Feedback System: This system is almost similar to a closed-loop irrigation system, but with additional parameters like humidity, rain, temperature or surface tension is also accounted for operation. Here the starting, stopping, and the plant itself decides operation of the irrigation system.

6. Computer-based irrigation control systems: This system is based on interactive control and has computer hardware and software as an integral part of the system shown in Fig. 3a. So, all the operations are automatic. This system also looks out for fertigation. This system may be said as a fully automated system.

Fig. 3 (a) Computer-based irrigation control systems (b) Wireless Automated irrigation system

7. Wireless Automated irrigation system: Wireless automated irrigation system (Fig. 3b) includes various sensors installed in the field. These sensors record data and send information to the controller through GPRS/GSM/ZigBee/Bluetooth etc. modules. Then microcontrollers process the data and based on predefined threshold values apply irrigation. Further, the information on scheduled irrigation, water applied and the data recorded will be sent to the farmers mobile.

Challenges of an Automated Irrigation System

1. Availability of cost-effective sensors.
2. Devices operate in a challenging environment.
3. Lack of availability of data.
4. Lack of technical experts in the farming community.
5. Network connectivity.
6. Scale factor farming.

Conclusion

Different irrigation systems are listed in this article. Each system has its own merits and demerits. Instead of following surface irrigation methods and pressurized irrigations methods (drip and sprinkler irrigation) shifting to automated irrigation methods save a large quantity of water and eliminate the need for human interference. Automatic irrigation system (AIS) is a viable solution in places where water scarcity problem existed, thereby improving sustainability. The AIS helps the farmer by making his work smarter. The development of sensor-based applications in agriculture increases productivity, efficiency, and profitability through precision irrigation farming. AIS saving of irrigation water to the tune of 20 to 42 % without compromise in yield and quality. More advancement in the field of IoT is expected in the coming years; these systems can be more efficient, much faster and less costly.

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Black Rice: The Nutraceutical Grain

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Introduction

Black rice is the native of the common rice species (*Oryza sativa*) and the scientific name of black rice is (*Zizania aqatica*). It is known as Chak-hao Ambi in Manipur (Chak-hao means 'delicious' and ambi means 'black) and thus refers to delicious black rice. In Odisha it is known as Kalabati (kala means 'black and bati means 'rice' in oriya). In south India it is found Keelapoongudi village in karaikudi district of Tamil Nadu and it is called as 'kavuni rice'. Black rice is a rich source of iron, antioxidants and vitamin E, thus ensures good health and increases the overall life span of human beings.

Black rice has a rich cultural history; called "Forbidden" or "Emperor's" rice, it was reserved for the Emperor in ancient China and used as a tribute food. In the time since, it remained popular in certain regions of China and recently has become prized worldwide for its high levels of antioxidants. Despite its long history, the origins of black rice have not been clear. Black rice cultivars are found in locations scattered throughout Asia. However, most cultivated rice (*Oryza sativa*) produces white grains, and the wild relative *Oryza rufipogon* has red grains.

Black rice is a type of the rice species *Oryza sativa* L. which is glutinous, packed with high level of nutrients and mainly cultivated in Asia. The pericarp (outer part) of kernel of this rice colour is black due to a pigment known as anthocyanin, an antioxidant. It is also known as purple rice, forbidden rice, heaven rice, imperial rice, king's rice and prized rice. Many people assumed that this rice as a panacea of many culinary diseases because of its high nutritive value and curative effect. The rice is supposed to enhance the longevity of life; hence also known as long life rice. This rice includes several varieties with a long history of cultivation in Southeast Asian countries such as China, India and Thailand.

Geographical Distribution

It is found that approximately 200 types of black rice varieties have been reported in the world. Among country, China produces 62 % of global production and has developed more than 54 modern black rice varieties with high yield potential and multiple resistances. Thereafter, Sri Lanka, Indonesia, India, Philippines and other countries found placed. Thailand occupies ninth position in its cultivation. Black rice is indigenous to north-east India and is extensively grown in Odisha, West Bengal and Jharkhand. It is commonly eaten in Manipur because of its medicinal value. Called chak-hao, meaning rice (chak) which is delicious (ahaoba), black rice is eaten during traditional feasts. Chak-hao kheer is a popular pudding in these regions and the water in which it is boiled, is used to wash their hair with belief that it makes hair strong.

Properties of Black Rice


Black Rice

The pericarp (outer covering) of black rice is black in colour due to the presence of the black colour pigment called anthocyanin which is rich in antioxidants and poses a variety of health benefits such as anti-aging, anticancer, anti-diabetes, lowering the risk of obesity etc. Black rice is glutinous and contains a high level of nutrients such as vitamin B, vitamin E, iron, thiamine, magnesium, niacin, phosphorous and it is also rich in dietary fibre. Similar to normal white rice black rice is also free of gluten and cholesterol, low in sugar, salt and fat. Black rice is generally consumed along with the bran due to the presence of anthocyanin and is sold as unmilled rice. On cooking it turns into purple colour with a shiny indigo finish and has a mild nutty flavour and its texture is smooth and firm.

Types and Varieties of Black Rice

1. Black Japonica Rice: This type of rice is a mix of short and medium sized rice grains grown on the same field. It has an earthy flavour with a mild sweet spiciness.

2. Black Glutinous Rice: It is also known as the 'Black Sticky Rice'. This type has a short grain size and has a sticky texture. The grains are unevenly coloured and generally used to make sweet dishes in Asia.

3. Italian Black Rice: This variety has long rice grains and has the characteristics of both Chinese black rice and Italian rice with a rich buttery aroma.

4. Thai Black Jasmine Rice: It is of a medium grain size and originated from Thailand that combines Chinese black rice with jasmine rice. Jasmine rice is native of Thailand and has a subtle floral aroma which is also observed in Thai black jasmine rice due to the combination.

Health Benefits of Black Rice

The main healthy component present in black rice is the coloured pigment called Anthocyanin. Anthocyanins possess antioxidative and antimicrobial activities, improve visual and neurological health and also protects against non-communicable diseases. These all good health benefits are due to the antioxidant activity i.e., free radical scavenging activity which prevents the release of free radicals in the body. Anthocyanins are used to treat a wide variety of minor health issues like blood pressure, cold, urinary tract infections. It can also cure major health problems like heart attack (CVD), cancer, obesity and diabetes. Thus, incorporating black rice in the normal diet can enhance the overall life span and improves the health and well-being of people.

1. Anti-inflammatory properties: Research was conducted on 2 groups of animals in which one group consumed black rice and the other brown rice. It was found that black rice suppressed dermatitis (skin inflammation) whereas brown rice did not. Therefore, it was regarded that black rice "is a therapeutic agent that is capable of curing and preventing chronic diseases associated with inflammation".

2. Obesity: Black rice helps in weight management and reduce weight because of high fibre content on the bran. On consuming black rice, it gives the feeling of fullness and the person does not feel hungry and also decreases the fatty acid synthesis thus resulting in intercellular lipid accumulation in between the tissues. Black rice also aids in detoxification.

3. Cardiovascular disease prevention: It is found out that anthocyanin present in black rice lowers the LDL (bad cholesterol) and increases the HDL (Good cholesterol) levels which decrease the chances for developing atherosclerosis and heart attack. Since it prevents the accumulation of LDL on the heart valves it keeps the heart healthy.

4. Anti-cancer effects: Anthocyanins protect the body from damage of free radicals which can prevent cancer. A research conducted on the anthocyanins extracted from black rice revealed that these anthocyanins have the potential to prevent the formation of tumours.

5. Anti-diabetic effect: The naturally low content of sugar and high fibre content in black rice prevents the occurrence of diabetes. Black rice does not cause fluctuations in blood glucose levels like white rice and thus it also maintains blood pressure.

6. Reduces allergies: Black rice prevents the release of the amino acid histamine which is responsible for the release of allergic symptoms. Black rice soothes skin and reduces inflammation and irritation.

7. Prevention of constipation: As black rice contains twice the amount of fibres than brown rice it eases the bowel movement and even cures chronic constipation. The fibres also bind with toxic compounds in the colon and are easily flushed out along with the faces.

8. Anemia: Since black rice is rich in iron it is involved in the generation of new RBCs which increases the hemoglobin content and prevents anemia.

The Way Forward to Plan for India

The Government of India should take step for the popularization of black rice cultivation. However, few institutions are working for creation of awareness among farmer to adopt black rice cultivation and enhance income. Black rice must be including in area of normal rice cultivation, so that its benefit cannot be ignored and harvest more nutrition from black rice. A special market that attracts the grower can be established primarily for export purposes. The infrastructure, market support and financial incentives should provide by government to the farmer so that cultivation of black rice can be promoted.

Conclusion

Black rice is a variety of rice which has several promising health benefits. The high antioxidant activity of black rice makes it a super food and its application as an ingredient in other food products can create highly nutritious foods. Anthocyanin, the main pigment of black rice has gained attraction among the researchers due to its high antioxidant activity, health benefits and natural colouring properties for use in other food applications. Black rice is rich source of tocopherols (vitamin E), iron, antioxidants and the overall nutritional profile of black rice has made it a functional and novel ingredient in food processing. Consumption of black rice by individuals those who show allergic symptoms to other cereal grains has proved to be beneficial and also helps in reducing the risk of developing cardiovascular diseases, diabetes and obesity. There is a dire need to include black rice as a novel ingredient in food processing to explore its complete benefits.

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Microbial Polysaccharides: A Review on Applications in Food Industry

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Abstract
Microbial polysaccharides are important sources in food industry. Microbial polysaccharides can serve as renewable sources for hydrocolloids used in food, pharmaceutical and other industrial applications. Among the profound variety of polysaccharides some of them are approved by the FDA as food additives and are extensively used in food processing industry. Due to the novel characteristics and physiochemical nature, these polysaccharides attain more attention in the field of food, feed, pharmaceutical, biomedical and cosmetic application. In the food industries these polysaccharides gave desirable rheological property, texture and sensory. This paper gives a review on some microbial polysaccharides and application of microbial polysaccharides that are most commonly used such as Xanthan gum, Gellan gum, Dextran and Pullulan. Most of these find their application as stabilize, thickener, emulsifier, texturizer and as gelling agents. The addition of these microbial polysaccharides as food additives enhances the overall food quality.

Keywords: Microbial polysaccharides, Dextran, FDA, Food industry, Food additives, Gellan, Xanthan, Texturizer.

Introduction
Polysaccharides are the carbon sources which are found in huge amount in the biosphere. Most of these polysaccharides have found their importance in fields such as pharmaceutical industries, food industries, medical industries and various other related industries. Due to their unique structure and physical properties they are widely used as emulsifiers, stabilizers, thickeners, viscosifiers, film-formers and gelling agents.

In recent years, the biopolymers are gaining more importance over synthetic polymers since they are safe and environmentally friendly. The natural biopolymers, especially polysaccharides are obtained from trees (cellulose), tree gum (gum arabic, gum karaya, gum ghatti and gum Traganth), plants (starch, pectin and cellulose), seeds (guar gum, locust bean gum, tara gum, tamarind gum) tubers (konjac mannan), seaweeds (carrageenan, agar and alginate), animal (gelatin, whey protein, chitosan) and microbes (gellan gum, xanthan, curdlan, pullulan, dextran) (Ganesan et al., 2018).

Most polysaccharides are hydrocolloids, as they are water-loving polymers and dispersed spontaneously in water. Hydrocolloids are high molecular weight polysaccharides that have been utilized as stabilizer, emulsifier, thickener, and gelling agent primarily in food products such as bread, sauces, syrup, ice cream, instant food, beverages and ketchup. (Koocheki et al., 2009). In the pharmaceutical industry, hydrocolloids are used in drug delivery systems particularly in capsule formation, hydrogel, nanoparticles, microsphere, and matrix tablets. (Hamdi et al., 2001).

Among commercial hydrocolloids used in food, cosmetics, and the biomedicine industry, gelatin offers multifaceted applications because of its unique properties such as gelling, binding, thickening, stabilizing, and film forming agent. Gelatin, derived from partial collagen hydrolysis, is the most common hydrocolloid that is commercially available in various applications. Hitherto, the most ubiquitous source for commercial gelatins are limited to pig skins or cow skins and bones, conceivably due to the relatively low cost of the final gelatin product (Karim and Bhat, 2008). For particular groups of consumers, the applications of animal-based-gelatin in the food and pharmaceutical products are restricted because the animal source does not meet their religions' requirement. Muslims and Jews are prohibited to consume any pork related products, Hindus are not allowed to consume beef, while vegetarians and vegans do not include any meat in their diet (Maddern, 2008).

Food processors are already seeking substitutes for animal-sourced ingredients. Although these alternatives meet some gelatin characteristics, none is yet available that matches all the desired functional properties of gelatin. Until now macromolecules of plant origin include starch, locust bean gum, guar gum, carrageenans, and alginate, have captured the commercial market for their ease of availability and cost-effective purification process. However, renewability, stable cost, constant, and reproducible physico-chemical properties of the microbial polysaccharides have provided them an edge over the macromolecules of plant origin, although so far only few of them have been commercialized (Sutherland, 2001).

In searching for an alternative to natural ingredients derived from animals and plants, many researchers have discovered the potential of microbial polysaccharides as viscosifying, stabilizing, emulsifying, or gelling agents in food and pharmaceutical products. Several biological activities such as antitumor, antioxidant, antibacterial, antiulcer, sand cholesterol lowering activity have been found in several microbial polysaccharides. Through the discovery of xanthan, gellan, and dextran, microbial polysaccharides have gained increasing attentions due to their novel functionalities, chemical and physical properties, reproducibilities, and cost production stabilities (Rico et al., 2011).

Microbial Polysaccharides

Microbial polysaccharides are long-chain, natural and/or semisynthetic polymers with different molecular weight and structure. They are manufactured via sugar fermentation by some microorganisms like *Xanthomonas campestris*, *Spingomonas paucimobilis* and *Leuconostoc mesentroides* (Mende *et al.,* 2016; Sutherland and Ellwood, 1979).

Microbial polysaccharides can be classified into three different groups according to their morphological localization; intracellular, cell wall, and extracellular polysaccharides. These polysaccharides can also be either homo- or heteropolysaccharides (Mollet, 1996). They can be categorized in three different groups, including exocellular, cell wall, and intercellular ones. However, the cell wall (structural) and intercellular polysaccharides are fundamental parts of the cell wall and difficult to be apart from cell biomass. The exocellular ones named exopolysaccharides, are easily isolated and released into the cell culture medium. Exopolysaccharides can be used as substitute of other synthetic or natural water-soluble polymers or as original polymers in thickening, suspending and gelling applications in food, pharmaceutical and other industries. Polysaccharides produced by microbes can be generally classified by their biological functions into intracellular storage polysaccharides (glycogen), capsular polysaccharides which are closely linked to the cell surface (e.g., K30 O-Antigen) and extracellular bacterial polysaccharides (for example, xanthan, sphingan, alginate, cellulose, etc.) that are important for biofilm formation and pathogenicity. (Ogaji, 2012).

Intracellular microbial polysaccharides are located inside on part of the the cytoplasmic membrane, while cell wall polysaccharides form a structural part of the cell wall. Extracellular polysaccharides or exopolysaccharides (EPS) exist either associated and covalently bound to cell surface in the form of capsule, or loosely bound to cell surface in the form of slime (Sutherland, 1998). EPS have gained greater interest in the food industry ever since xanthan and gellan have been permitted as food additives in the United States and Europe. Most microorganisms are able to secrete EPS naturally into the extracellular environment with a few microorganisms having great ability to exude EPS in high amount (>$40gL^{-1}$) under stress condition (Papinutti, 2010).

The extracellular polysaccharides (EPS) have specific biological functions as the adhesion to surfaces, as protective barrier or as structural elements of the biofilms. EPS such as xanthan gum, scleroglucan, gellan gum, curdlan, bacterial alginate, dextran, pullulan, bacterial cellulose, etc. are already successfully used in the food industry, in medicine, pharmacy, cosmetics or oil industry (Ganesan *et al.,* 2018).

Microbial polysaccharides are secreted by the micro-organisms. They are of two types; a) Capsular polysaccharides b) Exo-polysaccharides.

Capsular polysaccharides are the ones which form a protective capsule and thus prevent the pathogenic micro-organism from immune system defences. Exopolysaccharides are the polysaccharides that are secreted out by the micro-organisms. They have the capacity to form solutions of high viscosity even at low concentrations

(Clíona and Karen, 2005). Based on their position of polysaccharide secreted these microorganisms are termed exopolysaccharides and capsular polysaccharides. These exopolysaccharides act as barrier in preventing the harmful intruders and capsular polysaccharides are however evolved to avoid any antibody responses. As extracting these polysaccharides at low cost in larger quantities makes it more useful in any research industries. Bulk amount of these microbial polysaccharides is used in food industry such as xanthan to dextran (Morris and Harding, 2009). Some of the microbial polysaccharides play an important role in the food industry. Due to their unique structure and physical properties they are widely used as emulsifiers, stabilizers, thickeners, viscosifiers, film-formers and gelling agents (Bajaj *et al.,* 2007).

Mentioned below in Table 1 are some of the microbial polysaccharides that are commonly used in the food industry and the organisms from which they are obtained (Ramalingam *et al.,* 2014).

Table 1: Microbial polysaccharides and their sources:

Microbial Polysaccharide	Organism(s)
Xanthan	*Xanthomonas Campestris*
Gellan	*Sphingomonas paucimobilis*
Pullulan	*Aureobasidium pullulans*
Dextran	*Leuconostoc Mesenteroides and Leuconostoc Dextranicum*
Xylinan /Acetobacter xylinum cellulose	*Acetobacter xylinum*
Alginates	*Azotobacter chroococcum and Azotobacter vinelandii*
Curdlan	*Alcaligenes faecalis*

Applications of Microbial Polysaccharides

Xanthan gum: Xanthan gum is a natural polysaccharide and an important industrial biopolymer. It was discovered in the 1950s at the Northern Regional Research Laboratories (NRRL) of the United States Department of Agriculture (Margaritis and Zajic, 1978).

Xanthan is a microbial polysaccharide secreted by organism *Xanthomonas campestris* Xanthan *is* produced in tones in aerobic fermentation process for commercial uses in food and pharmaceutical industries. The high viscosity at very low concentrations makes it an excellent agent as food additive for syruping, stabilizer and as a thickening agent. Another property that makes xanthan so suitable in food industry is the high shear thinning i.e. good pourability. Xanthan is replaced in many low-calorie drinks which increase the thinning consistency where the total or partial sugars are replaced by artificial sweeteners. Xanthan acts like a stabilizer in most liquid and semi-liquid foods and gives a body form to most dairy products. Xanthan is extensively used in bakery products to help retention of water in baking food and therefore increases the shelf life of the food. It's used in low fat food to increase the viscosity of the aqueous phase and stabilize the food system. Such as mayonnaise, cheese, ready-to-eat meals etc. Xanthan was approved by FDA as food additive few decades ago and since then it's widely used in commercial food industry (Ramalingam *et al.,* 2014).

Gellan: Gellan is a bacterial exopolysaccharide produced by aerobic submerged fermentation of *Sphingomonas paucimobilis* (previously called *Pseudomonas elodea*) (Pollock, 1993; Chandrasekaran and Radha, 1995). Gellan has been approved for food use by the FDA in USA in 1992, and later in Europe (E418) as suspending, stabilizing, thickening, binding and gelling agent, either alone or in combination with other hydrocolloids. It is used in food and pharmaceutical industry for its wide various texture properties. It's majorly manufactured by C.P KELCO in Japan (Sutherland, 1998; Sanderson and Clark, 1983).

Gellan gums are also applicable to fortify beverages as a suspending agent for protein, minerals, vitamins, etc. They are used in formulation of some food products such as confectionary products, jams, jellies, fabricated foods and dairy products such as ice cream, milk shake and yogurt (Bajaj *et al.,* 2007). Gellan exhibits a wide range of gelation characteristics where acylated gellan forms soft, elastic, thermo-reversible gels but becomes hard, brittle, and thermally irreversible in the de-acylated form. The gels appear transparent when the ionic strength and polymer concentration is low. Raising the ionic strength results to higher gel turbidity which is believed to be caused by intermolecular aggregation and addition of sucrose can be used to refurbish the lucidity of the gels. In acidic conditions, the strongest gel can be produced (Arsenio *et al.,* 2008).

Dextran: Dextran is an exopolysaccharide which is primarily made up of (1→6) linked α-D-glucopyranose units, commonly excreted by *Leuconostoc mesenteroides* NRRL B-512 F but newly isolated strains of *Leuconostoc mesenteroides* PCSIR-4 and PCSIR-9 have been reported to produce dextran with different quality (Qader *et al.,* 2005). Important characteristics that allow dextran to become functional hydrocolloids are its flexible structure due to free rotation of glycosidic bonds, its high solubility in water, and its biocompatibility and biodegradability for biotechnology exploitation. Dextran, and its derivatives, are generally used in the pharmaceutical industry and utilized as thickener for jam and ice cream in food products because they prevent crystallization of sugar, improve moisture retention, and maintain flavour and appearance of various food items (Naessens *et al.,* 2005).

Alginate: Alginate is commonly produced by extraction from brown seaweeds which undergoes alkali treatment with aqueous solution, generally NaOH. Several microorganisms namely *Pseudomonas aeruginosa* and *Azotobacter vinelandii* can also synthesize alginate (Rehm and Valla, 1997). Alginate are extensively used as thickeners, stabilizers, gelling agents, and emulsifiers in food, textile, paper making, and pharmaceutical industries owing to its biocompatibility, low toxicity, relatively low cost, and mild gelation condition. Salts of alginate (Na, K, and Ca) and algenic acid are used in food as per GRAS (Generally Regarded as Safe). In addition, they possess anti-inflammatory and detoxifying properties (Gombotz and Wee, 1998).

Curdlan: Curdlan is a high molecular weight polysaccharide obtained from *Alcaligenes faecalis* but nowadays commercially produced by non-pathogenic strain of Agrobacterium i.e. *Agrobacterium* biobar. The use of this polysaccharide is limited to the boundaries of Japan where they consider microbial polysaccharides as natural products and can be employed in food industry. It is the improved version of the gums providing viscosity, rehydration, gelling and texture-modification properties (Ramalingam *et al.,* 2014).

Conclusion

These microbial polysaccharides enhance the quality, texture, mouth feel and flavor of the food as thickeners, stabilizers, and texturizer and also as a gelling agent. This ensures food processed packages available today in the market has uplifted the expectations of food quality from ready to eat meals to instant mix as boon to the mankind in today's era. In the food industry, microbial polysaccharides can function as thickeners, stabilizers, emulsifiers, and gelling agents to enhance viscosity and texture of food product formulation. In the pharmaceutical industry, predominantly in drug invention, polysaccharides are extensively being used to develop an efficient drug delivery system.

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Integrated Pest Management of Cauliflower and Cabbage

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Introduction

Cauliflower and Cabbage are important vegetable cole crops growing on area of 0.45 million ha and 0.41 million ha with annual production of 8.4 and 8.9 million tons, respectively. Worldwide, India ranks second in cabbage and cauliflower production. These vegetables are mainly grown in Utter Pradesh, Haryana, West Bengal, Odisha, Maharashtra and Bihar. They are rich source of Calcium, Phosphorus, Magnesium and Vitamin A&C. Market demand is consistent which fetch good price to farmers and promote them to grow it in more area. Now adays these crops are grown not only in main season but also during offseason. One of the major constraints identified in the potential production system is the increasing incidence of insect pests, and nematodes, often resulting in substantial yield losses and affecting the quality of the produce. Economic losses due to various pests vary from 30-40 per cent in vegetable crops. Cultivation of cabbage and cauliflower during different seasons results in continuous and abundant food supply for the build-up, perpetuation and multiplication of insect pests, diseases and nematodes. In order to reduce the losses due to these pests, farmers are highly dependent on excessive use of chemical pesticides and it is not unusual for the vegetable growers to even give 25-40 percent of chemical sprays in some crops in a season without concomitant increase in productivity. Losses due to insect pests in Indian agriculture have been estimated from time to time (Pradhan, 1964; Krishnamurthy and Murty, 1983; Atwal, 1986, Jayaraj, 1993; Lal, 1996; Dhaliwal and Arora, 1996, 2002; Dhaliwal et al., 2003, 2004). In general, the losses in post-green revolution era (Dhaliwal et al., 2004) have shown an increasing trend than in the pre-green revolution era (Pradhan, 1964). Overall, the losses increased from 7.2 per cent in early 1960s to 23.3 per cent in early 2000s. There is urgent need to minimize pest and diseases problems and to create awareness among the farmers through integrated pest management strategies for Cauliflower and cabbage.

Insect Pests

1. Diamond back moth *(Plutella xylostella):* The caterpillars are pale yellowish green while adult is a small greyish moth. A patch of three diamond shaped yellowish white spot is visible by joining both the forewings, hence the name ‘diamond back’. Young larvae feed by scrapping leaf tissues causing typical whitish patches on underside of leaves. Grown up larvae bite holes in the leaves.

Diamond back moth

Management strategies:

a. Remove and destroy all debris and stubbles after harvest of crop.

b. Grow mustard as trap crop at 2:1 ratio (cabbage: mustard) to attract DBM for oviposition at least 10 days ahead of planting of main crop (cabbage: mustard) to attract DBM for oviposition at least 10 days ahead of planting of main crop.
c. Use Neem seed kernel extract@ 5% (500gm/10 lit.) or Bacillus thuringiensis powder @10 gm/10 lit water.
d. Need-based spray of cypermethrin 10 EC @ 1.5 ml/ litre or spinosad 2.5 SC @ 1.2-1.4 ml/ litre or emmamectin benzoate 5 SG @ 0.3-0.4 gm/ litre or chlorantraniliprole 18.5 SC @ 0.1 ml/ litre or novaluron 10 EC @ 0.75-1.5 ml or indoxacarb 15.8 SC @ 0.3-0.5 ml / litre for DBM control.
e. Pheromone traps @ 12/ha.
f. Crop rotation with cucurbits, beans, peas, tomato and melon Conserve the activity of Cotesia parasite (60 % parasitism).

2. Tobacco caterpillar *(Spodoptera litura)*: Causes maximum damage from July to November in rainy season crop. Adult moth is stout, brown coloured with wavy white markings on the forewings. Eggs are laid on leaves in masses and are covered with brown hairs. Neonate larvae scrap the green matter in the leaf. Late instars feed voraciously on tender leaves and fresh growth. The larvae are blackish grey to dark green with dark longitudinal bands on the side of the body.

Management strategies:
a. Set up sex pheromone traps @ 5 / ha for mass trapping and to monitor the activity of tobacco caterpillar adult moths.
b. Spray SlNPV @ 250 LE / ha (2x109 POB) 2-3 times in evening with jaggery 2% when larvae are young. Need-based spray of cyantraniliprole 10.26 OD @ 1.2 gm/ litre for tobacco caterpillar.

Tobacco caterpillar

3. Cabbage head borer: *Helicoverpa armigera* (Noctuidae : Lepidoptera) The adult is stout built noctuid moth with a wing span of 30-40 mm. The colour of moth varies from olive grey to red brown. The forewing has a dark speck and dark area near the outer margin. The hind wing has a distinct smoky dark outer border. The young larvae begin to feed on tender portions of the leaves and heads of cauliflower and cabbage. They affect on marketable yield of this crop.

Management strategies:
a. Transplanting – October 4th week – Nov. 1st week.
b. Pheromone trap @ 10/ ha HaNPV @ 250 LE@ 400 – 500 lit/water Bacllus thuringiensis power 10 g /10 lit.
c. Neem seed extract @ 5 % (50 g/1.0 lit).

Cabbage aphid *(Brevicoryne brassicae)*: Aphids are serious during February – March months. Aphids disappear during rain fall. As a result of sucking of vital sap from the tissues, plants remain stunted resulting in poor head formation. Aphids also produce honey dew which makes the plant sticky and favour the growth of sooty mould with black coating thus hindering the photosynthesis and plant growth.

Cabbage aphid

Management strategies:

a. Install yellow sticky trap @ 12 /ha.

b. Timely transplanting of cabbage/cauliflower October- IV wek – Nov. -1 st week- planting

c. Bioagents – Lady bird beetle/ Chrysoperla, Syrphid fly, Diaeretiella rapae- active in field- avoid spraying of toxic insecticides but use botanical or biopesticides.

d. Use Neem seed kernel extract 5% (50gm/ 1.0 lit) or neem oil @ 20 ml (1 EC) to 40 ml (0.15 EC)

e. Use *Verticilium lecanii* @ 4 g/1.0 lit.

Conclusion

Economic losses due to various pests vary from 30-40 per cent in vegetable crops. Cultivation of cabbage and cauliflower during different seasons results in continuous and abundant food supply for the build-up, perpetuation and multiplication of insect pests, diseases and nematode. In general, the losses in post-green revolution era have shown an increasing trend than in the pre-green revolution era. Overall, the losses increased from 7.2 per cent in early 1960s to 23.3 per cent in early 2000s. There is urgent need to minimize pest and diseases problems and to create awareness among the farmers through integrated pest management strategies for Cauliflower and cabbage.

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Nutrients and their Key Role in Animal Nutrition

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India has the largest livestock population in the world and livestock production is backbone of Indian agriculture and also source of employment in rural areas for centuries. This sector has been the primary source of energy for agriculture operation and major source of animal protein for the masses. Therefore, India has been house to major draught, milch and dual-purpose breeds of cattle. Sustainable livestock production is highly dependent on the availability of quality feed and forage resources. The major nutrients and their benefits in the growth of the cattle are discussed hereunder.

Essential Nutrients

The dairy cow is an impressive animal, but to keep her in good health, a perfect balance of nutrients must provide be provided for consumption. The term nutrient is applied to any feed constituent or group of constituents of the same general composition, that are of aid in support of life. Proteins, carbohydrate fats, water, mineral matter and vitamins are the general nutrients. Each type of nutrients has some special function to perform.

1. Water: Water is the most important nutrient for dairy cattle, so cattle must have free access to a high-quality water supply at all times. Approximately 71 to 73% of a cattle's non-fat body weight is water. In the cattle's body, water helps to break down the consumed foods, transports nutrients through the system, helps chemical reactions occur, and also helps in maintaining a normal body temperature.

2. Energy: After water, energy is the primary nutritional need. Energy is defined as the capacity to do work. Cattle need energy to do things like produce milk, grow, maintain their large body frame and support pregnancy. Energy is available from three dietary sources: proteins, carbohydrates and fats. Fats provide the most energy per pound of feed, with protein and carbohydrates next.

a. Carbohydrates: Carbohydrates are the primary component found in livestock feeds and are a source of energy. Plant tissues are high in carbohydrates such as starch, cellulose and hemicellulose. When cattle consume carbohydrates, the ruminal microorganisms release enzymes that break them down into monosaccharides or "simple sugars". The monosaccharides are then converted by the microorganisms into volatile fatty acids. Volatile fatty acids are absorbed across the wall of the rumen and small intestine and then can be used by the cattle as energy.

b. Protein: Proteins are found in the highest concentration of any nutrient, except water, in all animals and most living things. Proteins constitute the structural components of cattle like muscle, hooves, bone and blood. Several hormones are proteins, including insulin and bovine somatotropin. Additionally, the enzymes important in digestion, absorption and metabolism are all proteins.

c. Fats: Fats, or lipids, are high in energy, and are found in many common feedstuffs. Oilseeds, such as whole cotton seed or whole soybeans, or animal fats, are common sources of fat in a cattle's diet. Fat is a very important part of young calves' diets because of the amount of energy they need to grow. It is also essential for absorption of fat-soluble vitamins.

3. Vitamins: Vitamins are essential for sustaining a healthy life for cows and humans alike. Each vitamin has a number of functions. They are needed for normal growth, and enable many critical processes that take place in the body. Some play a role in absorption and metabolism of carbohydrates, proteins, fats, and minerals. Others are important for brain function, resistance to infection, fertility, and the digestive system.

The major storage site for vitamins is the liver. Most vitamins are bound to specific proteins. The presence of vitamins in milk is important because it is often a sole source for newborn animals. Colostrum, a cow's first milk after calving, is especially high in vitamin content to ensure the calf gets adequate nutrition early in her life.

4. Minerals: Minerals are divided into two classes: macro minerals and microminerals. Microminerals are present in cattle in larger proportion. Like vitamins, minerals play a variety of important roles, and need to be fed in just the right amounts to prevent either deficiency or toxicity.

Feedstuffs

"Feedstuffs" is a common term for things that are fed to cows. They can be categorized into three.
1. Forages.
2. Energy concentrates.
3. Protein supplements.

Forages

Forages include the stem and leafy parts of a plant and are generally higher in fibre. They are bulkier, and provide less digestible energy than concentrates. Different Forage crops and their nutritive values is given in Table 1. Common forages include baled hay and corn silage.

1. Hay: Crops (Alfa – Alfa) should be harvested when they are at their optimum nutritional value. The maturity of a forage crop harvested for hay has a dramatic impact on its nutritional value. Making high quality hay also requires an optimum moisture content of 15 to 18%, to minimize leaf loss and prevent the hay from spoiling when you store it. The leaves contain more protein and carbohydrates compared to the stems.

2. Silage: Making silage out of grasses, alfalfa, corn or sorghum is a great way to preserve crops when drying isn't feasible, but it also makes good cattle feed. Like hay, it is important to harvest the crop at proper moisture and maturity. The biggest difference is harvesting the crop at a higher moisture content, and storing it in an oxygen-free environment. Limiting oxygen helps the feed ferment and preserve properly. Packing the silage tightly into whatever storage method used is critical to limiting oxygen exposure, preventing mould from growing and the silage quality from deteriorating. For most crops, a dry matter content of 25 to 35% is optimal for silage making.

Energy Concentrates

The energy concentrates in a ration are commonly referred to as "grain." Cereal grains come from plants that are grown primarily for their seeds, which we harvest as grain. This includes crops like corn, wheat, oats, barley, rye and sorghum.

Fats and oils can be added to a cow's diet to boost her energy intake. They are highly digestible and can help reduce dustiness and increase palatability. A small amount of fat may be added to lactating dairy cow diets, but it is very important in young calves' diets.

Protein Supplements

Protein supplements are generally defined as having 20% or more crude protein (CP). Some proteins come from plants. Soybean meal is the predominant plant protein feed. It is categorized as an oilseed meal, which refers to the process where oils are extracted from the seeds.

Table 1. Different forages and their nutrient values:

S. No	Name of the Forage crop	Nutrients		
		Crude protein (%)	Crude fat (%)	Fibre (%)
I. Grasses				
1.	Bajra Napier	10 - 16.5	2 - 3	18 - 24
2.	Guinea grass	6 - 9	2 - 3	20 - 26
3.	Cenchrus	6 - 9	2 - 3	28 - 36
II. Cereal forages				
4.	Sorghum	8 - 12	1 - 2	30 - 36
5.	Maize	8 - 10	2 - 3	20 - 26
III. Legumes				

6.	Lucerne	19 - 23	2 - 5	18 - 22
7.	Desmanthus	16 - 19	2 - 4	18 - 22
8.	Cowpea	15 - 22	1 - 2	18 - 22
IV. Tree Fodder				
9.	Subabul	26.0	7 - 10	28 - 36

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Potential Use of Weeds as Bio Resources

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Introduction

A weed is not actually a plant to be trifled with just like crop plants and considered as a plant out of place. But the damages caused by these plants in crop fields are a major concern. There are so many methods like physical, chemical, cultural and biological control methods have been developed to mitigate the effect of weeds. The genetic diversity, phenotypic plasticity and acclimatization power helps these plants to survive in any environment and make it more competitive than crops. Nowadays, the utilization of weeds as bio resources have been identified and its potentiality and adaptability have been studied worldwide.

Weeds as Bio Resource

Bio resources are any resource of biological origin and as weeds are easily available; these can be used as a potential source of bio resources. Weeds can be used for phytoremediation, composting, fibre extraction, bio fuel and bio energy production, pharmaceuticals etc. As these plants have allelopathic potential, these can be employed in controlling other weeds also.

Phytoremediation is the use of living plants to clean the surroundings contaminated with heavy metals or any other impurities. Several weeds have the capacity to accumulate heavy metals through different parts like roots, stems, leaves etc. The absorbed metals will be converted into stable compounds or phytochelates within the plant part and can be processed further. Eg. Siam weed (*Chromolaena odorata*) can be used to remove cadmium and lead, water hyacinth (*Eichhornia crassipes*) can be used to remove chromium, *Amaranthus viridis* can be used to remove cadmium etc. Because of wide spread, proliferated growth and absorption capacity of weeds, these are potential source for removing heavy metals. Another technique for mass removal of weeds is composting and used as manure for crop plants. Troublesome weeds can be removed by using this technique. Composting is also a pre-treatment method for disposing metal accumulated weed plants. *Parthenium hysterophorus* is an important noxious weed, which has a major impact on crop yield. This weed can be used to make compost and can use as an eco-friendly nutrient source for crops. Some weeds can also use to prepare biochar. It is charcoal prepared from burning agricultural wastes in a controlled process called pyrolysis. Weeds like *Lantana camara*, *Ageratum* sp., *Chromolaena odorata* etc. can be used to prepare biochar.

Weeds can also be used as a source for fibre extraction. The potential of weed fibre for paper making and in cordage industries is yet to be explored. Certain weed species like *Clynogynae dichotoma, Alpinia allughas, Urena lobata* and *Hibiscus* sp. are used for extraction of fibre and mat preparation. Aquatic weeds like *Pistia stratiotes*, *Nymphoides cristatum* and *Lemna perpusilla* also produce fibrous residues as a by-product, which also contain lignin, cellulose and pectin. Water hyacinth fibre can be used to produce a range of attractive, specialty papers. Weeds like *Lantana camara*, *Melastoma malabathricum* and *Eupatorium odoratum* contain high amount of cellulosic biomass and can be used for the manufacturing of medium density particle boards.

Biofuel or bioenergy production from weeds is also gaining importance in the present condition as it is a type of renewable energy source. Weeds can be considered as an important contender in this sector as the invasion and spread of these plant species will be at an increasing rate in future also. Their fast growth rate, unique biochemical composition and adaptability to extreme conditions make it as an effective bioenergy source. Biodiesel of weed species biomass is having better quality and environment friendly. The properties like high cellulose, starch and lipid content of aquatic weeds (water hyacinth, Salvinia, water lettuce, Typha) make them a promising bioenergy feedstock and they can be easily transformed into alternate forms of energy like bioethanol, biodiesel etc. The dry stem and leaves of many weeds can be directly burned as fuel. Notorious weeds *Eichhornia crassipes* (water hyacinth) and *Cabomba caroliniana* were also used as feedstock for bioenergy production through anaerobic digestion. Cellulose extracted from water hyacinth can also be used for the production of silver nanoparticles.

Many weeds contain substances which can be utilized for the treatment of diseases or ailments. They are rich source of natural products/compounds most of which have been extensively used for traditional health care systems. Eg. *Scoparia dulcis* is an important weed which is used to cure hypertension, digestive problems, kidney stone etc. Vinca contain bioactive compound vincamine, which is used as an antidepressant. Phyllanthus plant extracts have been used for treating diabetics, hyper tension etc. Therefore, the potentiality of weeds as medicinal plants has to be understood.

Another important feature of some weeds is allelopathic potential. Understanding the hidden treasure of allelopathic character of some weeds on other weeds will help the farmers to control problematic weeds. Extracts from certain weeds contain compounds which can suppress the weed growth. Example – *Cassia occidentalis* is an important weed and aqueous leaf leachates of this weed in different concentrations showed significant inhibition in all biological parameters on parthenium and reduce its growth. Some weeds like *Imperata cylindrica, Cyperus rotundus, Chromolaena odorata, Ageratum conyzoides*, and *Axonopus compressus* contain terpenoids and phenolic compounds which can act as allelochemicals. The plant extracts of these weed plants can control *Amaranthus spinosus* at different concentrations. Therefore, after proper screening of these weed species; these can be utilized for controlling other weeds.

Conclusion

Weeds are a major problem for crop cultivation and reducing the yield. Weed management is necessary for minimizing weed population. Therefore, alternate benefits of weeds can be formulated and techniques for mass removal of weed species from field can be developed. Use of weeds as bio resources is an effective strategy that can be adopted to control problems caused by the weeds.

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Post-Harvest Management of Tree Spices

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Clove

Clove clusters are picked by hand when the buds have reached their full size and most of them develop a pronounced pink flush. From these clusters, cloves are separated from the stems consisting of peduncles and pedicel. Then it is dried. Dry cloves weigh one-third the weight of green, freshly harvested cloves. Quality of the dried spice is influenced by a number of factors of care taken in harvesting, drying and storing. Traditional method of drying is exposing it to sun on mats. Green buds are spread out in a thin layer on the drying floor and are raked from time-to-time to ensure uniform colour. It may take about 4 - 5 days to produce a spice of desirable colour. When properly dried, they have a bright brown colour and snap cleanly and do not bend when pressed across the thumb nail.

Value-Added Products

Clove bud oil is superior in odour and flavour to stem and leaf oil. Bud yields about 17% oil. It contains about 85% eugenol. Methyl-n-amyl ketone is present only in bud oil. Its stem has 5 - 7% oil containing 70 - 90% eugenol. The leaves also have 1.5-1.8% oil. Oleoresin is prepared by cold or hot extraction of the crushed spice using organic solvents. Volatile oil content of oleoresin is usually 70 - 80%.

Cinnamon

Cinnamon bark and leaves are commercially very important. Bark is used to extract oil and oleore sin and leaf for oil. Bark oil has high cinnamaldehyde content whereas leaf oil high eugenol. Cinnamon bark is extracted generally after the rains at the time when the red flush of young leaves turns green and their sap flows freely. The process consists of stripping the bark and preparing quills from the inner bark.

The outer bark is first removed using a crude curved knife. The stripped stem is rubbed briskly with a heavy brass rod to loosen the inner bark. Two cuts are made round the stem about 30cm apart and 2 longitudinal slits are made on the opposite side of the stem. The inner bark is then carefully eased off the wood with the pointed side of the knife. The curled pieces of inner bark are next assembled into quills or pipes.

Value-Added Products

Oleoresin is extracted from powdered cinnamon bark using acetone, ethylene dichioride etc. Cinnamon has about 7 - 10% oleoresin. Bark oil is obtained from its bark. The bark has 0.5 - 2.5% oil in it. It contains about 65% cmnnamaldehyde and 5 - 10% eugenol. Its leaves also contain 0.5 - 15% oil. Its main constituent is eugenol (70 - 80%). It is used in dental preparations and synthetic vanillin.

Cinnamomum cassin is another important spice with great commercial potential. Its bark and leaf have cinnamaldehyde as the main ingredient.

Nutmeg and Mace

Nutmeg is generally harvested when its fruits split. The seeds with surrounding scarlet aril are removed from the pericarp. Later the mace is taken off and dried separately from the nutmeg in its shell. The proportion of dried shelled nutmeg to dried mace is approximately 20:3. After harvesting, nutmegs are dried in their shells either under sun or by mechanical drying.

Value-Added Products

It contains 25 - 40% fat which can be recovered using solvents or by mechanical pressing. It is highly aromatic. Major constituent is trymyristicin. Oleoresin is extracted with solvents. It may have butter also. About 7 - 16% nutmeg oil is found in it. Aromatic ethers, myristicin and elemicin are present in oil and oleoresin. Both these have hallucinating property. Hence, the oil may be used for consumption only in small quantities. About 4 - 17% mace oil is obtained.

Allspice

Dried berries are a major item of commerce. It has about 3 - 4% of aromatic steam volatile oil and fixed (fatty) oil. They have resin, protein, pentosans, starch, traces of alkaloids, pigments and minerals. Volatile oil from berry is yellow to brownish possessing a warm spicy and sweet odour. Main components are eugenol (68%), methyl eugenol (8%), betacaryophyllene (4.2%), humulene (2.7%) and cineole (2.3%).

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Markers in Entomology

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Introduction

Insects are precisely most dominant form of life on earth accounting to three- fourth of the recorded animal species. Their diversified size, body structure, exquisite mating habits, sophisticated feeding behaviour and wide range of adaptation strategies are main reasons for established eminence on our planet. Since ages, classical and conventional genetic principles have been used for better harvesting the insect diversity from wilderness. DNA markers are the most successful handouts for the past 20 years which help us to study phylogeny, genetic relatedness, genome mapping and population dynamics in and among the insect groups. This article here forth provides an overview of DNA based markers used in entomological research viz., restriction fragment length polymorphisms (RFLPs), randomly amplified polymorphic DNAs (RAPDs), amplified fragment length polymorphisms (AFLPs), microsatellites/simple sequence repeats (SSRs) and expressed sequence tag (EST) based marker system, single nucleotide polymorphisms (SNPs). In spite of high quantity sampling capacity, limiting factors like speed, cost involved and requirement of technical skills ought to be resolved. Main constraint in molecular entomology is the effect of environmental interactions on genetic variability of insects, making molecular results not very reliable.

Why should We Use DNA Markers?

In an organism, be it an insect, great number of molecular alleles can be seen at a molecular locus unlike fewer morphological features. As most of the phenotypic characters are confined to particular instar or part of insect life, the stable molecular genome which is independent of life processes must be studied. Phenotypic features are epistatic, interacting with environment whereas in the case of molecular traits numerous polymorphic loci can be observed and generated as they are unaffected by epistasis and pleiotropy. Phenotypic markers are limited while the latter has wide search specific options as they are numerous. Most of the molecular methods have better ascertainment and assay methods, except for RFLP and AFLP. Morphological alleles inherit in dominant – recessive manner making it difficult to identify, while DNA markers are co-dominant (except for RAPDs) which can be identified in any segregating population of insects. They can be used to solve species identification issues, destructive locusts, insect diagnostics, pathogens carried by insects, systematics, insecticide resistance, resurgence physiology and metapopulation origins etc.

How to Choose a DNA Marker?

Choice of a DNA marker depends on factors like degree of polymorphism needed, markers available, genome information already available, technical expertise, protocol that can be followed etc. Neutral markers viz., RAPD, RFLP, AFLP or SSRs are used to analyse the simple differentiation between two individuals or two allopatric populations of a species. Non-neutral markers like complex microarrays and isozymes are used to distinguish environmentally influenced characters, population dynamics, xenobiotic resistance and DNA fingerprinting (Fakrudin et al., 2006). Among all the markers, those requiring great expertise in addition to being expensive are RFLP, AFLP and micro-arrays.

1. Restriction Fragment Length Polymorphisms (RFLPs): It is a category of polymorphism caused due to different nucleotide base sequence at positions called ‘recognition sites’ of a specific ‘restriction endonuclease’ (RE) on the DNA. Length polymorphisms are the alternative RFLP phenotypes at specific locus. After this, the REs cuts DNA to recognize corresponding sites on DNA in gel electrophoresis. The resulting restriction DNA fragments are visualized under UV-light using agarose gel stained with ethidium bromide or polyacrylamide gels. In eukaryotes, probes are used to identify the RFLP alleles on the gel blot as the eukaryotic genome size is larger.

Use: RFLPs have been used to build genetic linkage maps in apple maggot fly, Mulberry silkworm, Colorado beetle etc, for sex determination in honey bees, phylogenetic studied in ticks and mites and gene flow among insect species. But this technique is less used due to large quantity sample demand, expertise, radioactive element usage and toxic reagents.

2. Randomly Amplified Polymorphic DNAs (RAPDs): It is a PCR-based marker system in which oligo-nucleotide primers are used to bind with homologous sequences in the genome. When identical primer sites are found within the range by Taq polymerase, PCR amplification of sequences upto3500-4500 base pairs (bp) take place in thermo cycler. Amplicons formed are observed under UV-light after fractionation on ethidum bromide stained agarose gel. Limiting factor of RAPD is the non-repeatability of amplicon profiles due to shorter length of primers and less binding capacity to target genomic DNA. But RAPD band can be used to develop sequence characterized amplified regions (SCARs) (Garner & Slavicek, 1996).

Use: RAPDs are used in insect DNA fingerprinting, insect diversity studies, taxonomy and population genetic studies of aphids, parasitoids, moths etc., maternal contribution in insects and genetic linkage studies. Its major success was in making molecular maps for social insects like honey bees which helped in social behaviour study.

3. Microsatellite markers: They are also known as short tandem repeats (STR) or simple sequence repeats (SSRs). STRs are short sequence units varying in number and composition (generally 2-7 bp tandem repeats) and present in eukaryotes. Variations in length are identified by PR using reverse and forward primers. Polymorphism is detected by separating them on polyacrylamide gel with silver staining procedure or ethidium bromide staining to resolve the amplicons formed. SSR developed from one organism can be used in other organism also, making them extensive to study the gene flow, forensic, genome divergence studied and parent offspring differentiation studies. Being codominant, SSRs are used to determine degree of variation between two insect populations. The recent high throughput approach is viable with SSR due to high reproducibility. Main limiting factor is the need to screen large number of loci in order to get sufficient information and to make sure if primers are present in target species.

Use: In entomology, milestones of SSRs are, paternity studies of hymenoptera (Estoup et al. 1995) and genetic sexing of lepidopteron insects (Ananthakrishnan, 2005). Population genetics of aphids, bees, mosquitoes, silkworms, Drosophila moths and butterflies were studied my several scientists.

4. Amplified Fragment Length Polymorphism (AFLP): It is a combination of RFLP and PCR in which REs are used to cleave DNAs to form adapters using PCR amplification. Only subset of restricted fragments is amplified by adding selective nucleotides to 3’ ends of primers. Extensive generation, high reproducibility, increased degree of polymorphism, minimal errors, repeatability and robustness in laboratory are the advantages of AFLP, replacing RAPD and RFLP. The only constraint is high cost due to silver staining, radio-labelling and fluorescent dyes.

Use: In entomology, AFLPs are used to genetically study closely related taxa and genetic linkage maps construction in mosquitoes, honey bees, Colorado potato beetle, Helicoverpa and Heliothis sp, Diamond back moth, Fruit flies, silkworms etc., (Blears et al., 1998).

5. Single Nucleotide Polymorphisms (SNPs): The site on DNA sequence with more than one nucleotide (G, A, T or C) in the population is called SNP. Frequency of SNP occurrence is one for every 200-500 bp. They are known for including time-scale component making them successful tool for studying insect evolution.

Use: SNPs are ideal markers for genetic map making, high-resolution genotyping insect systematics, population dynamics, for differentiating species and subspecies, population genetics parameters, conservation biology of insects and phylogeography (Morin et al., 2004).

6. Expressed Sequence Tag (EST) markers: They primly denote coding part of genes, being made by partially sequencing the randomly selected cDNA clones which are formed from cytosolic RNA. Though variation is rarely detected, ESTs are used in studying interactions between population and environment, functional differences between alleles of a locus, to clone genes of interest and full genome mappings.

Use: In entomology, ESTs are widely used to study insecticide resistance and to incorporate the results into insecticide resistance management (IRM) programs. Till date ESTs have been established in many known species viz., spiders, ticks, aphids, whiteflies, honey bees, silkworms, Heliothis sp, Drosophila, Tribolium sp. (Horn et al. 2003).

Utility of Markers in Entomology

Apart from above mentioned applications of DNA markers in entomology:

1. To study comparative insect genomics.
2. Sophisticated technique called genetic sexing has been employed in sericulture (Ananthakrishnan, 2005).
3. To identify insect species at species, sub-species, biotype and population levels.
4. For quality control of Entomo-pathogenic viruses and other biocontrol agents through DNA fingerprinting.
5. To track insect populations by diversity assessment of predators, parasites and biocontrol agents. Markers have been developed to track the koinobiont larval parasitoid *Apanteles opuntiarum* imported from Argentina to control *Cactoblastis cactorum* (Mrittunjai *et al.,* 2019)
6. Screening markers for specific sex pheromone biosynthesis which was recently achieve in Three Z-Strain and an E-Strain population of the European Corn Borer, *Ostrinia nubilalis*, Occurring in Central Europe (Bozsik *et al.* 2019).
7. For molecular characterization of insect gut microbes and endosymbionts. Recently *Candidatus portiera aleyrodidarum*, an obligate primary endosymbiont living in whitefly including the sweetpotato whitefly, *Bemisia tabaci* (Gennadius) was genetically characterized (Mritunjoy *et al*., 2020).

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Notorious Pest, Diamond Back Moth (DBM) Management

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Diamond back moth (DBM), *Plutella xylostella* (Linnaeus) is a notorious pest of crucifer crops throughout worldwide. This pest is cosmopolitan in nature. Application of synthetic insecticides has become more prevalent as a control strategy than other methods. However, resistance problems in DBM are increasing whenever a chemical pesticide or mixture of pesticides is used intensively for any extended period because there are few classes of available insecticides with limited mode of actions. The absence of effective natural enemies and insecticide resistance are believed to be the major causes of *P. xylostella* outbreaks in many parts of the world (Talekar and Shelton 1993). DBM may cause losses up to 70 per cent in the absence of control.

Life Cycle

Adult female lays 50-60 small yellowish eggs singly along the veins on underside of leaves during night period. Egg hatches in about 7 days. Caterpillars are pale yellowish green in colour. Pupation takes place underside of leaves within a transparent cocoon. Moths are small greyish brown with long antennae. Forewings have three white triangular spots along the inner-margin. It has got a very characteristic diamond shaped marking on its back, whenever it is at rest. Hence it is normally referred as diamond back moth. Total life cycle takes about 24-35 days. Four to six generations occur annually. Adults overwinter in plant debris or in the soil. The pest is active throughout the year.

Nature of Damage

Damage is caused by caterpillar which attacks at all stages of plants. After hatching, first instar larvae will mine into the leaf, the epidermal layer and then feed on the internal tissues. After the completion of the first instar, the larva comes out and then starts scraping the chlorophyll content on the plant or on the leaf, as a result white papery patches on the leaves. Then the later instar larvae will start making in small irregular holes on the leaves. In severe infestation only network of veins is left. The caterpillars hinder the healthy parts of the plants. Young larvae causes' small hole in leaves and full-grown larvae causes larger holes.

Management

Remove and destroy plant debris and stubbles after harvesting of the crop. Collect and destroy moth eggs and larvae by crushing or keeping in a bucket of soapy water. Intercropping with mustard at 2:1 ratio (cabbage: mustard) to attract DBM for oviposition at least 10 days ahead of planting of main crop. Cabbage-tomato intercropping is reported to reduce infestation of DBM in the cabbage. The odour from the tomato intercrop repels the DBM (Silva-Aguayo, 2007) or has an oviposition deterring effect on DBM. Fine tuning with using Chinese cabbage (*Brassica rapa sub* sp. *pekinensis*) as trap crop improved the attraction/trapping of DBM larvae 9 times more than mustard. Crop rotation with cucurbits, beans, peas and tomato. Pest monitoring by installing pheromone traps. Release larval parasitoid, *Cotesia plutellae* at 20000/ha from 20 days after planting. Application of neem seed kernel extracts 5 per cent, cartap hydrochloride 0.5 per cent at 10, 20 and 30 DAS (nursery) and primordial stage and application of the commercial Bt @ 1ml per litre is also very effective against DBM.

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Lemon Squash

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Introduction

Lemon is one of the most popular citrus fruits in the world with multiple uses. Belonging to flowering plant family Rutaceae, it is packed with rich nutrients and health benefits. In 1493, first lemon tree in America is planted by the Italian navigator Christopher Columbus. The major producers of lemon today are USA, Italy, Turkey, Israel, Spain and Greece. In India, the cultivation is carried out in UP, Madhya Pradesh, Karnataka and Punjab. In India though the most popular variety of citrus fruits cultivated and used is acid lime. It is grown largely in Andhra Pradesh, Bihar, Gujarat, Maharashtra, Rajasthan, and Tamil Nadu, and to a limited extent in other states of country. Areas with dry climate and low rainfall are best suited for growing limes. Lemons can be grown in heavy rainfall humid regions. The best season of planting is June to August.

Tree can grow about 12 to 22 feet tall and will start giving fruits at the age of 3- 6 years. Irrigation water containing 1000 ppm of salt is injurious to the growth of the crop. High humidity can favour several diseases. Frost is injurious and hot wind during summer results in desiccation and drop of flowers and young fruits. Average production is about 700 fruits after stabilization. Life span of tree is about 15 to 20 years. Planting of lemon can be a profitable business. James Lind in 1747 found that lemons are very useful to treat scurvy, a deficiency of vitamin C. The researchers claimed that vitamin C plays a significant role in immunity and helps to neutralize free radicals in our body and thus reduces the risk of cardiovascular disease.

Medicinal Value of Lemon

Lemon has very appealing colour, odour and flavour. People of India regularly used lemon to treat a wide variety of medical problems since ancient times. It improves digestion, enhances our immune system, boosts energy, alkalizes and hydrates the body, reduces mucus and phlegm, promotes healthy and rejuvenated skin, boosts brain power and helps in weight loss.

This fruit is said to reduce inflammation of joints by removing uric acid from joints. It has antibacterial and antiviral properties. It increases absorption of iron. Lemon soothes the itching and alleviates the rash, reduces the age spots, and cleanses the face. Lemon water helps in the enzyme functions in our body stimulating the liver and flushing out toxins. Lemon juice relieves symptoms of indigestion such as bloating, burping and heart burn. It can reduce the effects of nausea, dizziness, and also found beneficial in chills, fever, headache, respiratory problems, arthritis, diphtheria, rheumatism, depression, stress, diabetes, cholera, high blood pressure, heart diseases, indigestion, constipation, sore throat, internal bleeding, burns, and obesity.

Using lemon juice in a glass of water with one teaspoonful of sugar and pinch of black salt is a quick and healthy remedy for minimizing the side effects of scorching heat during summer. It contains potassium, which is responsible for controlling high blood pressure. Furthermore, lemon juice is the best for oral health. It stops bleeding from gums, mitigate toothaches, and gives fresh breaths. It is a powerful antiseptic and can be used for vaginal hygiene. Juice of half lemon in a bucket of water during bath will help to remove bad odour of sweat during summer season. Lemon with turmeric powder and rose water is used to improve the skin complexion. It helps to fight skin damage caused by sun and pollution. Lemon can lend a wonderful flavour to sauces, salads, desserts, and drinks.

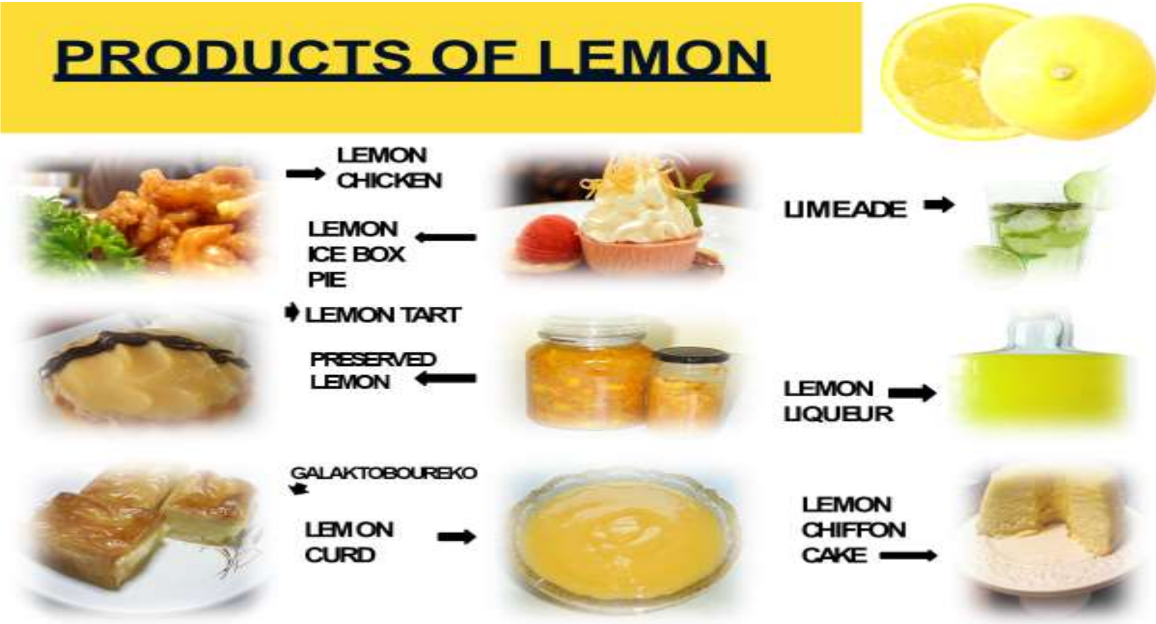
Lemon pickle is a side dish often seen in Indian dining tables. Lemon can also be used to preserve the food. Few small pieces of ginger soaked in lemon juice are eaten before meal to increase the appetite. For the hardware industry, it is also a very valuable raw material in the manufacture of stain removers, detergents, perfumes made of oil extracted from the skin, etc. The used lemon is cut into small pieces, boiled in water, filtered, and after adding very small quantity of any detergent powder, can be used to clean utensils. The scent of lemon is deterrent for pests in the house. Daily consumption of lemon water helps to purify the blood and also significantly improves mental health. It is a powerful antiseptic and can be used to disinfect cuts, abrasions and scrapes. In order to keep good health, it is recommended that one lemon squeezed in about 150 ml of water must be taken daily in the morning before going to toilet.

Fruit Beverages

Fruit beverages and drinks are one of the popular categories of beverages that are consumed across the globe. The fruit beverages and drinks are easily digestible, highly refreshing, thirst quenching, appetizing and nutritionally far superior to most of the synthetic and aerated drinks. In recent past the consumption of fruit-based beverages and drinks has increased at a fast rate. Fruit juices or pulp used for the preparation of these products are subjected to minimal processing operations like filtration, clarification and pasteurization. The fruit juice or pulp, are mixed with ingredients like sugar, acid, stabilizers, micronutrients and preservative to develop beverages and drinks.

There are various categories of fruit juice or pulp-based beverages and drinks which are listed below:

1. Ready-to-Serve (RTS) pre-packaged Beverages.
2. Fruit juice and Nectars.
3. Dilutable beverages.



Ingredients

Prepared lemon squash by using the following ingredients: -Lemon juice – 1/2 kg, Sugar – 2kg, Water – 800 ml and Preservative – 1.25 g KMS.

Steps

1. Squeeze the juice from the lemons, cover and keep ready.
2. Add water to the sugar and stir till it dissolved.
3. Heat the sugar and water together on low heat till well mixed and slightly sticky.
4. Add salt, stir to dissolve and cool on room temperature.
5. When cold stir in the freshly squeezed lemon juice and mix well. Strain through a thin muslin cloth to remove any pulp or impurities in the prepared syrup.
6. Fill in bottles and store in the fridge.
7. Allow 1.5-2 tbsps./glass full of cold water.


Conclusion

Lemon improves digestion, enhances our immune system, boosts energy, alkalizes and hydrates the body, reduces mucus and phlegm, promotes healthy and rejuvenated skin, boosts brain power and helps in weight loss.

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Honey Bee Communication

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In order for a eusocial society to function an effective method of communication is essential. Honey bees use multiple modes of communication in order to coordinate foraging efforts, hive management, and swarming. The primary modes of communication used by honey bees include body language in the form of dances, as well as chemical-based communication via pheromones.

Dance

Honey bees use physical signals to communicate extremely specific information in a short period of time. Physical communication in honey bees comes in the form a variety of dances. These dances make up one of the most sophisticated non-chemical communication systems in the insect world. Dance is used for communication between individual bees in a colony. These dances are performed by worker bees on the vertical surfaces of combs, or on the outer layers of a swarm if the colony is dividing.

We will outline 3 ways honey bees' groove across the dance floor to communicate with their colony members. Honey bees use dance to communicate the availability of food in the area.

Round Dance

Simplest type of dance and it is used by honey bees to advertise the presence of food close to the nest, usually within 15 m. While the dancer moves in a circular pattern to broadcast the presence of food nearby, she offers some pollen and nectar from the food source to her audience. This tells the spectating bees which sent to follow when leaving the nest to find the food source. The round dance only tells other bees about the presence and type of food in the area, but not the location of the food source. This may be beneficial, since the foragers are less likely to visit the same flowers from which nectar has recently been harvested.

Waggle Dance

A more complicated dance that conveys information about food sources. It is used to communicate precise information to other bees, specifically the direction and distance of faraway food sources. This dance takes on a figure-eight pattern during which the bee's "waggle" their abdomens.

The waggle dance is composed of two phases. The waggle phase is the straight portion in the middle of the dance, and the return phase follows two ring-shaped paths to return the dancer to her starting point. The waggle phase of the dance corresponds to the direction of the food at an angle relative to the sun.

For example, if the food source is 30 degrees to the left of the sun when leaving the hive, the angle of the straight portion of the dance will be tilted 30 degrees to the left of a vertical axis.

1. The length of the waggle phase portion of the dance tells spectators about the relative distance to the food source.
2. The longer this straight portion of the dance, the further the food source. Bees don't communicate this information using the metric system.
3. They report distance to a food source in terms of the amount of effort required to reach the destination.
4. Consequently, a trip that requires lying against strong headwinds would be reported as farther than the same trip would be on a day with calmer weather.
5. Just like the round dance, bits of food are exchanged during the waggle dance to allow the other bees to locate the food source efficiently.
6. The richer in pollen and nectar the resource is, the more vigorously the communicating bee will waggle during the dance.

7. The waggle dance communicates locations that are more than 100 m away from the hive. Any food sources located between 15 m-100 m will be advertised with an intermediate form of the round and waggle dances.

Dorso-Ventral Abdominal Vibration Dance, or DVAV Dance

This aptly named dance involves the dorso-ventral vibration of the broadcaster's abdomen. The exact reasoning behind this performance is unclear, but it is thought that the dance is used to regulate foraging activities in response to seasonal food availability. The DVAV dance may also be used to influence the emergence of new queens, or help initiate swarming behaviour.

Pheromones

Honey bees, like most other insects, communicate an abundance of information through chemical cues, pheromones.

Honey bees have many glands located in different parts of the body. Some are used to produce the wax, or substances for turning nectar and pollen in to digestible forms, while other glands produce a diversity of pheromones to communicate information to conspecifics.

Nasanov's Gland

Produced in the bee's abdomen or the tarsal glands in the tarsi, produce foot print pheromones. These pheromones are used to help bees orient to important places. Foot print pheromones act as beacons that guide bees to their nest entrance, water sources, foraging sites, or a swarm cluster. Synthetic foot print pheromones cab be used by bee keepers to attract a swarm of hive- less bees to a new hive.

Alarm Pheromones

Another type of pheromone produced by worker bees. These are produced and released from both the mandibular and abdominal glands. Alarm pheromones are released by worker bees when defending the hive against raiding bees or other animals attempting to access their sweet honey reserves. When a bee releases these chemicals, they signal danger and elicit defensive behaviours from other hive members to ward off attackers in a group effort.

Queen Mandibular Pheromone, or QMP

Queen bees also produce a variety of pheromones that are primarily used for colony management and maintaining an equilibrium in the hive. This pheromone is being constantly released by the queen, though the amount of QMP produced generally drops as the queen ages. It informs the colony about the presence of a healthy queen, while simultaneously inhibiting the production of eggs in the ovaries of workers. The queen feeds QMP from her mandibular glands to her attendants, who then pass it to other workers so the pheromone can be spread throughout the colony.

Other pheromones produced by the queen include chemicals that inhibit the construction of queen cells, allow workers to recognize the queen, and chemicals that can influence swarming behaviour. Queens and drones also produce sex pheromones to locate and attract each other when the time comes to mate.

Adult bees aren't the only ones to use chemical communication. Developing larvae produce pheromones as well, which indicate their presence to nurse bees and stimulate pollen foraging activities. Cells that contain brood are chemically labelled to inform nurse bees about the type of larva in the cell, which is especially important for queen cells. Scents are also released by empty honeycomb. If there is an abundance of empty cells intended to store honey, scent signals released by these clusters of empty cells induce foraging in worker bees.

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Water Footprint: A Concern for India

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Introduction

Earth is called blue planet as there is water covering 70% area of its surface. But only 3% water is present as fresh water which is of use. This available freshwater is unevenly distributed in the form of glaciers, lakes, reservoirs and rivers. This scenario creates problem of water scarcity. As a result, around 2.8 billion people are facing water scarcity in the world. The water footprint is a measure of humanity's appropriation of fresh water in volumes of water consumed and/or polluted. If water-use efficiencies are improved, agriculture can be more profitable and more water will be available to other domestic and industrial users.

Water Stress Scenario in India

In India, water scarcity is a national issue that affects both rural and urban populations, while impinging on agriculture, industry and the ecosystems that support life and biodiversity. India lies in risk zone regarding water stress and scarcity. India faces high water stress. India has both physical and economic water scarcity. In India, the highest demand of water is for irrigation for agricultural production. More than 70% of the total available water is utilized in agriculture and allied sectors of the country. It is projected that the annual demand for food-grains in India will rise to 333 million tons by 2050, up from 250 million tons today.

As India is the second most populous country in the world with around 16% of world's total population. Stress is given on the per capita water availability as there is increase in demand due to population explosion, urbanization, industrialization and other factors. There is a huge gap exists between water demand and supply.

Water Footprint Concept

Water footprint is defined as the volume of water utilized for the production of goods and services consumed by a particular person or community or a nation. The concept of water footprint was introduced by Arjen Y Hoekstra in 2002. Water footprint of humanity has exceeded sustainable levels and is unequally distributed among the people. The global water footprint of humanity in the period 1996-2005 was 9087 billion of cubic meters per year. Agricultural production contributes 92% to this total footprint.

The water footprint looks at both direct and indirect water use of a process, product, company or sector and includes water consumption and pollution throughout the full production cycle from the supply chain to the end-user. It is also possible to use the water footprint to measure the amount of water required to produce all the goods and services consumed by the individual or community, a nation or all of humanity. This also includes the direct water footprint, which is the water used directly by the individual(s) and the indirect water footprint – the summation of the water footprints of all the products consumed.

Water Footprint of a Nation

Water footprint of a nation can be categorized as:

1. Internal Water footprint: Water used within the country to produce goods and services consumed by the national population.

2. External Water Footprint: Water used in other countries to produce goods and services imported into and consumed in the country.

3. Water footprint of a nation can be defined as:

National WFP = national water use + virtual water import – virtual water export.

Factors Affecting Water FP

1. Consumptive characteristics:

a. Consumptive volume.
b. Consumptive pattern.

2. Production circumstances:
a. Climate.
b. Agricultural practices.

Components of Water Footprint
1. Green water footprint.
2. Blue water footprint.
3. Grey water footprint.

Green Water Footprint
Green water is defined as the volume of rain water consumed (evaporated) from a crop field during the growing period. Green water concept is more relevant to agriculture and forestry products. This is more important in rainfed agriculture compared to irrigated agriculture.

Blue Water Footprint
Blue water is the runoff into streams or lakes, or percolates into an aquifer. Blue water footprint is the volume of irrigation water (withdrawn from surface or ground water) that evaporates from a crop field during the growing period. The sum of evaporation of irrigation water from the irrigation canal and artificial storage reservoirs.

Grey Water Footprint
The fresh water is polluted during production chain of a product. This is the volume of fresh water that is required to dilute the load of pollutants (fertilizers & chemicals) to an extent that water quality remains above standard acceptable levels. Due to agricultural chemicals- high nitrate concentrations occur in groundwater.

Importance and Application of Water FP
1. To understand the water requirement to produce a product.
2. Enhances environmental integrity and increase sustainable performance.
3. Helps to minimise water footprint of humanity.
4. To understand and address the challenges of global water stress.
5. In integrated water resources management.
6. Global water policy and sustainable management of water resources.
7. Raises awareness among the general public, government and stakeholders considering the environmental impact of social activities.
8. A water footprint includes a temporal and spatial dimension, used to assess when and where the water was used.

Water Footprints of India
Average water footprint of India is 980 m3/cap/year. Out of which around 2% falls outside of the country. India has the largest footprint among major rice producing countries. Among the states of india, the rice producing states have higher values of water footprint as compared to others. This is due to the use of high amount of water for the rice production. The water scarcity from the perspective of consumption is the highest in the states of Rajasthan, Punjab, Uttar Pradesh, Tamil Nadu and Haryana. Researchers have found out that water saving techniques as TSR and DSR can significantly reduce the water footprint of rice production.

Ways to Reduce Agricultural WFP
1. Improving physico chemical properties of soil
2. Maximizing the pre-season soil moisture storage

3. Precision farming
4. Minimizing evaporation and transpiration and other losses
5. Conservation agriculture
6. Organic farming
7. improving the irrigation application efficiency
8. Improving water productivity
9. DSR/ TSR
10. Pressurized irrigation

Conclusion

Water footprint of nation depends on climatic condition and consumption pattern of people. Rice has more of green water footprint in India. Irrigation and drinking purposes hold the most demand among all the sectors. Drip irrigation, mulching, alternate wetting and drying can be some technologies to reduce agricultural water footprint. There is need to develop and adopt the precision irrigation practices to reduce blue water footprint. Developing the technologies to harvest and conserve the rain water to reduce wastage of green water. Research, development and training in management of water resources is required as water is essential for sustaining all forms of life.

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Present Youth and Agriculture: Key Challenges and Concrete Solution

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Introduction

Global population is projected to reach 9 billion by 2050. The number of young people (aged 15 to 24) is also expected to increase to 1.3 billion by 2050, accounting for almost 14 percent of the projected global population. Many developing countries including India are giving utmost priority to engaging youth in agriculture. This is apparent from global trend of youth moving away from agriculture and rural areas. The International Labour Organization (ILO) (2005) defined youth as people between the ages of 15 and 24. India is also losing more than 2,000 farmers every single day and since 1991, the overall number of farmers has dropped by 15 million (Sainath, 2013).

Why Youth in Agriculture?

1. Young people bring energy, vitality, and innovation into the workforce.
2. To increase the number of producers and level of productivity.
3. Important to facilitate food and nutritional security.
4. Youth are capable of adopting new concepts, ideas, technology which are vital for increasing production.
5. Active participation of youth will reduce their unemployment in rural areas.

Ways to Engage Youths in Agriculture

1. Greater use of information and communication technology: Not only can ICT be used to educate and train those unable to attend higher education institutions but it can be used as a tool to help young people spread knowledge, build networks, and find employment. Such technologies can also reduce the costs of business transactions, increasing agriculture’s profitability.

2. Facilities to access the land and credit: Land is often scarce and difficult to access for young people, and without collateral getting credit to buy land is highly impossible. Innovative financing for agriculture and small businesses is needed.

3. Link social media to agriculture: The rise of social media and its attraction among young people with access to the appropriate technologies could be a route into agriculture if the two could be linked in some way. Mobile phone use in country is growing rapidly and people are now much more connected to sources of information and each other. Utilising these channels to promote agriculture and educate young people could go a long way in engaging new groups of people into the sector.


4. Put agriculture in school curriculum and strengthen higher education in agriculture: Primary and high school education could include modules on farming, from growing to marketing crops. This could help young people see agriculture as a potential career. Relatively few students choose to study agriculture, perhaps in part because the quality of agricultural training is mixed.

5. Greater public investment in agriculture: Young people may see agriculture as a sector much neglected by the government, giving farming the image of being old fashioned. Regional and continent-wide programmes such as the Comprehensive Africa Agriculture Development Programme (CAADP) may go some way in transforming the prominence and reputation of agriculture in Africa but national efforts and public investments are also needed.

6. Learning from current situation: As it was recently in the news that the GDP of our country has suffered a downfall to -23.9% and every sector has its contribution in negatives except Agriculture. In itself, it shows that it is the sector that has the potential to deal with tough and tougher times if dealt in correct manner.

Initiatives of Government to Attract Youth in Agriculture

1. Attracting and Retaining Youth in Agriculture Scheme (ARYA): This scheme ARYA has recently been launched by the Indian Council of Agricultural Research (ICAR). This program is planned to be implemented through Krishi Vigyan Kendras (KVK-Agriculture Science Centres) in 25 states of our country. Each KVK would train about 200 to 300 youth in taking up agriculture's allied and supplementary activities such as poultry farming, dairying, fisheries, goat rearing, mushroom production and other similar activities which keep the rural youth attached to agriculture, either directly or indirectly. eking bank loans.


2. License for sale of agriculture inputs: Government of India has made B.Sc. Agriculture as mandatory qualification requirement to get license for sale of agriculture inputs like seeds, fertilizers and pesticides. This will create several thousands of jobs for agriculture graduates in the country.

3. Agri Clinics and Agribusiness Centres Scheme (ACABC): It is implemented by the Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Govt. of India to foster entrepreneurship in agriculture. Through these schemes fresh and unemployed agricultural graduates are imparted training for 2 months on entrepreneurship avenues in agriculture and transformed as agripreneurs through establishment of need-based agribusiness ventures. The scheme has been in operation from 2002 onwards.

4. Start Up India & Stand Up India: India initiative of the Government of India will boost entrepreneurship among the youth, create new job opportunities and help set up a network of start-ups in the country. The scheme will create an entire start-up ecosystem that would be set-up and will work as a friend, mentor and guide for start-ups through their entire journey of entrepreneurship.

5. Krishi Vigyan Kendras: The organizational setups like Krishi Vigyan Kendras (KVKs), NABARD farmers' club, National Skill Development Council (NSDC) include training and capacity building of youth in their set of activities. The Economic Survey 2014-15 stated that as per the Labour Bureau Report 2014, the present skilled workforce in India is only 2 per cent, which is much lower when compared to the developing nations (Borpuzari, 2015).

6. Digital India: Digital India is an initiative to integrate the government departments and connect the people of India directly with all the departments to address the issues in a better way. It aims at ensuring that the government services are made available to citizens electronically by reducing paperwork and a lot of time.

List of the Programme / Scheme Launched by the Government for Youth / Agriculture

1. National Skill Development Corporation (NSDC): Proposed by the Agricultural Skills Council of India (ASCI).

2. Skill India: includes "National Skill Development Mission", "National Policy for Skill Development and Entrepreneurship, 2015", "Pradhan Mantri Kaushal Vikas Yojana(PMKVY)" and the Skill Loan scheme.

3. Mukhya mantri kaushal Vikas Yojana (Rajasthan).

4. The Student READY (Rural Entrepreneurship Awareness Development Yojana) programme.

Conclusion

1. Youth in agriculture can be sustained through mechanization and innovative approach.
2. All initiatives should work in a co-ordinated manner through multidisciplinary approaches for mutual benefits.
3. Youth should take part in making NGOs for the development of agriculture.
4. Government should develop Agro-based Industries in rural area for better employment chances for rural youth and agriculture production.
5. Foster adequate means and opportunities for youth to be able to remain in rural areas and manage migration.

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Entomotoxicology - A Promising Approach in Forensic Investigation

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Introduction

Entomotoxicology is a branch of forensic study, in which insects play an important role as an alternate toxicological sample in the investigation of death caused by poisoning. It is estimated that about 20% fatality is due to toxic chemical ingestion and in several cases these dead bodies were recovered after many weeks to months. In such cases, the conventional toxicological samples like cell, tissues, body fluid, internal organs were partly or completely decomposed and it becomes very challenging to establish the ultimate cause of death. By analysing the bodies, shed skins or faeces of flesh-eating insects found at a crime scene, forensic entomologists may be able to determine whether drugs were used or not through different techniques such as immunoassays, radio immunoassays, UV-spectrophotometry, Thin Layer Chromatography (TLC), High Performance Liquid Chromatography (HPLC), Liquid Chromatography–Mass Spectrometry (LCMS) and Gas Chromatography-Mass Spectrometry (GCMS). The first report of use of entomotoxicology in forensic investigation was published in 1980, where *Cochliomyia macellaria* (Diptera: Calliphoridae) larvae was used as entomological sample feeding on a death body of 22-years old female found 14 days after her death. Through Gas Chromatography and Thin Layer Chromatography of the larvae, Phenobarbital was detected.

List of some drugs and toxicological substances recovered from some entomological samples:

Species	Family	Drugs Detected
Calliphora vicina	Calliphoridae	Ethanol, Morphine, Amitriptyline, Temazepam and a combination of Trazodone and Trimipramine, Nordiazepam and its metabolite, Ethyl sulphate, Sodium amylobarbitone, Sodium barbitone, Sodium brallobarbitone, Sodium phenobarbitone, Sodium thiopentone, Alprazolam, Clonazepam, Diazepam, Flunitrazepam, Nordiazepam, Oxazepam, Prazepam, Temazepam, Triazolam, Amphetamine, Propoxyphene
Protophormia terraenovae	Calliphoridae	Morphine
Calliphora vomitoria	Calliphoridae	Methamphetamine, Endosulfan
Calliphora stygia	Calliphoridae	Morphine
Cochliomyia macellaria	Calliphoridae	Phenobarbital
Phormia regina	Calliphoridae	Ethanol
Lucilia sericata	Calliphoridae	Methylphenidate, Opiates, Cocaine, Barbiturates, Clomipramine, Amitryptiline, Nortryptiline, Levomepromezine, Amitryptyline, Tioridazine, Codeine, Methadone Narcodeine, Malathion, Phenobarbital, Phenothiazine, Metals like Antimony, Barium, Cadmium, Lead
Chrysomya albiceps, Chrysomya putoria	Calliphoridae	Diazepam, Amitriptyline, Citalopram, Morphine
Chrysomya megacephala	Calliphoridae	Malathion, Buscopan
Chrysomya ruffifacies	Calliphoridae	Malathion

Dermestes maculatus	Dermestidae	Morphine

(Chophi et.al., 2019)

Insects as Toxicological Samples

Blow flies (Calliphoridae; Diptera) and flesh flies (Sarcophagidae; Diptera) are usually the first visitors to a dead body. These necrophagous dipteran flies are attracted and locate the odour source of a fresh corpse within a few minutes to hours of death with their specialised chemoreceptors and adult females oviposite on it. After hatching the maggots feed on the tissues and during feeding process other xenobiotics, toxins, drugs present in the body also get transferred to the metabolic system of maggots. In the later stages of decomposition, when the corpse becomes too dry for the mouth hooks of maggots to operate effectively, some beetles and other arthropods species colonise there. With chewing mouthparts, the ham beetles (Cleridae; Coleoptera), hide beetle (Dermestidae; Coleoptera), carrion beetle (Silphidae; Coleoptera), rove beetle (Staphlynidae; Coleoptera), dermestid beetle (Dermestidae; Coleoptera) devour the dry flesh, skin and ligaments. Drugs and toxins are detected by toxicological analysis of immature insect stages (maggots), empty puparial cases, exuviae and fecal material of beetles. Morphine is generally accumulated in the cuticular layer of *Calliphora vicina* maggots and Cocaine in between the endocuticle and exocuticle of *Chrysomya albiceps* larva. Toxic chemicals like trimipramine, trazodone, and temazepam were maily reported in the larvae of *Calliphora vicina*, but were can not be detected in the pupae and adult instars.

1. Ishak *et.al*, 2019 claimed that, in *Lucilia cuprina*, Heroin and its complete metabolites i.e. Morphine was generally detected in the second and third instars larvae whereas, in first instar and in pupa it was not found in appreciable amount.

2. A case of maternal filicide was also confirmed by entomotoxicological analysis, where 40-year old women and her two children were found completely burned in a car with an early stage of insect activities. Toxicological analysis of the larva feeding on children bodies showed positive report for the presence of Diazepam and its metabolites, which act as a sub-lethal sedative prior to death. But the insects collected from the mother's body didn't show any such chemical, which conformed the case of a maternal filicide (Bugelli *et.al.*, 2017).

Effect of Toxin on Insects

In many studies, Barbiturates were found to increase the length of larval period of flies whereas, Morphine and heroin were found to slow down the rate of development of *Calliphora stygia, Protophormia terraenovae*, *Calliphora vicina* and *Lucilia Sericata*. Concentration of Malathion in the food source of *Chrysomya Megacephala* and *Calliphora vicina* is positively correlated with the overall timing of development from egg to adult. The time taken for adult emergence is longer in Malathion treated colony which is 10-12 days as compare to only 6-7 days in control colony. Cocaine and methamphetamine also accelerate the rate of larval period and also affect the rate of pupal development. Magni *et.al.*, 2018 reported presence of Ketamine in the food substrate not only delay the developmental periods of larva and pupa but also affect the morphometry of *Calliphora vomitoria* larva. The length and width of larvae and pupae was found to be significantly larger than usual. These varieties of effects of drugs and toxins on insect developmental rates serves as the most useful entomological evidence for the forensic investigation of crime scenes in order to get an accurate estimate of time since death i.e. PMI (Postmortem Interval) from the remains of decomposed bodies.

Detection of Drugs in Insects

The foremost step in the toxicological analysis is sample collection, storage, sample handling and its proper preservation. After collection sample such as larva or adults are killed by boiling or freezing and then are stored at -20 °C or with 70% alcohol, whereas pupa is generally stored in dry condition at 2-6 °C. To avoid contamination, insect specimen should be washed with NaCl solution (0.9%) or with methanol. The solid insect specimens are first homogenised or digested using any strong acid or base or are simply pulverised in a grinder before the extraction of drugs from the insect body. Drugs or toxins are extracted from the matrix using classic extraction techniques such as protein precipitation, liquid-liquid extraction (LLE) and solid phase extraction

(SPE). After extraction, it is analysed both qualitatively and quantitatively using different analytical techniques. Choice of any technique depends on the physiochemical properties of the drug of interest and its sensitivity. For qualitative analysis of drugs, techniques like Immunoassay, High Performance Liquid Chromatography (HPLC), Gas Chromatography (GC) are used whereas, quantification of even a low-level drug is best done using Liquid Chromatography–Mass Spectrometry (LCMS) and Gas Chromatography-Mass Spectrometry (GCMS) technique.

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Effect of High Temperature in Plant Growth and Development

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Abstract
Global worming has led to increase temperature that produced high temperature stress effect on plant growth, metabolism and productivity worldwide. Many different biochemical and physiological processes are involved in plant growth and development which are highly susceptible for high temperature stress. Pollination is one of the most sensitive phonological stages to temperature extremes across all species and during this developmental stage temperature extremes would greatly affect production. During photosynthesis processes PSII is most susceptible for high temperature and reduces rate of photosynthesis. Reproductive stage is the most sensitive to high temperature which leads to reduction of crop yield and quality.

Introduction
Increase in temperature beyond the threshold level which cause irreversible damage in plants and reduces plant growth and development called as a high temperature stress. Increase global worming effect and due to effect of climate change continuously temperature increasing. It has a negative impact on plant growth and development.

Through-out plant life cycle required different rang of temperature and that is responses differ among crop species i.e., different stages of plant growth and development. Each crop required different range of maximum and minimum temperatures form the boundaries of observable growth. At the time of vegetative stage usually higher optimum temperature required than reproductive stage. Plant growth and development depended on several physiological, biochemical and molecular process. Photosynthesis process is a main activity for increase or decrease plant dry matter production. It is a light energy converted in to chemical energy use CO_2 and water as a raw material and store photosynthetic product as a dry matter in plant.

Various stages of plant life are temperature dependent including seed germination and flowering. Seed germination and seed vigour are reduced due to high temperature that causes thermal injury or death of the seed. Barlow et al., 2015 found that high temperature and frost caused sterility, abortion of formed grains, reduction in grain number and reduced duration of the grain filling period.

Direct injuries due to heat stress include protein degradation, and increased fluidity of membrane lipids. Indirect or slower heat injuries impair the stability of proteins, membrane integrity, RNA and activity of enzymes in chloroplast and mitochondria, resulting in an imbalance in the metabolic homeostasis.

Major Effects of High Temperature on Plants (Hasanuzzaman et al., 2013)
1. Reduces seed germination.
2. Reduction in plant growth.
3. Irregular or improper development.
4. Alteration in photosynthesis.
5. High respiration and water loss.
6. Reduced in dry matter partitioning.
7. Yield reduction.

8. Reduces crop quality.

Growth and Development

Among all different plant stages, the first one to get affected is seed germination. Different ranges of temperature show different adverse effects on various crops during seed germination. Decreased germination percentage, abnormal seedling, poor seedling vigor, reduced radical and plumule growth is major effect of heat stress in different plant cultivation species. Cheng at al., 2009 suggested that seedling rate were reduced due to the death of cell and embryo in wheat crop, where plant height, number of tillers and total biomass were reduced in rice cultivar at very high temperature (450C).

Higher temperature causes loss of cell water content that ultimately reduces cell size and growth of the plant. Reduced Net Assimilation Rate (NAR) is another reason for reduced Relative Growth Rate (RGR) in maize, millet and sugarcane under heat (Srivastava et al., 2012).

Although all plant growth stages are sensitive to excessive heat but flowering and reproductive stages are the most sensitive. During reproduction, Short period of heat stress can cause significant decrease in floral buds and flowers abortion although a great variation in sensitivity within and among plant species and variety exists. Application of high temperature at reproductive stage of plant reduce flowers production and also reduces economic yield (Maheshwari et al., 2012). While high temperature stress more adversely affects grain filling stage than the flowering stage and reduce yield in maize which were observe by Edreira and Otegui. Heat stress modifies the early dough and maturity stage in wheat which shortens the kernel desiccation period and cause grain yield loss.

Seed Germination

High temperatures are often the most limiting factor affecting plant growth as well as crop yield. During seed germination major impacts caused by heat stress documented in various plant species like as a, reduced germination percentage, plant emergence, abnormal seedlings, poor seedling vigour, reduced radicle and plumule growth of geminated seedlings.

Photosynthesis Activity

Photosynthesis is highly sensitive process to heat-temperature and mostly injuries produces due to high temperature stress in chloroplast and mitochondria. Photosynthesis is more sensitive in C_3 plants than C_4 plants under excessive heat because the present of photorespiration process in C_3 plants.

Chlorophyll biosynthesis are reduced in plant due to high temperature. Heat stress leads to impairment of chlorophyll biosynthesis which is the first process occurring in plastids. The inhibition of chlorophyll biosynthesis under high-temperature regimes results from a destruction of numerous enzymes and decreased activity of 5-aminolevulinate dehydratase (ALAD). Chlorophyll content were reduced in soybean crop at and above 35^{o}C, up to 18 % total Chlorophyll content, 7% Chlorophyll *a*, 3% Chlorophyll *a*/*b* ratio, 9% sucrose content and an increase in 47 % reducing sugar content (Hasanuzzaman *et al.,* 2013).

In photosynthetic apparatus photo-system II (PSII) is considered to be one of the most thermo sensitive components. The two most important factors are responsible for susceptible to heat stress (i) increase in fluidity of thylakoid membranes at high temperature which causes dislodging of PSII light harvesting complexes from thylakoid membrane and (ii)dependence of PSII integrity on electron dynamics. The sensitivity of PSII to stress depends on the organization level of the system in question and there is also variation in the extent of the acclimation of PSII to heat stress (Janka *et al.,* 2013).

High temperature greatly affects starch and sucrose synthesis by reduced activity of sucrose phosphate synthase, ADP-glucose pyrophosphorylase and invertase. Heat imposes negative impacts on leaf of plant like reduced leaf water potential, reduced leaf area and pre-mature leaf senescence which have negative impacts on total photosynthesis performance of plant.

Cell Membrane

High temperature affects cell membrane permeability, thereby inhibiting cellular function, as a result of the degradation of proteins and lipid content present in cell membrane that disrupt water, ion, and organic solute movement across membranes. Thylakoid membranes typically show swelling, increased leakiness, physical separation of the chlorophyll light harvesting complex as specially PSII core complex are injured (Bita et al., 2013).

Pollen Viability

Pollination stage is highly susceptible stages in plants at high temperature stress. Pollen viability decrease when pollen is expose above 35-degree temperature in maize crop. Effect of high temperature and under high vapor pressure deficit decrease the pollen viability, because functioning of pollen under moisture content which is strongly dependent on vapor pressure deficit. Reduced yield between 2.5% to 10% due to high temperature in agronomic species (Hatfield et al., 2011).

Stomata Opening and Closing

Transpiration is a vital process in plants and removes water from different plant part in the form of water vapor these processes maintain by stomata opening and closing. In this process net radiation energy is converted into latent heat, under physiological control by changes in stomatal aperture. Strong relation between photosynthesis is strongly dependent on opening and closing of stomata because stomata is responsible for movement of gas between plants and environment. In plants at high temperature reduces water level and intercellular CO_2 concentration in plants (Ashraf and Hafeez 2004).

Stomata conductance and net photosynthesis are inhibited by moderate heat stress in many plant species due to decreases in the activation state of Rubisco while Photorespiration activity increases with temperature because of decreases in both the relative specificity of Rubisco for CO_2 compared with O_2 and the relative solubility of CO_2 compared to O_2.

Yield and Quality

Crop productivity is quantified in terms of crop yield in the given field area and crop yield of seed crops is the measure the amount of seeds/grains produced. Heat stress during reproductive stages leads to considerable loss of yield and seed quality. Heat stress during pre-anthesis and reproductive development results in a reduction in floret fertility which translates to lower seed number (Bheemanahalli et al., 2019). At high temperature stress during reproductive development is detrimental as it negatively impacts the male and female reproductive function compromising the seed set and reduces the seed filling duration, resulting in smaller seed size and lower yields.

Conclusion

High temperature stress has become a major concern for crop production worldwide because it greatly affects the growth, development, biochemical, enzyme activity and productivity of plants. The present rate of emission of greenhouse gases from different sources is believed responsible for a gradual increase in the world's ambient temperature, and is resulting in global warming. Due to high temperature reduces rate of photosynthesis, percentage of seed germination, cell membrane, pollen viability, growth and development, create water and oxidative stress.

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Plan-Wise Report on Five Year Plans (I-XII) Vis-À-Vis Animal Husbandry and Dairying

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Abstract

At the time of independence of the India; there were 150 million cattle and 43 million buffaloes in the country as per the 1951 livestock census. About 10% of the cattle population (roughly 11.4 million adults) were unserviceable or unproductive (Cattle Utilization Committee). The quantity of fodder available was about 78 per cent of requirements, while the available concentrates and feeds were sufficient for only 28 per cent of the cattle. Thus, thorough its various five-year plans the Govt. of India executed the different measures for upgrading the cattle and removing inefficient animals to *Gosadans* received high priority. During 1951-52, 94 artificial insemination centres, with 196 key villages, were sanctioned. 60 artificial insemination centres and 150 key villages had started work by the time the first five-year plan was approved. In 2nd plan, provision was made for an outlay of over Rs. 56 crores on animal husbandry, including dairying. Despite large population of livestock, the net value of livestock products amounted only to Rs. 664 crores or about 16 per cent of the income from agriculture in 1950-51. In the first four Plans, planning was found to be comparatively exhaustive, while in the successive Plans it got more “general” in terms of steps-to-be-taken. Even in the Eleventh and twelfth Plans a lot of instructive measures, rather than concrete measures were seen. The sub-sectors were found to be missing altogether in some of the Plans. Of course, there has been a tremendous improvement in animal husbandry and dairying since the inception of the first Plan, but there is no denying the fact that we lacked:

1. Consistency.
2. Timely checks: A comparative analysis of the Plans with regard to each of the sub-headings in the sector, namely, Poultry, Piggery, Equines, Small Ruminants, etc., can be undertaken to get a further insight into the lacunas in the development and growth in animal husbandry and dairying in India. This would help in drawing out strategies for the construction of a wholesome, all-inclusive plan for animal husbandry and dairying in every subsequent Five-Year Plan hereafter.

Keywords: Animal husbandry; Cattle population; Dairy; Five-year plans; Fodder.

1st Five Year Plan (1951-56)

There were 150 million cattle and 43 million buffaloes in the country (1951 livestock census). About ten per cent of the cattle population (roughly 11.4 million adults) were unserviceable or unproductive (Cattle Utilization Committee). Thus, measures for upgrading the cattle and removing inefficient animals to Gosadans received high priority.

The quantity of fodder available was about 78 per cent of requirements, while the available concentrates and feeds were sufficient for only 28 per cent of the cattle. That is, only two-thirds of the cattle could be maintained in a fair condition on the then existing food and feed resources.The three broad divisions of cattle breeds were: milch, draft and dual-purpose breeds. Some of the draft breeds were capable of yielding more milk.

There was thus a possibility of most of the breeds of Indian cattle being developed eventually into dual purpose animals, and that was the prime objective of the breeding policy of Government of India. Approximately 750 farm-bred bulls of known pedigree were distributed annually in different states for developing draft as well as milch breeds, but the number of approved bulls met less than 0.5 per cent of the total requirements of the country.

Schemes

1. Key Village Scheme: Tills work was proposed to be taken up at 600 centres – each centre was to consist of three or four villages having about 500 cows over three years of age. In those areas, breeding was to be strictly controlled and confined to three or four superior bulls. The unapproved bulls were to be castrated or removed. Maintenance of records of pedigrees and milk production, feeding and disease control, was to be taken care of at every centre. About 150 artificial insemination centres (one per four key villages) were proposed to be established during the period of the plan. Poultry development and selective breeding in poultry were also part of the key Village scheme. During 1951-52, 94 artificial insemination centres, with 196 key villages, were sanctioned. 60 artificial insemination centres and 150 key villages had started work by the time the first five-year plan was approved. The important targets set in the plan in this regard were:

Year	Number of key villages	Number of AI centres
1952-53	196	94
1953-54	206	24
1954-55	94	16
1955-56	104	16

This scheme was expected to produce about 60,000 bulls per year. To facilitate castration of scrub bulls and protection of animals against contagious diseases, legislation was to be introduced. It was proposed that the Control of Contagious Diseases Act and the Livestock Improvement Act be adopted by the states that were yet to implement the two legislations.

2. Gosadan Scheme: Out of 48 million cows over three years of age, 28 million were dry. The plan in this connection provided for establishing 160 *Gosadans* at a cost of about Rs. 97 lakhs. The useless cattle were to be segregated and sent to *Gosadans* located in wastelands. The remains of dead animals, such as hides, skins, horns, etc., were to be fully utilized by setting up a small tannery at each centre. Each *Gosadan* was to maintain about 2000 cattle. By 1954-55, 320,000 useless animals were to be removed to the *Gosadans*.

Feed and Fodder Problem

In order to improve the supply of green fodder, leguminous fodders like Lucerne, berseem, cow peas, field peas, etc., were to be introduced in crop rotations in irrigated areas. The possibility of Kudzu and clovers were also to be explored. Research on fodder crops and on feeds like mango-seed-kernel and jamun seed, etc., was proposed to be carried out.

Disease Control

Of all the diseases that affected Indian cattle, rinderpest was the most important and was responsible for about 60 per cent of the total mortality. A sum of Rs. 15.7 lakhs were provided in the Plan to initiate work for the eradication of rinderpest by large-scale vaccination with the new, evolved Lapinised vaccine. At the beginning of the Plan, there were about 2000 veterinary dispensaries in the country. During the span of the Plan the number was proposed to go up to 2640.

Poultry

The number of poultry in the country was estimated at about 70 million, but the ordinary village he was generally under-utilized and laid only about 50 under-sized eggs in a year. The Indian Veterinary Research Institute had evolved an Indian strain by selective breeding. The strain was estimated to increase the yield by 100 per cent. It was proposed in the Plan that the strain be tested in field under different soil and climatic conditions. An effective vaccine for Ranikhet disease was also brought out and the state governments had provided a sum of Rs. 25.15 lakhs during the five-year period to encourage poultry farming.

Sheep and Wool

The 39 million sheep of the Indian Union produced about 55 million pounds of wool per year, out of which 31.6 million pounds of wool worth Rs. 43 crores were exported mainly to the UK and USA. But the average yield of wool per sheep was two pounds, which was very low. With this in mind, a plan of regional development was developed by ICAR, wherein three regional centres were to be established in important wool-producing areas, namely, UP or Punjab hills, Rajasthan, and the Deccan Plateau.

Veterinary Education and Research

In addition to IVRI, there were nine veterinary colleges in the country, with an output of 275 graduates. A sum of Rs. 84.43 lakhs were provided in the Five-Year Plan for veterinary education and training. The total expenditure for livestock and animal husbandry schemes in the Plan amounted to Rs. 1432.52 lakhs.

Dairying

1. 36 per cent of the total number of cattle and buffaloes (193 million) in the Indian Union were milch animals. Though buffaloes were only 30 per cent of these, they accounted for 54 per cent of the total milk produced, as compared to 42 per cent yielded by cows.

2. The average yield of milk per cow in India was 413 pounds, which was the lowest in the world. According to 1951 cattle census, the average per capita consumption of milk and milk products worked out at 5.5 ounces. Except Punjab and Rajasthan, all the major states were deficient in milk consumption by the standard of 10 ounces per day.

3. The gross annual milk production in 1945 was estimated at 21.42 million tons, of which only 14.5 million tons was marketable.

4. 95 per cent of the milch cattle were found in rural areas, where 86 per cent of the people resided, but the demand for milk and milk products was found in urban markets. 60-70 per cent of fluid milk requirements of urban areas were derived from cattle maintained within the municipal limits. The remaining 30-40 per cent came from villages situated within 30 miles of the urban areas.

5. The trade was in the hands of milk vendors, whose methods of handling and transporting milk were neither efficient nor sanitary. There were also about 75 dairy farms in the Indian Union in 1949, most of which belonged to the military and Civil Departments of governments.

6. Due to shortage of supply, the retail milk price was higher in India than in any other important country. For all these reasons, measures for increasing milk production were accorded the highest priority. The State Plans included 27 schemes for dairying and milk supply. They were estimated to cost Rs. 781.0 lakhs.

It was proposed in the Plan that a Milk Board be set up for each urban area. The Board was to be a statutory body with a paid executive, consisting of representatives of producers, distributers, consumers, municipalities, health authorities and the State Government. A Milk Plan for the area, matters relating to import, handling and distribution, quality control, prices of milk and milk products, etc., were to be dealt with by the Board.

While those steps were being taken to augment supplies, the machinery employed for licensing, sampling and testing was to be strengthened by the Board and prosecutions were to be hastened against those who adulterate milk.

2nd Five Year Plan (1956-61)

In this Plan, provision was made for an outlay of over Rs. 56 crores on animal husbandry, including dairying. Despite large population of livestock, the net value of livestock products amounted only to Rs. 664 crores or about 16 per cent of the income from agriculture in 1950-51. An expert committee on the prevention of slaughter of cattle was appointed by the Government of India in 1954 to suggest measures to arrest the deterioration of cattle. The committee concluded that the feed and fodder and other resources of the country were grossly inadequate. If slaughter of cattle was totally banned, the cattle population was estimated to increase at the rate of nearly 6 per cent per annum, jeopardizing the well-being of the limited number of good cattle that the country possessed.

In the 1st Plan, *Gosadans* had been seen as a solution to the problem. Out of the total 160 proposed *Gosadans* (that were to house 320,000 cattle), in the first phase of the 1st Plan, only 22 had been established for 8000 cattle. During the second Plan it was proposed that 60 *Gosadans* be set up for 30,000 cattle. It was also proposed to select 350 Goshalas (out of the total 3000) and develop them into livestock improvement centers. The selected Goshalas were to send their unserviceable and unproductive cattle to the nearest *Gosadan*. Each *Gosadan* was to have facilities for better utilization of hides, bones and other products. Each Goshala was to be provided with a certain number of improved breed animals, and it was to secure an equal number from its own resources. About Rs. 1 crore were provided for the scheme.

Cattle Breeding Policy and Programmes

There were 25 well-defined breeds of cattle and six well-defined breeds of buffaloes in India. An All India Breeding policy was drawn up by the Indian Council of Agricultural Research and accepted by the Central and State Governments. The Policy, in brief, was:

1. "In the case of well-defined milch breeds, the milking capacity should be developed to the maximum by selective breeding and the male progeny should be used for the development of the nondescript cattle.

2. In the case of well-defined draught breeds, the objective is to put as much milk in them as possible without materially impairing their quality for work."

For the implementation of the Policy each state was divided into zones according to the breeds used in them. It was mainly through the Key Village Scheme that the programme of livestock improvement was being pursued by State Governments. During the 1st Plan, 600 key villages and 150 AI centres had been established. During the Second Plan, 1258 key villages, 245 AI centres and 254 extension centres were to be set up. The programme was intended to produce about 22,000 improved stud bulls, 950,000 improved bullocks and a million improved cows.

The scheme had made encouraging progress, but in respect of fodder development and marketing of animal husbandry products, not much headway had been made.

Dairying and Milk Supply

It was reckoned that the total milk output of the country at the beginning of the First Five Year Plan was over 18 million tons. Of this, 38 per cent was estimated as being used for consumption as fluid milk, about 48 per cent for ghee and the rest for khoa, butter, curd and other products. A national production target for milk had not yet been formulated. It was proposed in this Plan that local and regional targets should be set up in national extension and community projects. The general objective was to achieve an increase of about 30 to 40 per cent in milk output over a period of 10 to 12 years in intensively worked areas.

In order to encourage the breeding of high yielding animals, a scheme for the establishment of pedigree breeding stations was proposed in the Second Plan. That was to demonstrate to the farmer the benefit of using progeny-tested sires for high milk production at reduced costs. It was also proposed to organize 36 urban supply schemes, 12 co-operative creameries, and 7 milk drying plants.

The latter were to be located in rural areas and were to produce butter, ghee and skimmed milk powder. The milk producers were to be given assistance in terms of remunerative price, AI, technical advice, etc. Milk collected from rural areas was to be distributed in the urban under the control of Milk Boards. Large-scale milk schemes were also proposed to be taken up in Delhi and Madras (now Chennai) with the minimum size of cattle colonies in relation to their needs. A provision of Rs. 17.44 crores were made for various dairy development programmes.

Control and Diseases

A programme aimed at the eradication of rinderpest was drawn up based on a pilot scheme undertaken during the First Plan. Veterinary dispensaries had been increased from 2,000 to 2,650 in the course of the First Plan. During the Second Plan, 1900 veterinary dispensaries were proposed to be added to that.

Sheep and Goats

The long-term approach adopted in the Second Plan vis-à-vis sheep included:

1. Selective breeding of indigenous breeds in the plains and where defined breeds exist.
2. Upgrading of non-descript breeds with Bikaneri.
3. Cross-breeding with foreign breeds in selected hilly areas.

It was proposed that three new sheep-breeding farms be established, in Himachal Pradesh, Madhya Bharat and Saurashtra. The farms were intended to produce rams of good quality, both for pure breeding and for cross-breeding. At each farm a fleece testing laboratory and a wool utilization centre was to be set up. It was also proposed to establish 396 sheep and wool extension centres in different regions. The Plan provided Rs. 1.5 crores for sheep and wool development. In relation to goats it was suggested that goat breeding be carried on under arable conditions. Closer studies of the economics of meat production under stall-fed conditions and of special diseases of goats were also proposed to be carried out.

Poultry

Four regional farms, each with 2000 laying hens for acclimatizing exotic breeds, and from which foundation stocks were to be distributed to 300 extension centres, were proposed to be set up. Each extension centre was to comprise a demonstration unit with a development block attached to it. It was proposed to provide training to private poultry breeders in modern methods of poultry rearing on each of the demonstration units. A de-fertilization unit was also to be attached to each extension centre for processing village eggs in order to prolong their keeping qualities, especially during the summer months. It was expected that with the planned measures the production of upgraded indigenous hens (by crossing with White Leghorns and Rhode Island Reds) would be up by about 50 per cent, and by the end of the Second Plan the per capita availability of eggs per annum would increase from four to twenty.

Research and Education

In the Second Plan it was proposed that animal husbandry research be organized at three levels, namely, national, regional and state. At the national level, central institutes like Indian Veterinary Research Institute (IVRI) and National Dairy Research Institute (NDRI) were to be strengthened and expanded. At IVRI, the research divisions for animal genetics, poultry, animal nutrition, pathology, bacteriology, parasitology and biological products were to be given larger staff and equipment, and a biological products standardization division was to be added for regulating and controlling the quality and use of vaccines and sera prepared at different centres. Separate divisions for research in dairy husbandry, nutrition, chemistry, bacteriology, technology and machinery, and dairy extension, were to be set up at NDRI, in addition to the establishment of a Dairy Science college (to provide about 1000 personnel for dairying). To harness the resources of NDRI for the development of cattle wealth, the Central Gosamvardhana Council instituted a twelve-month course for training Goshala workers for appointment in the more important goshalas. The Government of India also proposed to develop four research institutes, one in each of the four regions in which the country had been divided for animal husbandry research: temperate (Himalayan), dry (northern), eastern, and southern.

3rd Five Year Plan (1961-66)

In the Third Plan, emphases were laid on mixed farming system, in which crop production and animal husbandry were dovetailed for efficient and economic utilization of land, labour and capital. According to the 1956 Livestock Census, there were 306 million farm animals: 159 million cattle, 45 million buffaloes, 39 million sheep, 55 million goats, 8 million other animals and 95 million poultry. The total production of milk was estimated to be 22 million tons and by the end of the Third Plan it was expected to go up to about 25 million tons. The per capita consumption of milk, including milk products, the minimum requirement of which is about 10 oz per day, was placed at 4.9 oz per day. It was expected to increase to 5.1 oz per day by the end of the Third Plan.

During the First Plan, among the animal husbandry programmes undertaken were the establishment of 146 key village blocks with artificial insemination centres and 25 *Gosadans.* During the Second Plan, 196 new key village blocks were taken up and 114 key village blocks established in the First Plan were expanded. By the end of the

Second Plan, 2,000 key village units were established. By 1960, 670 AI centres had been set up. During the Second Plan, 34 more *Gosadans* were established and 246 goshalas were selected for development. By the end of the Second Plan, 4,000 veterinary hospitals and dispensaries had been established. The total Plan outlay in the First Plan was Rs.8 crores, and that in the Second Plan was Rs.21 crores.

Extension of Veterinary Facilities and Disease Control

It was expected that in the course of the Third Plan the number of veterinary hospitals and dispensaries would increase to 8000. Increased production of vaccines and sera required for the control of contagious diseases was also stressed upon. About 90 million heads of cattle had been vaccinated and protected against rinderpest during the duration of the Second Plan; the balance of about 41 million was expected to be covered during the Third Plan.

Piggery Development

13 piggery breeding units for the production of breeding boars for use in piggery development blocks were set up during the span of the Second Plan. Further, 28 piggery development blocks were also established and two regional pig-breeding station-cum-bacon factories were established at Aligarh in Uttar Pradesh and at Haringhata in West Bengal. Establishment of two regional breeding-cum-bacon factories, 12 piggery units and 140 piggery development blocks were proposed in the Third Plan.

Equine Breeding

No systematic efforts were made for improving and developing the breeds of horses during the First and the Second Plans. A horse breeding farm was proposed to be established during the Third Plan. The farm was to maintain 48 mares and 2 stations, 20 donkeys and 5 donkey stallions. It was to produce 12 horse stallions and 6 donkey stallions every year. The stock was to be located at 10 selected stud centres for the improvement of local breeds. It had also been agreed to import a limited number of horses for the span of the Third Plan.

Sheep and Wool Development

The export value of sheep and sheep products was estimated to increase to about Rs. 35 crores by the end of the Third Plan. 15 sheep breeding farms were proposed to be established and 17 farms were to be expanded in the Third Plan. 2,000 to 2,500 quality rams were to be supplied from the farms to flock owners in the rural areas. The production of wool by the end of the Plan was expected to go up to about 90 million lb. (from 72 million lb.). In addition, a large programme for correct shearing as well as systematic grading was to be taken up in Rajasthan during the Plan.

Poultry Development

The Third Plan provided for the expansion of 60 state poultry farms, 3 regional poultry farms and 50 extension-cum-development centres. Commercial hatcheries were also to be set up in the centres. It was expected that with the measures taken, the annual average egg production would go up from 60 to 70 eggs per hen. Two regional duck breeding farms, 17 duck extension centres, one egg powder factory and 15 centres for the manufacture of poultry feeds were also proposed to be established.

Marketing

It was suggested in the Plan that a programme for marketing of livestock and livestock products in each state, and especially in the key village blocks, should be initiated. Schemes for correct shearing, grading and marketing of wool were also stressed upon. It was further proposed that the Plans of states should include schemes for demonstrations and propaganda regarding correct methods of flaying and utilization of carcasses. Exports of hides and skins were expected to go up from Rs. 28 crores in 1960-61 to Rs. 34 crores in 1965-66. In this regard, a large-scale programme for the better collection of fallen hides and improved flaying was proposed, the perquisites of which were:

1. Timely recovery of carcasses and full utilization of all by-products such as meat, bones, horns, etc.,
2. Tanning of hides and skins by improved methods under the guidance of trained personnel, and,

3. Provision of adequate training facilities at selected centres.

One large and 14 small hide flaying, curing, and carcass utilization centres, and two mobile bone crushing units were proposed to be established. In addition, a regional training centre in hide flaying, curing and utilization was also to be established.

Cattle Insurance

A beginning in the direction of insuring milch animals and draught cattle had been made by the Co-operative Mutual Insurance Company, Bombay. Interest was also shown in this direction by the states of Kerala, Andhra Pradesh, Uttar Pradesh, Maharashtra, Rajasthan, Mysore, Madras and Punjab.

Other Schemes

For cattle development it was proposed to provide 168 more *goshalas* with financial and technical assistance to convert them into cattle-breeding-cum-milk production units. In the Second Plan the scheme for the rehabilitation of nomadic cattle breeders was taken up in Andhra Pradesh, the former Bombay state, U.P. and Rajasthan. Provision was also made in the Third Plan for the development of *Rathi* and *Tharparkar* breeds of cattle maintained by the nomadic cattle breeders of Rajasthan. The Central Council of Gosamvardhana was reorganized in 1960 and it had been assigned specific functions such as to organize, implement and coordinate activities relating to the preservation and development of cattle and to administer schemes for increasing milk yield and improving draught quality. The council was also to run training centers for *goshala* and *charmalaya* workers, organize exhibitions and issue journals, films and pamphlets for field workers.

Education and Research

Two new veterinary colleges, one in Gujarat and the other in Bihar, were proposed to be opened. An extension wing was to be attached to each of the two colleges to provide adequate training in extension methods pertaining to animal husbandry. The estimated demand for 5,000 veterinary graduates during the Second Plan had been largely met. During the Third Plan it was estimated at 6,800 as against the output of about 5,800 from various veterinary colleges. Arrangements were also to be made to train about 70,000 stockmen in order to meet the demands of the Third Plan. A Central Sheep Breeding Research Institute was proposed to be established in Rajasthan with two sub-stations, one in the hilly region of Punjab and the other in the Nilgiris.

Dairying and Milk Supply

Due to the shortage of foreign exchange and the difficulty in obtaining plant and machinery, dairy development programmes in the Second Plan had to be confined to those schemes for which equipment was available within the country. Two milk products factories (at Amritsar and Rajkot) and three rural creameries (at barauni, Aligarh and Junagarh) were being set up with foreign aid.

There were 2,257 co-operative milk supply societies and 77 milk supply unions in the country at the end of 1958-59, with membership of 211,131 and owned funds of Rs. 183 lakhs. Two units each for the manufacture of infant milk foods and malted-milk foods and one large-scale unit for sweetened condensed milk were also set up during the Second Plan.

During the Third Plan, two plants, with a capacity of about 900 tons, were to start the production of infant milk foods, three units with a total capacity of 5,300 tons per annum were to produce condensed milk and one unit was to manufacture 670 tons of milk beverages per annum. In addition to development aimed at in the public sector, manufacture of milk products was proposed to be encouraged in the private sector.

55 new milk supply schemes were to be taken up in cities with population exceeding one lakh and in growing industrial townships. 8 rural creameries (for the production of butter, ghee, cheese and other by-products such as casein, lactose, milk powder, etc.), 4 milk product factories and two cheese factories were proposed to be established for developing the rural milk pockets. Establishment of 4 cattle feed compounding factories in the close vicinity of large milk supply plants was also proposed. A provision of Rs. 36 crores had been made for dairy schemes and Intensive Cattle Development (ICD) projects in the Third Plan.

Research, Training and Education

The National Dairy Research Institute (NDRI), with all its research divisions, was to be fully established during the Third Plan. Training and degree courses offered by the institute were proposed to be expanded. Training courses up to graduate levels were to be started at the Agricultural Institute, Anand. In-plant training in large dairies and the FAO regional training programme were to be continued and expanded.

4th Five Year Plan (1969-74)

The Intensive Cattle Development (ICD) projects introduced during 1961-69 included improved methods of breeding, provision of feed and fodder and disease control. But the production of milk increased from 20 million tonnes in 1966-67 to 21.2 million tonnes in 1968-69, representing a growth rate of only about 3 per cent per annum. The Third Plan had witnessed a notable breakthrough in poultry farming: egg production had increased from 2,880 million in 1961 to 5,300 million in 1968-69. Wool production had also increased from 32.55 million kgs. in 1961 to 37.60 million kgs. (Estimated) in 1969.

The approach to livestock development in the Fourth plan was based on three major considerations. First, it was estimated that only about 12 per cent of the agricultural component of the Gross Domestic Product was accounted for by livestock production in India. Second was nutritional consideration. And third major consideration related to the fact that animal husbandry offered considerable scope for the diversification of economy of the small farmer and landless labourer. In the light of the considerations, the Fourth Plan aimed at increasing the supply of protective foods like milk, milk products, meat and eggs, and at improving the output of certain animal products, like, wool, hides, skins, bones, etc.

While framing targets of livestock development for the Fourth Plan, major constraints in the area were identified and considered:

1. Absence of a significant research breakthrough comparable to that in cereal crops.
2. Shortage of feed and fodder.
3. A large percentage of bovine population had to provide drought power for agriculture.
4. Lack of sufficient integration between crop husbandry and livestock production.
5. Intense competition for land and water resources.

In the light of the identified constraints, the following production targets of selected animal products were fixed:

Targets of Production of Animal Products:

Sl.No.	Item	Unit	1965-66	1968-69 (estimated)	1973-74
1	Milk	Million tonnes	20	21.2	25.86
2	Wool	Million kgs.	35.66	37.60	41.50
3	Eggs	Million nos.	4100	5300	8000

In the animal husbandry sector, the outlays included in the Fourth Plan were:

Outlay on Animal Husbandry:

Sl. No.	Outlay (Rs. Crores)
1. (States)	70.91
2. (Union Territories)	5.40
3. (Central Sector)	12.50
4. (Centrally Sponsored Schemes)	5.25
5. (Total)	94.06

The public sector outlays were proposed to be supplemented from various institutional sources, like the Agricultural refinance Corporation (ARC) and Co-operative credit.

Cattle Breeding Policy

The main emphasis of the new cattle breeding policy was on cross-breeding. A set of detailed guidelines related to the area of operation where cross-breeding could be attempted most preferably, selection of breed, etc., had been suggested by the Government of India to the States Directorate of Animal Husbandry. It was also suggested that while introduction of 50 per cent of exotic blood had proved to be satisfactory, the introduction of 75 per cent of exotic blood had generally reduced body weight, viability and milk yield. The quality of the cross-bred bulls used for breeding was given utmost importance.

Cattle Development Programmes

In addition to the 31 Intensive Cattle Development (ICD) programmes being run, 15 large ICD projects were to be set up in milk shed areas of dairy plants with a minimum capacity of 20,000 litres. 20 medium type ICD projects were proposed in milk shed areas of dairy plants with a capacity of 15,000 litres. Sixty new key village blocks (in addition to the 490 then operational blocks) were to cover small dairies.

In the Fourth Plan, a centrally sponsored scheme was to provide for progeny testing units at 10 state farms. Three central cattle breeding farms and eight bull rearing farms were to be set up. Sire evaluation cells were to be established in each state.

Buffalo Development

An All-India Coordinated Research Project on buffaloes was envisaged with a view to improve the production potential of buffaloes through assessment of vital character, selection for high economic value and development of breeds with the help of different systems of breeding.

Sheep and Goat Development

To improve the quality of wool from indigenous sheep, the proposed development programme envisaged cross-breeding of local sheep with exotic fine wool varieties as well as upgrading with some of the important local breeds. Establishment of 8 large sheep-breeding farms with a flock strength of 5000 or more sheep, expansion and re-organization of 15 state sheep-breeding farms, establishment of 5 new sheep-breeding farms and 50 sheep and wool extension centres besides the expansion of 80 centres established during the Third Plan, were also proposed in the Fourth Plan. Import of fine wool breed of sheep and of mutton types was also suggested. The programme was to be taken up in 8 states. It was also proposed that farms for *Pashmina, Angora* and dairy goats be organized.

Poultry Development

The Agricultural Refinance Corporation had already provided finance for five poultry projects. It was proposed to take up a coordinated poultry breeding programme at three central and ten state farms to evolve superior lines and to cross them in various combinations with a view to exploit hybrid vigour. One hundred intensive egg and poultry production-cum-marketing centres were to augment supplies.

Piggery Development

It was proposed that pig-rearers be supplied breeding stock at subsidized rates. The bacon factory at Haringhata was to be provided additional facilities. Work was proposed to be completed in remaining three bacon factories and one pork processing plant. Four more pork processing plants were proposed to be set up in different states. 10 piggery farms were to be expanded and 26 new piggery development blocks were to be established.

Feed and Fodder Development

It was proposed to set up 5 fodder banks in suitable areas where the available grass production could be harvested and conserved. It was also proposed to popularize silage and hay making. Seven regional forage demonstration stations were to be set up and foundation seeds were to be multiplied at 20 seed farms.

Livestock Marketing

It was proposed to establish a livestock marketing cell in the Directorate of Marketing and Inspection with the object of developing effective supervisory and advisory control over the grading schemes for livestock products. Other schemes proposed were, classification of raw hides, improvement in the collection, preparation and grading of materials used for manufacture of animal casings, and management for grading of wool at producers' level. Setting up of corporate bodies to develop a few large, medium and small slaughter houses and meat markets was also proposed in the Plan. Bacon factories and poultry dressing plans were to be set up for processing piggery products and dressed birds. Carcass utilization centres were to be established in most of the states.

Animal Health

200 new hospitals, 1000 veterinary dispensaries, 60 mobile dispensaries and 2000 stockmen centres were proposed to be established. 500 dispensaries were to be converted into hospitals and 60 clinical and investigation laboratories were to be established. Immunization programme against rinderpest was to be intensified and production of tissue cultures vaccines against rinderpest and foot-and-mouth disease was to be augmented. In addition to the measures suggested, an animal quarantine and certification service was also to be set up.

Research

Indian Veterinary Research Institute (IVRI), Izatnagar and the Central Sheep and Wool Research Institute, Avikanagar, were transferred under the administrative control of the Indian Council of Agricultural Research in 1967. The research facilities at both the institutes were proposed to be strengthened and a new Plant Animal Virus Research Institute was proposed to be set up. At IVRI, new divisions of Epidemiology, Veterinary Public Health, Experimental Medicine, and Surgery and Livestock Products Technology were proposed to be set up.

The two new aspects of research proposed concerned the diseases communicable from animal to man and vice versa, and the problem of rendering animal products safe for human consumption. The research on foot and mouth disease was to be intensified and typing of the disease's viruses was to be undertaken.

Dairying and Milk Supply

At the start of the Fourth Plan, the total number of dairy plants in operation was 91, comprising 47 liquid milk plants, 7 milk product factories and 37 pilot milk schemes. 53 plants were in the public sector, while the rest were in the co-operative sector. Most of the plants were operating at a loss and due to this reason; the principal task in the Fourth Plan was to review the work of the projects and to take corrective measures. This was to include measures like change in the milk pricing policy and introduction of modern management practices. It was necessary to establish a direct link between the small producers and the public sector milk plants through co-operative organization. A phased programme was intended to be drawn up to increase production in the milk shed areas and gradually eliminate dependence on imported milk powder. The financing of dairy development was to be based on three principal sources: Plan Outlays, Institutional Finance, and counterpart funds generated by the sale of commodity gifts under the World Food Programme. The total outlay under the Plan and its break-up was:

Outlay on Dairying:

Sl.No.	Outlay (Rs. Crores)
1. (States)	39.77
2. (Union Territories)	1.95
3. (Central Schemes)	97.25*
4. (Centrally Sponsored Schemes)	--
5. (Total)	138.97

*included an outlay of Rupees 95.00 Crores provided for Indian Dairy Corporation.

The first priority in the Fourth Plan was given to completing the 33 spill-over dairy schemes from the earlier period. The organized dairy industry was to be extended by 24 new schemes in towns with a population of about 50,000. Four milk products factories and 64 rural dairy centres were proposed to be established. With the cooperation of the World Food Programme, the Government of India had formulated a project to stimulate milk marketing and dairy development. Under the project, the World Food Programme was to supply, free of cost, in the duration of the Plan, 1.2 lakhs tonnes of skimmed milk powder and 42,000 tonnes of butter oil. The international valuation of the supply was Rs. 41.90 crores, which was to generate funds worth about Rs. 95.40 crores. The generated funds were to be used for investment in increased milk processing facilities, improved breeding, feeding and management of milch animals. The project was also expected to set up additional storage and transport facilities for balancing seasonal and regional variations in milk production.

Milk Producers' Co-Operatives

Stress was laid in the Third Plan on the organization of a network of producers' co-operatives. Their total number at the beginning of the Fourth Plan was 8,000. In the Fourth Plan, further efforts were proposed to be made towards strengthening and development of milk producers' co-operatives in two directions: re-organization of primary societies into viable units with a minimum collection of 500 litres of milk per day on an average, and working towards a progressive co-operativization of Government milk plants, so that the entire chain (from collection to distribution) could be integrated.

Research

The National Dairy Research Institute (NDRI), Karnal, was transferred to the Indian Council of Agricultural Research in October, 1967. Research facilities at the institute were proposed to be expanded, with the addition of the divisions of dairy cattle genetics, physiology and nutrition and dairy economics. Research on economic utilization of whey for the production of yeast protein was to be undertaken. Coordinated multi-disciplinary research projects were also proposed with the objective of increasing the productivity of dairy cattle and improving the economics of milk production.

5th Five Year Plan (1974-79)

The revised Fifth Five Year Plan outlay was Rs. 39,303 crores, out of which Rs. 4,643.59 crores were proposed to be spent on agriculture and allied programmes. By the time the Fifth Plan was initiated, there were 85 subsidized projects for cross-breed calf rearing, 57 poultry production projects, 45 piggery development projects and 38 sheep production projects being run through small and marginal farmers and agricultural labourers in 148 districts. The targets under production-oriented projects, such as Intensive Cattle Development (ICD) Projects, intensive poultry production-cum-marketing centres, sheep and wool extension centres and fluid milk plants and milk product factories, were expected to be achieved in full during the Fifth Plan.

Operation Flood had already been started by NDDB in 1970. Integrated milk production-cum-marketing projects were proposed to be implemented in the states of Meghalaya, Assam, Sikkim, Himachal Pradesh, J&K, Orissa and Kerala, as the second phase of the 'Operation Flood' project. Emphasis was continued to be laid on cross-breeding in cattle through establishment of exotic cattle breeding farms and intensive AI measures. Scientific poultry breeding programme and programmes for the control of rinderpest and foot and mouth diseases were to be continued.

In Research and education, provisions were made for projects with collaboration of agencies of United Nations.

6th Five Year Plan (1980-85)

By the beginning of the Sixth Plan, the triple function of research, education and extension education was being implemented through 34 Central Research institutes, the National Academy of Agricultural Research Management, five Project Directorates and 54 All India Coordinated Research Projects under the Indian Council of Agricultural Research and 21 Agricultural Universities located in the State Sector. A national grid of cooperative research had been established, in which the role of Central Institutes and the State Agricultural Universities, as equal partners, had been well-defined. With a view to strengthening mission-oriented research, National Research Centres with eminent scientists were to be established during the Sixth Plan period on the one hand and, on the other, a National Agricultural Research Project had been started to enhance capabilities of Agricultural Universities to do location-specific research in each of the agro-climatic zones.

Efforts were proposed to be directed towards collection of statistics on production of major livestock products on the basis of sampling techniques already developed. The Directorate of Economics and Statistics, Indian Agricultural Statistics Research Institute and National Sample Survey Organisation were to examine the recommendations for early implementation under the Sixth Plan.

7th Five Year Plan (1985-90)

The Seventh Plan aimed at increasing employment opportunities, economic productivity in general and productivity of small and large-scale farmers in particular, social justice, anti-poverty programmes and energy production, among other goals. The total Plan outlay for Animal Husbandry and Dairying was Rs. 1,076.68 crores.

8th Five Year Plan (1992-97)

The contribution of the livestock sector had increased to about Rs. 27,700 crores in 1987-88 as compared to Rs. 10,600 crores in 1980-81, which constituted 25.5% of the total agricultural output. Animal husbandry sector had made good progress in the livestock production and health. Achievements during the Seventh Plan (Year-wise) and Annual Plan (1990-91) were:

Year	Milk (mill.tonnes)	Eggs (mill.nos.)	Wool (m.kgs.)
1984-85	41.5	14252	38.0
1985-86	44.0	16128	39.1
1986-87	46.1	17310	40.0
1987-88	46.7	17795	40.1
1988-89	48.4	18890	40.8
1989-90	51.5	20204	41.7
1990-91	54.9	21342	42.0

Operation Flood Project had been started in 1970 by the National Dairy Development Board (NDDB) and the number of dairy cooperative societies had increased from 34,523 in 1984-85 to 64,000 in 1991-92. The peak milk procurement had increased from 7.9 to 13.5 million kgs./day, fluid milk from 5 to 11 million litres/day and rural milk processing capacity from 8.8 to 17.8 -million litres/day.

9th Five Year Plan (1997-2002)

During the Eighth Plan period, milk production witnessed a significant growth of 4.5 per cent per annum to reach the level of 68.6 million tonnes during 1996-97. This had increased the per capita availability of milk from around 180 gms. per day in 1991-92 to 201 gms. per day in 1996-97.The poultry sub-sector had also made significant progress due to research and development activities. Egg production, which was at 22 billion during 1991-92, increased to 28.2 billion during 1996-97. The per capita availability of eggs increased from 25 to 30 per annum during the period. Wool production had increased from 416 lakhs kg. in 1991-92 to 443 lakhs kg. at the end of the Eighth Plan.

10th Five Year Plan (2002-2007)

The Department of Animal Husbandry and Dairying, Ministry of Agriculture, had issued the Milk and Milk Product Order (MMPO) in June 1992 under Section 3 of the Essential Commodities Act. The order sought to ensure the supply of liquid milk to the consumers by regulating its processing and distribution. Restrictions on establishing new milk processing capacity under Milk and Milk Products Order (MMPO) were removed before the start of the Tenth Plan.

The allocation for animal husbandry, dairying (and fishery) was Rs. 2500 crores during the Tenth plan. Animal husbandry and dairying received high priority in the efforts for generating wealth and employment, increasing the availability of animal protein in the food basket and for generating exportable surpluses. The overall focus was on four broad pillars, namely:

1. Removing policy distortions that were hindering the natural growth of livestock production.
2. Building participatory institutions of collective action for small-scale farmers that allow them to get vertically integrated with livestock processors and input suppliers.
3. Creating an environment in which farmers increase investment in ways that would improve productivity in the livestock sector.
4. Promoting effective regulatory institutions to deal with the threat of environmental and health crises stemming from livestock.

There was absence of a lot of data, like those relating to breed-wise milk production of cattle and buffalo, egg production from commercial farms and households, cost of production of milk, egg and wool, availability of livestock resources, etc. A National Animal Health and Production Information System was proposed to be established with the active involvement of research Institutions, Government departments, Panchayati Raj Institutions (PRIs), Urban Local Bodies (ULBs), private industries, cooperatives and NGOs.

11th Five Year Plan (2007-2012)

At the beginning of the Plan, the contribution of livestock to the GDP was about 4.5% and the sector provided employment to about 5.5% of the work force. Growth during the Tenth Plan had been at the rate of 3.6%.
The goals for the Eleventh Five Year Plan for the livestock sector were:

1. To achieve an overall growth between 6% and 7% per annum for the sector as a whole, with milk group achieving a growth of 5.0%per annum and meat and poultry group achieving a growth of 10% per annum;
2. The benefit of growth should be equitable, benefiting mainly the small and marginal farmers and landless labourers and should benefit poorly endowed areas like draught prone, arid, and semi-arid areas;
3. To provide adequate animal health services for effective disease control;
4. The sector should generate additional employment opportunity to people in the rural areas, especially to the female population;
5. Livestock should provide major source of income in the selected areas having potential for mixed crop-livestock farming system; and
6. The growth in the sector should result in the improvement of environment, especially in the rural areas.

The Eleventh Plan allocation (at 2006-07 price) was projected at Rs. 54801 crores, as against a Tenth Plan outlay of Rs. 20513 crores (at 2001-02 price). The total projected Gross Budgetary Support (GBS) for the Eleventh Plan for Department of Agriculture and Cooperation was Rs. 36549 crores (2006-07 price) and Rs. 41337 crores (2007-08 price), for DAHDF was Rs. 7121 crores (2006-07price) and Rs. 8054 crores (2007-08 price) and for Department of Agriculture Research and Education was Rs. 11131 crores (2006-07 price) and Rs. 12588 crores (2007-08 price).

The National Project on Cattle and Buffalo Breeding was the flagship scheme of DAHDF initiated in October, 2000, for a period of 10 years. The scheme envisaged genetic upgradation of indigenous cattle and buffaloes, development and conservation of important indigenous breeds, and development of sustainable breeding policy. The project was being implemented by State Implementing Agencies (SIAs) in 26 States and 1 UT. In the Eleventh Plan, the scheme was observed to be suffering from many shortcomings, particularly quality of progeny bulls and inadequate attention to tagging and registry.

Further, feed and fodder were a perennial problem for exotic breeds and efforts made during the Tenth Plan to improve feed and fodder resources for livestock were not very successful. The performance of the Central Fodder Development Organization was also evaluated by the Centre for Management Development, Thiruvanthapuram, and found to be unsatisfactory. Moreover, with the completion of 'Operation Flood' Project by National Dairy Development Board (NDDB), the pace of investment in dairy sector had slowed down.

The allocation for dairy development by the Central and State Governments had also diminished over the Ninth and the Tenth Plans. Assistance from Government of India under CSS, Intensive Dairy Development Programme, had gone to non-viable areas without conducting proper feasibility studies and had been implemented without proper technical supervision. De-licensing and the subsequent decision to do away with the concept of milk sheds were expected to boost private sector investment in dairying, but this had not happened. Furthermore, there appeared to have been no concentrated efforts to invest in technology for development of value-added and innovative milk products. Consequently, in the first four years of the Tenth Five Year Plan, the growth rate of milk had been less than 3% per annum.

12th Five Year Plan (2012-2017)

The Twelfth Five-Year Plan of the Government of India has been decided to achieve a growth rate of 8.2% but the National Development Council (NDC) on 27 December 2012 approved a growth rate of 8% for the Twelfth Plan. With the deteriorating global situation, the Deputy Chairman of the Planning Commission Montek Singh

Ahluwalia has said that achieving an average growth rate of 9 percent in the next five years is not possible. The Final growth target has been set at 8% by the endorsement of the plan at the National Development Council meeting held in New Delhi.

"It is not possible to think of an average of 9% [in the Twelfth Plan]. I think somewhere between 8 and 8.5 percent is feasible," Ahluwalia said on the side-lines of a conference of State Planning Boards and departments. The approached paper for the Twelfth Plan, approved last year, talked about an annual average growth rate of 9%."When I say feasible... that will require major effort. If you don't do that, there is no God given right to grow at 8 percent. I think given that the world economy deteriorated very sharply over the last year...the growth rate in the first year of the 12th Plan (2012–13) is 6.5 to 7 percent."

Source (https://en.wikipedia.org/wiki/Five-Year_Plans_of_India#Twelfth_Plan_(2012%E2%80%932017)

The objectives of the Twelfth Five-Year Plan were:
1. To create 50 million new work opportunities in the non-farm sector.
2. To ensure that 50% of the rural population have accesses to proper drinking water.
3. To increase green cover by 1 million hectare every year.
4. To provide access to banking services to 90% of households.

Specific plans and objectives for the major sub-sectors (a) livestock: For achieving growth rate of 5–6 per cent per annum the animal husbandry sector would need to address important challenges during the Twelfth Plan. These include delivery of services, shortage of feed and fodder and frequent occurrence of deadly diseases. Compared to its contribution in the economy livestock sector has received much less resources and institutional support. Livestock extension remains grossly neglected.

The country still lacks adequate facilities and the infrastructure for disease diagnosis, reporting, epidemiology, surveillance and forecasting. Livestock markets are underdeveloped, which is a significant barrier to commercialisation of livestock production. Besides, the sector is also coming under significant pressure of increasing globalisation of agri-food markets. Although there is demand for Indian meat products in international markets, lack of international processing standards is a hindrance. Unfortunately, schemes on modernisation of slaughterhouses and by-product utilisation have not been effectively implemented. In the animal husbandry sector, the major priority areas during Twelfth Five Year Plan will be breed improvement, enhancing availability of feed and fodder and provision of better health services, including proper breeding management.

Taking NDP into account and, with RKVY incentives for States to substantially enhance public sector investment in agriculture and allied sector during the Eleventh Plan, the Department of Animal Husbandry, Dairying and Fisheries (DAHDF) has also decided to redesign its schemes. It aims to provide more flexibility to States while reducing the number of Centrally Sponsored Schemes (CSS) and reorientating these to secure better programmatic focus. 12.127. On genetic improvement in bovines, the current major programme is the 'National Project for Cattle and Buffalo Breeding (NPCBB)' which is being implemented since October 2000. Unlike NDP, which aims to provide breeding services from the dairy side, NPCBB is administered as part of States' veterinary services. DAHDF proposes to continue NPCBB in this present form since the DAHDF target is to expand the artificial insemination programme from present coverage of about 25 per cent of breed able population to 50 per cent, which will require an expansion of AI services beyond the about 35 per cent coverage planned for under NDP. This is because NDP will not cover all States and there are likely to be farmers not covered by dairy led breeding services even in States covered by NDP. Moreover, States have already established Livestock Development Boards (LDBs) in the present format to implement bovine breeding programmes with a stated focus on development and conservation of important indigenous breeds.

Conclusion

The planning lacks uniformity in terms of both pattern and measures taken for the development of each of the sub-sectors in animal husbandry and dairying. In the first four Plans, planning was found to be comparatively exhaustive, while in the successive Plans it got more "general" in terms of steps-to-be-taken. Even in the

Eleventh and twelfth Plans a lot of instructive measures, rather than concrete measures were seen. The sub-sectors were found to be missing altogether in some of the Plans.

Of course, there has been a tremendous improvement in animal husbandry and dairying since the inception of the first Plan, but there is no denying the fact that we lacked:

1. Consistency.
2. Timely checks.

A comparative analysis of the Plans with regard to each of the sub-headings in the sector, namely, Poultry, Piggery, Equines, Small Ruminants, etc., can be undertaken to get a further insight into the lacunas in the development and growth in animal husbandry and dairying in India. This would help in drawing out strategies for the construction of a wholesome, all-inclusive plan for animal husbandry and dairying in every subsequent Five-Year Plan hereafter.

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Seed Upgradation Techniques: An Important Tool for Quality Seed Production

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Introduction

In seed lot either before processing or after storage or due to improper processing, the seed lot may have less vigorous seeds such as immature, ill filled and insect damaged seed which may adversely affect the planting value of the seed. Removal of this seed will favour the better establishment and higher production potential in the field. Hence seed upgradation is warranted to eliminate the low vigour or dead seeds and meet out the Indian Minimum seed certification standard.

Egg Floatation Technique in Paddy

Paddy seeds are upgraded by using egg floatation technique. In this technique high vigour and low vigour seeds are separated based on densities of seed using salt solution.

Materials required: Seed, Common salt, Egg and water

Methodology:

a. Take 10 litres of water in a plastic bucket of 15 litre capacity.
b. Drop a fresh egg in water.
c. Add commercial common salt, little by little into the water and allow it to dissolve. (@ 2 kg/10 litres of water).
d. Watch the egg to rise up as the density of the solution increases.
e. Stop adding salt when the surface of the egg of a size equivalent 25 paise coin, is visible above the solution. Now the density of the water is suitable for separation of good quality seeds.
f. Add 10 kg of rice seeds to this salt solution.
g. Remove the seeds floating on the surface.
h. Collect the seeds sunk in the salt solution and wash them thoroughly.
i. Calculate the 1000 seed weight of floaters and sinkers.
j. Subject the floaters and sinkers to germination test.

Caution:

Egg flotation techniques in rice

a. Egg is only for measurement of specific gravity and has no work to do with separation.
b. If the density of water is more, more portion of egg will float if less egg will be inside the solution.

c. If the density of water is more loss of quality seed may occur, lesser density the separation will not be perfect.

Live Seed Separation in Groundnut

Groundnut seed are classified as micro biotic due to their fast-deteriorating nature due to its oil content. It also has production problems that lead to the yield of poor-quality seeds. But in groundnut for getting required yield plant population has to be maintained (33plants / sq.m.) This warrants the need of sowing good quality seed selection technique is the live seed separation. Hence live seed separation technique is the separation of germinable seed from dead seed.

Materials required: Seeds, 5% $CaCl_2$ and gunny bags

Methodology:

a. Separate the pest attacked, brokened and immature seeds before soaking
b. Soak the seeds in equal volume of 0.5% CaCl2 salt solution for 6 hrs.
c. For preparation of 0.5% CaCl2 solution we have to dissolve 125 gm of CaCl2 in 25 lit of water.
d. Keep the seeds in between gunny bags in thin layer for about 16 hrs.
e. After 16hrs the live seeds radicle might have germinate up to 5mm.
f. Separate those germinated seeds from that seed lot and dry it in shade.
g. For every 2hrs internal the germinated seeds can be separated from that lot for about 3-5 times.
h. That seeds can be dried in the shade.
i. The remaining ungerminated seeds are considered as dead ones.
j. Further these germinated seeds are treated with either Carbendazim (Fungicide) or Rhizobium.
k. Sprouted seeds can be used for sowing.

Separation of live seed from dead seed

Precautions

1. Do no spread as thick layer.
2. Avoid fungal spread in the gunny bag.
3. Do not allow to over sprout.
4. Shade dry the seed of each interval of collection separately.

Advantages

1. Seed rate will be reduced.
2. Dead seed can be discarded before sowing.
3. Calcium deficiency can be overcome by soaking the seeds in $CaCl_2$ solution.
4. About 10-15% of the yield can be increased.

Conclusion

Quality seed is the important basic input for successful agriculture, which demands each and every seed should be high germination percentage and produce vigorous seedlings to ensuring the high yield. "Care with the seed and joy with the harvest" and "Good seed doesn't cost it always pays" are the popular adage which enlightens the importance of the quality seed. The farmers always very much interested in the best seed management practices which are low cost, safe, environmentally sound and scientifically proven technologies. An egg floatation technique in paddy and live seed separation in groundnut are noteworthy seed upgradation techniques to obtain the quality seeds for the farmers and seed producers.

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Crop Simulation Model

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Introduction

A crop simulation model is a simple representation of crop that aims to study crop growth and development and to compute their responses to the environment.

In essence, they are computer programs that mathematically simulate the growth of a crop in relation to its environment. They often operate at time steps one or two orders of magnitude below the duration of the growing season and provide output data to describe attributes of the crop at different points in time on the web. The main advantage of using crop models are linked with the possibility to overcome the limitations of classic experimental approach (i.e. extrapolating the results in different conditions) and to provide information to the end-users. Crop model can be used at field and regional scales, under different weather regimes and in different conditions, cultivars, cropping systems, etc.

Important Crop Models

DSSAT: It is a software application program that comprises crop simulation models for 28 crops. The program integrates the effects of soil, crop phenotype, weather and management option and allows users to ask "what if" questions and simulate results by conducting experiments on a computer in minutes that would otherwise consume a significant part of an agronomist's career. DSSAT has been in use for more than 20 years by researchers in over 100 countries. DSSAT is one of the principal products developed by the International Benchmark Sites Network for Agrotechnology Transfer (IBSNAT) project supported by the U.S. Agency for International Development (USAID) from 1983 to 1993.

ORYZA: A Crop Growth Simulation Model for Rice

ORYZA2000 is a growth model for lowland rice (Oryza sativa L.) developed by the International Rice Research Institute (IRRI) and Wageningen University.

ORYZA is an ecophysiological model which simulates growth and development of rice including water, C, and N balance (Bouman et al., 2001; IRRI, 2013) in lowland, upland, andaerobic rice ecosystems. It works in potential, water-limited, nitrogen-limited, and NxW-limited conditions, weather, irrigation, nitrogen fertilizer, general management, variety characteristics, soil properties. This model has been evaluated extensively in a wide range of environments. The model ORYZA2000 simulates the growth and development of rice under conditions of potential production and nitrogen limitations. Model ORYZA2000 was sufficiently accurate in the simulation of leaf area index (LAI) and biomass of leaves, panicles, and total above ground biomass yield under nitrogen limit conditions.

Why ORYZA?

It can be used to study rice cropping management on water (irrigation), nitrogen fertilizer, sowing/transplanting date, etc. It has strong ability on estimating weather constrained rice growth and yield. Thus, it can be used in application-oriented research such as the design of crop ideotypes, the analysis of yield gaps, the optimization of crop management, the ex-ante analysis of the effects of climate change on crop growth, and agro-ecological zonation. Thus, it was calibrated and validated for 18 popular rice varieties in 15 locations throughout Asia.

Benefits of Crop Simulation Models

1. Reduction in time required for experimentation and observation.

2. Increased control over environmental variability.
3. Provision of safe learning environment.
4. Provision of opportunity to undertake undesirable experiments.
5. Transferal of expert knowledge and research experience.
6. Elucidation of complex plant environment mathematical descriptions.
7. Synthesis of fragmented knowledge.
8. Integration of different but associated topic areas.
9. Facilitates distance education and education at a distance.

Limitations of Crop Simulation Models

1. Missing field and laboratory skills.
2. Separation from the subject of study.
3. Development of belief that CSMs are reality.
4. Experimentation and observation outside model range.

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Entomophagy

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Insects as Food

The practice of consuming insects is known as ENTOMOPHAGY. It is more common than you may think, as over 2 billion people regularly consume over 1900 species of insects around the world. It has been a documented part of the human diet for more than 2000 years in some parts of the world, and some archaeological evidence suggests we have consumed insects for over 1.7 million years. Bone artefacts found in South Africa have wear patterns that suggest they were used as tools to dig into termite mounds.

Insects are commonly farmed today as a protein source for vertebrate livestock, such as poultry. Fish and soy meal, which are farmed intensively, can be partially replaced by the more sustainable production of insect protein, such as fly larvae, to reduce agricultural and fishing intensity. Unlike other substitutes, this does not place additional pressure on other industries as the flies can be reared entirely on waste products.

Nutritional Benefits

Part of the reason insects may help with food shortages is because they are a highly nutritious food source. While the nutritional content varies by species and their diet, insects are more nutritious than many foods we currently eat. Per unit weight, insects provide more calcium than milk, more iron than spinach, and more magnesium and vitamin B12 than beef. They also provide all 9 amino acids essential to humans, and protein can make up as much as 50% of an insect's dry weight. Some insects also have a high quantity of natural fats. Their overall nutrient content is comparable to many of the animals that are farmed and consumed by humans today.

While insects are extremely high in protein, their chitinous exoskeletons are largely indigestible by humans. The indigestible exoskeleton, however, acts as a good source of fibre, which can promote healthy communities of endosymbionts in the human gut. As we learn more about the importance of microbiota in the human gut, we begin to understand how important it is to promote the maintenance of these communities through the addition of probiotics and prebiotics to human diets. Probiotics are living microbes that complement naturally occurring gut fauna, while prebiotics are types of fibre that nourish the gut fauna. Chitin can act as a prebiotic for the good microbes in the human gut.

Interesting Fact: A recent study has found that arthropods regularly consumed by humans in some parts of the world are also high in antioxidants. Crickets and silkworms both showed antioxidant capacity similar to that of olive oil and orange juice, foods that are well-known to have antioxidant effects in humans. In fact, insect extracts have 5 times the antioxidant capacity of fresh orange juice. Antioxidants are molecules that can help protect our cells from damage caused by free radicals, which are constantly produced through regular cellular processes.

Sustainability

One of the major issues with much of livestock production today is the sustainability of the practice. Insects can be more sustainably reared than most livestock today, and use less input and a smaller footprint of land, while producing fewer greenhouse gas emissions.

1. Insects can be reared on a smaller carbon footprint partly due to the fact that they are ectothermic.

2. Unlike endothermic livestock reared today, insects convert a large proportion of food into edible tissue because they do not need to use energy to maintain body temperature. This generally means less food and water are required to rear the animals.

3. Crickets have an impressive ratio of conversion of food into body mass. For every 2 kilograms of food consumed, crickets gain 1 kg in body mass. Compare this to pigs, which require 5 kg of food for each kilogram of body weight, or cows, which require 10 kg of food for each kilogram of body weight gain.

4. The consumption of water is also more efficient for cricket rearing than endothermic livestock. Since endotherms maintain high body temperatures, more water is lost through evaporation compared to ectotherms.

5. Insects also contain a higher proportion of edible tissues compared to traditional livestock. Only 40% of the mass of a cow is used as food, with inedible tissues put to other uses. Compare this to crickets, in which 80% of the insect's mass is made up of edible tissues.

6. In addition, the rapid growth and short lifespan of insects means a quick turnover of plant food into animal protein, which can make entomophagy even more useful in times of resource scarcity.

7. Another one of the benefits to the use of insects as food is the space efficient conditions in which these animals are reared. While consuming less food and water than traditional livestock, insects also have minimal requirements for growth.

8. Small areas and vertical spaces can be better utilised than in the rearing of vertebrate livestock. For instance, cows require 6 times more space than crickets in order to produce a single kilogram of protein.

9. The rearing of insects also produces less waste than vertebrate livestock in terms of greenhouse gas emissions. Insects produce significantly less carbon dioxide, ammonia, methane, and nitrous oxide than vertebrate livestock. For instance, cricket rearing produces 90% less methane and 99.7% less nitrous oxide compared to the rearing of cattle.

10. The faces of mass-raised insects can also be put to use. Just as waste from vertebrate livestock can be used as fertiliser and for other applications, the frass of reared insects, such as silkworms, is used to feed fish, either directly or by using it to culture plankton.

In order to feed an ever-growing human population, we need to explore sustainable food sources, such as the use of insects as food. While the benefits of entomophagy are abundant in terms of health and sustainability, the overall perception of insects held by much of the world hinders the progression of entomophagy in many nations.

Entering the Market

Many people struggle with the thought of insect consumption due to the common perception people hold that insects are "unclean" or "gross". Fortunately, entomophagy is on the upswing as sustainability is brought to the forefront of global policies. Most examples of insect foods today come in the form of novelty items, such as seasoned dried insects or those covered in chocolate or candy. However, some insect-based foods in North America are beginning to be marketed as a staple in human diets.

Cricket and mealworm flours have become popular as protein-filled substitutes to wheat flour in cooking and baking. These are much more nutritious than wheat flour, and can provide a gateway into entomophagy since the consumer doesn't see or chew whole insects while eating. Challenging the perception of insects in society can be tricky, but the first step in introducing insects into the human diet may be as simple as presenting the foods in a visually appealing manner.

However, there are other challenges in bringing insects to the dinner table. Even once the perspective of citizens changes and insects become more widely accepted as a food source, there are few regulations to govern the use of insects as food for human consumption. It requires the development of clear guidelines that state whether insects have been raised or produced at a standard conducive to human consumption. This blocks many large-chain grocery stores from stocking insect-based foods, which further hinders the progression of entomophagy in developed nations.

Conclusion

Insects have had an undeniable influence on human society. They provide us with important ecosystem services and a variety of products as well. Insects are also widely present in aspects of human culture, such as art, literature, and television. Their influence has spread into virtually all forms of media. Insects have also acted as inspiration for science and technology through biomimicry, and research on insects contributes to many scientific fields such as robotics and genetics. In the future, insects may become even more present in our lives as human diets shift toward insect-based protein. Entomophagy may be an important solution to global food shortages, but there are challenges entering the market when the food you're promoting is viewed negatively by much of the population. Regardless of the way arthropods are perceived, these animals will always have important impacts on many aspects of human culture.

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Irrigation Scheduling of Rice by Improved Device

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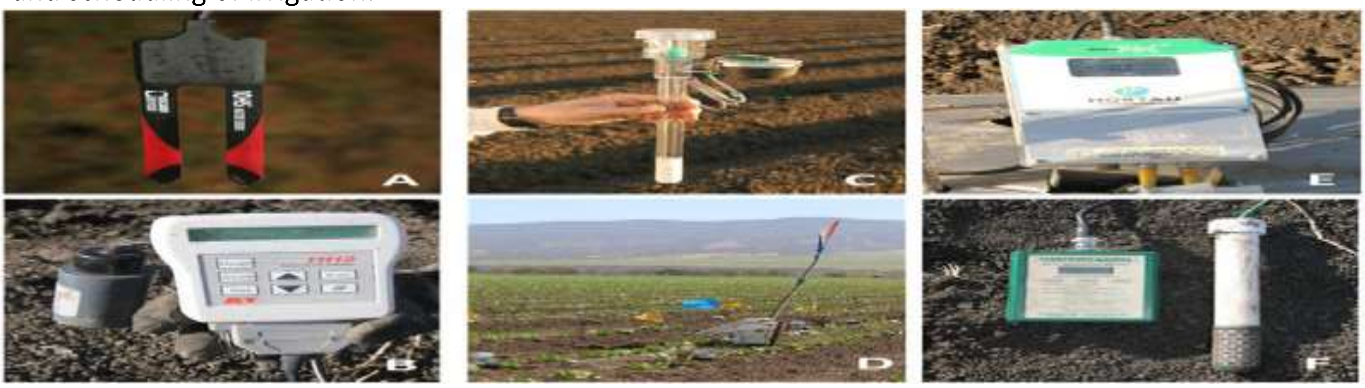
Introduction

Rice is an aquatic plant and thrives on saturation conditions. Total submersion of the rice plant for extended periods of time, however, decreases yields. Thus, it is important that both the supply and the drainage be closely controlled. As rice is usually irrigated in basins, the basin bottoms should be well levelled to prevent excessive submergence in places and inadequate wetting in others. The water use (Et) by a non-stressed rice crop can vary between 450 and 700 mm per day, depending on climate and variety. Kc for the initial 2 months varies from 1.1 to 1.15, depending on the wetness of the soil surface. Mid-season Kc varies from 1.1 to 1.3 and, for the final month, it varies from 0.95 to 1.05. Saturation or near saturation conditions must be maintained during most of the growing season. After transplanting, saturation is maintained by a film of water (about 10 cm) over the surface. Flowering and head formation are most sensitive to a lack of water. Some scheduling approaches for rice follow. In continual saturation scheduling, water is maintained at approximately 10 cm depth for about one week after transplanting. Through tillering, a maximum depth of about 3 cm is maintained. From 30 days before head formation and flowering to the start of maturity, soil is covered with water often to a depth of 8 or 10 cm. A continual flow of water is frequently maintained. The fields should be drained completely 30 to 45 days before harvest to ensure that they will be dry enough for harvest. This method generally a result in maximum potential yield. Intermittent irrigation is another scheduling approach used on rice when water is scarcer. Irrigations are applied periodically to maintain the crops at near-saturation level when possible. Yield may be reduced significantly with this method if moisture cannot be maintained at saturation from heading to flowering. In the controlled water savings method of irrigation, the field is maintained as close to saturation as possible, except that the field is flooded at transplanting and then for about 30 days (from heading through flowering). Maximum yields can be achieved with this method.

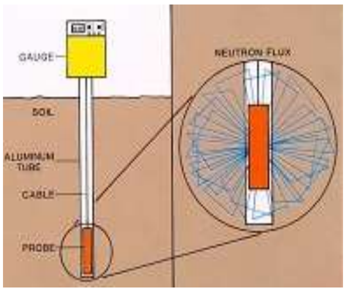
Tensiometer

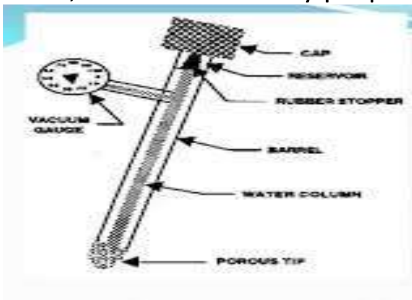
It is also called as irrometer, since they are used in irrigation scheduling. Tensiometer provide a direct measure of tension with which water is held by soil. It works satisfactory up to 0.85 bars of atmosphere consist of 7.5 cm porous ceramic or clay cup and a metallic tube a vacuum gauge with hollow metallic tube. At the time of installation, system filled with water from the opening at the top and rubber corked when setup in the soil moisture from cup moves out with drying of soil, creating a vacuum in the tube which is measured with gauge. Rice is the staple food and water shortage is major threat for sustainable rice production worldwide. Therefore, our main focus is water saving rice production such as aerobic rice, direct seeding, alternate wetting and drying etc and scheduling of irrigation.



Neutron Meter

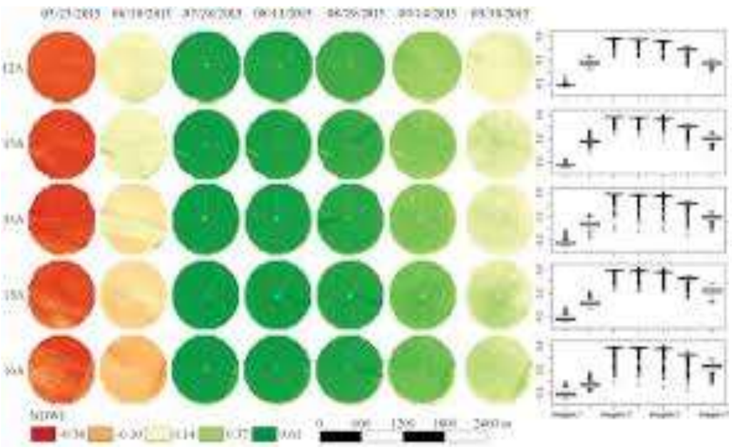
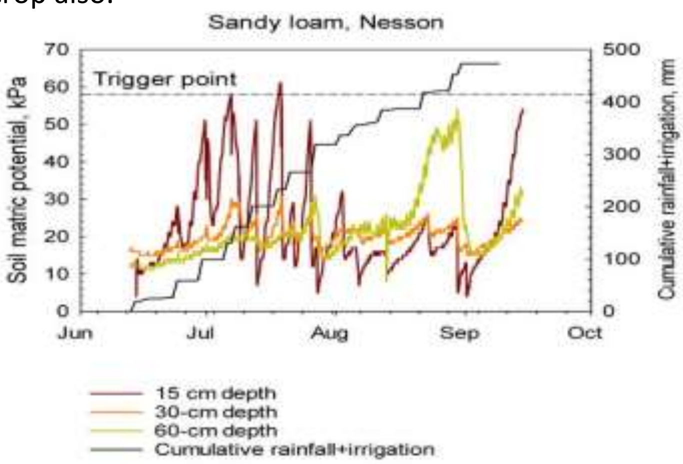
Soil moisture are estimated quickly and continuously with neutron moisture meter in case of aerobic rice without disturbing the soil. This meter also scans the soil to about 15 cm diameter around the neutron probe in wet soil and 50 cm in dry soil. It consists of a probe and a rate meter. The probe contains fast neutron source which may be a mixture of radium and beryllium and americium and beryllium. The tubes are aluminium tubes which are placed in the field where moisture to be estimated. Fast neutrons are released from the probes that scatter into the soil when neutrons encounter nuclei of hydrogen atom of water, their speed is reduced. The rate meter counts the number of slow neutrons, which are directly proportionate water molecules.





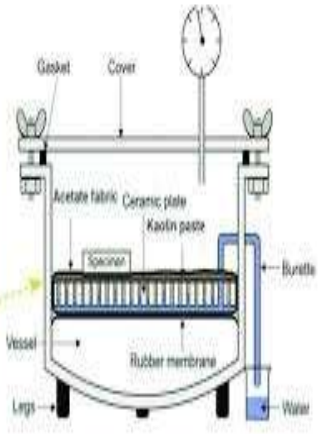
Multi-Band Sensor

Multispectral sensor or multi band sensor is now days used for irrigation scheduling and management purpose. It measures plant canopy temperature and multispectral reflectance. It comprises sensors which are used for measuring radiation and spectral reflectance over five bands a microprocessor to receive and store measured data from the sensors and a wireless transmitter for transmitting data from the microprocessor to a remote receiver. The sensors, microprocessor and wireless transmitter are framed together. The sensors of the device include an infrared thermometer effective for remotely measuring the temperature of a Surface (e.g., plant canopy and/or soil), and photodiode detectors effective to individually measure filtered radiation in the near infra-red (NIR) band region, the red band region, the green band region and the blue band region. It also has the capacity to observe variations in spectral signature due to plant stress (e.g., disease, water stress) and due soil background and to qualify temperature data accordingly. The data from the sensors provide information for decision Support algorithms related to the initiation of automatic irrigation scheduling and it is very useful to schedule irrigation in almost all type of soil as well as crop also.

Pressure Membrane and Pressure Plate Apparatus

It is mainly used to estimate field capacity and permanent wilting point and also moisture content at different pressure. It is consisting of air tight metallic chamber in which porous ceramic pressure plate is situated. Then pressure plate and soil sample placed in metallic chamber and the soil sample held less than the required pressure applied flow out of the outlet till equilibrium against applied pressure is achieved then the soil sample are taken for determine moisture content through this process we can easily schedule irrigation in rice.



IrriSAT

It is a technology that is develops in last few years and it is mainly a weather-based irrigation scheduling device. The methodology uses satellite image for determining NDVI. Then plant canopy size, specific crop coefficient also estimated by this. IrriSAT shows current crop water use and simultaneously historical data of the selected field and cumulative crop water from the planting date. IrriSAT is mainly a weather-based irrigation scheduling device. So, we can easily use it by forecast evapotranspiration and rainfall but it iproblematito install.

Conclusion

Irrigation scheduling of rice through the improved device has greater potential as compare to the other regular used device because it provide the higher accuracy of the result and time saving and non-destructive but in this improved device also have some draw back because of higher initial investment and skilled expertise person should need and it is not used for small area or field .so there are so many advantage and disadvantage are there but although for getting accuracy of the results and grater yield improved device are so much useful and beneficial.

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Insect Pollinators and their Economic Importance

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Abstract

Pollinators are biotic agents that transfer pollen from anther to the stigma of the flower. Pollinators include insects and other animal pollinators that play a vital role for the production of healthy crops that give us food, fibres, edible oils, medicine, and other products. There are about 1,300 types of plants cultivated around the world for the purpose of food, beverage, medicines, spices, fabric and other economically important commodities. Out of the total plants cultivated, about 75% of the plants are pollinated by animals. Pollinators such as bees, bats and birds affect about 35% of the world's total crop production which benefits the production of leading food crops worldwide.

Introduction

Pollination is an essential service which regulates and supports a cultural ecosystem. Pollination refers to the transfer of pollen from the anther to the stigma of the flower. In some of the plant species pollination can occur by the means of wind or water (abiotic pollination) but is seldom the dominant route. Wind pollination takes place in less than 10% of the flowering plants. 94% of all the flowering plants depend on the mode of animal pollination for the purpose of reproduction. A pollinator is any biotic agent, animal or vector which transfers the male pollen from the anthers of a flower to the stigma of another or same flower to complete the fertilization in the ovule (female gamate) of a flower. Pollinators provide ecosystem service for agricultural food production at both global and national level. They play an important role in the production of many field crops, vegetables and fruits. Crop pollination by insect is an important agriculture ecosystem service which provides economic benefits necessary for the sustainable production of food and management of farms.

Among insect pollinators, honeybees are the most important pollinators as it constitutes about 80% of the pollinators. Other pollinators include wasps, beetles, lemur, monkeys, Flies, butterflies, mosquitoes, moths, ants, rodents, lizards, snails, slugs, bats and humans. Bat is considered to be the principal pollinator among mammal pollinators, critically important for the pollination in plants such as agave and cacti.

The crops produced in India have high diversity in pollination requirements. Cereal crops grown in India such as rice, wheat and corn are either self or wind pollinated. Crops such as sugar beet, potato and onions comparatively require lower rate of pollination but forms an important part of the human diet. Most pome and stone fruits rely on biotic pollination i.e pollination by means of living organisms. Insect pollination can increase the total yields in cherry by 80% and in plum crops by 30%. The honey bee is the primary pollinator for fruit crops like cherry and plum. Other contributors are bumblebees and solitary bees. In oilseeds such as rapeseed pollination can increase yields by up to 20%. In times of minimal abiotic pollination due to unfavourable winds, insect population can contribute a yield increase of 15%.

Biotic pollination adds variety of fruits and vitamins to our diets. In addition to the tree crops, many berry and vegetable crops such as watermelon, pumpkin, raspberries, cucumbers and spices also rely on insect pollination. 264 crop species globally have been verified as being partially or fully dependent on pollination. The 57 of the world's most produced crop species has also shown an increase in yield due to biotic pollination. Pollination improves the availability of food by increasing the yield. This makes food more affordable.

Pollinators can visit flowers for many reasons, including pollen collection, feeding or warmth. When pollinators visit the flowers, pollen drops or sticks on their bodies. As the pollinator moves from one flower to the next, this pollen then gets transferred to another flower of a same plant or a flower of another plant. This process pollination is a pivotal stage in the life cycle of all flowering plants to start the production of seed and fruit in flowers.

Insect mediated pollination is largely important to the economy. Bees, both domesticated as well as the wild bees (250+ species) along with other insect pollinators have high commercial value because of their efficient pollination of important crops, such as rapeseeds, oilseeds, strawberries, apples and tomatoes. By improving the quality of the yield and increasing its shelf life insect pollination increases both crop yields and marketability. A large portion of India's cultivated land has crops that require insect mediated pollination and the costs of pollinating these crops without insects are estimated to be large. Honeybees pollinate between 5 and 15% of crops. The others are pollinated by wild pollinators and some plants are pollinated by pollinators which cannot be substituted by honeybee. A diverse range of pollinators is for resilience in the face of future change and will be important for crop yield.

Declination in the pollinator population spell bad news especially for wildflowers which are highly dependent on insect- pollination and a quarter of which are now threatened. And in turn, other wildlife depends on these pollinating insects and pollinated plants for food and shelter. Insect-pollinated Ivy and hedgerows provide the birds with fruit in winter months and provides shelter while the insects themselves pose as an important link in food chain as prey for other insects, bats, insect-eating birds and other animals. Pollinators also provide certain benefits to the society. Many other sectors in a society apart from agriculture and the environment also benefits from the services of pollinators, this includes health and social well-being, recreation, education, energy such as biofuels, tourism and culture.

Honeybees are one of the most important pollinators for both cultivated and wild plants. Globally, they are crucial for agriculture as they pollinate diverse range of cultivated plants. Pollination occurs when pollen grains are transferred from the flower of one plant to another flower of same plant or to another flower of a different plant of same species to complete the process of fertilization. Some plants rely on wind pollination, and some are self-pollinating, but almost all flowering plants require natural pollinators such as honeybees for the purpose of fertilization. A good pollination system makes up a healthy ecosystem.

Although honeybees are valuable pollinators, there has been a declination of the bee population due to anthropogenic activities. In such cases where the pollination services of honeybees or other primary or common pollinators are compromised, alternative pollinators can ensure pollination services. Alternate pollinators include bee species such as the stingless bees, bumblebees and orchid bees which are closely related to the honeybees. There are about 300 species in America, 50 in Africa, 10 in Australia, 60 in Asia and 4 in Madagascar. Species of stingless bees such as *Plebeia emerina Friese* and *Tetragonisca fiebrigi Schwarz* are very efficient pollinators. *A. mellifera* is also an efficient pollinator because it effectively touches the reproductive organs of the flower though they are efficient pollinators only when collecting pollen.

Bumble bee is the third group of social bees. They do not make honey rather store nectar in the hive. They have smaller colonies, with a population of about 50 to 250 individuals depending on the bee species. They have annual colonies which means they produce new queens in the fall, then they hibernate and the ones that survive the winter starts a new colony in the spring. They have buzz pollination in which the movement of flight muscles causes vibration. This dislodges and disperses the pollen causing pollination.

Pollinators provide an essential ecosystem service; the contribution to the maintenance of biodiversity and to enhance the survival of plant species including crop plants. Plants and animals, particularly insects, largely interact at the point of pollination and this relationship is vital to continue functioning and existence of plants and animals in balance and stable state. The ultimate fruits production depends upon a number of aspects such as flowering period, floral morphology, anthesis, pollen morphology, pollen productivity, stigma morphology, stigma receptivity, flower-visitors interaction and their foraging behaviour.

So, the relationship between the flower and visitor is one of the most critical parts of plant reproduction as well as pollen dispersal and pollination. Pollinators are of immense importance in agriculture pollinating for major crops such as apple, pear, stone fruits etc. Insect pollination increases crop yields as well as marketability by improving the quality of the produce and its shelf life. Major pollinators such as honeybees, bumblebees, stingless bees, coleopterans and other minor pollinators such as bats, humans, snails etc pollinate about 75 percent of the total cultivated crops globally. Honeybee is considered to be one of the prime pollinators and beneficial insects providing economically important commodities such as honey, beeswax, propolis, royal jelly etc along with the role of pollination. Anthropogenic activities such as use of pesticides, habitat unavailability due to expansion of urban areas has resulted in the declining population of honeybees. Declining bee population poses a threat to global agriculture. Improving the health of bees and other pollinators is a necessity because without pollinators, much of the food we eat and the natural habitats we enjoy would not exist.

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Abiotic Stress Management for Sustainable Agriculture

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Introduction

What is stress: External conditions that adversely affect growth, development or productivity.

Types of stresses:

a. Biotic: Imposed by organism (i.e. living things).
b. Abiotic: Arising from an excess or deficit in the physical.

The term abiotic stress refers to factors such as sub and supra optimal temperature, excess salt level, reduced water availability leading to dehydration stress, excess water resulting in flooding stress and oxidative stress.

Importance of Abiotic Stress

Abiotic stress not only determines the geographical and regional distribution of crops, but they also dictate if a potentially arable land piece can actually be used for cultivation. It is estimated 24.2% of the geographical area is under actual cultivation, and the rest of the area is not accessible for cultivation due to abiotic stresses.

Impact of Abiotic Stress

1. Abiotic stress management is one of the most important challenges facing agriculture.
2. Abiotic stress can persistently limit choice of crops and agricultural production over large areas and extreme events can lead to total crop failures.
3. Abiotic stresses adversely affect the livelihoods of individual farmers and their families as well as national economies and food security.

Losses Caused by the Abiotic Stress

The progressive salinization of soil, estimated at around 20 % of irrigated land in world. High temperature coupled with drought during pollination period of maize plants can result in up to 100 % yield. It was estimated that approximately 70 % of yield reduction was due to abiotic stress. The estimated potential yield losses are 17 % due to drought, 20 % due to salinity, 40 % due to high temperature, 15 % due to low temperature and 8 % due to other stress.

Pressure Membrane and Pressure Plate Apparatus

It is mainly used to estimate field capacity and permanent wilting point and also moisture content at different pressure. It is consisting of air tight metallic chamber in which porous ceramic pressure plate is situated. Then pressure plate and soil sample placed in metallic chamber and the soil sample held less than the required pressure applied flow out of the outlet till equilibrium against applied pressure is achieved then the soil sample are taken for determine moisture content through this process we can easily schedule irrigation in rice.

Temperature Stress

1. Heat stress: Heat stress is often defined as the rise in temperature beyond a threshold level for a period of time sufficient to cause irreversible damage to plant growth and development. Heat stress affects plant growth throughout its ontogeny, though heat-threshold level varies considerably at different developmental stages. Different greenhouse gases will gradually increase world's average ambient temperature.

Effects of Heat stress on plants:

a. Seedling establishment is hampered.
b. Drying of leaf margins and scorching effect on leaves.

c. Reduction in plant growth.
d. Pollen development is affected.
e. Alteration in photosynthesis.
f. Total biomass is reduced.
g. Spikelet sterility.
h. Grain and fruit development and quality is affected.

2. Low temperature stress: Low temperatures can damage plants both by a chilling effect, leading to physiological and developmental abnormalities. Injury that is caused by a temperature drop to below 15°C but above freezing point. By freezing, causing cellular damage (intra cellular) directly or via cellular dehydration (extra cellular).

Effect of cold stress on plant growth: Some physiological processes such as flowering in rice are extremely sensitive to low temperature and damage may occur at temperature as high as 20°C. According to Levitt (1980), Witt and Barfield, (1982) commonly visible symptoms of low-temperature injury to the leaves include,

a. Wilting.
b. Bleaching due to photo oxidation of pigments.
c. Waterlogging of the intercellular spaces.
d. Browning.
e. Eventually leaf necrosis and plant death.

Salinity Stress

A soil is saline when the electrical conductivity (EC) of saturated soil extract is > 4 ds m-1 and a soil is sodic when the sodium adsorption ratio (SAR) is > 15 ds m-1. These types of soils are particularly common in arid and semiarid regions of West and Central Asia, and Australia.

Mechanism of salt stress on plants:
1. Osmotic effect or water deficit effect: Reduces the plant's ability to take up water, and this leads to slower growth. This is the osmotic or water-deficit effect of salinity.
2. Salt specific effect or Ion Excess Effect: Salts enter the transpiration stream and eventually injure cells in the transpiring leaves, further reducing growth.
3. High salts can cause leaf burn, inhibit water uptake and can interfere with uptake of certain essential elements (e.g., calcium).
4. Stress at reproductive stages leads to spikelet sterility in case of rice.
5. Accumulation of Na^+ and Cl^- is toxic to cell in terms of the effect in enzyme activity.

Effect on Plants

1. On growth: Decreased rate of leaf growth is primarily due to the osmotic effect of the salt around the roots. Increase in soil salinity causes leaf cells to lose water. Reductions in cell elongation and also cell division.
2. Germination: Increased osmotic pressure of the soil solution which restricts the absorption and entry of water into the seeds. Certain salt constituents are toxic to the embryo and seedlings. Anions like CO_3^{-2}, NO^{3-}, Cl-, SO_4^{-2} are more harmful to seed germination. Salt stress hampers the metabolism of stored materials.
3. Vegetative growth: Causes closure of stomata leads to reduction in CO_2 assimilation and transpiration. Reduced turgor potential affects the leaf expansion. Because of reduction in leaf area, light interception is reduced, photosynthesis is affected.
4. Photosynthesis: Accumulation of high concentration of Na^+ and Cl- in chloroplast, photosynthesis is inhibited. The enzymes responsible for carbon assimilation are very sensitive to NaCl.
5. Reproductive growth and yield: Onset of flowering is delayed due to the limitations of source size. The quantum of reproductive structure such as number of flowers is reduced. This disturbance in the normal metabolism affects the mobility of metabolites. Hormone synthesis is hampered leads to reduction in quantity as well as quality of crop produce.

Management of salt effected soils
1. Scraping and removal of surface soil.

2. Appropriate use of ridges or beds for planting.
3. Planting into a pre-flooded field.
4. Grow safflower crop on salt affected soils Mulching (crop residue).
5. Deep Tillage (chiseling)/ sub-soiling.
6. Leaching.
7. Growing green manure crops.

Water Stress

Two main conditions develop water stress in plants.

1. Drought stress: Drought can be defined as the absence of rainfall or irrigation for a period of time sufficient to deplete soil moisture and injure plants.

2. Waterlogging: Waterlogging refers to the saturation of soil with water. Soil may be regarded as waterlogged when the water table of the groundwater is too high to conveniently permit an anticipated activity, like agriculture. In agriculture, various crops need air (specifically, oxygen) to a greater or lesser depth in the soil.

Draught

An extended period of dry weather, especially one injurious to crops. A long period with no rain especially during planting season.

Droughts are of Three Types

1. Agricultural Drought: Period when insufficient water is available to support the normal activities of a crop over a fairly normal long period of a fortnight or more.

2. Meteorological Drought: The intensity of drought is a ratio of actual evapotranspiration (AET) to potential evapotranspiration (PET) during the growing season.

Meteorological Drought = AET/PET

3. Hydrological Drought: Means low flows in the streams, inadequate storage in reservoirs and lowering of water level in the reservoirs, lakes and aquifers.

Effects of Drought Stress on Crops

1. Poor vegetative growth.
2. Reduced seed germination and seedling development.
3. Reproductive growth is severely affected.
4. Plant height and leaf area reduced.
5. Reduced photosynthesis.
6. Significantly reduction in the total dry matter.

Drought Management

1. Soil moisture conservation: Improve infiltration rate, reduce percolation losses, land configuration and selection of crops.

2. Improve infiltration rate: Conserve every drop of rainfall, tillage practice, INM improves structure of soil.

3. Land configuration: Sowing across the slope, dead furrow at optimum distance, bund and furrow preparation to conserve soil and water.

4. Selection of crop: Short duration crops, drought resistant crops, cover crops, hairy and small leaves, water saver plants.

Waterlogging

The soil whose surface layers are saturated with water is called as waterlogged soil. The phenomenon of rising of water table is known as Waterlogging.

Causes of Water Logging

Mainly Waterlogging is caused by Seepage from canals, Over irrigation of fields, Inadequate surface drainage, Incorrect & Defective methods of Irrigation, Improper land levelling, Irrigation during rainy days, Floods, Poor water management.

Effects of Water Logging

1. Absence of aeration of soil in the root zone.
2. Difficulty in cultivation operations.
3. Growth of water weeds & wild aquatic plants.
4. Rise of salts in surface layers.
5. Restricted root growth.
6. Lower soil temperature.

Mitigation of Flooding Stress

1. Providing adequate drainage for draining excessive stagnating water around the root system.
2. Spray of growth retardant of 500 ppm cycocel for arresting apical dominance and thereby promoting growth of laterals.
3. Foliar spray of 100 ppm salicylic acid for increasing stem reserve utilization under high moisture stress.
4. Balance the use of fertilizers (NPK or NPK + lime).
5. Apply lime on acid soils.

Plant Nutrient Stress

Incorrect land use and management may result in an excess of nutrient causing soil contamination and contributing to water quality deterioration and greenhouse gas emissions. Conversely, a lack of nutrients may lead to low soil fertility.

Soil Management Practices for Stress

Increasing soil organic matter can boost soil fertility and balance the soil nutrient system. Improvements in nutrient use efficiency can lead to substantial plant growth. Reductions in the use of agricultural inputs, providing direct benefit to the environment and increasing food production.

Strategies for Nutrient Stress

1. Application of Organic manures.

2. Integrated Nutrient Management Adopt Rs 4.

a. Right Dose.
b. Right time.
c. Right Method.
d. Right source.

Conclusion

Suitable stress management practices, stress tolerance cultivars, soil moisture conservation practices, PGPR or supplemental irrigation with fertilization ameliorate the adverse effect of stress resulting in increased growth, yield, nutrient content and uptake by crops.

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Nano Technology and Agriculture

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Introduction

Nanotechnology is the science and technology of tiny things, the materials that are less than 100 nm in size (1 nm = 10-9 m). Nano- technology combines solid state physics, chemistry, chemical engineering, biochemistry, biophysics and material science.

Nano technology is a new scientific approach that includes the use of materials and equipment's capable of using physical and chemical properties of a substance at molecular levels to explore the biological and material worlds in nanometre-scale and use it in various carriers from medicine to agriculture.

1. Agriculture is considered as the backbone of most developing countries, with more than 60% of the population dependent on it for their livelihood.
2. In the same times, there are many challenges facing agricultural sector, like climate change, non-reasonable use of resources and usage of too much chemical fertilisers.
3. Plant nutrition is crucial for agricultural production and crop quality, and about 40% to 60% of the total world food production depends on the application of fertilizers.
4. It is considered as an emerging field of science widely subjugated in many scientific fields and supposed playing the main role in the field of agriculture and food science in next era.

Applications of Nanotechnology in Agriculture

1. Nano-fertilizer for balanced crop nutrition.
2. Crop improvement (Zinc Nano fertilizer used to enhance crop production of Pennisetum americanum).
3. Plant protection ingredients (pesticides, fungicides, weedicides).
4. Nano sensors.
5. Post-Harvest Technology.
6. Bioprocessing (bio synthesized) nanoparticles for agricultural use.
7. Nano biotechnology (Analysis of gene expression and Regulation).
8. Monitoring the identity and quality of agricultural produce.
9. Precision agriculture.
10. Seed technology.
11. Water management.
12. Plant growth regulators.
13. Soil management.
14. Agricultural engineering.
15. Plant disease detection.

Accumulation of Toxic Wastes

1. Inorganic fertilizers are not entirely composed of the nutrients needed by the plants. They also contain salts and other compounds.
2. These are not absorbed by the plants so they are left behind in the soil and build up over time.
3. When found in large amounts in the soils, these compounds can alter the chemistry of the soil that makes it less ideal for planting.
4. Furthermore, these toxic compounds may also get washed away when we water the plants and seep into groundwater.

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Mitigation of Harmful Effects of Inorganic Nutrients

1. Organic farming.
2. Less application of inorganic fertilisers.
3. Application of water-soluble foliar fertilisers.
4. Soil tests should be done and apply the fertilisers according to the requirement.
5. Increase awareness among people.
6. Application of nano nutrient based fertilisers and pesticides to reduce environmental pollution.

Nano Nutrients

1. Nanofertilizers are nutrient carriers of nano-dimension ranging from 1-100nm and capable of holding bountiful of nutrient ions due to their high surface area and releasing them slowly and steadily that commensurate with crop demands.
2. Nanofertilizers may contain nano nitrogen, phosphorus, potassium , zinc, silica, iron and titanium etc.
3. Example: Pal et al.(2018) found that yield of hybrid rice (Rajalaxmi variety) in kharif was increased significantly upto 24% by application of NPK + Nano Zn, whereas application of NPK + $ZnSO_4$ icreased the yield upto 21% in sandy loam acid inceptisols.

Positive Effects of Nano Nutrients in Agriculture

1. The higher solubility of nanonutrients in suspension.
2. The higher surface area and particle size of the nanoparticles, which facilitates penetration of seed coats and subsequently emerging roots.
3. Better bioavailability of molecules to the seed radicals.
4. Providing actual concentration and controlled release of fertilizers or pesticides in response to certain conditions (TiO2 Nano particles used as plant fertilizer for Mung bean to enhance crop production).
5. Improved targeted activity.
6. Lower Eco harmful with safe and relaxed transport.

Examples of Some Nanofertilisers

1. Nualgi Foliar Spray:

2. NanoMax-NPK:

3. Tag Nano Npk:

Conclusion

Nano nutrients offer generous visions for the development of agricultural sector through advanced applications and the probability of products and can increase global crop production volume to feed the world population in next decades.

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Nutritional and Medicinal Properties of Turmeric

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Introduction

A prestigiously beneficial food commodity by the nature that exhibits remarkable medicinal properties is *Curcuma longa*, Linn, which is commonly known as turmeric and belongs to ginger family (Zingiberaceae). It is perennially cultivated in red soils to clay loam, sandy loam and light black soils with favourable weather condition of tropical and sub-tropical regions of Southeast Asia. It requires a thriving temperature of 20- 30oC with considerable amount of irrigation water (Yadav and Tarun, 2017).

Indian turmeric is considered to be the best in the world market because of its high curcumin content. The important turmeric growing States in India are Telangana, Andhra Pradesh, Tamil Nadu, Orissa, Maharashtra, Assam, Kerala, Karnataka, West Bengal and Rajasthan. The area under turmeric cultivation is 237.96 thousand hectares with a production of 1132.72 thousand MT and the productivity is 4.76 MT/ha (Horticultural Statistics at a Glance 2018).

Nutritional and Biochemical Composition

Turmeric has very good nutritive and medicinal values. Turmeric contains protein (6.3 per cent), fat (5.1 per cent), minerals (3.5 per cent), carbohydrates 3 (63.0 per cent), fibre (6.1 per cent), moisture (13.1 per cent), calcium (0.02 per cent), phosphorus (0.26 per cent), iron (0.05 per cent), sodium (0.01 per cent) and potassium (2.5 per cent). Vitamins presents in turmeric are B1 (0.09 mg/100 g), B2 (0.19 mg/100 g), vitamin C (49.8 mg/100 g) and niacin (4.8 mg/100 g). Turmeric contains up to 5 per cent essential oils and 3 per cent curcumin, a polyphenol (Ganpati et al. 2011).

Medicinal Properties

Turmeric is mainly used as a spice in Indian foods and has medicinal value also (Peter 1999). The rhizomes of this plant, when dried and ground, provide a yellow and flavouring powder, used for centuries as a natural colouring agent in food, cosmetics and textiles, and also as insect repellent. Recently, it has been valued worldwide as a functional food, due to its health promoting properties. Turmeric has been used as antioxidant, digestive, anti-microbial, anti-inflammatory and anti-carcinogenic agent. It lowers total cholesterol levels. It is also efficient in the treatment of circulatory problems, liver diseases, and dermatological disorders and in blood purification.

The curcumin present in the turmeric inhibit skin cancer by decreasing the expression of proto-oncogenes. External application relieves pain and swelling, heals wounds and treats many skin diseases ranging from acne to leprosy. Turmeric supports the heart by inhibiting the accumulation of platelets which reduce the chance of heart attack or stroke. It is used as blood purifier and supports the respiratory system as an anti-oxidant to protect lungs from pollution and toxins. The major chronic disease including atherosclerosis, cancer, cardiovascular diseases, cataracts, and rheumatoid arthritis are relieved with anti-oxidants like Vitamin C, Vitamin E and Turmeric.

Conclusion

Turmeric is a sacred spice known from ancient times. It has many nutritional and medicinal properties. Phytochemical analysis of turmeric has revealed a large number of compounds, including curcumin, volatile oil, and curcuminoids, which have been found to have potent pharmacological properties.

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Farm Bill 2020: Will it Really Benefit the Farmers ?

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Introduction

If we consider agriculture as an industry, it will be the largest industry as 70% of our nation are directly or indirectly engaged in it. In previous month (September, 2020) farmers came on road to protest against three new farm bills passed by Parliament:

1. “The Farmer’s Produce Trade and Commerce (Promotion and Facilitation) Bill, 2020”
2. “The Farmer’s (Empowerment and Protection) Agreement of Price Assurance and Farm Services Bill, 2020”
3. “The Essential Commodities (Amendment) Bill, 2020.”

These three bills have been introduced on “One Nation, One Agricultural Market” concept. It gives freedom to farmers to sell their produce anywhere in the country. As per government, taking their produce to beyond APMC market yards will benefit the farmers.

The Farmer’s Produce Trade and Commerce (Promotion and Facilitation) Bill, 2020

According to this bill, farmers will have an additional choice to sell their produce instead of just APMC. This will attract private companies to invest in agriculture and famers will be benefitted by the competition between APMCs and private players. It will be responsible to break the monopoly of the APMC market. This bill will also promote farmers engagement through electronic trading platforms. And, one more distinct dispute resolution system will set up for farmers to avoid pending court litigation.

Arguments Against this Bill

If a private system will be set up parallel to the APMC, there will be loss in revenue generation to the APMCs. As there is a vast network of APMCs in northern states of Haryana & Punjab. The “Mandi fees” which is collected is an important source for state governments and it will be hampered by introduction of this bill. The person who works as commission agent will lose his job and business as all the middle men will be eliminated.

The Farmer’s (Empowerment and Protection) Agreement of Price Assurance and Farm Services Bill, 2020

The farmer’s agreement of price Assurance and farm services bill basically allows farmers for contract farming. This bill allows farmers to enter into direct or commercial agreement with companies related to agriculturally based products, exporting companies and trading companies. It is expected to remove the fears of farmer from being exploited and making the world as global market village. Investment to be done by the buyer related to infrastructure and other agricultural input costs. It is assumed to increase the income of farmers by reducing the costing. The contract will only be in way that company will provide the inputs and will purchase the output at a mutual price which is fixed before sowing of the crop by buyer and the seller (grower). This has nothing to do with the ownership of the piece of the land. In such case a farmer can go for multiple or mixed cropping instead of monocropping to earn more benefit at a particular time.

Arguments Against this Bill

As per the 10th agricultural census, small and marginal farmers having land area less than 2 hectare are around 86% of the total farmers population and owns 47.3% area of total cropped area. So, these farmers can be deprived from contract farming by buyer. Again, due to same reason private players and big corporate houses have an upper hand in case of any contract and farmers will have weak negotiation power to get a better deal in front of them.

In case of any disputes the buyer (private players) will have an added advantage due to power of money. The freedom is with the corporate players as they can purchase at any price because the least procurement price is not mentioned in the bill as APMC has a lower limit of MSP. And this is one of the biggest reason of farmers protest across the nation.

The Essential Commodities (Amendment) Bill

This bill removes the limit of stocking of agricultural commodities at famer level as well as trader level. This also allows private player to enter into the market for establishment of warehouses and cold chain structure to improve the existing supply chains present in the agricultural system.

If the cereals, pulses, oilseeds, onions & potatoes are removed from the list of essential commodities, there will be imposition of stock holding limits. Government can also take the control back but in case of emergency situation like too much price high of any commodity, war, natural calamities etc.

Arguments Against this Bill

The freedom to stock commodities will impact farmers & traders in different ways. Traders will purchase at low price and will stock it until the price goes high. But farmers can't stock material due to lack of infrastructure and financial problems. The freedom which is given to both farmers and traders will lead to exploitation of common people as large corporate players will charge more prices.

Why these Reforms are Needed?

As per the government, these reforms are meant to increase the growth in agriculture sector by attracting private sector players for building infrastructure and to provide a better supply chain from farmers field to consumers bowl at national as well as international levels. These bills are supposed to support small farmers (which are about 65-70 per cent of total farmer's population in our country) who are not having bargaining power & access to modern technologies to increase their productivity.

The 1st bill allows farmers to sell their crops outside the designated APMC's to whomsoever they want to sell. According to government, farmers will get better price due to competition in buyers i.e. APMC's & Private Players. But if famers sell their produce directly to Private players, the state Government will be end up in losing side as there will be no or less collection of taxes in the form of Mandi fees & commission. As per Farmers (Empowerment and Protection) Agreement on Price Assurance Bill, farmer can enter in contract farming with private firms related to agriculture sector or supply chain sector to sell the produce on mutually agreed price which is pre-decided by both the parties entering into the contract.

While, Farm Services and Essential Commodities (Amendment) Bill attempts to remove cereals, pulses, oil seeds, edible oils, onions & potatoes from the list of essential commodities. Now by doing, it removes the limit on storage of the commodities mentioned and this will increase hoarding.

Farmers are Doubtful About the Bill

Farmers are worried regarding getting the MSP for their produce in regulated market. As per the Shanta Kumar Committee which was set up to recommend restructuring of Food Corporation of India (FCI) in 2015, revealed that only 6 percent of farmers are getting MSP for their crop.

Rest 94% of the farmers are selling their produce at price lesser than the MSP. Only 6 percent farmers are getting benefits of MSP in regulated market, so if the private players will enter; this percentage will fall lesser than even 6%. And if private players (MNC) will enter into the market many Arthiyas0 and commission agent will lose their jobs.

Ground Testing in October

In October kharif crop will be harvested & farmer will come to market for selling them that will be the real time testing as:

1. In this month, will get to know how government will procure the food grains mainly rice in northern states of country like Haryana & Punjab where APMC's holds a good network. The thing which has to be noticed is that how government will protect MSP if farmer sells it to non APMC players.

2. Due to modification in Essential Commodities Act, it will be fascinating to see how it will be affecting food inflation as there is no limit for stocking agricultural commodities except in case of emergency situations.

3. Government has given assurance to the farmers that they will not be denied from MSP. This thing needs to be checked that either it was just said or it will be fulfilled also, as already said only 6 percent farmers are getting MSP.

4. Private players intervention to be evaluated and monitored properly, when they invest in value chain and supply chains. Also, Foreign Direct Investments (FDI) into the agriculture be monitored closely.

Suggestions

1. As per the report by Shanta Kumar Committee only 6% of the farmers are able to get MSP for their produce even in regulated market of APMC. The same situation will be continuing even after the bill and maybe it can become worse as even if private player will enter. Government should order that even if farmer will sell it to private companies, companies can't purchase it less than MSP. Then leave it to farmers that we want to sell it to APMC's or to private players.

2. Same is the case with contract farming, in contract farming farmer may get price more than MSP and may get the price lesser than the MSP. The current market price at which farmer sell his produce after harvesting to the contract farming companies may be less than MSP or may be more. If it is more, it will be profitable to the farmers but if it will be less farmers will suffer a loss. Both prices MSP and at which contract farming companies will purchase are announced before sowing but the current market price may vary. So, to protect farmer from being exploitation MSP should be given to each and every farmer. Because small and marginal farmers have a weak negotiation power with respect to big private players.

3. To give the negotiation power and to create the better facilities for marketing and storage infrastructure, farmer needs to come forward and to set up Farmer Producer Organization. It will be a win-win situation for both farmers and private player. On behalf of FPOs the local leader or any Board of Director should talk with the companies regarding the terms and conditions of contract farming, this way farmers can be saved from exploitation.

Conclusion

Agriculture contributes to around 15% of our GDP. These three farm bills which have been passed recently by government are steps towards establishing a bigger and better platform for farmer to sell their produce. These bills will increase the growth in agricultural sector by providing farmers better facilities of marketing and storage infrastructure like cold storage chains.

This will definitely generate employment and will strengthen the economy. But on the other hand government should closely monitor that farmers should not be exploited much by entry of private players into the industry as it is the duty of the government to protect farmers as they are the soul of the nation who protected GDP even when all other industries failed to perform well during the 1st two quarters of financial year 2020-21 when this Covid-19 outbreak happened.

Now farmers have their own choice whether they want to sell their produce to APMCs or directly to the private player outside designated market space. There is no guarantee that by passing these three bills farmers income will increase. In Bihar, when APMCs established farmers received prices much less than the MSP. So instead of letting private player to enter into the system, we have to strengthen the APMCs, so that they can help farmers to increase their income.

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Artificial Intelligence and Horticulture

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Summary

There is no question that A.I. is a large part of the future of horticultural production. Artificial intelligence (AI) is everywhere in the news right now, from autocorrecting cell phones to self- driving cars to new forays into agriculture by large companies like Microsoft. In many ways, it is an overarching term for a number of different tools. From computer vision to machine learning to actual robots. It's only been within the last few years that AI has made its debut in the agriculture sector. Artificial Intelligence holds the promise of driving an agricultural revolution at a time when the world need produce more food using fewer resources. It's more complex than one broad definition, which experts worldwide are still struggling to come up with and agree upon. Because plant manufacturing is more complex than building airplanes, it's not surprising that it has taken manufacturing automation technology until now to reach the point of offering the same advantages to the horticulture industry.

Introduction

Artificial intelligence (AI) refers to the simulation of human intelligence in machines that are programmed to think like humans and mimic their actions. The term may also be applied to any machine that exhibits traits associated with a human mind such as learning and problem solving. Artificial Intelligence (AI) is set to disrupt practically every industry imaginable and horticulture is no different. "The combination of robotics, computer vision and machine learning will dramatically change the horticultural business. The world sees a clear future for automated crop monitoring systems in greenhouse production. "There's a real need for more tools to automatically monitor pests and diseases, humidity, temperature and light. Real time data would allow many new ways for sharing other best practices with production facilities worldwide."

In today's horticultural business climate, collaboration, communication and connectivity are essential to success. Digital communication is key to increase these interactions. The ultimate goal is to have a transparent, competitive young administration system with detailed information. Fixed in place robots are now being used to automatically stick cuttings at rooting stations but, we can expect that mobile robots will soon follow the same. Currently, greenhouse robots perform de-leafing and harvesting jobs (strawberries and other horticultural produce) but they're also used for scanning crops for pests, diseases and plant deficiencies. Overall, there's vertical integration in the horticultural supply chain with increased cooperation between breeders, propagators, growers, etc.

Currently, the fresh produce and ornamentals business is comprised of many growers, traders and wholesalers that don't exchange data or information. But in the future a much more transparent system will arise, one that allows large sales volumes as well as small batches, accompanied by clear information regarding quality and sustainability. Today, performance system allows growers to manage their operations in an easy and reliable way. Often overlooked and taken for granted as it works in greenhouse process. It includes control logic and a user interface that has evolved over the past couple of decades. There's an option to run it by artificial intelligence allowing growers to get the most out of their crop production, while using resources such as water, energy, crop protection in the most efficient way possible.

Challenges in Adoption of Technology

"Of course, technology will replace some jobs. It already has for centuries. But we also know that new technology creates new opportunities and new jobs as well. And with a world population that is growing so fast that we can't provide enough food for each and everyone. We should consider all solutions that enable growers to generate a higher yield and better quality and contribute to a healthy future. We owe it to future generations." Yes, there are some tasks that may be replaced by machines, but people will be reallocated to different roles, requiring different skills, in areas they are comfortable. The main challenge in incorporation of AI may be the investment. The very first step is to identify where the technology should be incorporated. Each business has a number of tasks. Key decision points at which decisions are made more frequently are often the best place to install smarter tools and to maximum utilise the investment.

Conclusion

If everything that can be automated, will be automated. In most countries, there are fewer people available who want to work in greenhouses, so we don't have to worry about large groups of people becoming unemployed. In the end, if AI surpasses humanity in general intelligence and becomes "superintelligent", then it could become difficult or impossible for humans to control. A second source of concern is that a sudden and unexpected "intelligence explosion" might take place by surprise.

The field of artificial intelligence with its rigorous learning capabilities have become a key technique for solving different agriculture related problems. Systems are being developed to assist the agricultural experts for better solutions throughout the world. So, we can say that AI is the multidimensional development of Agro-Intelligent systems.

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Radio Frequency Identification (RFID) Technology in Food Processing Sector

Article ID: 32588

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Introduction

Nowadays barcodes and other visual traceability systems are applied for tracing and tracking of food products through supply chain. Barcode only stores the product information but it does not deal with the smart traceability like tracing the quality and shelf life of the product. This is the major limitation of the barcode system. The market competition in 21st century increases day by day this is also true for agricultural food products. Customers wants quality products and they are ready to pay for that. By tracing the quality during supply chain Radio Frequency Identification (RFID technology helps for maintaining the quality of the product. The technology first used by Brittan during second world war for identification of friend or enemy. The technology had first patent in 1973. RFID is radio frequency identification technology used for electronic and wireless identification of objects and animals. It shows important advantage over barcode system as it allows updating the item data as it moves along the supply chain. The technology assesses the data regarding quality of the product and we can also detect spoilage of the food product with the help of RFID sensors. This technology is therefore finding great application in food processing industries. The present article is mainly dealing with the application of this technology in various food sectors like fruit and vegetables, meat, poultry, fish, beverages, and other food industries. RFID is an emerging technology that has been increasingly utilized for supply chain management of perishable produce. This technology has ability to integrate with sensors and other communication technologies like GPS, which make it excellent choice for tracing and tracking of food products through various stages. In RFID technology radio waves are used for wireless transmission of the information of the product.

Components of the System

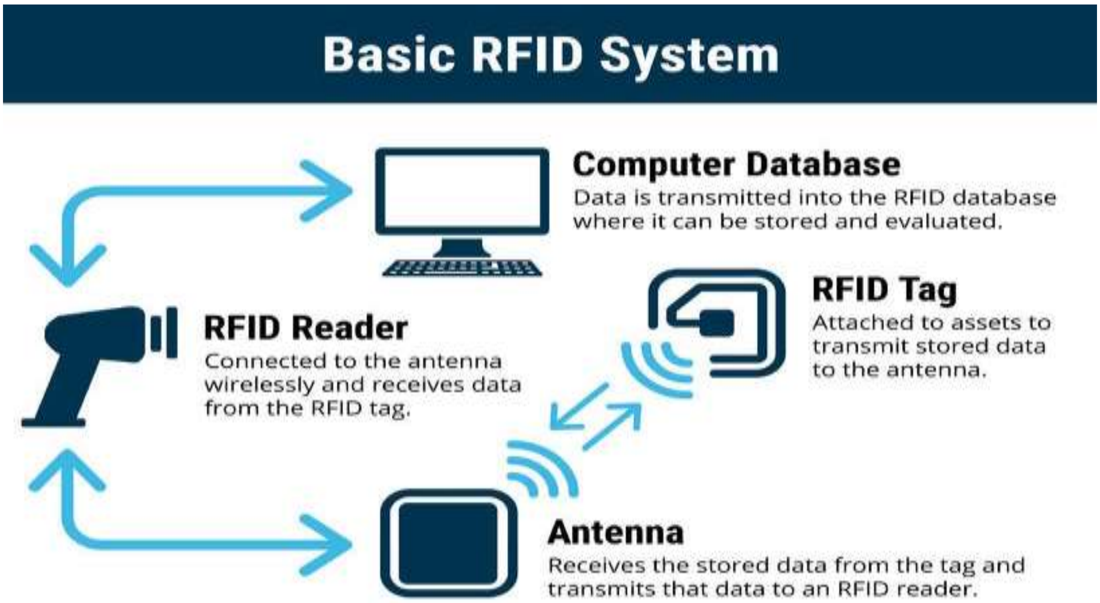

Fig 1: Basic RFID System (https://blog.ttelectronics.com/hs-fs/hubfs/Basic-RFIDSystem.jpg.link)

First important component of system is RFID tags fixed to product with unique electronic product code (EPC) per product (wireless RFID network). Second is Networked RFID readers, and real time database. While third component is RFID antennas which provide information between the tags wireless network and control platforms. When we attach sensors like temperature loggers, freshness indicators and other chemical sensors then we can control not only the product flow but also shelf life or quality during supply chain.

RFID tag can be Classified as Follows

1. Depending upon working:

a. Read only- memory is factory programmed and data is static. That is, we cannot change data during supply chain.

b. Read- write- Data can be dynamically altered and we can change or update the information when product is in the supply chain.

2. Depending upon power source:

a. Passive- Operating power from reader therefore storage capacity and reading range are low.

b. Semi passive- Uses a battery to maintain memory. Therefore, it can store sufficient amount of data.

c. Active- Powered by an internal battery Batteries replaced periodically. Therefore, storage capacity is high and reading range is more.

Fig2: Tag Reader

Frequency Ranges

1. Low Frequency – 100-500 kHz, short range, low data rate, low cost, & power.
2. Intermediate Frequency – 10-16 MHz, medium range and data rate too.
3. High Frequency – 850-950 MHz & 2.4-5.8GHz large range, high cost, high data rate also needs line of sight.

(The choice of frequencies is depending upon the application).

Applications in Food

RFID are applicable in various fields like Healthcare Applications, Baggage Applications, Toll road asset tracking, Libraries, Animal identification system, National identification etc. as the article mainly talks about RFID in food sector, therefore we will see the detail application of RFID in same.

1. Wine Sector: RFID technology used in wine processing and wine supply chain. implementation of technology began at harvesting of grapes. At that time Tags are glued to the boxes/ containers and transported to the winery which helps to select / classify the received grapes by categories e.g. variety of grapes, degree of ripening, etc. RFID tags are also allowed to identify all the different tanks where wine was processed.

This is important in blending operation. For this purpose, Specific identifier on each bottle of final product are labelled. On which information regarding the time of production, and other parameters are noted. Reading range of the tag is 3 to 6 meters. It is useful for online buying of wine and provides correct product to customers (Rahman, 2016).

2. Fish Sector: Identification of fish done by batch or by individual e.g. name, sex, body length, weight, etc. The tags used are generally High Frequency RFID tags. Smart tags are attached on the product to be tracked integrates sensors, memory chip and antenna and Sensor logged data were stored in memory chip. Reader was used for reading and writing data on smart tag. Reading distance is 10 cm. Advantage is the possibility of reading the data without opening the fish box and therefore it reduces bacterial contamination. RFID reader and active tag integrated with sensors were used to assess the quality of fish. But Any conductive material or humidity affects reading reliability (Trebaret.al., 2013).

3. Cheese sector: In the cheese industries High Frequency RFID tags are used. Tag directly inserted on side of cheese at the end of forming process. Tracing and quality information are combined on the tags e.g. Ripening period, temperature and humidity sensors are placed.

Reader and antenna also placed on ripening chamber. In the cheese processing industry tags are inserted on cheese blocks before ripening process. All the information is stored in the tag. The system is able to read/write tags inside a radius of around 20 cm. (Aloe et.al., 2010).

4. Supply chain management: Supply chain management of perishable food items is important and challenging task owning to huge variations in products, strict traceability requirement, limited shelf life of food products and agri-produces and need for management of adequate environmental conditions during various stages from producer to end user. Primarily RFID technology is used for tracking of items through the various stages of food supply chain starting from production to the end products for consumer.

Fig 3: Supply chain management from farm to fork

5. Other food products: RFID finds application in poultry farming for identification of the birds. The general information of bird like age, weight, vaccination etc. are available on the tags. Semi active tags are used for monitoring the quality of apples by measuring the produced gases such as ethylene. RFID tags integrated with O_2 and CO_2 sensors are used for checking freshness of broccoli.

Semi passive RFID tags are used for prediction of shelf life of lettuce in refrigerated container. RFID technologies provides a significant opportunity to ensure wheat flour quality and safety & successfully applied in a large process enterprise. By implementing RFID Compared to the cost, an increase in sales income was reached 32.5% (Quianet.al.).

Advantages & Limitation

There are no chances of human error. Data are stored on the tags hence we can change the data while produce in the supply chain. Data can be hidden. Most important is it reduces manpower and no requirement of line of sight. the limitation of the technology is it is very costly, therefore cannot applicable in small scale industries.

Conclusion

This article presents the application of RFID technology in various food sectors. It puts forward for discussion of several ideas for employing the RFID in conjunction with integrated sensors for solving the various problems of assessment of the status of the content of a packaged food container without opening it. It especially important for shipping of perishable food products like fruits and vegetables, fish and fish products, meat and meat products. RFID system can be applied to a wide range of perishable goods. And it can show significant savings, improvements in food safety, and supply chain management.

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Biotech KISAN Hub Project Increases Income of Smallholder Farmers through Makhana *(Euryale ferox)* Cultivation

Article ID: 32589

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Introduction

Gorgon nut or fox nut, commonly known as Makhana(*Euryale ferox)* is an aquatic crop, producing bright purple flowers. In India it grows as a natural crop in Madhya Pradesh, Rajasthan, Jammu & Kashmir, Tripura and Manipur. In the state of Bihar, major Makhana producing districts include Darbhanga, Sitamarhi, Madhubani, Saharsa, Supaul, Araria, Kishanganj, Purnia and Katihar.

Approximately, 80 per cent of total production of processed Makhana comes from Darbhanga, Madhubani, Purnia and Katihar districts alone. It grows in stagnant water of wetlands, tanks, ponds, lakes and ditches in the northern parts of Bihar. Besides stagnant water bodies, it is also cultivated in paddy fields and low-lying areas. It is a cash crop and is marketed in the form of popped makhana commonly known as Makhana Lawa**.**

In Bihar, area under makhana cultivation is about 13,000 ha and the state accounts for more than 85 percent of the makhana produced in the country(Kumar *et al* 2018). It yields 1,20,000 MT of makhana seeds, which after processing yields 40,000 MT of makhana pop. Though Bihar is the major producer of makhana in the country, yet the major wholesale markets are *Khari Bowli* (New Delhi), *Nayaganj* (Kanpur), *Gola Dinanath* and *Vishweshwar ganj* (Varanasi) etc.

Cultivation of Makhana is highly cumbersome, labour intensive and involves human drudgery while sweeping bottom of the water body for seed collection. Processing involves sun drying, size grading, pre-heating, tempering, roasting, popping, polishing, grading and packaging. The popped kernels of Makhana content 12.8 % moisture, 76.9 % carbohydrate, 9.7 % protein, 0.1 % fat, 0.5 % total minerals, 0.02% calcium, 0.9% phosphorous,0.0014 % iron (Shankar *et al.,* 2010).Due to high nutritious value and low-fat content makhana has high potential for acceptance among higher income group people as an alternative snack.

Use of Makhana

1. Roasted makhana pop is used as a snack item.
2. Makhana powder is used for preparation of Kheer.
3. Makhana pop is used for making curries like paneer makhana etc.
4. In some parts of Manipur, the vegetative parts of the plant are used for making vegetables and leaf petiole is used as salad.

BAU DBT Biotech KISAN Hub Project in Promoting Makhana Cultivation in Bihar

BAU Sabour received Biotech KISHAN Hub Project from Department of Biotechnology Ministry of Science and Technology Government of India for economic improvement of farmers of aspirational districts of Bihar. Under Biotech KISAN Hub Project three Aspirational District Araria, Katihar and Purnea were selected for Makhana cultivation.

Area under these three districts are 33.2 ha, 30 ha & 25 ha respectively and total number of beneficiaries under these three districts are 125 for Makhana cultivation. Under the project makhana seeds, fertilizers were provided and training programme also conducted for the farmers. A total of 16 training was conducted for the farmers under the project and 125 farmers were trained on makhana cultivation and seven field days were conducted for the farmers.

Table 1: No. of Training & Field Days Conducted

Sl.No.	Districts	No. of training Conducted	No. of trainees	No. of field Days Conducted
1	Araria	5	40	3
2	Katihar	7	45	2
3	Purnea	4	40	2
Total		**16**	**125**	**7**

For scientific cultivation of this aquatic crop, Sabour Makhana -1 Variety was demonstrated in farmers' field. For scientific management of this crop, scientific interventions were done under the supervision of project scientists and project staff/Young Profession. The interventions carried out were Nursery Raising Care and maintenance of Nursery, Land Preparation / Pond cleaning, Transplanting, Fertilizers / chemical, Foliar Spray of nutrients, Weeding, Flowering & Fruiting and Insect / Pest / Disease Management.

Table 2: Major Interventions & Number of field visit:

Sl. No.	Major interventions	Districtwise No. of intervention carried out		
		Araria	Katihar	Purnea
1.	Nursery Raising	8	6	10
2.	Care and maintenance of Nursery	20	4	25
3.	Land Preparation / Pond cleaning	12	6	10
4.	Transplanting	6	19	-
5.	Fertilizers / chemical	5	16	5
6.	Foliar Spray of nutrients-20-25 days interval of DAT	7	12	10
7.	Weeding (intercultural operations)	10	9	15
8.	Flowering & Fruiting	25	22	20
9.	Insect / Pest / Disease Management	14	18	15
10.	Harvesting	3	30	5

Economics of Makhana Cultivation

The cost of cultivation of Makhana per hectare is Rs. 97,866/-.The crop yield around 21 quintals per hectare and fetch Rs.1100/- per quintal and gives net return of Rs. 1,33,134/- with B:C ratio of 2.36.

Cost of cultivation per ha	Return per ha	B:C Ratio	Net Profit per ha
Rs. 97,866/-	Rs.2,31,000/-	2.36	Rs. 1,33,134/-

Conclusion

Hence it can be concluded that through the Biotech KISAN Hub Project the farmers accrued a net profit of Rs. 1,33,134/- per hectare.

Fig 1: Distribution of Makhana Seed among Farmers

Fig2: Distribution of fertilizers & Chemicals among Makhana Grower

	
Fig 3: Foliar spray of Nutrients in Makhana crop	**Fig 4: Harvesting of Makhana**
	
Fig 5 : Harvesting of Makhana	**Fig 6 : Packaging of popped Makhana**

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Drying Beads - A Novel Loom in Dry Chain Skill

Article ID: 32590

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Introduction

A central issue for the 21st century is to continue to feed the growing human population in a sustainable manner, while accommodating the effects of climate change and limiting expansion of agricultural land and water use. Although predictions vary, there is little doubt that the human population will increase to 9 to 10 billion from the present 7.6 billion during this century. The Food and Agriculture Organization of the United Nations has estimated that due to this increasing population and changing demand accompanying economic development (e.g., more meat in the diet), food production will need to increase by 60% in 2050 compared to 2005. A complementary approach is to reduce postharvest food losses. Although estimates of loss vary depending on location and handling system, about one-third of food produced for human consumption is spoiled or wasted. In developing countries, most losses occur between the farm and the consumer, while in developed countries a similar percentage of food is wasted by the final purchaser. For dry products (e.g., cereals, which provide 70% of all calories consumed and 53% of total caloric losses), the majority of losses are due to microorganisms (moulds, bacteria), insects and rodents resulting from poor postharvest storage management.

Most research has focused on increasing crop plant resistance to microorganism's growth, on modifying the fungal organisms to prevent toxin biosynthesis, or on eliminating them from the production environment, while research on improved drying and storage conditions has been largely by passed. "Dry chain" approach is analogous to the "cold chain" commonly employed for the postharvest preservation of perishable commodities. The cold chain is the process of cooling fresh vegetables and fruits quickly after harvest and then maintaining an unbroken chain of low temperature conditions throughout storage, transport and marketing to the consumer. However, the majority of stored food commodities are dry products, primarily grains and seeds, whose preservation simply requires maintenance of dryness without investment in refrigerated trucks and storage facilities.

The Dry Chain is the Solution

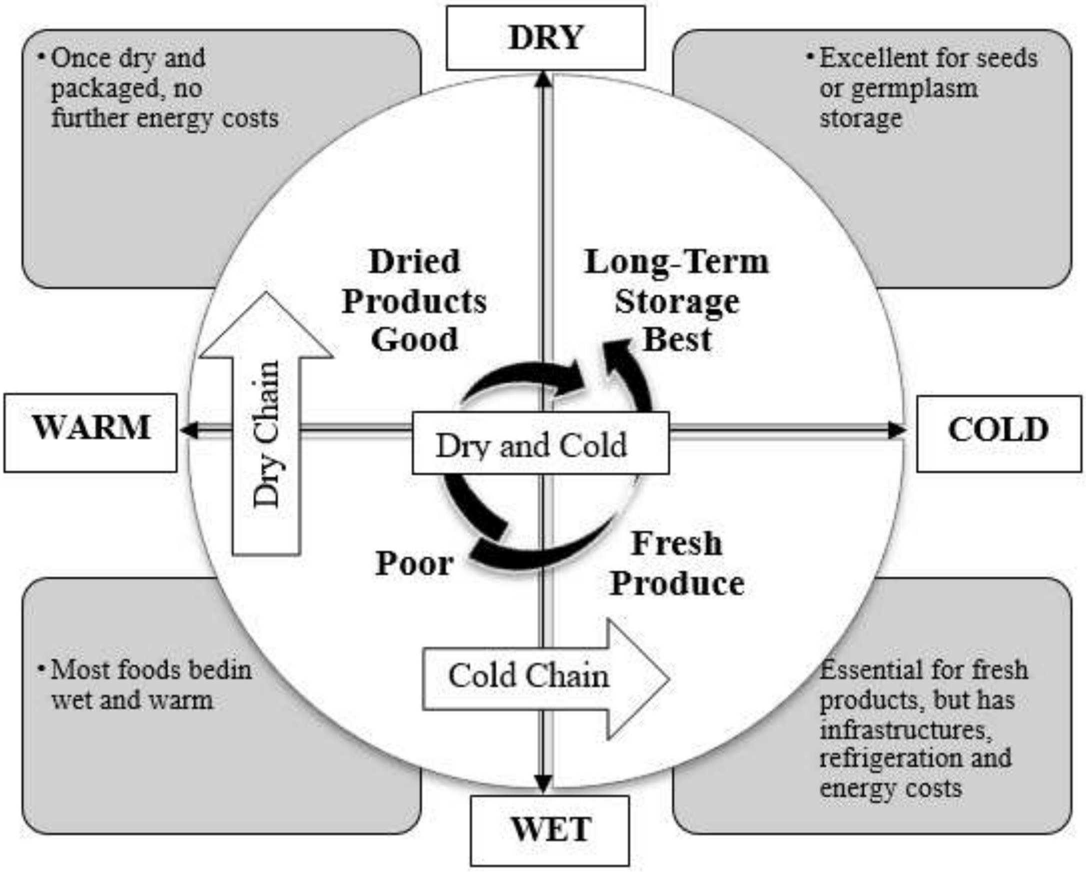
Drying was the primary method for long-term food preservation until the relatively recent introduction of canning or freezing. Meat, fish, fruits, berries, herbs and other plant foods were dried for storage and consumption during less abundant seasons by virtually all human cultures. A major application of drying was for preservation of grains following the invention of agriculture and increasing human dependence on cereals. As the equilibrium relative humidity (ERH) of food products decreases, the metabolic activity of spoilage bacteria, fungi and insects is slowed because they require water to function. When sufficient water is removed from the system, they are unable to remain metabolically active and either desiccation-resistant structures (e.g., fungal spores) or perish. Safe storage conditions for food products can be described with a set of axes representing wet versus dry in the vertical direction and warm versus cold in the horizontal direction (Fig).

Drying of Food Commodities

1. Air drying: Drying large quantities of grains and other food products and protecting them from rehydration has been a challenging problem in practice, particularly in humid climates. As the product MC at harvest is generally higher than is optimal for storage, sun drying or heated-air drying is almost universally employed.

2. Heated-air drying: Heated-air driers are used for drying grains and commodities and are standard practice in developed countries, particularly in temperate climates. However, heated-air drying becomes less effective as the ambient temperature and relative humidity (RH) increase. For example, incoming air at 20 °C and 50% RH would have an RH of 12% when heated to 45 °C, but when the incoming air is at 35 °C and 80% RH, elevating the temperature to 45 °C would reduce the RH only to 45%. While this would be adequate for foods, seeds for planting must be kept below 35–43 °C during drying to prevent loss of viability, limiting the effectiveness of heated-air drying.

3. Desiccant-based drying: Another option for seed and commodity drying in humid climates is the use of desiccants that can absorb water and bind it strongly. Forced air driers based on silica gel as a desiccant are widely used in the seed industry and germplasm storage facilities to dry seeds and dehumidify seed storage rooms. A more effective desiccant for drying to low ERH is produced from zeolite clays, which can form a microcrystalline pore structure that specifically and tightly binds water.



Drying Beads - A Novel Loom

Drying beads are modified ceramic materials (aluminium silicates or "zeolites") that specifically absorb and hold water molecules very tightly in their microscopic pores. The beads will continue to absorb water until all of their pores are filled, up to 20 to 25% of their initial weight. When placed in an enclosed space like a plastic or metal container, the beads will remove water from the air, creating and maintaining a very low humidity environment. Seeds (or other materials such as fruits or herbs) placed into a container with the beads will lose water due to the low air humidity, and will continue to do so until they come to equilibrium. Hence, desiccant- based drying simply transfers the water in the seed to the drying beads through the air without the need for heating. The beads can subsequently be removed and regenerated separately by heating at >200°C for 3-4 hours to release the absorbed water.

Why use Drying Beads?

Farmer co-operatives, government institution and seed companies use their resources in setting up drying systems that are expensive and consume time and energy resulting in increased costs. Some even try adapting lower humidity European and American technologies for seed drying in Asia but we know that the higher humidity conditions differ in much of South East Asia, so these technologies may not give the desired results.

This is where the Drying Beads technology comes into play. The Rhino Research Group is proud to describe this technology as "World' Best Practice". Utilization of drying beads is an economic, environmentally friendly, and faster way of drying and storing seeds. Drying Beads can be used in small scales (ex. Horticultural crops) or even large-scale storage. Wherever water is required to be removed from a product consideration should be given to using drying beads as an economic alternative to existing methods.

Characteristics of Drying Beads

Specific pore size for water (3Å): Drying Beads only hold water molecules and after reactivation processes keeps the original water-holding capacity overtime.

Crystalline structure: Ceramic product with crystalline structure very resistant and durable. Longer lifetime than any other desiccant.

Economic and Efficient desiccant: Compared with all other desiccants Drying Beads combine better performance, efficiency and long lifetime making it a very economic system.

Other Characteristics: Micro porous materials pore dimensions, No size changes between dry and wet, Thermal very stable, Mechanically very stable, No polymerization during heating, Adsorption heat, Adsorption at high temperatures, Non-toxic, food grade, 20-25 weight % water.

Reactivation of Drying Beads

1. After heating for 2:30 hours, the beads should be cooled in a metal container with a lid (to reduce re-absorption of water) until they can be safely handled. Drying Beads in a moisture-proof container at ambient room.
2. After heating for 2:30 hours, the beads should be cooled in a metal container with a lid (to reduce re-absorption of water) until they can be safely handled.
3. Drying Beads in a moisture-proof container at ambient room.

Package and Storage

With respect to how to store the beads, the simple answer is watertight. This can be a simple plastic bag with a special knot, a sealed bag, a laminated pouch, a plastic box (but not all plastic boxes are watertight), a glass jar or a metal drum, or even combinations thereof. The intended storage time is also relevant, as most plastics leak air and moisture through the material at some rate. It also is in relation to the temperature of the storage and the quality of the lid or closure.

If the seeds are dried to 20-30% RH and stored in a watertight container, cold storage is often not needed for intermediate storage durations. For long-term storage, cold temperatures further extend storage life. Once the seeds are dry, the Drying Beads can be removed, reactivated and reused for other samples, so long as the seeds remain sealed inside of the moisture-proof container.

Precautions

The beads release heat by an exothermic reaction (generating heat during the absorption of water by the beads) when they absorb water. At the rate that water is absorbed from the air, this heat is readily dissipated and no discernible increase in temperature (can reach 140°C) will be detected. However, if liquid water is added directly to dry beads, the rapid release of heat will raise the bead temperature to levels that can be injurious to the seeds and to workers. Thus, Do Not add beads directly to very wet seeds such as cucumber, melons or tomato seeds immediately after washing. Dry the seeds in air first to remove excess water before mixing directly with beads.

Rules for Safe Drying

Pre-moisturize the beads (do not use completely dry beads but have them pre-moisturized (will happen automatically because after the recuperation, you will always have some water intake and thus premoisturizing. In other words, do not use beads with water intake higher than 22% on relatively wet seeds). Make sure that the seeds are surface dry (easily to check with a paper towel). Should be use an appropriate background or protocol and properly follow it. System should be tested and implemented correctly.

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Impact of Climate Change on Honey Bees In view of Sustainable Life

Article ID: 32591

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The role and economic importance of the pollination service by honey bees to Agricultural crops and food security in the World is totally Blessing to us. Honey bees provide pollination services that are crucial for sexual reproduction and improving the quality and quantity of many agricultural crops. From the significant 53 crops, 33 (62.2%) of them are dependent on biological pollinators (Apis sp.) are the most frequent floral visitor in natural habitats worldwide, averaging 13% of floral visits across all networks (range 0–85).

In recent decades, climate change resultant global warming has become issue of serious concern worldwide for existence of life on the earth (Abrol et al. 1996; IPCC, 2007). Over past hundred years, the global temperature has increased, On the other hand, Humidity, precipitation, CO2 concentration in the atmosphere has increased drastically doubled in 2100 (IPCC, 2007). Such changes in climate and weather could supremely affected Bee's population both directly and indirectly.

Direct affect generally influences the pest population including change in phenology, distribution, community composition, Foraging habit, colonies development, Floral Biology and ecosystem dynamics that finally leads to extinction of bees. For this problem there are some Eco-friendly strategies and approaches like Habitat Management, less use of pesticide, Awareness of skill and knowledge of bee ecology to local traditional people so, that can minimise the influence the parasitic environment and benefit of pollen quality and ultimate health of Bees.

Climate

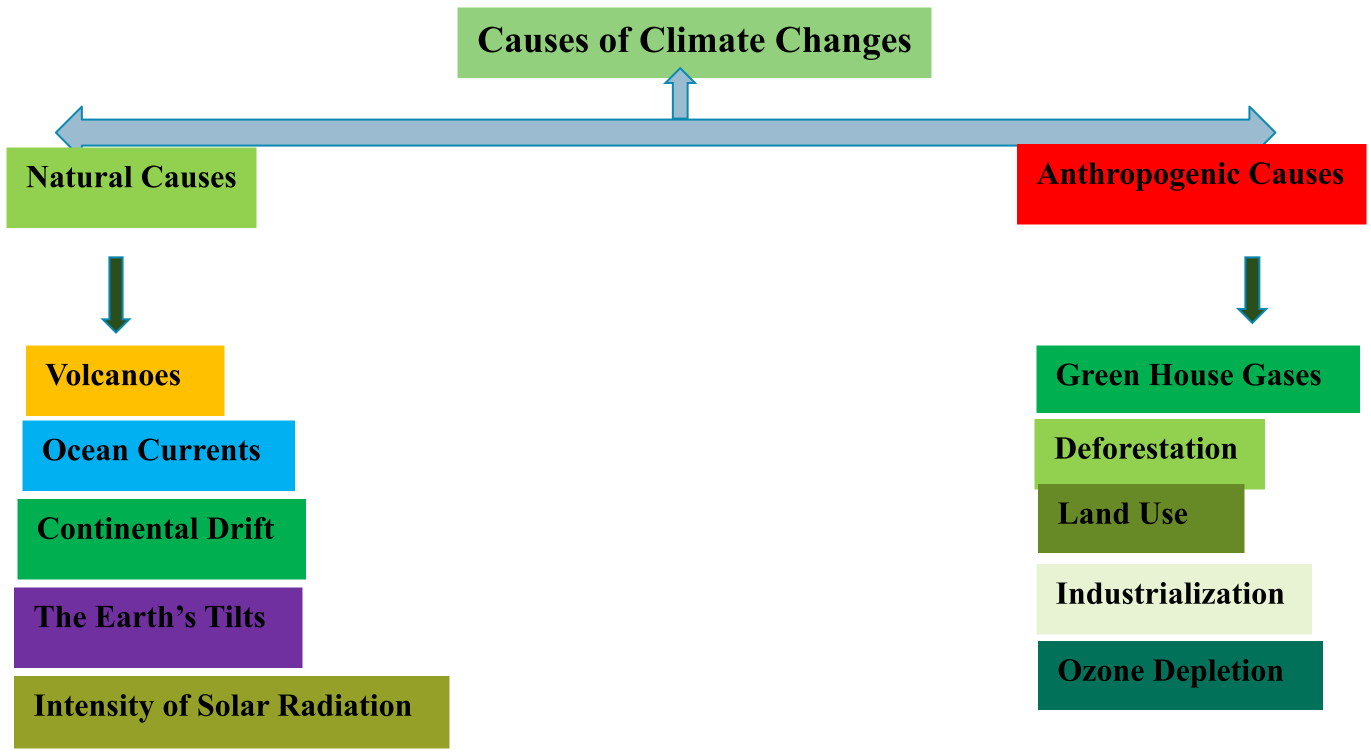
According to, the "Intergovernmental Panel on Climate Change" (IPCC) "Climate in a narrow sense is usually defined as the average weather, or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years.

Climate Change

According to the 'Intergovernmental Panel on Climate Change' (IPCC) Climate Change is "change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods."

Causes of Climate Change

The earth's climate is dynamic and always changing through a natural cycle. What the world is more worried about is that the changes that are occurring today have been speeded up because of man's activities. The causes of climate change can be divided into two categories - those are due to natural causes and another is created by man (Anthropogenic).



Impact of Climate Change on Honey-Bees

Effect of Climate change to the Bees can be categorised into two ways: 1. Direct Impact to the Bee Life, 2. Indirect Impact.

1. Direct: Biology and physiology of honeybees: Behaviour, foraging, reproduction, lifecycle, distribution. Honeybees has biologic and genetic characters to adapt to climate change over hundreds million year for survival.

2. Indirect: Affect through Plants which is act as nectar and pollen sources, availability of forage, water, agricultural landscape. Parasites and Pathogens likes Mites (Varroa destructor, *Tropilaelaps* spp., Acarine), Small Hive Beetles, Wax Moth, Pesticides and Fungicides, Herbicides Social-Economic Factors: Agricultural system, Land use, Policy, Social perception. (Josh.M. Flores et.al. 2019).

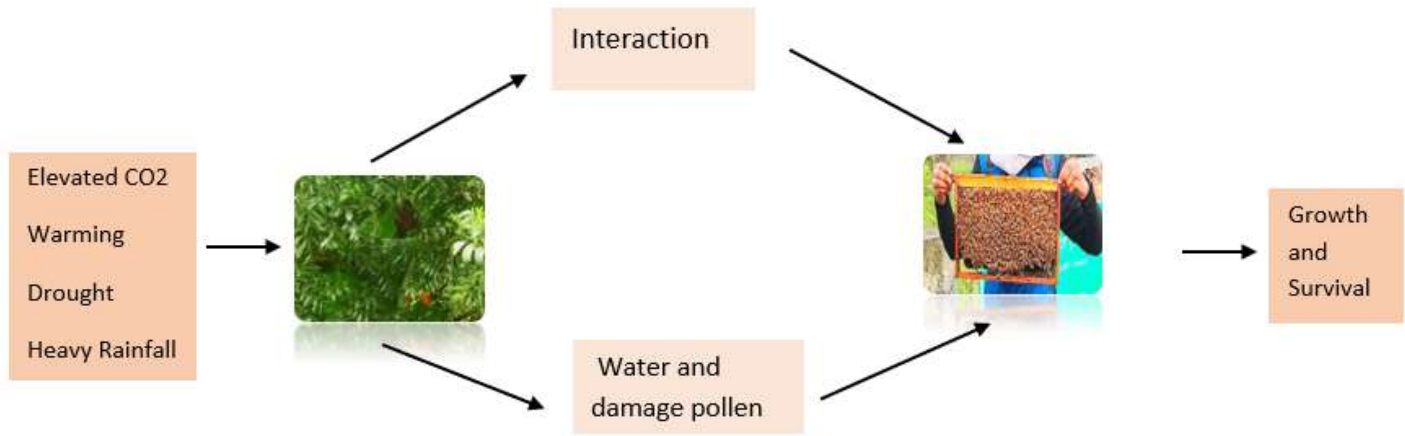


Fig: Effect of abiotic factor on flowering plant which is directly affect to bee growth

The Effects of Changing Climate on Bees

1. Effect of temperature on bees:

a. On Bee Behaviour: Of the behavioural variables examined, temperature showed the greatest effect on the number of stigmas visited per minute. The number of stigmas visited per minute showed an increasing trend with increasing temperature.

b. Abundance: Honey bees that were more abundant at high temperatures (25°C) than at low temperatures (<20°C), also showed increasing abundance with increasing light intensity and decreasing humidity.

c. Honeybee Phenology: Honeybee spring phenology showed strong negative relationships with temperature but no overall change through time because temperatures of key early spring months had not increased significantly.

d. Effect on Foraging Activity: A positive correlation with temperature was found between the foraging frequency of most bees.

2. Effect of humidity on bees:

a. On Bee's Feeding behaviour: The relative flatness of the trend between RH 40 and 70% at which foraging individuals were mostly recorded makes drawing a conclusion to trends tenuous.

b. Abundance: The abundance of honey bees strongly declined with increasing humidity.

c. Survival rate: At a temperature of 35 °C honey bee workers have been found to survive better at 75% RH, whereas at low RH of 50% to 15% worker survival was negatively impacted (Abou-Shaara et al.).

3. Effect of elevated CO_2 in flower:

a. Effect on Pollen quality: Rising CO_2 level reduced protein in pollen Sources in North American Bees. The effects of rising CO_2 on the diet of bees. "Bee food is less nutritious than it used to be," said Jeffrey Dukes.

b. Locomotory activity decline: The locomotor activity of bee workers declined with the increase in CO_2 concentration from 20 % to 60 %.

c. Deep anaesthesia: It was also observed in all workers treated with various concentrations of CO_2 in N_2.

4. Effect of rainfall upon bees:

Effects on plants Threats to flower: Pollen degradation, floral architecture: Rain can disrupt this pollen transfer and therefore hinder the reproductive efforts of flowering plants through several mechanisms. More recent climate projections also suggest an increase in heavy precipitation in many high-elevation and high-latitude regions if temperatures continue to rise (IPCC 2018). The prospect of increases in localised rainfall is made more troubling when coupled with the fact that pollinator diversity and abundance is in decline at a global scale. (D. A. Lawson, S. A. Rands 2019).

5. Effect of Electromagnetic Radiation on Bees:

a. Disrupt the Navigation system of Bees: The radiations emitted by mobile phones are possibly the reason behind a great natural disaster: the disappearance of the honeybees all over the world. The mobile phone radiations disturb the bees' navigational system, leaving them unable to find their way back to the colony; this phenomenon will lead to problems in their reproduction system and to their death eventually. Honeybees are becoming extinct in the world. (Ritu Ranjan Taye et al.)

b. Disturbing life cycle and increasing Colony Collapse disorder: The Colony Collapse Disorder. Many reasons have been proven to be behind this environmental disaster like climate changes, |in addition to radiations generated by mobile phones, especially, since in recent years wild life has been exposed to microwaves and radio frequency's radiation signals from various sources, including wireless phones.

c. Effect on the foraging activity: Most of the predominant bee species depended mainly on two abiotic factors: luminosity and temperature. After a certain period of the day, the scarcity of floral resources produced by most plants can stimulate the bees to forage in the flowers early in subsequent days, which may occur before the period in which the abiotic conditions are really favourable.

d. Mobile phone radiation had significantly reduced the hatching ratio but not the mating success.

6. Shift in species distribution range: Species distribution models for the arid-adapted Australian small carpenter bee, *Ceratina australensis* Perkins, 1912 (Apidae: Xylocopinae) under Intergovernmental Panel on Climate Change (IPCC) climate change conditions predicted for 2070 (Representative Carbon Pathway 8.5).

7. Future Challenges:

a. The honeybees, pollinate >90 commercial crops, have declined by 30 percent in the last 20 years. This has posed a great challenge to agricultural production.

b. Critical thresholds of bee species diversity and/or bee population abundance beyond which there are significant impacts to meeting certain SDG targets.

c. The phenological shifts and changes in abundances do vary at the species level, which is important for analysing whether some species will adapt while others will suffer.

d. Strive for restore balance and reverse bee decline trajectories if we are to encounter a future in which bees continue to contribute to the sustainable development of society.

e. Lack of honeybee professionals and trained bee labours allows poor management of colonies.

f. Depletion of floral resource because of growing concrete jungles is one of the major concerns in beekeeping.

g. Many beekeepers report that the cost of the equipment's is too high and this will also discourage the entrepreneurs in this field.

h. Increasing Electro-Magnetic Wave from mobile and various machines at very High Frequency day by Day on Bees specially on *Apis cerana*.

i. The lack of major changes in most economic indicators in the years since Colony collapse disorder appeared suggests that adjustments in beekeeping.

j. Human modifications of natural habitats for the persistence and stability of the plant- pollinator interactions.

k. Present species extinction rates are 100 to 1 000 times higher than normal due to human impacts. Insects will likely make up the bulk of future biodiversity loss with 40 percent of invertebrate pollinator species – particularly bees and butterflies – facing extinction. Though to a lesser degree, vertebrate pollinators (16.5 percent) are also threatened with extinction globally. (FAO)

8. Adaptation Measure for Safe the Bee's Against Climate Changes:

a. Conservation and restoration strategies to protect biodiversity should consider the types of land use and also the socioeconomic development in the region.

b. Proactive risk evaluation approach.

c. Need to change pollination research emphasis.

d. Need to Sustainable Production of Cross-Pollinated Crops.

e. Modern genomics methods in which sequencing of bee genome which is play a crucial role in stress management of bees.

f. Management of Habitats.

g. Make an environment with availability of forage and safe for honeybees.

h. Raising awareness of the community about beekeeping.

i. Government roles though Policies, Enhance Capabilities of Lab, training, Research and development and encourage developing traditional beekeeping model (log hives, top-bar-hives) with *Apis cerana*.

Conclusion

Honey bees are currently the single most abundant species on these crops and temperatures tend to result in an even greater dominance of honey bee abundance, relative to other pollinators. These findings indicate that increasing temperatures per se should not impact on their pollination performance but may enhance it, if adequate numbers remain available. The availability of honey bees for crop pollination is dependent on successful management strategies to control varroa mite and related bee health issues. Climate change scenarios suggest that, assuming the same or highly similar crops are still grown, the current stable but diverse range of insect species providing pollination services might shift in species composition it may be possible to conserve or restore species biodiversity and ensure the ecosystem services delivered by pollinators, as well as increase the economic income and welfare of the local population. The practical measures of combating climate change will include working with communities to reduce their vulnerability to the disasters made worse and more numerous by climate change. For this problem there are some Eco-friendly strategies and approaches like Habitat Management, Colony manipulation, Hive technology, less use of pesticide, awareness of skill and knowledge of bee ecology to local traditional people for sustainable future.

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Mineral Deficiency of Vegetable Crops

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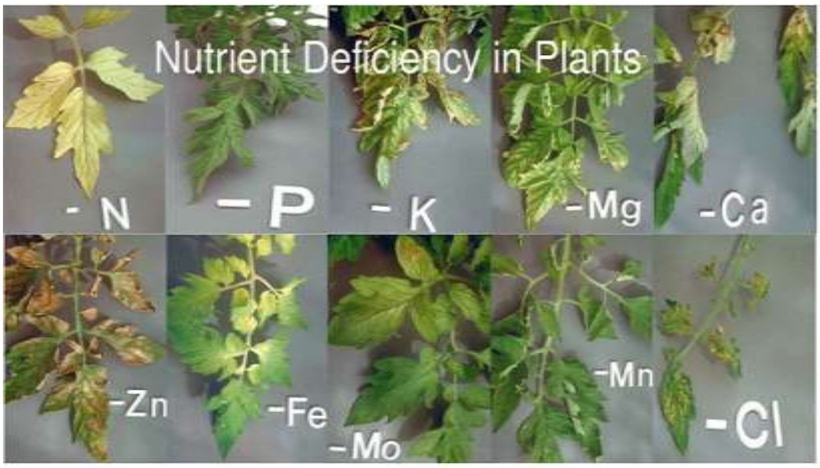

Introduction

1. The term mineral nutrient is generally used to refer to an inorganic icon obtained from the soil and required for plant growth.
2. The process of absorption translocation and assimilation of nutrients by the plant is known as mineral nutrition.
3. The element C, H, and O are not minerals. The rest of the elements are absorbed from the soil and these are called mineral elements since they are derived from minerals.
4. These mineral elements are mainly absorbed in ionic from and to some extent in non – ionic from and to some extent in non – ionic from.

Criteria of Essentiality

Plant body contains about 30 elements and in some cases as many as 60 elements Arnon and Stout [1939] proposed criteria of essentiality which was refined by Arnon [1954].
1. The deficiency of the element makes it impossible for the plants to complete the vegetative or reproductive stages of its life cycle.
2. The deficiency is specific to element in question and as such can be prevented or corrected only by supplying that particular nutrient element to the plant.
3. The elements must have a direct influence on the plant and must be directly involved in nutrition and metabolism of the plant.

Classification of Nutrients

There is different basis of classification of essential nutrients:
1. Quantity of nutrient required.
2. Mobility of nutrient in soil.
3. Mobility of nutrient with in plant.
4. Functions in plant.

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Basic Nutrients

1. Carbon.
2. Hydrogen.
3. Oxygen.

Macro Nutrients

The nutrients which are required by plants in large quantities are called macro or major nutrients. These are nine in number.

Name of Macro Nutrients

1. Nitrogen.
2. Phosphorus.
3. Potassium.
4. Calcium.
5. Magnesium.
6. Sulphur.
7. Carbon.
8. Hydrogen.
9. Oxygen.

Primary Nutrients

Among macro nutrients, Nitrogen, Phosphorus and Potassium are known as primary nutrients which are required in a proper ratio for a successful crop.

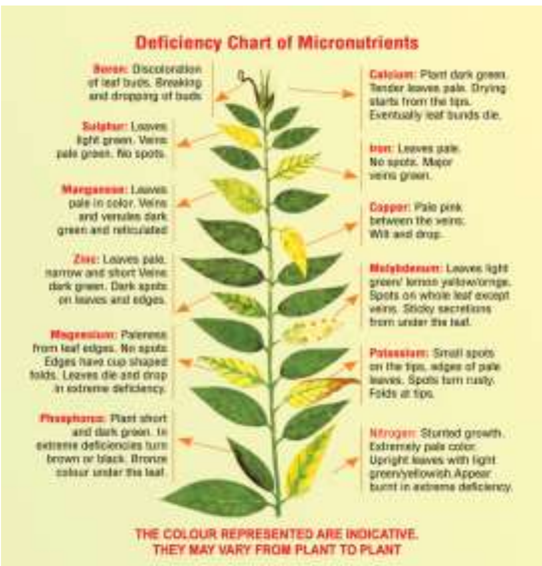
Secondary Nutrients

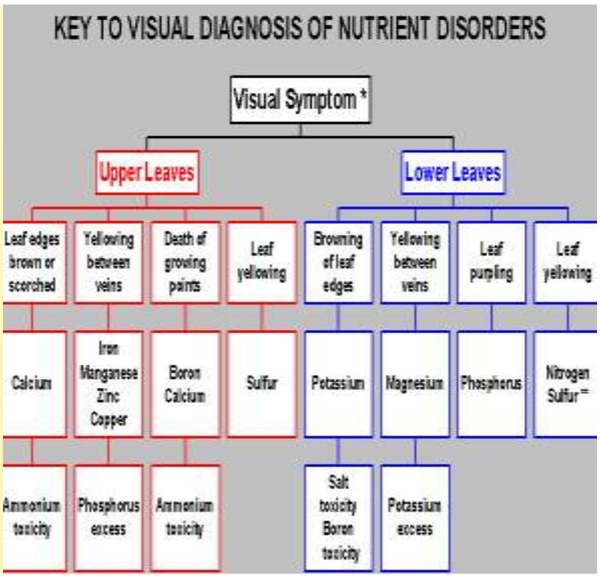
Next to primary nutrients, there are three elements such as Calcium, Magnesium and Sulphur which are known as secondary nutrients.

Micro Nutrients

These nutrients required by plants in small quantities and also known as minor or trace elements. These are eight in number.

Name of Micro Nutrients

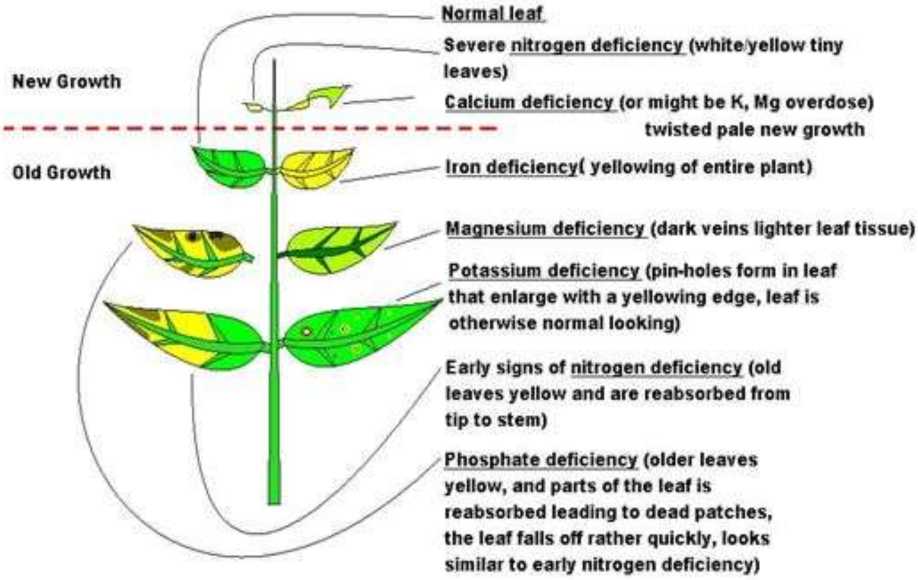




1. Manganese

2. Iron
3. Zinc
4. Copper
5. Boron
6. Molybdenum
7. Chlorine
8. Cobalt.

Deficiency Symptoms



Elements and its Major Role

Elements	Major role
C,H,O	Provide basic structure
C,H,O,N,P,S	Tissue building elements
K,Mg,Ca,Cl	Electrolytic balance
Ca,Mg,P	Skeletal elements
H,O	Energy exchange elements
N,P,S	Energy storage, Transfer & Bonding
C,N,S,P	Plastic and storage [of energy] elements
Fe,Co,Mn,Cu,Zn	Oxidation reduction [Redox] regulator
Cu,Fe,Mn,S	Catalytic elements.

Nitrogen (N)

Nitrogen is an important constituent of proteins, chlorophyll, amino acids, amides and alkaloids:
1. It improves vegetative growth and increases the size of plants and so nitrogen requirement is highest in leafy vegetables like cabbage and lettuce.
2. It increases crude protein , crude fibre and total carbohydrates in bhindi.

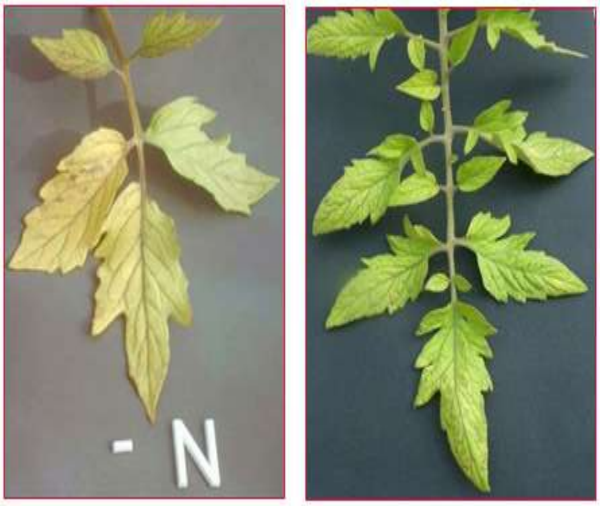
3. It increases protein content in cauliflower, yield in brinjal, no. of leaves and protein content in radish, duration of flowering in sweet pepper, and vegetative growth and vitamin C content in tomato.

Nitrogen Deficiency Symptoms

1. Stunting of growth and yellowing of age-old lower leaves.
2. Reduction of the yield and quantity of the produce.
3. Reddish colour in tomato and corn plants.
4. Onion leaves become yellowish green erect and upright curled, wilted and dwarf at maturity tissue above bulbs become soft.
5. Older leaves generally at the bottom of the plant, will yellow, Remaining is foliage often light green. Stems may also yellow and may become spindly. Growth slows.

Control

Among the available nitrogenous fertilizers, ammonium sulphate is preferred for vegetable crop because of its sulphur content (24%).



Phosphorus (P)

1. Phosphorus is a constituent of ATP, nucleic acid, phospholipids, and certain coenzymes and energy transfer system in plants.
2. It promotes early growth, prolific flowering and yields.
3. It improves the developments of fibres and laterals roots.

4. Phosphorus reduces the buttoning of cauliflower, increase percent of fruit set and number of fruits per plants in tomato; vitamin A, vitamin C, and dry matter content in brinjal , keeping quality in some vegetables and aid in the formation of nodules is leguminous vegetables.

Phosphorus Deficiency

1. Stunted growth with restricted foliage.
2. Reddish brown or purple coloration of older leaves.
3. Reduction of storage life in onion.
4. Delay in starch production, low cambial activity and lack of succulence in plants .
5. Small leaves that may take on a reddish – purple tint. Leaf tips can look burnt and older leaves become almost black. Reduced fruit or seed production.
6. The leaves become pale green in colour.
7. Nitrogen deficiency causes growth reduction chlorotic.

Control

About 25-50kg P2o5/ha has been recommended. IT has been found that single super phosphate is the best source of phosphorus as it contains calcium (19.5%), sulphur (12.5%) and phosphorus (16%).

Potassium (K)

1. Its acts as a coenzyme or activator of many enzymes and aid in protein synthesis.
2. High potassium levels increases starch and sugar content in plants.
3. Potassium maintains cell turgidity and iron supply for chlorophyll synthesis.
4. It is required in large quantities by roots crops, tuber crops and bulb crops.
5. It also improves quality and storage life of vegetables.

Potassium Deficiency symptoms

1. Marginal chlorosis of lower leaves.
2. Weak stems.
3. Impairment in yields and quality.
4. Lack of potassium causes stunted plants with small branches and little vigour.
5. Potassium deficient plants exhibit chlorosis or yellowing along the leaf margins or tip starting with the bottom leaves & progressing up the plant.
6. The yellowing and necrosis spread rapidly in a proximal direction until the whole leaf has withered in a normal position.

Control

Normally , about 50 kg k2o/ha will be adequate for the soil deficient in potassium:
1. Potassium may be supplied regularly in the form of potassium sulphate.
2. All k2o should be applied at the time of sowing as a basal-dressing by adopting furrow placement method.

Calcium (Ca)

It is essential to membrane integrity and is found in cell walls as calcium pectate for strengthening of stems.

Calcium Deficiency Symptoms

1. Stunted growth of growing plants, yellowing and dieback of shoot tips.
2. Wrinkled leaves.
3. Blossom end rot of tomato, black heart of celery, brown heart of endive, tip burn of lettuce, and internal tip burn of cabbage.
4. Dieback of root tips.
5. Root cavity in carrot and parsnip.
6. Although calcium deficient plants, fruit quality is inferior and the skin splits when ripe.

Control

Apply 250-500 kg / ha gypsum in the fruiting zone.

Magnesium (Mg)

It is an essential constituent of chlorophyll and needed for activation of many enzymes in the energy transfer process.

Magnesium Deficiency Symptoms

1. Interveinal chlorosis and withering of old leaves.
2. Reddish coloration first at the tips and margins of leaves and spread to area between leaf veins.
3. A large range of leaf symptoms have been attributed to magnesium deficiency, including marginal yellowing extending to near the midrib, changes in phyllotaxy, purple mottling of the petioles, marginal necrosis and separation of leaf sheaths from pseudostem.
4. In the case of magnesium deficiency the symptoms generally start with mottled chlorotic areas developing in the interveinal tissue.

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Control

Spray of foliage with 1% MgSo4 solution to correct the deficiency.

Sulphur (S)

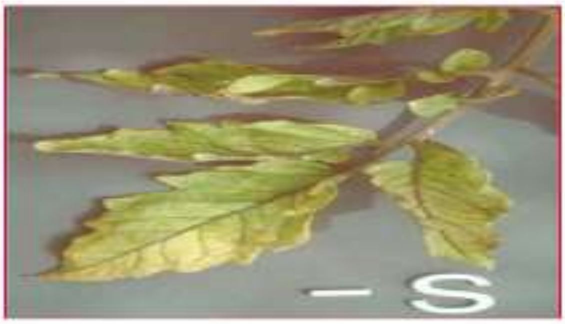
It is an important constituent of some amino acids and proteins , coenzyme A, thiamine and biotin.

Sulphur Deficiency Symptoms

1. Yellowing of younger leaves with alive terminal bud.
2. Thicker and firm leaves.
3. Chlorosis in potato leaves.
4. The growth is stunted and the bunch is very small or chocked.
5. The sulphur deficiency symptoms appear in both young and old leaves.
6. The initial symptoms are chlorosis in young leaves and reduced leaves development. The leaves took on a silver – green colouring.

Control

Apply 100 g Ammonium sulphate per plant or Apply 100 gypsum per plant.



Manganese (Mn)

1. It is required for activation of some enzymes involved in fatty acid synthesis, DNA and RNA formation and the enzyme isocitrate dehydrogenase in the krebs cycle.
2. It is involved in production of oxygen from water in photosynthesis and chlorophyll synthesis.

Manganese Deficiency Symptoms

1. Interveinal chlorosis on the young plant tissue.
2. Yellow spotting on the brinjal leaves.
3. Leaves become small in size showing yellowing at tips.
4. Reddish leaves in garden beet and narrow yellow stripes on leaves.
5. The main symptoms of manganese deficiency chlorosis or yellowing between the veins of leaves.

Control

Apply 10kg /ha manganese sulphate through soil; foliar application @0.12 kg Mn/ha is useful.

Iron (Fe)

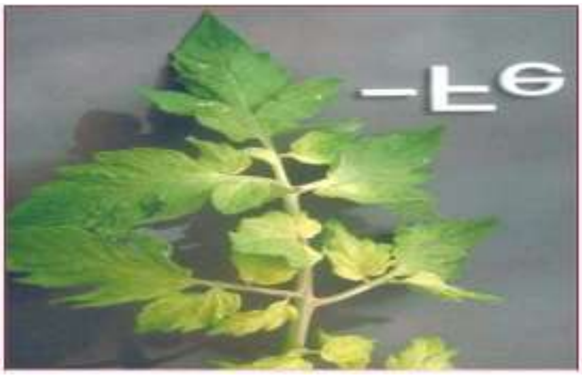
It is essential for the synthesis of chlorophyll and an important part of the cytochromes which serve as electron carrier in photosynthesis and respiration.

Iron Deficiency Symptoms

1. Interveinal chlorosis of younger leaves.
2. Death of growing tissues and resetting of plants.
3. The main symptom of iron deficiency is chlorosis or yellowing between the veins of new leaves.

Control

Foliar spray of $FeSO_4$ @ 0.5%.



Zinc (Zn)

It is required for the synthetic tryptophan, precursor of IAA and is an enzyme activator.

Zinc Deficiency Symptoms

1. Shortened internodes and chlorotic areas on the older leaves, necrotic and dead areas on new leaves.
2. Reddish brown spots on leaves in beans.
3. Yellowing of leaves in onion and garlic.
4. Dwarfing of plants with small and chlorotic leaves in tomato.
5. Zinc deficiency also results in stunted growth, while young leaves are smaller than normal.

Control

Apply 15 kg/ha or more Zn through soil ; spray 10 kg/ha $ZnSO_4$.

Molybdenum (Mo)

It aids in nitrogen fixation of symbiotic nitrogen fixing bacteria is required for the reduction of nitrate by the enzyme nitrate reductase.

Molybdenum Deficiency Symptoms

1. Curbing of leaves edges in tomato.
2. Flower abortion.
3. Whiptail in cauliflower.
4. Symptoms of Mo deficiency resemble those of nitrogen deficiency that is, yellowing of leaves, stunted growth and low yield.
5. The effected spots are impregnated with resinous gum which exudes from rear side of the leaves from the reddish-brown spots; Brassica sp. most susceptible.

Control

Alternately, soil application of Sodium Molybdate (10-15 kg/ha) effectively controls the deficiency symptoms.

Boron (B)

It is probably required in carbohydrate synthesis and transport.

Boron Deficiency Symptoms

1. Stunted growth, dieback of shoot and root tips.
2. Curled, brittle, wilted and chlorotic leaves.
3. Hollow stems of cruciferous vegetables, brown heart of turnip, black heart of beet, internal browning of tomato, heart rot of radish and cracked stems in celery and soggy tubers in potato.
4. Necrotic areas are localized near the leaf margin.
5. This is classified as a form of internal damage and has been termed hollow heart.

Control

Spray 10 kg/ha borax or 0.2% borax through soil; foliar application of 0.1 ppm B at prebloom stage is advantageous.

Copper (Cu)

It serves as an electron carrier and is an important constituent of certain protein and enzymes.

Copper Deficiency Symptoms

1. Wilting of young leaves, chlorosis and necrosis.
2. Small and poorly formed fruits.
3. Thin bulbs with light coloured outer scales in onion.
4. Stunting, withering and extensive shedding in leguminous vegetables.
5. The stunted plants are green and wilted in early growth stages.

Control

1. Small amount of soil applied CuSO4 is able to correct the copper deficiency.
2. Apply 2-4kg Cu/ha as copper sulphate once in 3-4 years.

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Degreening of Acid Lime

Article ID: 32593

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Introduction

Consumers prefer bright coloured Acid lime fruit and are willing to pay a premium for them. Green coloured fruits are considered unripe and fetch lower prices. Hence the colour of the rind is important for the aesthetic value and as such it is the most important factor determining marketability (Ron, 2008). The external colour of the citrus fruit is not a reliable index of the internal maturity, but it does indicate maturity to certain extent when colour develops under normal conditions in the field. Despite citrus being a non-climacteric fruit, some aspects of its ripening could be still sensitive to external exposure to ethylene. (Sdiri et al, 2012). In citrus internal edible portion of the fruit (pulp) usually reaches maturity while the external peel is still green, therefore, degreening practices were developed to accelerate fruit colour change and render the fruit more acceptable for marketing (Ron, 2008).

Degreening of Citrus Fruits

1. Degreening is the process of degradation of chlorophyll by ethylene, where luxuriant growing conditions cause chlorophyll to persist or reappear in the rinds of mature fruit. The degreening process is carried out in special rooms designed to treat the fruit with air containing a low concentration of ethylene at controlled temperature and humidity.

2. The development of chloroplast and chromoplast is influenced by endogenous growth regulators. Ethylene causes loss of chlorophyll and produces the minor changes in carotenoids (Griersonand Newhall 1960).

3. The practice of postharvest degreening of green, mature and edible citrus fruit has developed in order to promote external colour development, i.e., destruction of green chlorophyll pigments and accumulation of orange/yellow carotenoid pigments. The degreening process is complicated, since it depends on various endogenous and exogenous factors, such as fruit maturity at harvest and sensitivity of the fruit to ethylene, and is influenced by ethylene concentrations and the duration of degreening process, temperature and relative humidity used, efficiency of air circulation and ventilation (Ron, 2008).

4. Ethylene do not ripe the immature fruits completely in terms of skin and flesh colour development. It was found that the ethylene has threshold level between 5-15ppm, optimum degreening temperature of 25°C, relative humidity of above 80% which favours both chlorophyll destruction and carotenoid accumulation, (Ron, 2008).

Effect of Post-Harvest Degreening on Quality Parameters of Acid Lime

1. Physiological loss in weight (%): Physiological weight loss is a continuous phenomenon during storage due to moisture loss. Moisture loss through respiration and transpiration during storage affects the salable weight and eventually the fruit becomes unsalable as a result of shrinking. Ladaniya and Singh (2001) reported that, no difference due to ethylene treatment but cumulative weight loss was higher in non-degreened fruits.

2. DA (IAD) meter Reading: DA meter measures the chlorophyll content in a fruit and, as a consequence, its state of ripeness. DA reading showed significantly decreased as the ripening advanced during storage at ambient conditions. The decreasing trend in DA reading with the advancement of ripening may be attributed to the reason that, chlorophyll concentration reduced substantially, while carotenoids concentration increased (Medlicott et al., 1990).

3. Hedonic score: Degreening advanced, hedonic score increased progressively at ambient conditions. Degreening of citrus fruits continued after removing from degreening chamber and resulted in elimination of original treatment differences. It has been reported that once the colour development started with ethylene, it remains unaffected by the break in ethylene supply (Ladaniya and Singh 2001).

4. Peel thickness (mm): The storage days increased there was a decreasing trend in peel thickness of citrus (Asutosh et al, 2016). Because the pulp mass of fruit increases during ripening due to an increase in water content, it could be due to the movement of water from peel to pulp and to the surrounding air (Ahmad et al, 2001).

5. O_2 and CO_2 (%): Degreening advanced, O_2 progressively decreased at ambient conditions. The trend of decreasing % of O2 with increasing degreening was observed by Ladaniya (2001) in Sweet Orange. Stimulation of respiration by ethylene was dose-dependent. Treatment with ethylene induces an increase in respiration similar to respiratory climacteric in banana. The rise in CO_2 production is immediate and related to the time duration of ethylene treatment (Dominguez and Vendrell 1994).

6. Fruit firmness (kg/cm2): Firmness of lime fruits was reduced with an increased storage. Ethylene encourages the fruit ripening can progress into physiological development and the flesh and fruit can become soft (Hayat et al, 2017).

7. TSS (Brix°): TSS of lime fruits were increased progressively with an increase in storage period. It may be due to continues process of respiration and transpiration have resulted in weight loss and conversion of starch to sugars by the activity of hydrolytic enzymes (Hayat et al, 2017).

8. Titrable Acidity (%): As the storage days increased there was a decreasing trend in titrable acidity of citrus. This can be attributed due to the conversion of organic acids into soluble sugars and long chain polysaccharides may also lead to decrease in acid content (Dhillon and Mahajan, 2011).

9. Content of Vitamin C: Vitamin C content was decreased with an increase in storage time. Degreening process promotes the conversion of acids to sugars leads to decrease in the ascorbic acid content. With the advancement of storage period, total soluble solids were increased while ascorbic acid and acidity of fruits decreased in Kagzi lime (Piyush and Dashora 2000).

10. Juice recovery (%): Juice recovery was decreased with the prolongation of storage period. This decrease might be due to the utilization of available organic acids at faster rate in respiration during ripening (Hayat et al, 2017).

11. Shelf life: Shelf life was diminished with the prolongation of storage at ambient temperatures and decreased with increased in ethylene dose. Sweet orange optimum response of degreening was recommended at 5-10ppm ethylene concentrations, although higher concentrations (100-250) of ethylene treatments increased the rate of post-harvest degreening decay losses (Ladaniya and Shyam 2001).

Conclusion

Finally, to conclude, degreening promote the colour development, increseses the rate of respiration, fruit firmness, TSS and juice recovery. Degreening decreases the Titrable acidity. Degreening has no effect on recovery of vitamin C. Shelf life is completely dose dependant. degreening of Acid lime through 15 ppm ethylene with 4 pulsings in 24 hours @ 6 hrs. interval or 15 ppm ethylene with 2 pulsings in 24 hours @ 12 hrs. interval can be recommended for Acid lime for uniform degreening and storage at ambient conditions.

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Encapsulation of Beneficial Microorganisms: A Novel Delivery System for Enhancing Crop Health

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Introduction

Plant health is a major concern in the context of increasing population, biodiversity decreases and food requirement, environmental contamination and resistance development in diseases and pests (Zhu et al., 2018). In this context, Year 2020 has been declared as "International Year of Plant Health" by FAO. It is therefore desirable to apply efficient and cost-effective eco-friendly measures for holistic crop health management that reduces adverse effects on environment and human health. One of such measure is through application of beneficial microbes to the soil as biofertilizers and bioagents for managing crop diseases and pests. However, commercial formulations based on beneficial microbes contain live spores as active ingredient and therefore require storing under refrigeration or at optimum temperatures, while field applications must be performed under conditions of high relative humidity. Furthermore, ultraviolet (UV) light is harmful to the beneficial microbes (Paula et al., 2011; Vemmer and Patel, 2013). Therefore, it is necessary to develop delivery system that can increase availability of this beneficial microbes in the field. The emerging technology way involves use of microencapsulation techniques which covers and protects the microorganisms against various stresses (Lewis and Papavizas, 1985; Knudsen, 1990; Fraceto et al., 2018).

Formulation of Beneficial Microbes

Talc, Lignite, Vermiculite, Perlite, Bentonite clay, Kaolin and Peat are the most commonly used inert carriers for powder-based formulations and vegetable oils and mineral oils for liquid based formulations are generally used (Prasad & Rangeshwaran, 2000) to inoculate seed and soil with various beneficial fungal and bacterial microbes (Denton et al. 2009).

Natural polymer like chitosan which is antimicrobial in nature used as plant defense inducers, growth promoter and in management of plant pathogens can be exploited as better carrier for delivery systems of bio control agents (Raphaël and Meimandipour, 2017; Rakesh et al., 2017a,b; Mohamed et al., 2016).Various biotic and abiotic factors effects on the quality of the final product, stability during storage, and survival of microorganisms in the final product since microbiological contamination decreases the shelf life of the inoculants.

Furthermore, Conventional formulations are not able to ensure high cells density and after 6 months of storage a reduction on cells viability is observed (Fallik and Okon, 1996). Liquid formulations comprise of bio-inoculants, which use broth cultures mainly in water, but also in mineral or organic oils. The seeds are either dipped into the liquid formulation before sowing, or an evenly sprayed on the seeds (Bashan, 1998). Liquid formulations ease process of application for the farmers and may have some advantages since they can be used with low-cost natural substrates and are easily attainable by small producers (Albareda et al., 2008).

Liquid formulations allow contacting directly seeds and microorganisms and consequently increasing the survival of beneficial microbes on plant roots. However, microbe's survival rates in liquid formulations decrease because this technique does not provide a protective environment and the number of spores distributed in each seed is quite heterogeneous. In addition, microorganisms are not sufficiently protected against environmental conditions and contamination during storage, transport, and application into the soil and lose viability (Bashan et al., 2002).

Encapsulation of Beneficial Microbes

The principle of bio-encapsulation is to protect the microorganisms introduced into the soil and to ensure a gradual and prolonged release (Kim *et al*., 2012). The degradation rate of the encapsulation matrix will have a direct relation with the biological activity of the soil microorganisms. The dried capsules can be stored at room temperature for a long period presenting a favorable environment for beneficial microbes and reducing the risk of decreased survival. Numerous advantages related to the bio-encapsulation of rhizobacteria are found, for instance, controlled release of fungal and bacterial spores into the soil, protection of microorganisms in the soil against biotic and abiotic stresses, and contamination reduction during storage and transport. A wide spectrum of natural and synthetic polymers polymers like polysaccharides, proteins, gums are used in the bio-encapsulation of beneficial microbes as seed coating agents. Hydrogels extracted from seaweed, such as alginate, carrageenan, agar-agar, and agarose, considered as natural, are formed by polymerization or cross-linking. Also, certain synthetic polymers have been used for bio-encapsulation of living cells, such as polyacrylamides, polystyrene, and polyurethane (Trevors *et al*., 1992; Cassidy *et al*., 1996). Gums and proteins are frequently used as protective materials to cells, although they usually turn out to be more expensive. Carbohydrates such as starches, maltodextrins, corn syrup solid, acacia gums, and so on are used extensively in spray-dried encapsulations (Reineccius, 1991). Among the properties of these materials, their low viscosity at high solids contents and good solubility, which are desirable in an encapsulation agent is pointed out. Starch and products derived from it such as maltodextrins and β-cyclodextrins have been widely used to encapsulate other type of compounds, such as flavors, being the subject of extensive studies (López *et al*., 2012). Sodium alginate is one of the most commonly used products for the bio-encapsulation of microorganisms. The resulting inoculum is used for various purposes: the immobilization of bacteria (Bashan *et al*., 2002), fermentation and application of biological control agents (Bashan and Holguin, 1994), or biostimulants for plant growth (Bashan and Levanony, 1990; Schoebitz *et al*., 2012). Sodium alginate is produced by brown algae, such as *Macrocystis pyrifera*, *Laminaria digitata*, *Laminaria hyperborean*, and *Eklonia cava*. Alginate production is not exclusive to seaweed. Indeed, there are some bacteria able to produce extracellular alginate. An example is *Azotobacter vinelandii* (Nunez *et al*., 2000) and several *Pseudomonas* strains (Fett *et al*., 1986, 1989). Alginates are linear macromolecules comprising two monomers linked by alpha 1–4: β-acid and D-mannuronic acid to α-L-guluronic acid having a molecular weight between 20,000 and 200,000 Da. The properties of alginate are variable according to the origin of the seaweed and the manufacturing process. For instance, in relation to their molecular weight, alginates will have different solubility properties and complexation with calcium. The alginate solution is mixed with the cell culture and is extruded into a solution of $CaCl_2$ in concentrations from 0.05 to 0.1 M. The residence time of the ball in this solution for the complete gelation is around 20–30 min. Alginate-starch beads are able to load a high cells concentration at 10^9 CFU g^{-1} with an average diameter of bead at more than 4 mm. However, the diameters of beads/capsules have a huge variation of diameter (1 μ to 6 mm) that depend on the encapsulation techniques, bead matrix composition, and the internal diameter of the diffusers. From the farmers and agricultural industry point of view, the ideal diameter of the beads should be similar to the seed used. Chitosan-PEG (Polyethylene glycol) (Cts-PEG) blend containing *T. harzianum* (Th4d) (Cts-PEG-Th) spores is developed and its storage stability, persistence in soil and bio efficacy against seed and soil borne pathogens of groundnut and safflower crops is studied. The blend was stable without much changes in pH throughout the storage period. Persistence studies conducted for 3 months revealed that Cts-PEG-Th amended soil, *Trichoderma* got released from polymer film slowly and reached a maximum of log 8 CFUs by 30 days and there after started declining to retain log 6 CFUs at 90 days. In shelf life study, the chitosan blend was able to maintain *Trichoderma* counts of log 10.0 and log 10.2 over a period of 6 months at storage temperatures of 30 °C and 4 °C, respectively and the antagonistic activity unaffected against three plant pathogens *viz., Macrophomina phaseolina*, *Fusarium oxysporum* f. sp. *ricini* and *Aspergillus niger* over a period of 6 months of storage. Bio efficacy testing in germination towels and green house pot studies revealed the effectiveness of seed treatment with Cts-PEG-Th blend significantly increasing the germination and seedling vigour and reducing the diseases in groundnut (peanut) and safflower. The calcium alginate microparticle encapsulated bioagent *T. harzianum* showed a better response to ultraviolet radiation when compared to non-encapsulated fungus through exposure, where it is sensitive. In the studies, it could be seen that the amount of fungal growth on the plate was lower for the non-encapsulated organism, compared to the growth of the encapsulated fungus, especially after 5 days of exposure to UV radiation. Considering the growth of the fungus exposed to UV radiation for the period employed here (7 days), it is evident that encapsulation of *T. harzianum* in provides protection against UV radiation. The enzymatic activity is a key point in the mechanism of action of *T. harzianum* (Druzhinina *et al*., 2011), and the results have shown that the encapsulation promotes an increase in the chitinase and cellulase activities of the encapsulated *T. harzianum*. This could be due the fact that the fungi are protected in the microparticles which makes then less exposed to external factors (UV, temperature, pH, etc.) (Maruyama *et al*., 2020).

Bioencapsulation Methods

Different methods are used to encapsulate beneficial microbes, pointing out physical processes, such as spray drying, spray chilling/cooling, extrusion, or fluidized bed; chemical processes like co-crystallization, molecular inclusion, or interfacial polymerization; and also, physicochemical processes, such as coacervation, liposomes, and gelation/inverse gelation (Madene et al., 2006). The bioencapsulation of beneficial microbes is performed in three stages. The first step involves the incorporation of an active ingredient into a matrix (liquid or solid). The second stage is a mechanical operation that involves making dispersion or spraying a solution onto solid particles under mechanical stirring, and the last step consists of a stabilization by a chemical process of polymerization or by a physical–chemical processes (gelation and coacervation) or physical (evaporation and solidification) on a droplet or pellet formed during the second stage. New techniques of encapsulation continue to emerge for developing formulations and processes to manage the improvement of capsule properties and characteristics.

Conclusions and Perspectives

The review highlights the potential for encapsulation of beneficial microbes for efficient delivery in agricultural practices and managing various stresses compared to liquid and conventional formulations. The advances in this field have been presented featuring encapsulation materials and techniques used for immobilization and bio-encapsulation of beneficial microbes. Nevertheless, conventional microbial formulations are not able to ensure high cell viability during formulation, storage, and application in the soil due to extreme temperature fluctuation, and the low shelf life of liquid inoculants. The use of conventional inoculants is not able to offer protection to beneficial microbes against biotic and abiotic stresses, such as pH, moisture and temperature. Instead, bio-encapsulation provides a niche where beneficial microbes are protected from the soil stresses. Furthermore, the encapsulated bio-inoculants confer a gradual spore release that achieves long-term effects in fertilization and managing stresses. There is most important aspect related to encapsulated microbes' application is each capsule may act as an independent unit around the rhizosphere soil, which increases the cells concentration enhancing the roots colonization and the microbial inoculants efficacy on the field. Therefore, trials on large fields are required to use innovative bio-encapsulation devices to investigate the effectiveness of the microbial inoculants at time of application and during entire season of crop for standardization of large-scale production of bio-inoculants. The choice of an appropriate technique of bio-encapsulation will depend on the properties of the beneficial microbes, the degree of stability required during storage and processing and also the production cost. In addition, fluidbed process is also becoming a promising encapsulation technique for large-scale production of beneficial microbes in agricultural industry. However, ionic gelation is currently the most adequate method found to encapsulate fungal and bacterial inoculants.

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Plant Response to Greenhouse Environment

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The productivity of a crop is influenced not only by its heredity but also by the microclimate around it. The components of crop microclimate are light, temperature, air compositions and the nature of the root medium. In open fields, only manipulation of nature of the root medium by tillage, irrigation and fertilizer application is possible. The closed boundaries in greenhouse permit control of any one or more of the components of the micro climate.

Light

The visible light of the solar radiation is a source of energy for plants. Light energy, carbon dioxide (Co2) and water all enter in to the process of photosynthesis through which carbohydrates are formed. The production of carbohydrates from carbon dioxide and water in the presence of chlorophyll, using light energy is responsible for plant growth and reproduction. The rate of photosynthesis is governed by available fertilizer elements, water, carbon dioxide, light and temperature.

The photosynthesis reaction can be represented as follows:

Chlorophyll

Co2 + water+ light energy ------------ carbohydrates + oxygen

Plant nutrients Considerable energy is required to reduce the carbon that is combined with oxygen in CO2 gas to the state in which it exists in the carbohydrate. The light energy thus utilized is trapped in the carbohydrate. If the light intensity is diminished, photosynthesis slows down and hence the growth. If higher than optimal light intensities are provided, growth again slows down because of the injury to the chloroplasts.

The light intensity is measured by the international unit known as Lux. It is direct illumination on the surrounding surface that is one meter from a uniform point source of 1 international candle. Green house crops are subjected to light intensities varying from 129.6klux on clear summer days to 3.2 Klux on cloudy winter days. For most crops, neither condition is ideal.

Many crops become light saturated, in other words, photosynthesis does not increase at light intensities higher than 32.2klux. Rose and carnation plants will grow well under summer light intensities. In general, for most other crop's foliage is deeper green if the greenhouse is shaded to the extent of about 40% from mid spring (May) to mid fall (August and September). Thus, it is apparent that light intensity requirements of photosynthesis are vary considerably from crop to crop.

Light is classified according to its wave length in nanometers (nm). Not all light useful in photosynthesis process. UV light is available in the shorter wavelength range, i.e less than 400nm. Large of quantities of it is harmful to the plants. Glass screens are opaque to the most UV light and light below the range of 325nm. Visible and white light has wavelength of 400 to 700nm.Far red light (700 to 750nm) affects plants, besides causing photosynthesis.

Infrared rays of longer wavelengths are not involved in the plant process. It is primarily, the visible spectrum of light that is used in photosynthesis. In the blue and red bands, the photosynthesis activity is higher, when the blue light (shorter wavelength) alone is supplied to plants, the growth is retarded, and the plant becomes hard and dark in colour. When the plants are grown under red light (longer wavelength), growth is soft and internodes are long, resulting in tall plants. Visible light of all wavelengths is readily utilized in photosynthesis.

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Temperature

Temperature is a measure of level of the heat present. All crops have temperature range in which they can grow well. Below this range, the plant life process stop due to ice formation within the tissue and cells are possibly punctured by ice crystals.

At the upper extreme, enzymes become inactive, and again process essential for life cease. Enzymes are biological reaction catalyst and are heat sensitive. All biochemical reactions in the plant are controlled by the enzymes. The rate of reactions controlled by the enzyme often double or triple for each rise of temperature by 100C, until optimum temperature is reached. Further, increase in temperature begins to suppress the reaction and finally stop it.

As a general rule, green house crops are grown at a day temperature, which are 3 to 60C higher than the night temperature on cloudy days and 80C higher on clear days. The night temperature of greenhouse crops is generally in the range of 7 to 210C. Primula and calceolaria grow best at 70C, carnation and cineraria at 100C, rose at 160C, chrysanthemum and poinsettia at 17 to 180C and African violet at 21 to 220C.

Relative Humidity

As the green house is a closed space, the relative humidity of the greenhouse air will be more when compared to the ambient air, due to the moisture added by the evapo-transpiration process. Some of this moisture is taken away by the air leaving from the greenhouse due to ventilation.

Sensible heat inputs also lower the relative humidity of the air to some extent. In order to maintain the desirable relative humidity levels in the green houses, processes like humidification or dehumidification are carried out. For most crops, the acceptable range of relative humidity is between 50 to 80%. However, for plant propagation work, relative humidity up to 90% may be desirable.

In summer, due to sensible heat addition in the daytime, and in winters for increasing the night time temperatures of the greenhouse air, more sensible heat is added causing a reduction in the relative humidity of the air. For this purpose, evaporative cooling pads and fogging system of humidification are employed. When the relative humidity is on the higher side, ventilators, chemical dehumidifiers and cooling coils are used for de-humidification.

Water

Most growing plants contain about 90 percent water. Water plays many roles in plants. It is a primary component in photosynthesis and respiration:

1. Responsible for turgor pressure in cells (Like air in an inflated balloon, water is responsible for the fullness and firmness of plant tissue. Turgor is needed to maintain cell shape and ensure cell growth).
2. A solvent for minerals and carbohydrates moving through the plant.
3. Responsible for cooling leaves as it evaporates from leaf tissue during transpiration.
4. A regulator of stomatal opening and closing, thus controlling transpiration and, to some degree, photosynthesis.
5. The source of pressure to move roots through the soil.
6. The medium in which most biochemical reactions take place.

Carbon Dioxide

Carbon is an essential plant nutrient and is present in the plant in greater quantity than any other nutrient. About 40% of the dry matter of the plant is composed of carbon. Under normal conditions, carbon dioxide (CO_2) exits as a gas in the atmosphere slightly above 0.03% or 345ppm.

During the day, when photosynthesis occurs under natural light, the plants in a greenhouse draw down the level of CO_2 to below 200ppm. Under these circumstances, infiltration or ventilation increases carbon dioxide levels, when the outside air is brought in, to maintain the ambient levels of CO_2. If the level of CO_2 is less than ambient levels, CO_2 may retard the plant growth. In cold climates, maintaining ambient levels of CO_2 by providing ventilation may be uneconomical, due to the necessity of heating the incoming air in order to maintain proper growing temperatures.

In such regions, enrichment of the green house with CO_2 is followed. The exact CO_2 level needed for a given crop will vary, since it must be correlated with other variables in greenhouse production such as light, temperature, nutrient levels, cultivar and degree of maturity. Most crops will respond favourably to CO_2 at 1000 to 1200 ppm.

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Utilization of Organic Amendments in Plant Disease Management

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Introduction

In the very beginning era of agriculture, the main form of providing crop nutrient was composts and manures which were derived from the plants and animals' by-products. The beneficial effect of organic amendments on soil quality has a great influence in plant health and ultimately increases crop production. The application of organic amendments helps to restore soil organic matter content and improved soil quality by affecting several parameters of soil such as aeration, structure, drainage, moisture, water holding capacity, nutrient availability and microbial diversity etc. Utilization of organic amendments has been an important strategy for the management of several soil borne plant diseases which are very difficult to manage with other's control measures. Organic amendments having high amount of nitrogen like poultry manure, meat and bone meal, soymeal, has significantly reduced populations of several broad-spectrum soil borne plant pathogens. The effectiveness of disease control by organic amendment occurs when soil and biological factors are conducive to activate the processes that can reduce survival of pathogens. So, understanding the mechanisms of action allocate in prediction of effective results based on analysis of soil and organic amendments.

But the effective results of organic amendments are inconsistent as compared to the effects of other chemical fertilizers and has high cost of transportation charges of bulky composts as well as their shelf life is very low so cannot kept for longer period of time. Besides, inconsistency of results is also due to faulty practices adopted by the farmers while preparing compost along with the use of not well rotten compost or manures also sometimes hinder the results. The changes in soil physicochemical parameters may also modulate the efficacy of suppression of plant pathogens. But an attempt was made to increase the efficacy of shelf life of marketed compost by the addition of dried and powdered plant biomass to the cattle dung manure.

In integrated pest management (IPM), the use of organic amendments or mulches has been successfully identified as an important tool for managing several plant diseases along with combinations of other strategies such as genetic host resistance, fungicide applications etc. But, the effectiveness of suppressive capacity of different types of compost differs depending on the type of organic matter, plant host and pathogen species involved. The mechanism of "General suppression" has been identified as a common reason of soil suppressiveness due to the effect of organic amendments. The application of organic matter may lead to many fold increases in total microbial biomass and its activity in soil ultimately resulted into inhibition of pathogen populations either by competition for nutrients and niches or direct forms of antagonism in the soil.

Mechanism and Impact on Plant Pathogens

1. Released of toxins: Direct antimicrobial action of toxins released by compost biomass in soil due to various microbial action.
2. Nutrients and niches competition: Supply of nutrients suitable for antagonists favouring them for competition of nutrients.
3. Hyper parasitism or antimicrobial action of antagonists: Manipulation of various soils physio-chemical properties in favour of antagonists.
4. Activation of disease resistance genes help in induction of plant defence mechanisms.

5. Absorption and transport of synthetic biochemicals by plant roots to aerial parts to provide resistance against air borne pathogens.
6. Release of fumigant biochemicals during microbial activity occur inside soil.
7. Stimulation of germination of fungal resting structures by aldehydes, etc. in absence of host.
5. Enhancement of hydrolytic activities like chitinases and gluconates.

Application in Plant Disease Management

The use of blood meal and fish meal can totally reduce the incidence of *Verticillium* wilt of tomato. The problem of *Fusarium* wilt of cucumber was managed by the application of pig manure and rapeseed bio-organic fertilizer in field (Zhang *et al.,* 2008). The application of vermicompost has suppressed *Rhizoctonia* damping off in white pumpkin (Rivera *et al.,* 2004) and use of compost sewage sludge suppressed the lettuce drop problem (*Sclerotinia* sp.,) in field.

Different composts derived from wastes materials and by-products of olive oil, wine and *Agaricus* mushroom agro industry were reported to suppress the problems of *Phytophthora* spp., *Fusarium* spp. and *Septoria* spp. in tomato fields (Ntougias *et al.,* 2008). Moreover, formulations of neem-based extracts have also been very effective against various pests and pathogens such as fungi, bacteria and viruses. Management of pests (*Aphis gossypii, Bemisia tabaci*) in cotton as well as pest and disease in soybean such as *Aproaerema modicelli,* Yellow Mosaic Virus (YMV) was reported by spraying of neem-based products. Successfully management of rice pests such as *Cnaphalocrocis medinalis* and *Nilaparvata lugens* and disease like sheath blight caused by *Rhizoctonia solani* was achieved by the application of neem cake to the soil, neem seed kernel extract (NSKE), spraying of neem oil on field (Ouerdraogo *et al.,* 2001). In field conditions, reduction of bacterial blight of rice (BLB) caused by *Xanthomonas compestris* pv. *oryzae* was verified by spraying of plant extracts such as neem cake extract @ 5%, neem seed kernel extract (NSKE) @ 2%, *Acacia* spp. leaf extract @10%, *Prosopis* spp. leaf extract @10%, Plantomycin @ 500 ppm and suspension of *Bacillus subtilis*. The influence of organic amendments not only affects the abundance of soil microbial populations but also affect bacterial diversity present in soil.

The different three green composts made from extracts of *Pisum sativum*, *Brassica oleracea* and *Sorghum vulgare* was able to suppress the problem of *Verticillium* wilt in potato (Ochiai *et al.,* 2008). Further, the report of *in situ* and *in vitro* suppression of several pathogens such as *Pythium debaryanum*, *Sclerotium bataticola and Fusarium oxysporum* by the application of leafy fruit compost, garden compost, crops compost and their water extracts were suggested. The combination effect of cattle and chicken manure with the addition of tomato and pepper residues has successfully suppressed bacterial canker of tomato caused by *Clavibacter michigansis* (Yogev *et al.,* 2009). Fritz (2007) has reported that dry biomass of rape seed powder application to field furrows without composting controlled pea root rot. Likewise, dried plant residues of *Brassica rapa*, *Arachis hypogaea, Trifolium pratense* @ 1 % (w/w) were tested against damping off caused by *R. solani* according to Kasuya *et al.* (2006).

The reduction of incidence of potato scab, *Verticillium* wilt and populations of nematodes were achieved by the use of soymeal, meat and bone meal amendments under field conditions. In field, the application of oil seed cakes of neem (*Azadirachta indica*), castor (*Ricinus communis*), mustard (*Brassica compestris*) and duan (*Eruca sativa*) against nematode populations such as *Meloidogyne incognita, Rotylanchulus reniformis* and *Tylenchorhynchus brassicae* and against plant pathogenic fungi such as *Fusarium oxysporum* f. sp. *ciceri, Macrophomina phaseolina* and *Rhizoctonia solani* has been well documented.

The chitin compost having composed of crab shell of 30% showed the ability to reduce late blight of pepper caused by *Phytophthora capsici* and the compost water extract inhibited the growth of pathogen under *in vitro* study. The reason was due to the increase number of chitinase producing bacteria in the rhizosphere and increase activities of enzymes such as chitinase and β-1,3 glucanase in plants amended with the chitin compost according to Chae *et al*. (2006).

The production of antibiotic compounds such as production of 2, 4 diacetylphloroglucinol, phenazines and pyrone compounds has enabled to suppress take all of wheat by fluorescent *Pseudomonas* spp. and *Trichoderma* spp. The abundance of higher populations of antibiotic producing *Pseudomonas* spp. in the rhizosphere has been reliably correlated with the natural soil suppressiveness against take all disease of wheat (Bonilla *et al*., 2012).

Conclusion

Thus, the use of organic amendments or composts could be a promising and environmentally friendly alternative to chemical pesticides against several soil borne plant pathogens. It has been considered as an important tool in integrated disease management but its large-scale practicability is limited due to its short shelf life, requirement of its bulk quantity for application, non-maintenance of quality control and several others biotic and abiotic factors exist in the soil has also great influence for the effectiveness of result. So, there is a need to focus on the proper exploitation of its negative effects towards its beneficial approach for the total utilization of organic amendments in a large-scale basis in the near future.

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Physiological and Molecular Advancement in Legumes Responses and Adaptation to Elevated CO_2

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Introduction

Due to the changing climate, scientists and plant biologists face a major challenge to feed a huge growing population as it requires maintenance of genetic gains necessary for sustaining crop productivity. In recent years, there has been a phenomenal emergency and greater impulsion to discover universal solutions to this issue. According to the Intergovernmental Panel on Climate Change (IPCC) 2013, there has been a greater rise in greenhouse gases such as methane, carbon dioxide (CO_2), and nitrous oxide increasing by about 150%, 40%, and 20%, respectively, since 1750. These increased greenhouse gases, particularly CO_2, trigger global warming that results in posing a serious threat to the productivity of crops throughout the world. In 2019, atmospheric CO_2 concentration surged at a breakneck speed of 411 parts per million (ppm) (https://www.co₂.earth/). The record-breaking rise in the concentration of CO_2 in the atmosphere fortifies the ambiguity of altered yield of crops and other physiological parameters. As per the report of IPCC 2018 on the "Impact of global warming of 1.5°C (SR 15) above pre-industrial levels" global warming would be limited to 1.5°C, which requires CO_2 emissions to fall 45% from 2010 levels by 2030 and reaching 'net zero' around 2050".

After cereals, legumes (lentils, peas, chickpeas, soybean, beans) belonging to Fabaceae or Leguminosae family, are regarded as the most important crops in the field of agriculture due to their miscellaneous uses, ranging from animal fodder and aquaculture feed to human food. Legumes also known as 'plant meat', are an exceptional source of proteins, playing a crucial role in achieving food security goals. Because of secondary metabolites pool such as lignin, saponin, folate, etc., legumes are capable of offering protection against a few cancers, diabetes, and obesity in humans. Legumes also perform a critical function in sustainable agriculture as well as natural ecosystems on the basis of their capability to fix atmospheric nitrogen symbiotically.

Effects of Elevated CO_2 on Major Physiological and Biochemical Traits in Legumes

1. Shoot and root length, plant biomass, and senescence: Initially, the length of shoots and roots are increased significantly owing to intensified vigour on the exposure of crops to elevated CO_2 (Figure 1). Thompson et al. (2017) reviewed the impact of increased CO_2 on photosynthetic rates and carbon partitioning, especially highlighting sugar metabolism in roots. In chickpea, elevated CO_2 caused a considerable increase in shoot length, but chlorophyll content was decreased. Under elevated CO_2 (550 ppm), shoot biomass was increased to 36% in field pea. While performing the experiments of free-air CO_2 enrichment (FACE) and open-top chamber (OTC), it has been observed that elevated CO_2-triggered root biomass, root elongation, and root production respectively in plants. Higher CO_2 concentration decreased leaf chlorophyll content, nitrogen balance index, and hence senescence occurred in legumes, for example, chickpea.

2. Stomatal behaviour: Water use efficiency (WUE) regulated by stomata, is amongst the most significant physiological trait that affects plant productivity. Any variation in the amount of CO_2 leads to changes in the WUE of plants. Both WUE and soil water availability are increased when stomatal conductance is decreased. Elevated CO_2 increases leaf area which in turn causes an improvement in the status of water in plants exposed to moderate drought stress. Further, an increase in WUE as a consequence of elevated CO_2- induced greater plant size leads to deterioration in plant water status. During the stomatal opening, the optimum level of CO_2

is maintained in the chamber of sub-stomata in response to a higher concentration of atmospheric CO_2, which results in minimized transpiration rates. This suggests that CO_2 enrichment in the atmosphere due to the changing climate has beneficial effects on overall plant water balance and productivity.

3. Photosynthesis and sugar content: The rate of photosynthesis is augmented upon elevated CO_2 levels with a shift in higher amounts of sugar towards better sink consumption. Depending on plant species/genotype, the storage of this increased sugar takes place in different plant parts. Various studies have demonstrated the positive influence of elevated CO_2 on photosynthetic rates in dry bean, cowpea, peanut, and soybean. Elevated CO_2 stimulates the accumulation of carbohydrates in soybean, cowpea, and dry bean. 660 µmol/mol of CO_2 promoted an increase in the photosynthetic capacity of soybean. Exposure of soybean to 800 µmol/mol of CO_2 yielded increased starch content and decreased sugar and total non- carbohydrate content respectively.

4. Nitrogen balance and nutritional quality: Generally, nutritional quality is depleted because of diminution in protein content of grains and vegetative tissues, affecting the economic value of crops. Since legumes possess the capacity to carry out the process of symbiotic nitrogen fixation, the balance between carbon and nitrogen is less affected, resulting in improved nitrogen fixation and greater productivity. Under elevated CO_2 concentration, legumes facilitate enhanced photosynthates allocation to root symbionts and maintain the concentration of nitrogen by symbiotic nitrogen fixation and thereby alleviating the consequences of photosynthesis acclimation. Macronutrients and micronutrients responded differentially to elevated CO_2. Macronutrients including sulphur, phosphorous, and calcium content increased significantly while iron and zinc showed a marked reduction in their values in response to high CO_2.

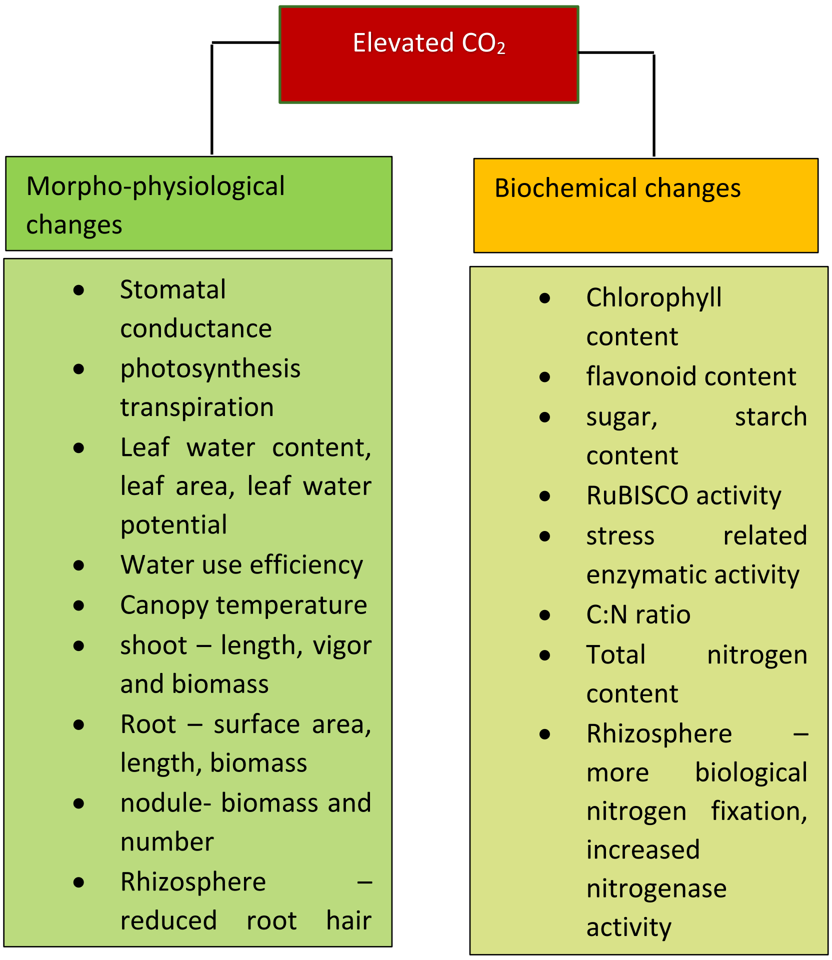

Figure 1. A representation of physiological and biochemical alterations in legumes under elevated CO_2

5. Changes in rhizosphere and nodulation: Nitrogen fixation can be stimulated by increasing nodule size, number of nodules, and activity of nodule. Numerous studies have documented the enhancement in biomass and nodule number in chickpea and other leguminous crops under elevated CO_2. Climate change impairs survival of rhizobia, rhizobia competitive ability, nodule development, growth, or activity and all these factors have a direct impact on symbiotic N-fixation. Also, symbiotic fixation may be affected indirectly by climate change-triggered modification of carbon supply to nodules.

Molecular Tools for Legume Management Under Elevated CO_2

The development of superior varieties is possible through genomics-aided breeding in conjunction with other contemporary approaches. Different types of molecular markers (SSR, SNP), genotyping platforms, draft genome assemblies have been found in legumes (peanut, chickpea, and pigeon pea). Molecular studies fall into two categories:

1. Genomics studies: Dissection of a physiological characteristic, exploring altered physiological traits via molecular breeding, genome editing.
2. System biology methodologies: Transcriptomics, proteomics, and metabolomics.

The molecular mechanisms underpinning elevated CO_2-mediated stomatal closure and decrease in stomatal density involves reactive oxygen species (ROS) accumulation. The pathway involves ABA and various regulatory components of ABA receptors (PYR/RCAR) that functions via guard cell ABA signal transduction pathway. In this mechanism, CO_2 triggers a rise in ABA which results in an increased system's sensitivity to elevated CO_2. The stomatal response can be facilitated under elevated CO_2 conditions through ABA-OST1/SnRK2.6 signaling.

Genome-wide association studies are used to detect climate-resilient traits in legumes for crop improvement. Different genes linked to heat and drought tolerance traits have been brought to light by performing sequencing and phenotyping in legume crops grown in different seasons and locations. Marker trait association studies have been specifically applied for economic attributes like yield factor, oil component, drought, and disease tolerance in peanut. To predict genotype x environment interaction, different prediction models have been employed in chickpea by coupling phenotyping data with genotyping data and genotyping-by-sequencing. Different studies of transcriptome and metabolome have been implemented for various physiological parameters – legume nodulation upon exposure to elevated CO_2 in combination with or without other abiotic stress conditions. Gene editing technology- CRISPR/CAS 9 has been employed to identify different genes responsible for natural phenotypic variation in rhizobia-legume symbiosis.

Future Perspectives

Employment of high throughput phenotyping for recording variations in elevated CO_2 has been initiated in certain legume crops over a period of time. Crop modelling is also a powerful tool that plays a very important role in rendering assistance to agricultural crops for adaptation to climate change. Crop models help to understand the impact of climate change on different crops. Various biotic and abiotic stress combinations under elevated CO_2 must be addressed through the application of prediction models in addition to adaptation policies of integrated pest management. Challenges associated with natural resource management, sustainable crop production, nutrition, etc., can be addressed by stimulating innovations in modelling. We have developed a clear understanding of molecular mechanisms underlying crucial and burdensome traits through omics approaches. Currently, system biology approaches should be used to realize the biology of plants at the system level under the scenario of climate change. Moreover, farmers' feedback should be taken into consideration for modification and modulation of climate-smart agricultural initiatives.

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Zero Energy Cool Chamber: A Low-Cost Storage

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Abstract

Zero energy cool chambers (ZECCs) we can also call it as Evaporative cooling chambers (ECCs) are a type of evaporative cooler, which are simple and inexpensive ways to keep fruits and vegetables fresh without the use of electricity. It is a cost-effective, eco-friendly and less energy requiring technology for storage and also improves the quality and productivity of vegetables and fruits by reducing field heat, increasing shelf life and checking post-harvest losses respectively. It works on principle depends on cooling by evaporation and we can also say that evaporative cooling is a gift of nature.

Introduction

Storage of fresh horticultural produce after harvest is one of the most challenging problems of a tropical country like India. Fruits and vegetables because of their high-water content are liable to rapid spoilage. The spoilage of fresh fruits and vegetables can be controlled by reducing the storage temperature. In India quality deterioration of horticultural produce takes place immediately after harvest due to lack of on-farm storage and maintenance of low temperature is a great problem in a tropical country. Refrigeration is energy intensive, expensive, not so easy to install and run in remote areas and not always environment friendly. Due to lack of cold/cool storage space a substantial amount of fruits and vegetables are lost after production. Considering acute energy crisis and lack of cool storage facility efforts made to develop low cost/low energy cool chambers. Based on the principle of direct evaporative cooling zero energy cool chambers have been developed.

Zero energy cool chamber

Zero energy cool chambers - an on-farm rural oriented storage structure which operates on the principle of evaporative cooling was developed at IARI, New Delhi, using locally available raw materials such as bricks, sand, bamboo, dry grass, jute cloth etc. The chamber is an above-ground double-walled structure made up of bricks. The cavity of the double wall is filled with riverbed sand. The lid was made by using dry grass/straw on a bamboo frame. The rise in relative humidity (90% or more) and fall in temperature (10-15°C) from the ambient condition could be achieved by watering the chamber twice a day [2]. Multi-locational studies at different agro-climatic zones have been found it to be very useful. It is most effective during the dry season. Small farmers can easily construct Pusa Zero Energy Cool Chambers (ZECC) near the field and store a few days' harvest before dispatching it to the market. In this way farmers can avoid the clutches of the middleman and are not forced to make any distress sale. It can be constructed by an unskilled person. It also allows small farmers to store produce for few days so that they are not forced to sell at low prices. Zero Energy Cool Chambers useful for temporary storage of curd, milk and can also use for sericulture, storage of bio-fertilizers, hardening of tissue-cultured plants, etc.

Some precautions should be taken while constructing and use of Zero Energy Cool Chambers like try to site in a place where breezes blow, Building of ZECC in an elevated place to avoid water logging, Use of clean, unbroken bricks with good porosity, Sand should be clean and free of organic matters, clay etc., Keeping the bricks and sand saturated with water, construction of roof over to prevent direct exposure to sun, Use plastic crates for storage and avoid bamboo baskets, wooden/fibre board/boxes, gunny bags etc., Prevention of water drops coming in contact with stored material, Keeping the chamber clean and disinfect the chamber periodically with permitted insecticide/ fungicide/ chemical, to protect from fungus, insect/ pests, reptiles etc.

Conclusion

Zero energy cool chambers can work on zero to very little energy and can retain the freshness of the fruit and vegetables for a short period. These units can be installed profitably where the fruits and vegetables are held temporarily viz. Farmer's field, packing stations, can work as pre-cooling unit also. If properly propagated and actually adopted availability of nutritious fruits and vegetables will increase and the consumer will pay less. The grower will also not be forced to make distress sale and will get better return.

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Insight of Rhizosphere

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Introduction

The rhizosphere is defined as the region of soil surrounding plant roots which is under the influence of the root (Broeckling et al., 2008). The activity and limit of this region is measured by soil microbial activity. In Rhizosphere, Root exudates are released by the root in abnormal condition which is food of soil microbes. Rhizosphere is the soil microbial hotspot due to the presence of food of microbes. In Rhizosphere found several chemicals that interact with microbes and help to the microbe growth and plant growth. Rhizopshere could indirectly increase nitrogen and phosphorus availability to the plant through nitrogen fixation and phosphorus solubilization process.

Rhizosphere Structure

This zone of soil ranges from only a few hundred micrometres to greater than 5 mm from the root surface. Thus, the spatial limits of the rhizosphere are determined by the soil biotic community under the direct or indirect influence of plant roots. Hiltner coined the term ‘rhizosphere’ in 1904 to describe the zone of soil under the influence of plant roots. His observations were initially based on the interactions between symbiotic N2-fixing bacteria and the legume root, but were then expanded to include all interactions. The rhizosphere effect is expressed quantitatively as the ratio of the number or activity of microorganisms or level of root exudates in rhizosphere soil (R) to that in the edaphosphere soil (E), i.e., the R/E ratio. The R/E ratio for microorganisms and root exudates is often found to range, respectively, from 2 to 20 and from 5 to 100, indicating enhanced microbial activity in the rhizosphere (Koo et al., 2005).

Rhizosphere Biosensors

Rhizosphere deposition included number of chemical compounds such flavine, tannins, alkaloids etc attracted specific microorganism toward the specific chemical. Rhizosphere deposition contain isoflavin or flavin act as biosensors for the nitrogen fixing bacteria. Carbohydrate in the rhizosphere act as biosensors to the VAM and mycorhiza.

Rhizosphere Microorganism

Different type of microorganisms is present in the rhizosphere like bacteria, fungi and actinomycets etc. Bacteria are a most dominant microorganism in rhizosphere followed by fungi and actinomycetes. The population of microorganism are varying with soil pH. Root exudates are the main food of the microbes. Most of the bacteria are affected by low pH, while fungi are not as sensitive to extremes in pH. Microorganism population only 7–15% of the actual root surface. Bacteria are found on the root surface in small colonies at the junctions of epidermal cells or at tears in the root surface. Microorganisms are move toward the root by three different mechanisms:

1. Motility of the organism (active transport).
2. Water movement on the surface of the root (passive transport).
3. Movement of microorganisms on the root apex as the root cells elongate (passive transport) (Kennedy and De Luna, 2005). Root exudates can also selectively influence the growth of bacteria and fungi that colonize the rhizosphere by serving as selective growth substrates for soil microorganisms. For example, Pseudomonad species are particularly stimulated by enhanced carboxylic acid production from root exudation (Koo et al., 2005).

Rhizosphere Deposition

Rhizosphere deposition is the release of root exudates by the biotic and abiotic factors. Root exudates are the sugars, amino acids, vitamins, tannins, alkaloids, phosphatides, and other substances such as growth factors, fluorescent substances, nematode cyst or egg hatching factors, and fungal growth stimulants and inhibitors. Sugars and amino acids are the most-studied root exudates. Root exudation can come out from those cells involved in root elongation and lateral root formation by two mechanisms. In first mechanism, exudation of extra waste chemical of unknown function is release by gradient process and in second mechanism, exudation of compounds of known functions, such as lubrication and defence by secretion process. Rate of rhizosphere deposition depend on several factors such as extreme temperature, water stress, P deficiency, increased light intensity, herbicides spray, pathogens, foliar treatments, and symbiotic association. In dry soils and waterlogged soils, the rate of rhizospheric deposition increase due to root injury (Kennedy and De Luna, 2005). It is well documented that about 40% from photosynthetically fixed carbon may be released as a plant root exudate (Doornbos et al., 2012). These phytochemicals or plant root exudates have a direct or indirect potential to protect plants against pathogens. It is reported that some plant root exudates have the ability to mimic or behave like pesticides or antibacterial or antifungal agents and are released from the damaged roots to protect the plants.

Table 1. Composition of root exudates (Koo et al., 2005):

Compositions	Substances identified
Organic acid	Acetic, butyric, citric, glutaric, lactic, maleic, malic, malonic, oxalic, propionic, pyruvic, succinic, tartaric, valeric.
Amino acid and Amide	-Alanine, -alanine, arginine, asparagine, aspartic acid, cystine/cysteine, glutamine, glycine, histidine, lysine, methionine, phenylalanine, proline, serine/homoserine.
Enzyme	Amylase, invertase, phosphatase, protease, polygalacturonase
Growth factor	p -Amino benzoic acid, auxins, biotin, choline, inositol, n -methyl nicotinic acid, niacin, pantothenate, pyridoxine, thiamine
Phenolic acid and coumarin	Caffeic acid, cinnamic acid, coumarin, ferulic acid, salycilic acid, syringic acid, vanillic acid
Sugar	Arabinose, fructose, fucose, galactose, glucose, maltose, oligosaccharide, raffinose, rhamnose, ribose, sucrose, xylose
Others	Nucleotide, flavonone, fatty acids, proteins, sterols, lipids, aliphatics, aromatics, carbohydrates

Table 2. Influence of environmental factor on root exudates:

Factors	Effect
Age of the root	Roots in the initial stages secrete exudates more frequently
Light intensity	High light intensity increases exudation
Microorganism	Presence of microorganisms increases exudation
NH4/NO3	Roots under NH4þ have lower organic acid concentrations
Nutrient availability	Nutrient deficiencies increase exudation
Oxygen status	Compositions are different under aerobic and anaerobic conditions
Plant species	Different plants and cultivars have different exudate compositions
Salinity	More organic and amino acids are produced under low salinity
Soil moisture	Relieving drought stress increases exudation
Soil pH	Acidification changes composition of exudates
Soil temperature	High temperature stimulates exudation
Soil texture	Sandy substrate produces greater amounts of exudates
Stress condition	Stress changes the composition of exudates

Rhizospheric Soil Benefits

1. It contain maximum number of microorganisms.
2. It contain higher amount of organic carbon.
3. It contain maximum amount of available nutrient.
4. It found antifungal chemical, pest killing compound, and plant growth promoting chemicals.
5. It reduce root diseases and attack of pest.
6. It found all chemicals.
7. It contain biosensors.

Rhizosphere Nutrient Chemistry

Nutrient chemistry in rhizospheric soil is somewhat different in the form of nutrient transformation than non rhizospheric soil. More than seventeen elements present in the rhizosphere, out of those only seventeen elements are essential for plant growth. The transformation of element in the rhizosphere is suddenly varies due to change in the soil pH frequently during plant growth. Uptake of cation and anion in plant cause changes in soil pH. The main cause to nutrient transformation in rhizosphere is soil pH. Changes in soil pH are the result of uptake of nutrient and soil aeration. In aerobic soil, oxidize form of micronutrient in non rhizospheric soil is unavailable to plant but in same condition, micronutrient is transfer by microorganism and less oxygen content to reduce form in the rhizospheric soil and become available to plant.

Fe^{3+}/Mn^{4+}/Zn^{2+}/Cu^{3+} (Non rhizospheric soil) ---------→ Fe^{2+}/Mn^{2+}/Zn^{2+}/Cu^{2+} (Rhizospheric soil)

In alkaline soil, micronutrient availability is higher in rhizospheric soil than the non rhizospheric soil due to production of organic acid and release of H+ ion in rhizosphere.

$Fe(OH)_2$ /$Mn(OH)_2$ /$Zn(OH)_2$/ $Cu(OH)_2$ -----------→Fe^{2+}/Mn^{2+}/Zn^{2+}/Cu^{2+}
(Non rhizospheric soil) (Rhizospheric soil)

Conclusion

Rhizosphere contains several deposition acts as herbicide, fungicide, insecticide and plant growth promoting chemical. Rhizospheric soil can be used as a base material to the horticulture plant. Rhizospheric soil is acts a plant protects. The rhizospheric deposition can be used as coating material to the coated fertilizer.

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Terrace Farming

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Terrace farming refers to the act of creating steps or terraces on mountain slopes to carry out farming activities. Each level consists of various crops being grown. The advantage is that rains do not wash away the nutrients thoroughly, but they are pushed down to the lower stratum. These steps also obviate a free-flowing avalanche of water that might destroy all crops. In this system, aqueducts are created to carry water to each level.

States in India where Terrace Farming Takes Place

In India, terrace cultivation takes place in the states of Punjab, Meghalaya, Haryana, Plains of Uttar Pradesh, Himachal Pradesh and Uttaranchal.

Types of Terrace Farming

1. Bench terrace: Bench terraces reduce the land slope. A bench terrace is a level or nearly level top and a step or vertical downhill face constructed along the contour of sloping land. Bench terracing consists of transforming the relatively steep land into a series of level or nearly level steps running across the slope. The steps are separated by almost vertical risers.

Bench type terracing can further be subdivided into hill type, irrigated type and orchard type based on usage.

a. Hill type: Hill type bench terraces are generally constructed in those hilly areas which have reverse land slope towards the hill.

b. Irrigated type bench terraces are also known as level bench terrace, and are generally constructed in irrigated conditions.

c. Orchard type bench terraces are constructed in the form of narrow strips, are widely used for orchard plantation purposes.

On the basis of the slope of bench it can also be classified as level, sloping inwards, sloping outwards, or California type based on slope.

a. Level Bench Terraces: This type of bench terraces consists of level top surface. Level bench terraces are generally used in those areas, which receive medium rainfall and have highly permeable soils. Since, the soils are highly permeable, therefore, it is expected that most of the flowing surface runoff passing through these terraces are absorbed by the soil, and remaining portion is drained through a suitable drain. These terraces are also known as irrigated bench terrace provided that they must be under irrigation. Sometimes, level bench terraces are also called table top or paddy terraces, because such terraces have level top surface that can be easily impounded with water and plantation of paddy crop can be performed. The level bench terraces for paddy cultivation have mild slope top, i.e. 1 %, so that a uniform water impounding over them can be easily made.

b. Bench Terraces Sloping Outward: These bench terraces are used in low rainfall areas with permeable soil. In these terraces a shoulder bund is essential. The main function of shoulder bund is to provide stability to the outer edge of the terrace. In addition, shoulder bund also helps in retaining the surface runoff on the benches that is either absorbed by the soil or drained. Bench terraces sloping outward are also known as orchard type bench terrace. For such type of bench terraces constructed on the soils having poor permeability, the provision of graded channel at lower end is most essential for disposing surplus surface water to the grassed waterway (outlet). On the other hand, in very less permeable soil, a strong bund along with spillway arrangement is essentially provided for making the terrace safe against heavy rainfall and allowing the water very safely, downward to the next terrace.

c. Bench Terraces Sloping Inward: The bench terraces sloping inward are preferred to construct in the areas of heavy rainfall and less permeable soils, from where large portion of rain water is drained as surface runoff. Such type of bench terraces has the provision to drain the runoff from their inner side by constructing a drainage channel, as shown in Fig. 13.2. The drain has connection to a suitable outlet (grassed water ways). This type of bench terrace is also known as hill type bench terrace. The inwardly sloping bench terraces are preferred for growing those crops, which are extremely susceptible to water-logging. These terraces are very common in Nilgiri hills of Tamil Nadu, steep Himalayan slopes of Himachal Pradesh and North-Eastern hill regions.

d. California Type Terrace: This type of bench terrace is also known as Puertorican type bench terrace. These are constructed by excavating the, soil in little amount at the time of each ploughing, and simultaneously making bench by pushing the soil down-hill against vegetative or mechanical barriers laid on the contour. These barriers should be placed across the slope at suitable intervals. Construction of these terrace is very slow; it may be throughout the year.

2. Ridge Terrace: Ridge terraces remove or retain water on slopes. Ridge type terrace is of two types, namely narrow-based and broad-based.

a. Narrow-based terraces: Base is 16 feet wide and they are parallel, so relatively easy to farm.

b. Broad-based terraces: A broad-based terrace has a ridge 25 – 50 cm high with gentle slopes and a dish stopped channel along the upper side constructed to control erosion by diverting runoff at a non–erosive velocity. Broad-based terraces are further subdivided into a level or graded terrace.

c. Graded terrace: A graded terrace had a constant or variable grade along its length and used to convey excess runoff at safe velocity into a vegetated waterway or channel.

d. Level terrace: A level terrace followed the contour line, in control to a graded terrace and recommended in areas having permeable soil.

Crops, Grown in Terrace Farming

Terrace farming enables the land fertile but requires a lot of complicated engineering and design and is labour intensive. But it is worth the trouble than to leave slopes on hills and mountains uncultivated.

Some crops that are grown using terrace farming are – paddy, cereals, fruits, vegetables, flowers, medicinal plants, aromatic plants, dye plants, wheat, maize, rice, pulses, oilseeds, millets, buckwheat, saffron, black cumin, grain amaranth, spices, etc. The major fruit crops are apple, subtropical and temperate fruits including nuts and dry fruits.

Climatic Conditions

The summer crop season receives about 75% of the total annual rainfall, of which much goes to waste through runoff. The major rainfed cropping systems are maize-wheat, rice-wheat, and intercropped pulses and oilseeds in maize and wheat. Rice-wheat and vegetable-based crop sequences are dominant under irrigated conditions. Only one cropping season is feasible in the high-hill temperate zone where crops are grown during the summer. However, two short duration crops such as pea-buckwheat and pea-pea are possible in a single summer season in the high-hill dry-temperate zones.

Benefits of Terrace Farming

1. Terrace farming is a bit labour-intensive but is effective in maximizing the arable land area in variable terrains and also reduces soil erosion and water loss.
2. Ridges and channels are constructed on slopes as a practice.
3. Terrace farming aims at preventing nutrient loss completely by passing in to on the next level below.
4. They also prevent free-flowing avalanche of water that could destroy crops completely.
5. Terrace farming reduces the length of the hill slope thereby reducing rill and sheet erosion and also the formation of gullies.

6. Terrace farming makes it easier to cultivate on hill slopes which might otherwise not have been possible
7. If terrace farming is not cultivated, it can lead to infertile lands on slopes. Practicing terrace farming can transform the moist and unused land into productive fields for cultivation of crops.
8. New varieties of crops can be grown on terraces that may not be possible on plains.

Problems with Terrace Farming

Undulating topography, small fragmented and scattered land holdings, with very limited use of inputs.

Soils are shallow and stony and subject to periodic water stress. The land is inaccessible, and infrastructure, communications and mobility are obstructed by different physical, climatic, biological and socioeconomic factors. Despite sufficient water resources, irrigation facilities are meagre. Shortage of energy and labour. Natural hazards like intense rainstorms, hailstorms, floods, epidemic diseases, insects and an erratic monsoon.

Farming in Hills. Crops predominantly grown in hills and mountains are cereals, wheat, maize, rice, pulses, oilseeds, millets, vegetables and fruit crops. In the higher hills, farmers also grow crops such as buckwheat, saffron, black cumin and grain amaranth. The major cropping systems are maize/wheat, rice/wheat, and the intercropping of pulses and oilseeds in maize and wheat.

Monocultures are prevalent in the higher hills where farming is only possible in summer, but at lower attitudes, rotational farming is traditional, often a sequence of barley, peas and wheat. Under irrigated conditions where rice cultivation is possible, it alternates with wheat. In the sub-humid zones rice, wheat, vegetables, potato, ginger, turmeric, garlic, etc. are grown. Under irrigated conditions, maize, rice, rapeseed, mustard, soybean, linseed, black gram and horse gram are the major crops. A large number of fruits, vegetable, spices, medicinal and aromatic plants are grown with relative advantage in the region due to the climate. Crops like potato and pea are sown in April and harvested during September and October. In HP, potatoes, cabbages, turnips, Chinese cabbages, lettuces or pea are grown alone, or intercropped with potato. The major fruits grown are apple, apricot, walnut and citrus. Tea and hops are important commercial crops in the high lands of the western Himalaya.

Waterways from Draining Excess Water for Fields

In order to avoid problems of erosion at the site of emptying and to reduce the speed of watershed runoff following rains; soil conservation structures should be designed for water retention and infiltration whenever possible. If it is judged necessary to drain water from a field, special care should be taken in selecting areas in which to deposit all the diverted drainage water.

Possible drainage areas include pasture areas with a thick ground cover, orchards, or forested areas; where infiltration of the diverted water can probably occur with a minimum of erosion, especially if the water is spread over a large area. Existing waterways may also be used as drainage sites, although one should avoid exaggerating erosion problems by diverting water into areas of active gully formation. In all of these cases, if erosion problems are noted upon diverting runoff water, then a permanent, protected site for receiving runoff should be designed and constructed as soon as possible.

Protected drainage ways can be formed by reshaping natural drainage ways or digging artificial drainage ways of a low, broad shape, protecting them from erosion by lining with rocks, planting grass, and/or placing drop structures or check dams periodically.

When no appropriate drainage area is available around a field, then retention wells can be dug and water diverted into, and stored in them while it gradually enters the soil or evaporates.

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Phytoanticipins: Defence Related Plant Secondary Metabolites Against Plant Pathogens

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Introduction

Plants synthesize diversity of secondary metabolites which prominently function to forfend plants against predators and microbes according to toxic nature of microbes and repel the microbes and herbivores. Some secondary metabolites avail plant to communicate with other organisms and some forfends plants from abiotic stress e.g. UV-B radiations, so these secondary metabolites are significantly paramount for magnification and development. Three major types of secondary metabolites viz. Phenolics, Terpenes and Nitrogen/Sulphur containing compounds are engendered in plant's body. Terpenes have 5-C isoterpenoid as their rudimental unit that are toxins and deters herbivores. Shikimic acid pathway gives the products that composes phenolics which imparts defensive faculty to plants. Nitrogen and sulphur containing compounds are mainly synthesized from amino acids. Function and structure of plant secondary metabolites explain that why plants have evolved induced defence, which is characterized with increased concentration in stress situations. Several studies have uncovered that hundreds of plant compounds possess ecological and chemical defensive role, which have opened a new area of research known as ecological biochemistry.

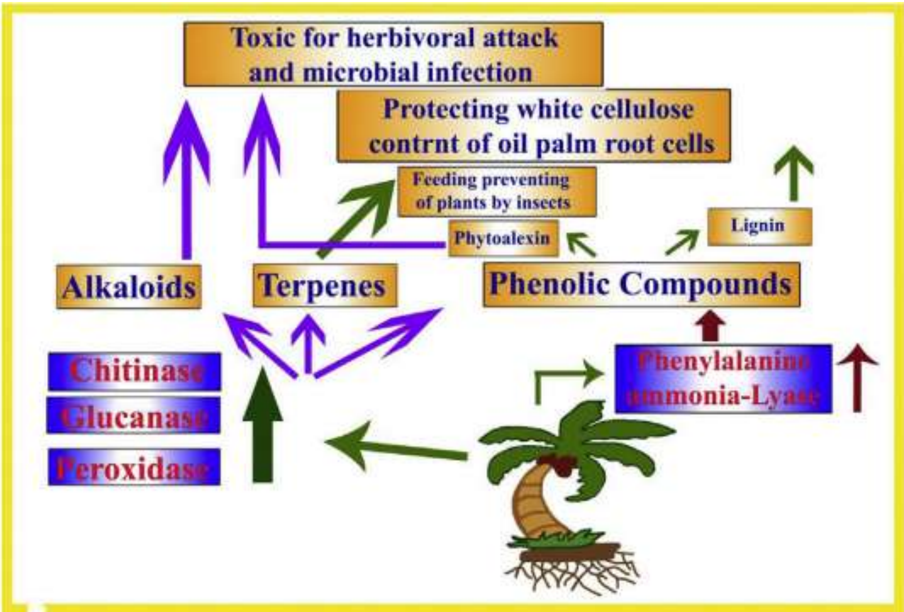

Fig. 1. Schematic presentation of Secondary metabolites that may be involved in defence mechanism of species against microbial fungi and virus.

Secondary Metabolites in Plant Interactions with Pathogens

From long time, secondary metabolites have been suggested to interact with pathogenic organisms. Decades of research have demonstrated that a large number of secondary metabolites have proven their role in plant defence response to pathogens. Functions of secondary compounds are heavily pooled in conserved framework aside from their high structural diversity and several biosynthetic pathways are not conserved in plant kingdom. Production and activation of these compounds like other mechanisms of plant defence is facilitated by microbial detection via defence proteins or MAMPs recognition by pattern recognition patterns. For the classification of

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secondary compounds several criteria have been introduced because of their diverse assortment in plant immunity. These criteria include common precursors, core structure and mechanism of action. Commonly used classification based on way of synthesis and accumulation of defence related phytochemicals. De novo production of metabolites due to an infection named as phytoalexins while, Phytoanticipins is a term used for production and storage of defence related metabolites in plant tissues.

Secondary Metabolites Mode of Action

In plants defence system, widely distributed compounds are phenyl propanoids and flavonoids which possess different mode of action. Hundreds of antifungal compounds target only 6 processes, most of them act parallel to cell signalling compounds and effects physiological activities or act on parts of pathogen like; enzyme inhibition, DNA alkylation and reproductive system etc. Mostly these compounds have hydroxyl group containing phenolics, which are likely to dissociate in phenolate ions. As phenolic hydroxyl groups form ionic bonds and hydrogen bonds with peptides and protons so, their higher number results in high astringency and denaturation. Without confirmation i.e. proper three-dimensional structure, proteins cannot work properly. Protein properties are changed with any change in protein confirmation which can prevent crosstalk with other proteins and DNA/RNA. Secondary metabolites interact and changes three-dimensional structure of proteins by forming covalent bond with free SH., OH- or amino groups, resulting in loss of function or change in protein turnover. Polyphenols form hydrogen bonds and stronger ionic bonds. When these weak noncovalent bonds are formed concomitantly and act with a protein changes its flexibility resulting in inactivation of protein. Polar nature of phenols makes them fewer toxic compounds because their absorption is less after oral intake. Plate experiment showed that at pinosylvin concentration which is enough to prevent fungal growth, resveratrol enhances the growth.

Fig. 2. Profiling Plant secondary metabolites and their role in plant defence system.

Plant Secondary Metabolites as Antifungal Compounds

Phenolics are known to change the cell permeability of microbes and also cause structural and functional deformation of membrane proteins which result in distraction of pH gradient, ATP production and conservation system, membrane bonded enzymes, substrate utilization for ATP production. Antimicrobial compounds hinder the pathogens growth in apoplast.

List Phenolic compound role against Fungus.

Chemical	Fungus
benzaldehyde	*Botrytis cinerea*
protocatechuic acid	*Colletotrichum circinans*
Salicylic acid	*eutypa lata*
Vanillic acid	*Phytophthora infestans*
Chlorogenic acid	*Fusarium oxysporum*
Naringin	*Penicillium digitatum*
Flavones	*Aspergillus*
Oleuropein	*Phytophthora*
Nobiletin	*Phoma tracheiphila*
Genistein	*Monilinia fructicola*
Hordatin A	*Helminthosporium sativum*

Conclusion

Plants developed defence system against several biotic and abiotic stresses with the passage of time. Gene cassettes for complete metabolic pathways may be generated in long term and defence related secondary metabolites may be generated by metabolic engineering of plants or in bioreactors. This will help to quickly overcome the plant microbes or environmental stresses.

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Epigenetics: A New Plant Breeding Technology

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Introduction

Scientists reveal that a fault in the process that copies DNA during cell division can cause epigenetic changes that may be inherited for up-to five generations. They also identified the cause of these epigenetic changes, which is related to the loss of a molecular mechanism in charge of silencing genes (Centre for genome regulation). Epigenetic changes can bring about new traits without altering the sequence of genes. This may allow plants to respond quicker to changes in their environment. Plant biologists have now demonstrated that epigenetic variation is also subject to selection and can be inherited. This could expand the possibilities for crop breeding. Sound Agriculture is one of a group of emerging companies that are using a life science approach to discovery that combines molecular biology with modern computational power, resulting in an entirely new understanding of plant and microbe interactions. The concepts and knowledge of epigenetic have been known in the plant science world for many years. The foundational science has been there. What we are learning now is how to harness that knowledge.

Bringing Epigenetics and Computational Sciences Together

New plant breeding technologies (NBTs) are a group of techniques which encompass a wide variety of approaches, methodologies and unique characteristics to develop new varieties. They may either be used alone in the breeding process or they may be used in combination with other NBTs, conventional breeding approaches or with genetically modified (GM) technologies. NBTs usually allow for the development of new varieties in a faster and more precise manner than conventional breeding techniques.

Traditional wisdom teaches that DNA is the foundation of heredity. A single letter change in this code can lead to genetic changes. The nucleotide cytosine (the C in the genetic code) can be changed into a methylcytosine.

"This cytosine methylation, which is one type of epigenetic mark, is typically associated with repression of gene activity," explains Frank Johannes, assistant professor at the Groningen Bioinformatics Centre. "In mammals, epigenetic marks are typically reset every generation, but in plants, no such dramatic resetting takes place. This opens the door to epigenetic inheritance in plants."

The best-known epigenetic process is DNA methylation. This is the addition or removal of a methyl group (CH_3), predominantly where cytosine bases occur consecutively. Another significant epigenetic process is chromatin modification. Many other types of epigenetic processes have been identified. Additional epigenetic mechanisms and considerations are likely to surface as work proceeds.

Using Epigenetics

To introduce an epigenetic trait, scientists use computational sciences to process big data to detect a specific target in the plant's DNA genome. Using a proprietary method, cytosine methylation is used to silence a specific gene function. The modified plant is genetically identical to the parent plant. There are no DNA changes. Current traits of interest include drought tolerance, disease resistance, yield increase or other agronomic factors like fertility and nutrient use efficiency.

"Plant scientists are enhancing the plant's physiology, not adding new pathways such as one that would make a plant glow in the dark. "The epigenetic pathway is a natural pathway with no large-scale changes in plant biology or the way the plant works. There is no need of introducing new genes like do with transgenics. What scientists are doing is enhancing specific aspects of the plant's physiology. (Joe funk, 2020).

There are some new discoveries for breeding that in Sound Agriculture's case involve epigenetics, which is different from CRISPR and gene editing. Sound uses proprietary algorithms to analyse genomic data to identify and silence the genes' expression levels as a way to guide crops to reveal desired traits. Scientists believe that the integration of these technologies — gene editing, epigenetic computational sciences will change the way breeding is done over the next couple of years. (Joe funk, 2020). Plant breeders said that a new trait can be developed within a few months. In some of their recent work, a new trait has been developed in a matter of weeks. Using epigenetics and NBTs, researchers together with plant breeders will advance increases in plant productivity comparable to the inflection points resulting from the invention of double-cross hybrids in the 1930s and the Green Revolution.

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Significance of Polyamines on Seed Physiological and Biochemical Traits with Respect to Normal and Abiotic Stress Conditions

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Introduction

Polyamines (PAs) are low molecular weight aliphatic nitrogenous bases containing two or more amino groups and they have potent biological activity (Xu et. al., 2009; Vuosku et. al., 2018). In living organisms, PAs mainly exist in free (F-PAs), covalently conjugated (CC-PAs) or non-covalently conjugated (NCC-PAs) forms (Gholami et. al., 2013). In higher plants, PAs are mainly present in their free form. Putrescine (Put), spermidine (Spd), and spermine (Spm) are the main PAs in plants and they are involved in the regulation of diverse physiological processes (Xu et. al., 2014; Mustafavi et. al., 2018) such as flower development, embryogenesis, organogenesis (Xu, 2015), senescence and fruit maturation and development. They are also involved in responses to biotic and abiotic stresses (Vuosku et. al., 2012; De Oliveira et. al., 2016; Reis et. al., 2016; Mustafavi et. al., 2018). PAs are present in vacuole, mitochondria and chloroplast (Tabor and Tabor, 1985). The diamine putrescine is synthesized from arginine or ornithine, catalysed by the enzyme's arginine decarboxylase or ornithine decarboxylase, respectively. The triamine spermidine and tetramine spermine synthesized from putrescine by the addition of an aminopropyl moiety from S-adenosylmethionine, the reaction being catalyzed by S-adenosylmethionine decarboxylase. They protect the plants from all kinds of stress (Bouchereau et. al., 1999).

Polyamines and Seed Physiological Parameters Under Normal Condition

Polyamines (PAs) are endogenous plant growth regulators that mediate many plant physiological processes. It is involved in the seed germination of plants. The PA content increases during the first 15 d of *Ocotea catharinensis* seed germination and then decreases and stabilize between 30 and 60 d of germination (Dias et. al., 2009). The PA levels increase during the seed development of soybeans and rice (Sen et. al., 1981; Lin et. al., 1984). Seed priming with putrescine improved the emergence energy, emergence index, root and shoot length and seedling fresh and dry weight in Rice (Farooq et. al., 2008) and hot pepper (Khan et. al., 2012). Inhibition of PA biosynthesis retards the pea germination process (Villanueva and Huang, 1993). Exogenous spermidine applied during cold stratification (3°C) increased the germination percentage in European beech (Szczotka et. al., 2003). Incorporation of spermidine in the priming medium resulted in lower time to start emergence, time taken for 50% emergence and mean emergence time; and enhanced the emergence energy, emergence index, root and shoot length and seedling fresh and dry weight in sunflower (Farooq et. al., 2007). Spd soaking treatment improved the seed germination percentage, vigor index, shoot heights and dry weights of shoot and root in sweet corn (Huang et. al., 2017) and rice (Fu et. al., 2019).

Polyamines and Seed Physiological Traits Under Abiotic Stress

Polyamines (PAs) are described as endogenous plant growth regulators or intracellular messengers that regulate plant growth, development and responses to abiotic stresses (Pal *et. al.,* 2015; Shi and Chan, 2014). PAs are closely associated with plant resistance to drought stress (Groppa and Benavides, 2008). Free spermidine (Spd) accumulation in seeds during the seed germination period favored wheat seed germination under drought stress; however, the free putrescine (Put) accumulation in seeds during the seed germination period work against wheat seed germination under drought stress. In addition, seed soaking in Spd and spermine (Spm) significantly relieved the inhibition of seed germination by drought stress; however, soaking seeds in Put had no significant effect on seed germination under drought (Yang *et. al.,* 2016). The growing medium supplemented with spermidine enhanced the seed germination amaranthus, spinach, green gram, green peas and chick pea under salt stress (Jeyanthi Rebecca *et. al.,* 2010). Polyamine treatment under adverse conditions can maintain high chlorophyll content in seedling leaves (Besford *et. al.,* 1993; Song *et. al.,* 2012). Basil (*Ocimum basilicum* L.) seedlings supplemented with spermidine increased the fresh and dry weight of seedlings and leaf chlorophyll content under salt stress (Chokami *et. al.,* 2019).

Polyamines and Seed Biochemical Parameters

External Spd and Spm significantly increased the endogenous indole-3-acetic acid (IAA), zeatin (Z)+zeatin riboside (ZR), abscisic acid (ABA) and gibberellins (GA) contents in seeds and accelerated the seed starch degradation and increased the concentration of soluble sugars in wheat seeds during seed germination under drought condition (Yang et. al., 2016). Spd application significantly increased endogenous Spd, gibberellins and ethylene contents and simultaneously reduced ABA concentration in embryos during seed imbibition in sweet corn (Huang et. al., 2017). The growing medium supplemented with spermidine increased protein content in green peas and green gram seedlings under salt stress (Jeyanthi Rebecca et. al., 2010). Exogenous application of spermine and spermidine significantly increased the activity of superoxide dismutase (SOD), peroxidase (POD) and catalase (CAT) and content of Spm, Spd, and proline (Pro), while putrescine (Put), malondialdehyde (MDA) and soluble sugar (SS) content decreased during seed filling in wheat under heat stress (Jing et. al., 2020). Seeds soaked in spermidine increased the protein synthesis in European beech (Szczotka et. al., 2003). Basil seedlings supplemented with spermidine increased the CAT, POD, guaiacol peroxidase and proline content and also decreased the MDA level under salt stress (Chokami et. al., 2019). Spd pretreatment significantly increased the POD activity and decreased the MDA content in rice seeds under heat stress (Fu et. al., 2019).

Conclusion and Future Perspective

It is concluded from previous published results that all polyamines (putrescine, spermidine and spermine) promoted the seed physiological and biochemical parameters and also alleviate the abiotic stress during seed germination and seedling growth. The molecular mechanisms of PAs on different seed quality parameters are not well elucidated; it is a suitable avenue for further research. It will be of great importance for producing transgenic plants that are tolerant to abiotic stress. Moreover, overexpression of genes responsible for the synthesis of polyamines will be a valuable tool to produce those abiotic stress tolerant transgenic plants.

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Kitchen Gardening-Bunch of Nutrition and Health Profits

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Abstract

Kitchen gardening is an important step in revolution to increase the vegetable production as well as availability of vegetables to consumers in cheap rate and short time. Kitchen gardening contribute to household food security and increase the environmental beauty. It provides active participants with significant physical and psychological health benefits. The nutritional home garden or kitchen garden is generally located close to the house and is used for growing vegetables, fruits and other food crops for the family round the year. It is not only saving our money and time but also provide a healthy, useful and environment friendly hobby for whole family. Kitchen gardens help to recycling of household waste especially when compost pit is developed. It is one of the easiest ways that ensuring access to a healthy, diet that contains adequate macro and micro nutrients. Kitchen garden becoming an important source of foods and income for poor households in rural, peri-urban and urban areas.

Introduction

It is known by name Home garden, Nutritious garden or kitchen garden where fruits and vegetable are grown in the backyard of a house or any available space in the home compound to meet the daily requirement of the family by using kitchen waste and water. The layout of a home garden will differ from individual to individual. However, broadly, a city home-gardener will follow a very intensive method of vegetable-growing compared with that followed by a home-gardener in a village. Fruits and vegetables play an important role in the balanced diet of human beings by providing not only the energy rich food but also promise vital protective nutrients. In order to make available the requisite quantity and kind of fresh fruit and vegetables every day to a family, it is better to have a nutrition garden to grow them in the house premises. Fruits and vegetables obtained from market lack freshness and deteriorate in the food value besides their exorbitant price. Therefore, the best quality of the fresh produce can be had from one’s own nutrition garden as the time interval between the harvest and the consumption becomes the least. Working in a garden becomes a pleasure, an inspiration, a means of recreation and a possible family enterprise in which all members have due share to spend the leisure hours. The whole family can be engaged in it, where no great technical skill is required. The land available within the compound of the residential building can be utilized for laying out a nutrition garden, which would help in taking proper care, harvesting, irrigation and other operations.


Advantages of Kitchen Garden

1. It is best meaning of recreation and exercise.
2. An excellent hobby and healthy occupation for young and old during their leisure time.
3. Cut down the expenditure on purchase of vegetables.

4. An ideal medium for training children in duty and order.
5. Vegetables grown in kitchen garden are fresh and are free from market infection.

Site Selection and Vegetables Grown in Kitchen Garden

Specially, backyard of the house is the site for kitchen gardening. Preferably open areas with plenty of sunlight near the water source. A model nutrition garden generally consists of growing vegetables and fruits either separately or in combination. Thus, the plan of growing vegetables and fruits has to be integrated in a most beneficial manner. Preference should be given to those crops which are early maturing and consumed afresh in kitchen. The size of the garden may depend on the area available in the compound, the time available for its care and daily requirement of fresh fruits and vegetables of a family. To meet the demand of vegetables for an average family of 5 to 6 members, an area of 200 square meters will be sufficient. Big trees should be planted towards the northern side of the garden as they will not only shade the vegetables but the roots may compete for moisture and nutrition if planted in between.

To produce 300 g of vegetables per day, all the year round, about 50 square meters of area is required. Depending on the space available and the family size the planning may be done either for a big or a medium or a small size garden. It is convenient to layout rectangular plot than a square plot. Garden should be well protected with suitable fence. Perennial vegetables like curry leaf, drumstick and quick growing fruits like papaya, banana and lime should be planted along the border.

Perennial vegetables like coccinia, chow-chow, etc., which require support should be planted at the rear end of the garden. Long duration vegetables like tapioca, elephant foot yam, etc., may be planted together. Suitable short duration companion crops such as radish, beetroot, carrot, etc., can be grown with the long duration crops. These crops can be grown on the bunds. Crop rotation should be followed in such a way so that each plot will be planted with leguminous vegetable crop at least once in two years and also see that at least 4-6 kinds of vegetables are always available. One plot should be kept reserved for raising nursery seedlings.

Knowledge of planting season is essential in planning the cropping pattern. The entire plot should be divided into a number of small plots (sub plots). The size and number of sub plots can be decided based on area available (family size) and crops chosen with convenience. One or two compost pits may be dug in the shady corner of the garden. The plot should be provided according to convenience using minimum space.

Creeping vegetables like gourds and others may be trailed on the fence or erected pendals. The area in between the perennial plants may be utilised for short duration shallow rooted annual vegetables or spices like garlic, coriander, etc. If the land is limited preference can be given for growing those vegetables which are costly, highly perishable not easily available in the market and which can produce maximum edible vegetables per unit area.

The irrigation channel from the water source and path should be so planned and prepared that it covers the whole area of the garden for easy operation. In cities, very limited or sometimes no ground space is available for kitchen garden. Under such situation, pots, boxes, sills, window space, house-roof etc. are equally good for kitchen garden.

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New Farm Bill 2020 and' Contention Behind It

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The farm bill 2020 is quite contentious nowadays; most people are either opposed to this bill or in support of this bill. Amidst protest from opposition and section of farmer's organizations, these three agriculture sector bills were passes from lower and upper house of parliament, which replace the existing ordinance. We need to know about three bills are:

1. The Farmers' Produce Trade and Commerce (Promotion and Facilitation) Act, 2020 permits intra-state and inter-state trade of farmers' produce beyond the physical premises of Agricultural Produce Market Committee (APMC) markets and other markets notified under the state APMC Acts. It allows trading in outside trade area like farm gates, warehouses, factory premises, and cold storages. Previously, only in the APMC yards/ Mandis could agricultural trade be conducted. It offers fair price to the farmer for their produce because of existence large number of traders in the market and direct bargain between farmers and traders and also allows barrier-free inter-state and intra-state trade of agriculture goods. The act prohibits state governments from levying any market fee or cess on farmers, traders and electronic trading platforms for trading farmers' produce in an 'outside trade area.

2. The Farmers (Empowerment and Protection) Agreement on Price Assurance and Farm Services Bill, 2020, it provides a framework for farmers to enter into direct contracts with those who wish to buy farm produce. It is an agreement between farmers and processing and/or marketing firms for the production and supply of agricultural products under forward agreements, frequently at predetermined prices. The arrangement also invariably involves the purchaser in providing a degree of production support through, for example, the supply of inputs and the provision of technical advice. The basis of such arrangements is a commitment on the part of the farmer to provide a specific commodity in quantities and at quality standards determined by the purchaser and a commitment on the part of the company to support the farmer's production and to purchase the commodity.

3. The Essential Commodities (Amendment) Bill, 2020, deregulates the production, storage, movement and sale of several major foodstuffs, including cereals, pulses, edible oils and onion, except in the case of extraordinary circumstances. The Ordinance requires that imposition of any stock limit on agricultural produce must be based on price rise. A stock limit may be imposed only if there is:

   a. A 100% increase in retail price of horticultural produce.
   b. A 50% increase in the retail price of non-perishable agricultural food items. The increase will be calculated over the price prevailing immediately preceding twelve months, or the average retail price of the last five years, whichever is lower.

What are the Concerns Behind it?

States will lose revenue as they won't be able to collect mandi fees if farmers sell their produce outside registered APMC markets. When entire farm produce moves out of APMC then commission agent will be useless. It may eventually end the MSP based procurement system. However, MSP isn't even mentioned in the new law or in existing ones. Electronic trading like in e NĂM is destroyed in absence of trading. The Price Assurance Bill, while offering protection to farmers against price exploitation, does not prescribe the mechanism for price fixation. There is apprehension that the free hand given to private corporate houses could lead to farmer exploitation.

Contract farming arrangements are often criticized for being biased in favour of firms or large farmers, while exploiting the poor bargaining power of small farmers. The sponsors may not like to deal with a multitude of small and marginal farmers because of their small fraction of farm produce. Problems faced by growers like undue quality cut on produce by firms, delayed deliveries at the factory, delayed payments, low price and pest attack on the contract crop which raised the cost of production. Being big private companies, exporters, wholesalers and processors, the sponsors will have an edge in disputes. Farmers in contract farming arrangements will be the weaker in terms of their ability to negotiate what they need.

To remove commodities like cereals, pulses, oilseeds, onion and potatoes from the list of essential commodities. It will do away with the imposition of stockholding limits on such items except under "extraordinary circumstances like war. It will lead to exporters, processors and traders hoarding farm produce during the harvest season, when prices are generally lower, and releasing it later when prices increase, so it increased black marketing.

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Bt Crops: Beneficial or Harmful?

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Bt crops, still being the burning issue, has been raising the tremendous controversies all over the world thrashing the agriculture in the vortex of the chaos. The chaotic uproar has grabbed a peak that has pressurized the grand decisive powers of all from the excogitative scientists up to the almighty governments of different countries in the world. Bt, a tool developed to control the hazardous pest attacks on different crops has been widely accepted in one form as spore-based formulations of the bacterium as organic applications while in other form as engineered genes transforming the genome of crops, it has been greatly abandoned. Deliberate discussions have been and are being constituted searching for the reasons of such an ambiguous momentum of this technique, a bit quantum of which is laid here.

What are Bt-Crops?

Bt stands for *Bacillus thuringiensis* which is a Gram positive, soil-dwelling bacterium, commonly used as a biological pesticide. The insecticidal property is conferred on it by the cry genes encoding the crystal-shaped proteins called Cry δ-endotoxins formed during sporulation, which after entering into the alkaline digestive tracts of certain feeding insect orders get solubilized by proteases liberating the toxin from the crystal and further get inserted into the insect gut cell membrane forming pores and paralyzing it due to which insect stops eating and starves to death. Bt crops are the genotypes of crops that have been genetically modified (GM) by genetically engineering these cry genes into the whole plant genomes making them resistant to certain insect orders. In addition to δ-endotoxins (Cry and Cyt toxins), Bt also produces a novel family of insecticidal proteins *viz.*, vegetative insecticidal proteins (Vip) during its vegetative stage. *Bacillus thuringiensis* was first isolated in 1901 by a Japanese biologist, Shigetane Ishiwata, who was investigating the sotto disease (sudden-collapse disease) in silk worms. Ernst Berliner isolated a bacterium that had killed a Mediterranean flour moth in 1911, and rediscovered *Bt*. He named it *Bacillus thuringiensis*, after the German town Thuringia where the moth was found. After knowing Bt's apparent effectiveness against caterpillars in 1920, soon from 1928 it started to be used against crop pests in the form of spore-based formulations and continued upto the 1980s. But the first transgenic approach employing the engineered Bt genes to derive genetically modified (GM) Hornworm-resistant tobacco plants was successfully attempted in 1987 by a company viz. 'Plant Genetic Systems' in Belgium. Commercialization of Bt crops started in 1996 with the introduction of 'Bollgard' cotton in the USA and was followed by Bt maize and Bt potato. In India, the Environment Protection Act was passed in 1986, under which the Genetic Engineering Approval Committee (GEAC) was constituted in 1989, to examine and give clearance to genetically modified organisms (GMOs). As per its first permit granted in 1994, M/s Pro Agro Ltd conducted transgenic rapeseed field experiments in 1995 whereas field testing of firstly introduced insect-resistant plants i.e. Bt tomato and Bt cotton were started in 1996. In 2002, three hybrids of Bt cotton were released for cultivation in India. The indigenous varieties of Bt cotton has been remained quite popular since before and has progressed a rapid further development with stacking of more genes imparting increased level of resistance to different insects from which a country like China also couldn't stay apart. A number of other Bt crops have been developed in the country *viz.*, tomato, potato, tobacco, cauliflower, okra, rice, sorghum, groundnut, sunflower and castor with some being in different stages of confined field trials but the issue has raised the dramatic uproar when the Bt brinjal, the first genetically modified food crop in India was on its first launch to be in the commercial market circumvolving all the GMOs in the controversial whirl. At present moment all the GM food crops have been banned in India. On the other side four varieties of Bt brinjal have got permitted in Bangladesh since 2014 which according to them have been dealing good with their brinjal production. The other countries cultivating Bt crops are Australia, Mexico, Philippines, South Africa and many European countries including Spain, the Czech Republic, Romania, Portugal, Germany, Poland, Slovakia, etc. covering more than one billion acres of cultivated area in the world.

Safety of Bt Crops

Bt crops, since beginning, have been and further will be being undergone the extensive investigation for their safety for use as a food and potential unintended impacts on the environment through various angles few of which could be as follows.

Human Dietary Risk Assessment

Concerning the safety of Bt crops for human consumption, rigorous testing is performed including acute oral toxicity test, assessment of the allergenicity, feeding studies on animals such as mouse, rabbits, fish, chicken, goats and cows, and also field trials conducted at different locations. But the results have generated divergent opinions about their veracity. Some agencies like Environmental Protection Agency (EPA) of USA, private seed companies like Monsanto, Mahyco declares them as the safest asserting on the basis of the long-term testing experiments, they have carried of their own. Whereas some other scientists deny the same pointing out many inadequacies in the tests conducted, lack of clear cut parameters for monitoring the tests, presenting insufficient data for thorough review, lack of details of the testing methods followed, lack of validation of the tests by an independent and reliable organization and so on further putting that the data made available also has some flaws. The concerns were intensely raised up in India in case of Mahyco developed Bt brinjal, the India's first vegetable/ food biotech crop in collaboration with Tamil Nadu Agricultural University (TNAU), Coimbatore and University of Agricultural Sciences, Dharwad. A French scientist notable for his anti-GM perspective, Professor Gilles-Eric Seralini of the Committee for Independent Research and Information on Genetic Engineering (CRIIGEN), after commissioned by Greenpeace India, assessed firstly and independently the Monsanto-Mahyco's dossier on toxicity tests submitted to the Indian regulatory authorities. He dogmatized the statistically significant differences on the health of animals fed GM and non-GM brinjal in the raw experimental data, which were discounted in submitted dossier summaries. He, based on his key findings, reported a number of health problems in GM brinjal fed animals viz. induced antibiotic resistance; less calories with different alkaloid content and more insecticide toxin affecting the blood chemistry, blood prothrombin, blood total bilirubin (liver health), and alkaline phosphate in goats and rabbits. He also found increased weight gain, roughage intake, milk production in lactating cows as if were treated by a hormone whereas in rats' diarrhoea, increased water consumption, decreased liver weight and also modified feed intake in broiler chickens. He further aware about the potential risk of long-term effects of developing cancers or tumours which could not be assessed in the still ever longest toxicity test of 90 days suggesting to call for further investigation. Further the fusion product of more stacked genes differing in their amino acid content e.g. Cry1Ab-Cry1Ac in brinjal rather than single Cry1Ac protein derived from bacteria used in tests may be different in conformations. According to the study in Australia in 2005 on GM peas (*Pisum sativum*) developed by the Commonwealth Scientific and Industrial Research Organization (CSIRO), glycosylation pattern of protein also changes from crop to crop due to which transgenic peas having a transgene for the enzyme alpha-amylase inhibitor-1 (α - AI1) from the common bean (*Phaseolus vulgaris*), succeeded in conferring 99.5% resistance against the pea weevil as similar in bean but failed the immunogenicity tests in mice and ultimately could not be commercialized. Also, the approval former made by GEAC in India for commercialization of the GM crops has been questioned regarding the norms, standards, procedures and criteria for what constitutes a safe product suggesting their reconsideration and its ambiguousness is imputed on some kind of conflict of interest of its few experts doubting its unbiasedness in assessment. Expert committees EC-I and EC-II set up to examine biosafety of Bt brinjal supported its benefits outweighing the perceived risks but some scientists feel that the number of animals tested and the time period for which the tests were conducted are inadequate. Another aspect of dissatisfaction against GM crops are gene transfer to other organisms such as gut microflora and development of antibiotic resistance in these organisms, lack of sufficient study on the digestibility of the Bt protein and the products formed after digestion.

Impacts on the Environment

Environmental safety of Bt crops has always been criticized and questioned regarding the numerous aspects. The impacts on environment stating the ecological risks to natural ecosystems including the non-target organisms are of a huge concern. The non-target lepidopterans such as butterflies and moths bear the high risk of which a renowned example reported in the late 1990s is of the Monarch butterfly larvae that are in danger of toxicity due to the exposure to high levels of Bt pollen from Bt corn. Though it is shown that the Bt toxin density in Bt corn pollen is not enough to cause any harm to the insect larvae, some criticize that the studies of a few species of non-target organisms are insufficient to guess the possible harm to complicated ecosystems and the food chain as a whole.

The cause of a phenomenon called Colony Collapse disorder (CCD) in bee hives is also offered up to the GM crops especially Bt corn as some German researchers observed a possible correlation between exposure to Bt pollen and compromised immunity to Nosema but it was found non-coherent as its occurrence observed even in the countries positing ban on GM crops like Switzerland and speculated to have exacerbating causes. A threat of extinguishing crop local landrace biodiversity can be imposed by the Bt crop varieties both due to their economical preference by farmers in controlling the insects as well as the invasive dominance and further unintentional gene flow in natural ecosystems on behalf of the fitness advantage conferred on them by the Bt genes.

Some pro-GM scientists' question about whether green revolution has dispelled local tall varieties from general cultivation or not while others assert on restricting such contamination due to the unintentional gene transfer. Another major concern about the Bt crops is the Bt resistance development in insects to more and more stacked Bt genes due to their long run use. The development of second generation Bt cotton by Monsanto after breakdown of resistance by pink bollworm in first generation bearing only one Bt gene viz., cry1Ac is the ascendancy of this process. Some other examples of such resistance development are in Indian mealmoth, cabbage looper, etc. Though this is the problem also of chemical pesticides, their dose could be increased or decreased accordingly which could not be the case in genetical modification. In such breakdown of resistance, farmers have to rely on expectations that new varieties with more stacked genes would soon be developed and solve the problem. But nearly all the scientists take this concern as granted because resistance itself is not a new phenomenon and is a very obvious natural consequence to evolve mechanisms to evade the effects of the older ones which could be delayed or almost ceased by one or the other ways e.g. pyramiding genes of multiple resistance in plants acting on different sites of the pests, crop rotation strategies or planting Bt seeds along with non-Bt ones in a certain proportion benefitting dually by escaping total crop from the pest attack due to availability of another host plants and also allowing natural enemies of pests to survive. But an alongside problem of resurgence of secondary pests is inevitable and has been found to erode the benefits of Bt crops due to the reduction in use of pesticides.

Although the number of insecticide spray applications controlling bollworm in cotton reduced drastically, the surge of sucking pests' population such as mealy bugs and aphids in India and of mirids in China which are not affected by Bt toxins went beyond the control which upon called forth the need of sprayings to control the emerging secondary pests. While one side is convincingly asserting how much the increased insecticide use for control of the secondary pests is lower than that the reduced one for control of target lepidopteran pests as bollworm, other side remonstrate the practicality of significant lower reduction in pesticide use than that actually reported one. Further, the Persistence of Bt genes in environment is yet another matter of concern and studies in this prospect has also forked the perceptions. Their accumulation in soil rather than other habitats with impact on soil microflora is admitted by many of the scientists. Some studies give the persistence period of over 200 days, with half-lives between 1.6 and 22 days, admitting their initial rapid degradation by microorganisms, as well as adsorption on organic matter and longer residual effect while some, in contrast, deny their persistence even in the soil demanding the requirement of more investigation.

Advantages of Bt Crops

1. It assists in improving the crop yields, thereby, raising the farmer's income. This results in increased farm production.
2. They help in controlling soil pollution as the use of synthetic pesticides is reduced.
3. Bt crops facilitate in protecting beneficial insects.
4. It can easily feed an increasing population due to increased yields in a short time.
5. It leads to the production of disease-free crops owing to the reduction of pesticides.
6. It leads to more productivity in a small area of land.

Disadvantages of Bt Crops

1. Bt crops are costlier than naturally grown crops.
2. It can disrupt the natural process of gene flow.
3. The pests might become resistant to the toxins produced by these crops and the crop production might decline.

Conclusion

The technique replaces conventional chemical pesticides. It has widespread application. Bt-crops leaves negligible hazard towards soil chemistry. After discussing a variety of aspects, it can be said that it is wise and natural approach towards crop protection. The techniques possess nearly harmless remedy against pests. Long-lasting fruitful results are possible if certain queries are addressed. The technique has a potential to be given a state of industry on national level.

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Role of Conservation Agriculture Under Climate Change Scenario

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Introduction

Climate change refers to any significant change in measures of climate (such as temperature, precipitation or wind) lasting for an extended period (decades or longer). Impact of climate change on rainfall, temperature, co2 level, extreme events, sea level rise and glaciers. Productivity of most of the cereals would decrease due to increase in temperature. Climate change through probable loss of 10-40% in crop production in agriculture. Impact of climate change on agriculture increase in temperature (1.4-6.1 0C), widespread runoff, reduction water availability, droughts and increased frequency of diseases and insect pest attacks.

Conservation agriculture (CA) can be defined as "a concept for resource saving agricultural crop production and sustain production level while concurrently conserving the environment." Management options for conservation agriculture include conservation tillage, crop residue management, land configuration, in situ moisture conservation, mulches and system of rice intensification (SRI).

Climate Change

Climate change refers to any significant change in measures of climate (such as temperature, precipitation, or wind) lasting for an extended period (decades or longer).

Climate Change: Impact on Agriculture

1. Increase in temperature.
2. Widespread runoff.
3. Reduction of water availability.
4. Droughts.
5. Increased frequency of diseases and insect pest attacks; and vanishing habitats of plant and animals.
6. Adverse impact on coastal agriculture due to rise in sea levels (17.5-57.5cm) and sea-water intrusion by 2100 and another 10-20 cm rise if polar ice melting continues (IPCC, 2014).

Mitigation of the Impacts of Climate Change

1. In rice-wheat system, zero tillage has a direct mitigation effect.
2. Crop residue management has the potential to mitigate effects of climate change.
3. Land configuration, land levelling to reduced water logging.
4. Application of mulching on soil which minimize the soil moisture loss.
5. Keep the rice fields moist rather than flooded.
6. Minimize anaerobic conditions.
7. Use of zymogenic bacteria, methanogens, nitrifiers and denitrifies in rice, which will help in maintaining the soil redox potential in a range where both NO_2 and CH_4 emissions are low.
8. Improved management of livestock population and its diet could also assist in mitigation of GHGs.

Conservation Agriculture

Conservation agriculture (CA) can be defined as "a concept for resource saving agricultural crop production and sustain production level while concurrently conserving the environment" (FAO, 2009). Conservation Agriculture (CA) enhances productivity of resource use; thus, offers opportunities for climate change adaptation and mitigation solutions while improving food security through sustainable production intensification. Conservation

Agriculture also contributes in adaptation of crop to climate change by reducing crop vulnerability. The total area under no tillage/zero tillage in India is about 3.43 m ha. Efforts to adapt and promote resource conservation technologies have been underway for nearly a decade. Spread of Conservation agriculture have been made through the combine effect of several SAU's and ICAR institutes. Conservation agriculture technologies is taking place in the irrigated regions of Indo-Gangetic plains where rice-wheat cropping system dominates. Conservation agriculture system have not been tried or promoted in other major agro-eco regions like rainfed, semi-arid tropic and the arid regions.

Management Options for Conservation Agriculture

1. Conservation tillage: Conservation tillage is defined as "any tillage or planting system in which at least 30% of the soil surface is covered by plant residues after planting to reduce erosion". Conservation tillage provides the best opportunity for halting degradation and for restoring and improving soil productivity. Appropriate tillage practices are those that avoid degradation of soil properties but maintain crop yields as well as ecosystem stability.

2. Crop residue management: "The portion of plant left in the field after harvest of the crop that is a (straw, stalk, stem, leaves and roots) not used domestically or sold commercially". Need of crop residue management to enhance physical, chemical and biological properties. Organic recycling has to play a key role in achieving sustainability in agricultural production.

3. Land configuration: Land configuration means alteration of shape of seed bed and land surface among the various method for obtain the better yield over the conventional method of sowing. They have an impact on the crop growth by influencing the soil moisture availability, aeration, crop lodging and nutrient availability. Land configuration is important for better growth and development of any crop and decides the effectiveness of crop management practices, regarding application of nutrient, weed management, irrigation, drainage etc. It provides optimum condition for better root growth.

4. In-situ moisture conservation: To increase moisture availability to the agricultural crops, it is a necessary to adopt in-situ moisture conservation techniques in addition to large scale soil and moisture conservation and water harvesting structures in the watershed. The principle behind the recommendation of different practices is to increase the infiltration by reducing the rate of runoff. In-situ moisture conservation practices of arresting the soil loss and runoff involves construction of bunds, slopes or other barriers on the contour.

5. Mulching: Mulching is the soil and water conserving and weed management practice through soil solarization also in which any suitable material is used to spread over the ground between rows of crops or around the tree trunk. This practice helps to retain soil moisture, reduce evaporation, prevent weed growth and enhance soil structure. The other advantage of mulching is improvement of soil structure due to decomposition of mulch.

Potential Benefits of Conservation Agriculture

1. Reduction in cost of production.
2. Enhancement of soil quality.
3. Enhancement of water and nutrient use efficiency.
4. Reduction of the incidence of weed, such as *phalaris minor* in wheat.
5. Enhancement of production and productivity.
6. Reduction in greenhouse gas emission.
7. Providing opportunities for crop diversification.
8. Improve of resource use efficiency.

Conclusion

In the initial stage of practices there was no significant difference in yield attributes were observed between conservation tillage and conventional tillage but as far as economic point of view, conservation tillage is more beneficial. Not only the quantity but the type of crop residue such as legume crop residues shows beneficial effect on crop yield as compared to cereals residue. Land configuration system is superior with respect to moisture conservation. Ample amount of moisture can be conserved by covering soil with any mulching material or moisture conservation techniques. SRI in paddy has many relative advantages over the traditional paddy cultivation method. Adopting CA such as zero tillage, reduced or minimum tillage, crop residue incorporation, mulches as well as in situ moisture conservation, SRI technology etc. can help to mitigate the effect of climate change, enhance productivity of crops and conserve soil and soil fertility. Protection of environment by elimination of burning of straw, facilitating recycling of residues and plant nutrients.

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Principles of Landscape Gardening

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Landscape gardening is very much needed these days to beautify various areas using different plant or non-plant components. To get the fantastic look of the garden it is necessary to plan the gardening process carefully. While planning certain things need to be followed which are known as principles. By following these principles, one can achieve the look they wish to see. So, the principles to be followed are mentioned below with the brief description.

Balance

The balance in landscape design is visual equilibrium of different garden elements. Balance can be created in a garden either formal or informal by grouping the components, structures and plants equally on both sides of the imaginary central axis. It is a striking feature in a formal garden.

The exact duplication of what is on right on the left imposes a balance. The balances should be colour wise, texture wise and shape wise. Trees as an avenue on one side will not make a balance. Care should be bestowed to create balance in colour and texture.

In an informal garden, the overall mass or dense of structure should be distributed on both sides of the axis which may be curved or informal. A large mass of yellow and white coloured flowers may be informally balanced on the other side with few flowers of red to create visual balance.

Proportion

Proportion refers to the share of the different parts or components to the whole. It is the relation of the component with other in magnitude. In a landscape garden, the space and area provided for a lawn, paths, borders, trees, buildings etc. should be in right proportion and not equal in proportion. Proportion helps in space organisation. The disproportionate occupation of any one component may distract the eye and attention.

Unity

Though diverse structures, plants and features are used to create a landscape, there should be a unity among each component and all the components with main building. Garden and building as well as adjacent components should hand together like a diamond in the jewel around the neck. Instead of the individual beauty of a component, the overall beauty should be focused to achieve unity admits diversity. Finally, a designer takes resource to the aesthetic principles of balance, rhythm, proportion and harmony to give unity to the composition.

Perspective

Any object situated at a distance will look small compared to the one of the same sizes kept close to the vision. Eg. i. Rail road converges at distance.

This visual phenomenon of shrinkage in size and converging in lines is called as perspective. The garden objects can be positioned either at the foreground or background to create pleasing visual illusions.

Artist's perspective is two-dimensional, sculpture's perspective is three dimensional while the landscape architect's perspective is of four dimensional, the fourth dimension being the time because, as the time passes, the size of plants differs, colour differ and ultimate visual quality will differ.

Vista

It is three-dimensional confined view of a terminal object along eye line at focal point. Natural vistas are very common around lofty mountains and snowy peaks.

Eg. Taj tomb as viewed from it opposite and sometimes it may be calm or suggest movement when fountains, single specimens are employed to create a vista.

Prospect

Prospect is the view of a scenery, natural or manmade through an opening such as window or a gap in the foliage of trees. This is nothing but the camera view of any scenery. Such prospects can also be created in landscape gardening by adopting suitable proportion and unity.

Restraint

Over use of any component including grouping of plants in a particular location mask the scenic beauty. If all the features whether natural or artificial are kept within bounds or used restraint, best results can be achieved.

Rhythm

Rhythm is measured as cyclic repetition of an object, effect, event. Ascending and descending rhythms can be achieved with regular increase or decrease or shape or tone of a colour. Rhythm can be better understood with tones or musical notes

In architecture, the domes of buildings or shrines, 'kalasams' on temple towers with repeated pointed structures against the open and plain sky create a rhythmic effect. In a garden, rhythm can be infused through cleverly repeated colours and shape, topiaries and hedges etc.

In moghul gardens, the fountains and cascades have been repetitively provided to create rhythm. Sometimes rhythm is created through action of lights under water.

Harmony

Harmony is the pleasing effect obtained due to opt arrangement and collation of the various garden features. It is the overall effect of various features styles, colours and structures in the total landscape. Every part of the landscape should synchronize into the other and all the components into the whole. No individual component should project itself beyond its expected limit.

The beauty of the landscape depends upon the degree of harmony of various elements. It is the evident relationship of all parts of a thing observed visually, audibly and psychically. When the components of landscape architecture possess harmony, the picturesque effect is produced and can aesthetically please the visitor. Further the garden should harmonize with the building and both should harmonize with the natural landscape beyond the boundaries of landscape area. The synchronization of one within the other is the key factor to achieve harmony.

Movement or Mobility

The concept of mobility is vital to garden as breath to human. If all the components are stiff, stony and static, it will harden the attitude of person and the aggressive tendency is triggered from within. Mobility can be introduced in the garden by graceful nodding gait of a flower, magnificent away of tall trees, innocent swing of a creeper, inviting dance of leaves on mild breeze, swinging blooms in jubilance, gliding birds in the sky, butterfly's dancing circling over flowers, dispersal of clouds in the sky, surging water in fountains, walking and jumping waters to keep walk with one and talk with one, the gentle curvature of roads, trunks, branches of trees etc. Thus, the mobility suggested will loosen the hardened attitude and relax him and release him from the tentacles of anger and revenge.

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Surprise

All components of a garden should not be exposed to the vision at one stroke from one point. If exposed, there won't be any curiosity in a person to walk along and move within to explore further. One component should be gracefully hidden from the other either by gentle turn of road, paths or screening through shrubbery, hedges or pergolas.

Skyline

Garden meets the sky in its vertical dimension. Planning a garden should include planning for a skyline also. A peak of a mountain, gigantic trees, an old monumental building, temple towers etc. if available, naturally can be woven into the background design to add beauty to the skyline of trees.

Scale

Scale is a relative dimension. The height and spread of trees and shrubs and the spread of the water garden are determined by adopting a scale, as one might adopt a scale in preparing a map. To make it clear, it may be noted that a small reflecting pool underneath a large tree will be dominated by the tree and render the pool ineffective, owing to the difference in their dimensions. To get the right picture of a tree beside a pool we should adopt a ratio between the size of the tree and pool as is obtained in nature. Nature is often very lavish. The large rivers, high mountains and rushing waterfalls are created on an elaborate scale. Man, in copying them, in his designed landscapes, reduces them in scale and relates them to a size convenient and acceptable to him. Appropriate adoption of scales and proportionate measurements are the success of imitative naturalistic garden art.

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Brochosomes and their Functions in Leafhopper

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Introduction

Brochosomes are the intricately structured protein- lipid particles produced from the specialized glandular segments of the Malpighian tubules of the leaf hoppers. Leafhoppers are the small, slender, sap-sucking insects which belong to the large family Cicadellidae (Jassidae) of the order Homoptera.

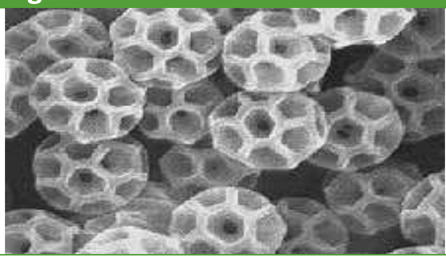
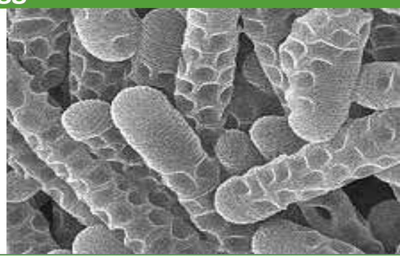
Brochosomes derived from two Greek words: brochos - the mesh of a net, and soma – the body. It was first described in 1952 with the aid of an electron microscope. After moulting, leafhoppers release the brochosome containing secretion through the hindgut and apply it onto the fresh integument. This behaviour is referred to as anointing. It usually observed within 1-3 hours after the molt before the leafhopper starts feeding.

(Brochosomes secretion through hindgut)

Structure and Composition of Brochosome

1. Most of the leafhopper species produce brochosomes which are hollow, spherical in shape with a diameter of 0.2 -0.7 micrometres.
2. They consist of 20 hexagonal and 12 pentagonal cells, making the outline of each brochosome approximating a truncated icosahedron which is similar to the geometry of a soccer ball and a C60 buckminsterfullerene molecule.
3. Brochosomes contain both protein and lipid components.
4. The brochosome secreting cells display an extensively developed rough endoplasmic reticulum, indicating production of large quantities of protein which is "brochosomin".
5. Some researches indicated that brochosomes comprise a protein skeleton coated with saturated lipids.
6. 60% of the brochosome skeleton comprises glycine-rich proteins.

Functional Types of Brochosomes

	Integumental Brochosomes	Egg Brochosomes
Examples		

Use	Distributed across the integument	Placed onto egg nests made in plant tissues or directly on to eggs
Distribution	All leafhoppers Worldwide	A small group of about 200 related species from the tribe Proconiini.
Produced by	Males, females and nymphs	Gravid females only
Function	Protection from excrement and water	Protection of eggs
Size	0.2-5.0 µm	1.0-20.0 µm
Shape	Spherical	Elongate, rarely spherical

Brochosomes and Leafhopper Morphology

Leafhopper morphology helps in the secretion and use of brochosome by the insects in two ways.

1. Leg chaetotaxy: Chaetotaxy is defined as the arrangement of bristles (macrosetae) on an arthropod. A distinctive feature of the leafhopper legs are rows and groups of strong setae (macrosetae) which serve as fine tools for manipulating brochosomes into the integument. In certain species from the leafhopper tribe Proconiini, females use one of the four longitudinal rows of setae in the hind tibiae to transfer brochosomes from the forewings onto the egg nests.

2. Wing: brochosome spots: Some leafhoppers (Typhlocybinae, Xestocephalini and Proconiini) store ready-to-use brochosomes on their forewings in form of spots. In the above three groups the brochosomes are stored in a modified area in the fore wing such as wrinked area, depreesed area and a patch of setae in typhlocybinae, xestocephalini and proconiini respectively.

Functions

Help in repellence of water and sticky substances (honeydews) and make them superhydrophobic.

1. Protection against the attachment and germination of the fungal spores. It also helps to protect form desiccation, UV light and temperature fluctuations.
2. Brochosomal coats act as non-stick coatings and protect leafhoppers from contamination with their own sticky exudates —filtered plant sap.
3. Females from certain genera of the tribe Proconiini (Oncometopia, Homalodisca, Molomea, Acrogonia, and some other) use brochosomes to cover their eggs inserted in plant tissues.
4. Protect the leafhopper from the attack of predators and parasites.
5. Useful in interpreting oviposition.
6. Also helps in thermoregulation.
7. Act as a hypothetical pheromone reservoir.
8. It also helps in the grooming behaviour in which they maintain the hygiene and keep clean the body and appendages from the contaminants.

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Biotechnology - Model Organism: Role Model for Discovery of Methods

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What is a Model Organism?

A model organism is a species that has been widely studied, usually because it is easy to maintain and breed in a laboratory setting and has particular experimental advantages. Over the years, a great deal of data has accumulated about such organisms and this in itself makes them more attractive to study. Non-human species used extensively to understand particular biological phenomena, with the expectation that discoveries made in the organism model will provide insight into the workings of other organisms.

There are Three Types of Model Organisms

1. Viruses.
2. Prokaryotic.
3. Eukaryotic.

How to Select a Model Organism?

Small size, develop rapidly, short generation time, simple life cycle, amenable to observation and experimentation, many known and mapped mutants, availability of genome sequences, easy for transformation, comprehensive on-line database, cheap to maintain.

Important Model Organisms are

Prokaryotes: *Escherichia coli (E. coli)* - This is common, Gram-negative gut bacterium is the most widely used organism in molecular genetics. It serves as a crucial model to study diseases of the gut and sepsis.

E. coli: **(**Circular chromosome): *E.coli* produces by two means: cell divisions and transfer of genetic material through a sex pili. In a bacteria conjugation depends on the fertility factor that is present in the donor cell and absent in the recipient cell. The cells that contain F are called as F+ and cells not contain F are called as F-. The F factor contains origin of replication and a number of genes required for conjugation. A cell containing F should produces sex pili which makes contact with a receptor on an F cell and pulls the two cells together. DNA is then transferred from F+ to F-. Conjugation that takes place only between a F+ cell to F- cell. Once inside a recipient cell the single strand is replicated producing a circular and double stranded copy of F plasmid. If the entire F factor is transferred to the recipient F-cell, then the cell becomes F+.

Role of *E.coli* in biotechnology: *E.coli* plays an important role in modern biological engineering and industrial biotechnology. The work of Stanley Norman Cohen and Herbert Mayer in *E.coli,* plasmids and restriction enzymes to create rDNA became a foundation of biotechnology. Considered a very versatile host for the production of heterologous proteins, researchers can introduce genes into the microbes using plasmids allowing for the mass production of proteins in industrial fermentation process. Genetic systems have also been developed which allow the production of recombinant proteins using *E.coli.* One of the first useful techniques of recombinant technology was the manipulation of *E.coli* to produce human insulin. Modified *E.coli* cells have been used in vaccine development, bioremediation and production of immobilised enzymes. However, *E.coli* cannot be used to produce some of the larger, more complex proteins which contain multiple disulphide bonds (or) proteins that also required post translational modification for activity.

Advantages of *E. coli* as a model organism: It is a natural mammalian gut bacterium used as a model organism. Easy to culture and grow in laboratory. Rapid growth. Ability to express proteins at very high levels. Expression of desired gene. Important tool in biotechnology. Genetic engineering like transduction and conjugation make to better understand genetic processes. Survive in bile salts. Colony formation make necessary to isolate pure strains from bacteria.

Eukaryotes:
Protists:
***Chlamydomonas reinhardtii* (2n=34)** - a unicellular green algae - Study chloroplast biogenesis, photosynthesis, light perception, flagellar structure and function, genetics of basal bodies (centrioles), regulation of metabolism, cell-cell recognition and adhesion, cell cycle control, response to nutrient deprivation etc. Genetics study, with many known and mapped mutants and expressed sequence tags, and there are advanced methods for genetic transformation and selection of genes. Genome Sequencing Oct. 2007 - Easy to grow on an inexpensive defined medium. Animal invertebrates: *Caenorhabditis elegans,* a nematode- an excellent model for understanding the genetic control of development and physiology. *C. elegans* was the first multicellular organism whose genome was completely sequenced.

***Caenorhabditis elegans* (2n=12)** (nematode round worm): One of the best characterized multicellular animals at the level of genomics, genetics, and embryology. Its genome is fully sequenced. *C. elegans* is unique in that it can be grown and genetically manipulated with the speed and ease of a micro-organism while offering the features of a real animal. *C. elegans* has a full set of organ systems, has complex sensory systems, shows coordinated behavior, and it is possible to trace the lineage of every one of its approximately 1000 constituent cells. RNAi and miRNA are discovered in worms. Developmental biology and Cell biology, Neurobiology, Aging & Human disease studies.

Benefits to Select *C. elegans* as Model Organisms

The transparency, anatomical simplicity and rapid development & mix of out crossing and selling.

***Drosophila melanogaster* (2n=8):** It is small and has an uncomplicated diet, easily raised in lab, thousands of Drosophila are kept in a collection of little plastic tubes with specially prepared food in the bottom. Rapid generations: it has a generation time of only two weeks. Mutations easily induced, many observable mutations. It is easy to create transgenic fruit flies that carry foreign DNA. Its tractability for genetic studies. Molecular genetics, Population genetics and Developmental biology. The research information available for *D. melanogaster* is huge, over 77,000 research publications.

Fungi:
***Saccharomyces cerevisiae*: Baker's yeast or budding yeast**
Yeast (2n=32) as a Model Organism: Eukaryotic system, signaling molecules and cell cycle are nearly similar. Good model system to understand many human diseases including cancer (Approximately 20% human disease genes have yeast homologues). Ease of genetic manipulation allows its use for analyzing and functionally dissecting gene products from other eukaryotes. Last decade four Nobel prizes were awarded for discoveries involving yeast.

Zebra Fish (2n=25): Very small size, high fertility, high predictively, embryo transparency and high development, Easy to manipulate, optically transparent, Advantage of cancer relevant phenotype, Regeneration of fins skin heart in adult, Brain in larvae.

***Arabidopsis thaliana* (2n=10):** Small flowering plant, small genome relative to other plants and is easily grown under laboratory conditions, amenable to some genetics particularly generation of transgenics, allows insight into numerous features of plant biology, including those of significant value to agriculture, energy, environment, and human health. Universal model plant, small size, relatively short life cycle, small sequenced genome, transformed easily.

Mouse (2n=40): Closest mammalian model organism to humans. Genes that code for proteins responsible for carrying out vital biological processes in both the human and the mouse share a high degree of similarity. Therefore, the mouse has already proven extremely useful in development, genetic and immunology studies. Transgenics and KO's possible. A great system for studying and understanding human disease, as well as a mechanism for investigating new treatment strategies in ways that cannot be done in humans. Developmental overview and life cycle slow same as for all mammals. Large mutant collection. Construction of chimeric embryos possible. Availability of material at all stages and source of primary cells for culture.

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Popular Chillies of India

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Introduction

Chilli is an important cash crop of India valued for its pungency and rich red colour. Botanically known as *Capsicum annuum*, chilli has four more domesticated species namely *C. chinense*, *C. frutescens*, *C. baccatum* and *C. pubescens*. But in India *C. annuum* is mostly cultivated almost throughout the country except in some parts of north eastern India where *C. chinense* and *C. frutescens* is also grown. Chilli is an indispensable item in Indian diet and is consumed as a condiment. Red colour in chilli is attributed to the compound capsanthin while pungency is due to capsaicin. India is the only country where chillies of different quality, shapes or sizes are raised. Nutritionally chillies are packed with vitamins, especially vitamin A and C along with minerals like potassium, magnesium and iron. It is also reported to have pharmaceutical uses like pain relief as they are known to inhibit pain messengers thereby alleviating the pain of arthritis, headaches, burns and neuralgia. It has a role in boosting immunity of individual and also lower cholesterol. They are also helpful in getting rid of parasites of gut.

Chillies from North

1. Kashmiri Chilli: Mainly cultivated in temperate regions of the country such as Himachal Pradesh, Jammu and Kashmir and also in subtropical regions of North India in winter season. Fruits of Kashmiri chilli are long, fleshy, and deep red in colour. Fruits are usually less pungent but it is a rich source of vitamin C. It is also rich source of antioxidants and vitamin A. The speciality of Kashmiri red chilli is it is mild to taste but offers rich flavour when added to any dish. It is commonly known as deggi mirch in India.

2. Jwala Chilli: This is the most famous hot chilli of India and consumed as both fresh green and dry red chilli. It has medium edible level of pungency. Commonly known as "finger hot chillies" as they look like slender, bent fingers. They have about 10 cm length with marginally wrinkled skin. At fresh stage colour varies from medium to light green colour and develop bright red colour on ripening. These chillies are grown almost throughout the country.

3. Mathania Chilli: This chilli has got its name from the place of its origin i.e., Mathania, a town in Jodhpur district of Rajasthan. It is called as "fiery Lal Badshah of Rajasthan." It is valued for its fine culinary qualities with characteristic aroma and spiciness. It is favourite delicacy of Rajasthan for generations but is only grown by few farmers and is on the verge of extinction as per reports of Central Arid Zone Research Institute. Residents of the town of Mathania are involved in harvesting, drying, grinding the chillies, while the ladies of the house also make the very Rajasthani, very intense mirchiki chutney with chillies soaked overnight and then ground with garlic and a few other spices.

4. Bhavnagri Chilli: These are thick and long chilli with a width of more than 2.5 cm and length of 13 cm. These are mostly used in preparation of stuffed chilli or 'bharwa mirchi'. These chillies are not so hot and its length and size helps to stuff the mixture. In south india, this fresh green type of this chilli is more commonly used for preparing pakodas or 'bhajii'.

Chillies from South

1. Guntur chilli: Belonging to C. annum species, it is grown in the districts of Guntur, Prakasam (Andhra Pradesh), Warangal (Telangana), and Khammam in India. These chillies are known for its high pungency content though they do not have rich red colour and are also used for extraction of capsaicin (the pungency factor). Fruit length varies from 5 to 15 cm with thickness varying from 0.5 to 1.5 cm. These chillies are renowned globally and is exported Asia, Canada and Europe. Common Guntur chilli varieties are LCA 334, Teja, Guntur Sannam (S4) and LCA 273.

2. Byadgi chilli: These chillies are famous throughout the country and are mainly grown in Karnataka state. It is peculiarly used for extraction of oleoresin (the red colour compound) which is used in making lipsticks and nail polishes. Depending on the shape there are two types of byadgis: dabbi (plump) and kaddi (thin). Byadgi Dabbi is thick long or short fruits which is popular for it colour, taste and flavor. It has more seeds in comparison to Byadgi kaddi. Byadgi Kaddi is thin, long and knarled type of chilli which is more pungent. Fruits of these chillies have thin skin which on drying crumbles easily like an ashed paper. These are commonly used as paprika flakes.

3. Boria chilli: Round chillis are known as “boria mirch”. They are large round chillies with bright red colour. On drying they turn tranclucent red-brown in colour and their seeds rattle inside. Being moderately pungent it is mostly used for tempering purposes in Indian cuisines like soups and curries.

4. Sankeshwari Chilli: This chilli originated from a place called Sankeshwar, Maharashtra but is grown in the state of Karnataka. These have very high level of pungency and hence should be used carefully. They also have very deep red colour and is used to make chilli powder which is used in many food preparations all over the country.

5. Kanthari chilli: It is bird’s eye variety of chilli which is cultivated mainly in the state of Kerala. It’s a highly pungent variety of chillies. These are very small in size yet possess very high pungency levels. Consumption of even one fruit will result in watering eyes. But it does not find much use in cooking. Major issues with cultivation of Kanthari chilli is its inability to find place in supermarkets, labout intensive harvesting and low production. It has now become famous more for its medicinal uses like controlling cholesterol, relieving pain in arthritis and increasing appetite. Demand for this type of chilli is increasing and foreseeing its profit in cultivation people have started growing Kanthari chilli.

6. Ramnad Mundu Chilli: This local chilli is exclusively grown in Ramananthapuram and Tuticorin districts of Tamil Nadu. These are small round chillis with deep red colour and medium pungency. This mundu chilli is widely preferred to add spiciness and mouth-watering flavour to chutneys, sambar, and tadkas in Southern India. These ramnad red mundu chilli is popular for its unique flavour and aroma and is also exported worldwide where they use it as a food colouring.

Chillies from North Eastern India

1. Naga or Bhut Jhalokia: It is an interspecific hybrid of *C. chinense* and *C. frutescens* which commonly grown in North Eastern region of the country. In 2007, Bhut Jhalokia, was registered as world’s hottest chilli in Guinness World Records which was superseded by Trinidad Scorpion Butch in 2011 and by Carolina Reaper in 2013. Unlike most chillies, Bhut Jhalokia produce capsaicin or the pungency compound in vesicles found in both the placenta around the seeds and throughout the fruit, rather than just in the placenta. This may be possible reason for high pungency levels of Bhut Jhalokia.

Fruit length varies from 6-9 cm with fruit width of 2.5 to 3 cm. They have very unique shape with either rough or smooth skin. These chillies are smeared on fences or burnt in fire to keep the wild elephants at distance in north eastern India. These are known for its ethnobotanical and pharmaceutical uses.

2. Dhani Chilli: This is bird’s eye chilli from Northeastern region of India. It has high pungency levels with small size.

Conclusion

This is not the complete list of numerous types of chillies grown across India. Other types of chillies famous in small regions of India include Longi, Reshampatti, Sangli Sannam, Nalchetti, Titimiti, Warangal Chappatta, Tadepalli chillies, Madras puri, Hindpur mirch, Kanthari satttur and many more.

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A Miraculous Plant Artemisia Annua for Curing Malaria and Cancer

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Artemisia annua L. (Asteraceae), has great medicinal importance due to the presence of secondary metabolite artemisinin in its aerial parts which is a sesequiterpene lactone, especially synthesized in the trichomes. Artemisinin is the most efficacious antimalarial drug in the world to date and is only produced in *A. annua* L. plants . The bioactive compound Artemisinin and its chemical derivatives have recently become increasingly known as a promising and safe effective drug for malaria treatment. It has also found very effective against a number of viruses including herpex simplex, hepatitis B and C, corona viruses such as SARS-COV2 and in variety of cancers. But the serious limitation is the very low concentrations of artemisinin in plants of *A. annua,* which ranges from less than 0.01 to 1.2 % dry weight (DW), is a serious limitation which makes artemisinin relatively expensive and not yet adequately available to meet global demand. Large demand, low yields of artemisinin and annual life cycle of the species are prompting significant research efforts on *A. annua*. Therefore, this plant is now becoming increasingly popular for the molecular and physiological dissections of its sesquiterpene metabolism.

In *A. annua,* like other plants, the primary metabolism is concerned with the synthesis of building blocks, cell division, growth, morphogenesis, photosynthesis and reproductive fitness (Figure 1). The secondary metabolism is concerned with survival and reproduction under biotic and abiotic stresses. The products of primary metabolism are very essential for normal growth and development. Secondary metabolites are thought to be not critically essential for plants and are produced/ accumulated in specific plant parts during a specific phase of life.

Figure 1 : Artemisia annua Plant growing in Field and structure of leaf (Right)

The plant *A. annua* also produces large number of secondary metabolites such as alkaloids, anthocyanins, coumarins, essential oils, flavonoids, glycosides, saponins, terpenes, and anthraquinones. The sesquiterpene lactone (Artemisinin) is presently of considerable interest due to its several products as valuable pharmaceutically important antimalarial drug. Artemisinin and malaria share a very strong relationship since hundreds of years. *Artemisia annua* plants extract for treating malaria like symptoms such as fever and chills has been reported in use since more than 2000 years in ancient Chinese herbal medicine system. Later enormous efforts of Tu you you and her co-workers identified the potential active ingredients of *A. annua* extracts as antimlarial agent and further artemisinin structure and its's derivative were also elucidated (Tu 1985). For this research Tu You You has been honoured with 2015 Nobel Prize in medicine or physiology. Today artemisinin-based combination therapies (ACTs) are among the first line drugs as antimalarial.

The bioactive artemisinin is the starting material for the derivatives used in ACTs, is extracted from dried leaves and inflorescences of *A. annua.* The very low artemisinin content in in plants of *A. annua*, is a major limitation which makes anti-malarial artemisinin a relatively expensive drug for tretment, especially for economically disadvantaged people in developing countries where malaria frequently occurs. The artemisinin recovery yield from plant is ~5 kg per 1,000 kg dry leaves obtained from ~1 ha of *A. annua* field plants. Based on this yield related data the estimated 17,000 ha are required to produce artemisinin *in-planta* for 100 million adult treatments per year. Recently efforts have been made to scale-up the cultivation of *A. annua* in Asian region and East Africa to increase the total acreage up to ~11,200 ha. For this, various approaches/methods have been employed to enhance artemisinin production in the plants including its chemical synthesis, cell cultures, hairy root cultures and by fermentation of the engineered microorganisms. However, none of these methods is effective to fulfil the demand because of high cost production.

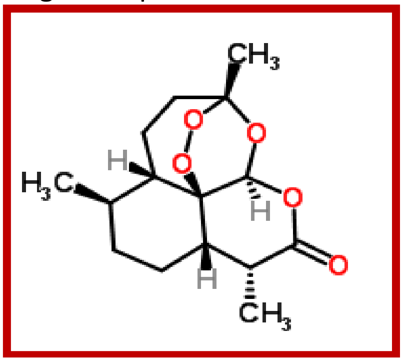

Figure 1 Chemical Structure of Artemisinin

The secondary metabolite artemisinin is generlly localized into the trichomes, small protuberances that are present on the surface of the stem, leaves and flowers. This drug is stored in exceedingly small amounts, usually < 1% of dry mass, thereby hindering treating of malaria. There are seasonal, environmental and accession/cultivar specific variations in artemisinin content and thus biotechnological approaches are essentially needed for higher production of artemisinin. Various biotechnological approaches which have been exploited for enhanced production of artemisinin are:

1. Non-transgenic.
2. Transgenic.
3. Heterologous transgenic systems.

Non-transgenic approaches include selective conventional breeding, alteration of nutrient content, hormones and environmental conditions, and exploitation of a plant's natural defence system through elicitation for induction of secondary metabolites. The transgenic approach has been also exploited for enhanced artemisinin productions, and the third recent approach the is used for increasing artemisinin is *via* heterologous systems by insertion of key artemisinin biosynthetic genes into organisms other than *A. annua.* In view of the fact, that the transgenic and heterologous transgenic approaches of artemisinin synthesis are very expensive methodologies, the intact aerial plant parts remain the only viable source of the artemisinin production and the enhanced production of the artemisinin content in the whole plant is highly desirable to meet the global demand as anti-malarial drug .

Beyond the therapeutic value as antiparasitic agent against Plasmodium parasites, the compound artemisinin along with *Artemisia* leaf flavanoids have potential of an anticancerous agent. Although this bioactive unique compound artemisinin is a major component synthesized and accumulated in the herbal parts of plants, various leaf flavonoids of this plant also have a variety of specific biological activities which have ability to synergize the effects of artemisinin as anti-malarial and anti-cancer drug. Cancer cells concentrate iron for use in cellular division similar to the malaria parasite which also collects high concentrations of iron than the normal cells and the peroxide of artemisinin "breaks" this iron, which is immediately transformed into two very aggressive free radicals that have ability to kill the affected cell rapidly. The combination of dihydroartemisinin with ferrous sulfate has been reported to reduce tumour growth. Therefore, iron is often administered several hours before artemisinin to enhance targeting of the cancer cells while sparing normal cells. In this chapter, anti-malarial, immunosuppressive, anti-inflammatory properties of this plant are presented using published information as an affordable medicine in treatment of malaria and cancer.

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Role of MGNREGA (Mahatma Gandhi National Rural Employment Guarantee Act) in Rural Development of India

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Role of MGNREGA in Rural Development of India

1. India is the land of villages and nearly 70 percent of the India's population lives in rural areas. These rural areas are characterized by various social and economic problems like poverty, illiteracy, low level of income, unemployment, poor food and health standard. So, to tackle these problems, various rural development programmed were implemented by the Government of India to improve the quality of rural life. The Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) is considered as most effective approach with an intention to develop the quality of rural life by providing a legal guarantee of one hundred days of wage employment to every rural household to do unskilled manual work. The scheme was initially implemented in February 2006 in the 200 backward districts of the country under Phase- 1 and was extended to another 130 districts of the country under Phase- 2 in April 2007 and in April 2008 under Phase- 3 the Act was implemented in the remaining districts of the country.

2. The Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), also known as Mahatma Gandhi National Rural Employment Guarantee Scheme (MNREGS) is Indian legislation enacted on August 25, 2005. The MGNREGA provides a legal guarantee for one hundred days of employment in every financial year to adult members of any rural household willing to do public work-related unskilled manual work at the statutory minimum wage. The Ministry of Rural Development (MRD), Govt. of India is monitoring the entire implementation of this scheme in association with state governments.

3. The Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) is to enhance livelihood security of households in rural areas of the country by providing at least one hundred days of manual wage employment to every household in a year. The most important and primary intention of the scheme is to eliminate poverty by providing fruitful guaranteed wage employment, strengthening natural resource management and an act in opposition to unemployment for the betterment of overall sustainability, it includes sustainability of the economy, agriculture, forest, income, health and many more ideas and principles of sustainable development, then it would be able to transform the face of rural India. The government of India enacted the National Rural Employment Act in the year 2005, to provide minimum days of employment to a registered, demanded household, of which the main purpose was to look out at the efficacy of this MGRNEGA in achieving the goals of development.

Objectives of MGNREGA

MGNREGA is a revolutionary step taken by the central Government of India for the rural poor people and is currently the largest self- targeting programmed in India. It is an influential instrument for ensuring inclusive growth in rural India through social protection, livelihood security and democratic empowerment.

The Important Objectives of the MGNREGA

1. Social protection for most vulnerable people living in rural areas through employment opportunities.
2. Livelihood security for the poor through creation of durable assets.
3. Strengthening decentralized, participatory planning through convergence of various anti-poverty and livelihoods initiatives.
4. Empowerment of weaker section of the society, Women, Scheduled Castes and Schedule Tribes through the processes of a rights-based legislation.

5. Deepening democracy at the grass-roots by strengthening Panchayati Raj Institutions
6. Effecting greater transparency and accountability in governance.

Salient Features of the MGNREGA

1. Adult members of a rural household, willing to do unskilled manual work, may apply for registration in writing or orally to the local Gram Panchayat.
2. The Gram Panchayat after due verification will issue a Job Card. The Job Card will bear the photograph of all adult members of the household willing to work under MGNREGA and is free of cost.
3. The Job Card should be issued within 15 days of application.
4. A Job Card holder may submit a written application for employment to the Gram Panchayat, stating the time and duration for which work is sought. The minimum days of employment have to be at least fourteen.
5. The Gram Panchayat will issue a dated receipt of the written application for employment, against which the guarantee of providing employment within 15 days operates.
6. Employment will be given within 15 days of application for work, if it is not then daily unemployment allowance as per the Act, has to be paid liability of payment of unemployment allowance is of the States.
7. Work should ordinarily be provided within 5 km radius of the village. In case work is provided beyond 5 km, extra wages of 10% are payable to meet additional transportation and living expenses.
8. Wages are to be paid according to the Minimum Wages Act 1948 for agricultural laborers in the State, unless the Centre notifies a wage rate which will not be less than Rs. 60/ per day. Equal wages will be provided to both men and women.
9. Wages are to be paid according to piece rate or daily rate. Disbursement of wages has to be done on weekly basis and not beyond a fortnight in any case.
10. At least one-third beneficiaries shall be women who have registered and requested work under the scheme.
11. Work site facilities such as crèche, drinking water, shade have to be provided.
12. The shelf of projects for a village will be recommended by the gram sabha and approved by the Zilla panchayat.
13. At least 50% of works will be allotted to Gram Panchayats for execution.
14. Permissible works predominantly include water and soil conservation, afforestation and land development works.
15. A 60:40 wage and material ratio have to be maintained. No contractors and machinery are allowed.
16. The Central Government bears the 100 percent wage cost of unskilled manual labor and 75 percent of the material cost including the wages of skilled and semi-skilled workers.
17. Social Audit has to be done by the Gram Sabha.
18. Grievance redressal mechanisms have to be put in place for ensuring a responsive implementation process.
19. All accounts and records relating to the Scheme should be available for public scrutiny.
20. Unemployment allowance as per the Act, has to be paid liability of payment of unemployment allowance is of the States.

The MGNREGA Provides Wages to Rural Employees Against Work Done for the Development of Rural Areas the Various Works for the Economic Development of Rural Areas are Done through MGNREGA

1. Water Conservation and water harvesting.
2. Drought proofing, including afforestation and tree plantation.
3. Irrigation canals including micro and minor irrigation works.
4. Irrigation facilities for landowners by households belonging to SC/ST or to land of beneficiaries of the INDIRA AWAAS YOJANA.
5. Renovation of traditional water bodies, including desisting of tanks.
6. Land development.

7. Flood control and protection of works, including drainage of water-logged areas.
8. Rural connectivity to provide all weather roads.
9. Any other work, which may be notified by the Central government in consultation with the state governments.

By these development works the MGNREGA has provide main role in infrastructure development in rural areas of India. There is a visible change in development in rural areas of India by MGNREGA like the development of roads, development of irrigation canals, development of housing in rural areas etc.

Impact of MGNREGA on Employment Generation in Rural India

Our country has completed more than sixty years of independence but poverty in rural India continues increase day by day. The country cannot achieve its goal of reach the goal of economic development unless and until these two problems are completely eradicated. Therefore, since independence, employment generation programmes in India have been continuously redesigned to generate productive employment and additional income. In the seventies, the policy makers of India used the approach of rural development and rural employment programme to remove the rural poverty. In the last phase of nineteen seventies, Government had created three majors antipoverty programmes namely Integrated Rural Development Programme (IRDP), Rural Landless Employment Guarantee Programme (RLEGP) and National Rural Employment Programme (NREP). Moreover, the Indian Government had made different types of schemes under different names and purposes to give partial employment to the rural India to support their family economy like Food for Work, Ensured Employment Scheme, Jawahar Rojgar Yojana, Sampoorna Gramin Rojgar Yojana, Rashtriya Sram Vikash Yojana etc. But these programmes have not proved so much successful due to their main reason behind that is inability to provide sufficient employment as per the demand and at the minimum wages. The limitations of these employment programmes created the need for making some other sort of employment model with the potential to provide employment and to reduce household poverty in rural India. In order to achieve this objective, the government of India introduced The Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) in 2006 that guaranteed 100 days of employment in a year to every rural house of rural India. Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) 2005 seems to be an advanced and radical scheme which directly provides a right to employment. Through MGNREGA, the Government was committed to providing employment to every rural family which demands such work and whose adult members volunteer to do such work, such work was to be providing at the minimum wage rate and, as far as possible, with a radius of five kilometer of the village where the applicant resided. Failure to provide such wage employment within 15 days of the receipt of the application entitled the applicant to receive unemployment allowance. Starting with 200 districts across the country in Phase-1 during 2006-2007 MGNREGA was extended to an additional 130 districts in Phhase-2 during 2007-2008. From1 April 2008 onwards MGNREGA covered the whole of rural India. MGNREGA was the main plank of the Eleventh Five Year Plan of poverty eradication.

Conclusion

Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) is considered as a “silver bullet” for eradicating rural poverty and unemployment, by way of generating demand for productive labor force in villages. It provides an alternative source of livelihood which will have an impact of reducing migration, restricting child labor, alleviating poverty and making village self-sustaining through productive assets creation such as road construction, cleaning up of water tanks, soil and water conservation work, etc. For which it has been considered as the largest anti-poverty programme in the world.

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Biodiversity: The Nature-Based Solutions for Pandemics and Human Wellbeing

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Biodiversity, an evolutionary result of billions of years, is the variability of living beings and diversity of ecosystems within which they flourish. It is critically essential for human wellbeing, economies, and vocations. However, in recent years, this biodiversity has become a victim of people's tremendous biological footprint and is contributing to climate change, which in turn is altering and accelerating the rapid loss of biodiversity. It is the circle of life–unfortunately, death as both biodiversity and climate change can prompt the ascent of pandemics. Because of our relationship with biodiversity, with its loss, we face the possibility of losing ourselves. The recent coronavirus pandemic is just a "wake-up call". It has shown how human wellbeing is associated with the natural world. As we infringe on nature and deplete habitats, more species including humans are at risk. Protecting nature is the best and most practical line to constrain such future outbreaks. Ceasing the exploitation and degradation of natural areas, cutting our carbon emissions, curbing illicit wildlife trafficking, protecting land and water can shield human wellbeing and fortify the country's economy.

Regardless of all our technological innovations, we are still totally dependent on healthy ecosystems for food, water, shelter, medicines, fuels, energy and clothes. Biodiversity is the basis of our livelihoods. It regulates the climate by controlling precipitation and carbon storage. Additionally, it mitigates the impact of catastrophic events such as avalanches, coastal storms, etc. by filtering our abiotic factors. But like everything good, biodiversity too is under threat.

Human exercises are pulverizing and degrading natural areas at a phenomenal rate enforcing the planet Earth towards the rise of a proposed new geologic "Anthropocene" epoch. The overexploitation of natural resources, the introduction of exotic species, and environmental pollution are causing unprecedented impacts on the ecosystem stability, dispersion and abundance of living beings, genetic drift, and evolution of organisms. In broad terms, these losses influence the natural balance of global biodiversity. Habitat destruction and loss of biodiversity are contributing to the ascent of new diseases by undermining the characteristic ability of ecosystems to diminish the risk of a pathogen spreading. Researchers have already reported that the change in land use is the primary driving cause of 33% of recent zoonotic outbreaks. By throwing ecosystems off balance, human actions have turned the natural areas from their first line of defense into hotspots for disease outbreaks and prevented systems from securing vital services for human wellbeing.

Several researchers have reported that the deadliest infectious diseases emerge when the natural boundaries among human and animal populations are breached. The "spillover" of infectious diseases along with increasing "human encroachment on nature" is not a coincidence. Rapid urbanization, coastal development, logging, mining, illegal wildlife trafficking, etc. results in overexploitation of wildlife and are routine in global trade. Seventy-five percent of the Earth's land area is currently altered by human use, and species extinction is happening at around a thousand times faster than the natural rate.

Natural habitats worth of a football field area are being lost every 30 seconds in the US alone and one of every five native species is in danger. The consistently expanding deforestation is linked to 31% of the outbreaks. The Ebola outbreak in Central Africa was the after-effect of deforestation. Land-use changes and altered climatic conditions constrained bats and chimpanzees to live around concentrated areas of food assets. The urbanization of frugivorous bats after habitat loss resulted in the Hendra virus. The Nipah virus in Malaysia was linked to intensive pig farming and avian influenza resulted from increased poultry farming.

West Nile virus, Marburg virus, Zika virus, HIV, Middle East respiratory syndrome (MERS), severe acute respiratory syndrome (SARS), Hantavirus, and swine flu are all linked to the connection of human beings and critters. Humans, by their actions, create opportunities for microbes. The current coronavirus pandemic is just another crisis that has emerged from our collision with the environment. The U.S. Centre for Disease Control and Prevention has estimated that around three-fourth of all the novel diseases that are infecting humans have originated in non-human animals and are zoonotic.

Furthermore, it has been projected that loss of plant species due to deforestation eventually affects the frequency, dispersion, and abundance of mosquitoes, increasing the probability of malaria transmission. Similarly, the disappearance of vultures in India due to the use of Diclofenac on livestock resulted in an increase of rabies in humans. Over 200 million people across the globe suffer from schistosomiasis, known to spread due to the disappearance of predators. The decline in fish population that feeds on snails due to unsustainable fishing in Malawi has resulted in the extensive spread of parasitic worms, causal agents of schistosomiasis.

Reportedly, all animal-borne diseases arise when people infringe on wildlife habitat or bring them into their communities. “Climate change” is also a major factor that influences this animal-human relationship. The greenhouse gas emissions have increased both escalating the loss of biodiversity and extreme climatic events. The “unprecedented forest fires” have devastated large areas of natural habitats. From the Arctic to Africa, Amazon, Australia – these fires have destroyed billions of lives.

It has been accounted that since 1970, we have lost more than 33% of the world’s wetland, and half of all our coral reefs. Recently, a review published in Science has revealed that the migration of around half of the wildlife species to new areas is due to shifting climatic zones. Similarly, the migration of humans to new locations in search of resources has increased the population’s vulnerability to biological threats. These changes in the habitats have altered and hastened the transmission patterns of infectious diseases. A research paper has recently projected that climate change could increase the spillover of the Ebola virus in Africa by 2070. Another study suggests that climate change could instinct substantial global increases in the transmission of novel diseases from animals to humans by 2070.

At the time of writing, the world is gripped by a global pandemic. “COVID-19” is thought to have originated in bats and transmitted to humans via another mammalian host, a pangolin, possibly at a wet market that traded live animals. A definitive answer is yet to come but human activity certainly enabled the virus to jump causing untold human suffering and social upheaval. Climate change, biodiversity, and pandemics are deeply connected. Each rises due to our seeming unwillingness to respect the interdependence between ourselves, animals, and the environment.

As if the coronavirus wasn’t enough, that second wave of the voracious insects arrived. The worst known “locust invasion” originated in Africa, where heavy rainfall triggered a breeding boom. The swarm travelled from Iran, Afghanistan to India, and caused massive crop damage in Rajasthan, Gujarat, Maharashtra, Madhya Pradesh, and Uttar Pradesh. Roxy Mathew Koll, a climate scientist at the Indian Institute of Tropical Meteorology stated that the heavy rainfall responsible for the locust’s swarms was caused by the Indian Ocean Dipole phenomenon, which is regulated by climate change. Furthermore, the massive cyclone “Amphan” crossed the unusually warm Bay of Bengal and devastated Indian coastal areas, sucked up large amounts of moisture, leaving hot, dry winds to form heat waves in Northern and Central India.

Despite that, there is some positive news. The significant economic slowdown has backed nature to recover. The way videos portraying wildlife animals coming back to human-inhabited zones are being adored illustrates how humans want to believe in the power of nature to recuperate. We must change this crisis into a golden opportunity by our cumulative endeavors towards a better future. We can find solutions in nature by conserving the genetic pools for posterity which in turn can be used for fighting pandemics, environmental pollution, and climate change. Doren Robinson, United Nations Environment Programmed biodiversity expert said that healthy ecosystems can protect disease transmissions.

Ambitious interdisciplinary research programs should be implemented to understand the causes of biodiversity loss and anticipate their consequences. Anthropogenic activities that increase the risk of disease spillover should be addressed. Over the past decade, the “One Health” approach has been encouraged at a global level. With this multidisciplinary and collaborative holistic approach towards the health of people, plants, animals, ecosystems the rise in potential risks can be addressed.

We still have time to reverse the biodiversity loss, but actions must be taken now. We should not get up suddenly one day as we have done before, that our watershed is being deteriorated and tigers are disappearing at an alarming rate. If the human race has to survive, biodiversity must be protected to support the web of life. Hundreds of years ago, great philosophers of India came up with a universal phrase of “Vasudhaiva Kutumbakam” which means “the world is one family”. Let us believe that our solutions are within nature and promise to protect our biodiversity and use our natural resources sustainably.

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Cisgenesis: A Novel Approach for Crop Improvement

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Introduction

Rising population and food demands necessitate global agricultural production be increased by 50% by 2030 (The Royal Society, 2009). In the meantime, climate change and shrinking environmental resources are restraining agricultural production over the world (Lobell et al., 2008). These challenges bring an urgent need to improve crop productivity. To breed crops with improved yield and resistance to environment stresses, a crucial consideration is how to efficiently utilize genetic diversity. Genetic crossing, natural or artificial mutations and transgenics are the main techniques for genetic improvement in plant breeding.

Traditional plant breeding utilizes crossing and mutagenesis for genome modification to improve crop traits. It introduces new beneficial alleles from crossable species. Crossing barriers, linkage drag and requires several generations of breeding and selection are major limitations of traditional plant breeding. Transgenic breeding uses molecular cloning techniques to identify cloned or synthesized genes of interest and directly transforms the recipient genome. This process manipulates plant genomes through insertion of gene(s) from another species. An organism that is generated this way is considered to be a genetically modified organism (GMO). Many plant species, such as rice, soybean, maize, cotton, canola, potato, cassava, squash, papaya, groundnut and oilseeds have foreign genes inserted in their genomes. However, improving crops through GMO is also often associated with safety concerns, environmental risks and health issues due to the presence of foreign DNA. These limitations have prompted the development of alternative technology like cisgenesis. It has been developed as new tool aimed to modify crops (Espinoza et al., 2013).

What is Cisgenesis?

Concept of cisgenesis introduced by Dutch researchers Schouten, Krens and Jacobsen (2006). They defined cisgenesis as the genetic modification of a recipient plant with a natural gene from a crossable, sexually compatible plant. Such a gene includes its introns and is flanked by its native promoter and terminator in the normal sense orientation. Cisgenic plants can harbor one or more cisgenes, but they do not contain any transgenes (Schouten et al., 2006).

Recent progress in plant genome sequencing facilitates the isolation of plant genes from crossable species. These genes are called cisgenes. Increasing numbers of these cisgenes have been isolated and new transformation protocols have been developed, which do not leave marker genes behind. Cisgenic plants are more likely to be acceptable to the public than transgenic plants.

Why Cisgenesis?

Some plant species difficult to breed by traditional breeding methods like woody plants that don't flower for many years, intolerant to inbreeding and highly heterozygous. Some other plant species viz., potato, apple, grape and banana that are naturally sterile / are part of a highly desired and commercially widespread clone whose genotype needs to remain intact. Escape of foreign genes via pollen flow to natural vegetation can be a problem for transgenesis. However, in case of cisgenesis the genes are taken from wild relatives. To overcome the problem of linkage, drag genetic make-up of the original cultivar is preserved.

To appreciate cisgenesis first we need to understand the problems related to transgenic approach, traditional breeding and translocation breeding.

Problems Associated with Transgenesis

In this approach transferred gene usually derives from an alien species. Such a novel gene might provide the target plant with a new trait that neither occurs in the recipient species in nature nor can be introduced through traditional breeding. It extends the gene pool of the recipient species. In recipient species fitness may change in various ways:

1. Through gene flow between a GM crop and its wild relatives potentially creating shifts in natural vegetation.
2. The generation of these new 'unnatural' gene combinations is regarded as both unethical and having potential long-term risks for health and environment. (Den Nijs et al., 2004).

Problems Associated with Traditional Breeding

Traditional breeding takes more time than other approaches like transgenic breeding and cisgenesis. The wild plant transfer genes of interest to the progeny, but deleterious genes are also passing. Linkage drag tremendously slow down the breeding process, especially if the gene of interest is genetically tightly linked to one or more deleterious genes. To reduce linkage, drag, need successive generations of recurrent backcrossing with the cultivated plant and simultaneous selection for the trait. Quality of crop is ruined.

Problems Associated with Translocation Breeding

Radiation treatment causes random chromosome breaks. The majority of translocations resulting from radiation treatments were formed between non-homoeologous chromosome arms. These non-compensating translocations are genetically unbalanced, and lead to reduced agronomic performance.

These all problems associated with transgenic approach, traditional breeding and translocation breeding can be overcome with cisgenesis approach.

The Prerequisites for Cisgenesis

Cisgenic approach requires complete sequence information of the plant and the isolation and characterization of genes of interest from crossable relatives.

Applications of Cisgenesis in Crop Improvement

Stress tolerance like disease and pest resistance (plant incorporated protection, PIP) and improvement of quality traits are currently major goals of plant breeders and researchers working on the development of cisgenic crops. The targeted traits include fatty acid composition (omega-3 fatty acids, reduced saturated and increased unsaturated fatty acids contents, elimination of trans fats), enhanced flavor, fiber quality, improved shelf life, and also optimization for the use as food, feed, biofuel or industrial uses (Dunwell, 2011 and Stein and Rodríguez-Cerezo, 2010).

Vanblaere *et al. (2011*) were produced cisgenic Apple lines of cultivar "Gala". They employed the ORF of the HcrVf2 genomic region from the wild relative *Malus floribunda*, including 242-bp from its 5' UTR and 220-bp from its 3' UTR and conferring scab resistance.

"Cisgenic barley with improved phytase activity" was confirmed by Holme *et al.* (2012). They achieved the marker-free status of the cisgenic plants by using the pClean dual binary vector system that uses hygromycin resistance for selection (Thole *et al.*, 2007). The genomic region belongs to HvPAPhy_a gene comprised of 5208-bp and was amplified by PCR. With the introgression of supplementary copies of the HvPAPhy gene, the accumulation of phytase levels in the mature barley grain will be extremely useful for both the bioavailability of phosphate in the grain and regarding the environmental aspects.

Induction of tolerance to the most important potato disease, late blight caused by the oomycete *Phytophthora infestans.* (Holme *et al.*, 2013)

Kichey *et al.* (2009) reported that the production of barley with enhanced nitrogen use efficiency (NUE). Their cisgenic approach used the genomic sequence of *TIP2* (3532-bp), including promoter (1999-bp upstream) and terminator (564-bp downstream), and the *GS1* gene (*GS1a* isoform) which consisted of a 5.2-kb gene fragment, including 1.5-kb promoter and 491-bp terminator.

Han *et al.* (2010) examined the impact of the introduction of five cisgenes PtGA20ox7, PtGA2ox2,Pt RGL1_1, PtRGL1_2 and PtGAI1 associated with gibberellin metabolism from the genome sequenced clone Nisqually-1 of *Populus trichocarpa* and were transferred into the clone INRA 717-1B4 of *Populus tremula* × *alba*. The growth performance, morphology and xylem cell size were identified under the greenhouse. The genes employed in this study were expressed in the xylem and phloem and identified by microarray expression data.

Limitations of Cisgenic Approach

Although cisgenics technology is exhibiting considerable advantages, but still there are a few limitations associated with this technology. In this technique characters outside the sexually compatible gene pool cannot be introduced and development of cisgenic crops involves extraordinary skill and time, therefore, the required genes or fragments of genes may not be readily accessible but have to be isolated from the sexually compatible gene pool. This technique requires sequence information of the plant. Transformation efficiency of this approach is low to generate large number of transformants. The production of marker free plants usually requires the development of innovative protocols, since such protocols may not be readily available for the crop.

Conclusion

Thus, we concluded that the cisgenesis approach is an important novel genetic tool for improving various plant traits. Application of cisgenic techniques enhances the chance to introgress the preferred genes into the new cultivars, without disturbing their characteristics. Therefore, the most undeniable role of cisgenesis may be expected for the development of monogenic resistance traits. Major advantages could be probable in breeding of plants with long life spans such as trees.

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Agro Techniques of Horse Gram Cultivation

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Introduction

Horse gram [*Macrotyloma uniflorum* (Lam)] is a multi-purpose legume valued for its grain, fodder for livestock's besides for green manuring. It is rich source of protein and basically consumed by poorer section of the people in the society because of that it is known as poor man's food. It is famous for its medicinal use because different parts of the plants are used for the treatment of heart disease, asthma, bronchitis, urinary discharges and for treatment of kidney stones (Ghani, 2003). This crop is generally grown when the farmers are unable to sow any other crop due to delay in rains and also grown in wider space of orchard.

Origin

It is native to Southeast Asia and tropical Africa, but the center of origin of cultivated species is considered to be southern India (Vavilov, 1951; Zohary, 1970).

Crop Status

Horse gram is mainly cultivated in the states of Karnataka, Andhra Pradesh, Orissa, Tamil Nadu, Madhya Pradesh., Chhattisgarh, Bihar, West Bengal, Jharkhand and in foot hills of Uttaranchal and Himachal Pradesh in India. It is also cultivated in other countries mainly Bangladesh, Myanmar, Malaysia, Sri Lanka, Bhutan and West Indies.

Climate Requirement

Horse gram is extremely drought-resistant crop. Moderately warm, dry climatic conditions are suitable for its optimum growth. Horse gram can be cultivated up to an altitude of 1000 m above the sea level. The temperature ranges of 25-30°C and relative humidity between 50 and 80% is optimum for its growth.

Soil

Horse gram can be cultivated on wide range of soils. However, black cotton soils, deep red loam and clay loam paddy soils are the best for its cultivation. Even stony soils can be cultivated in poor soils where other crops don't grow. Highly acidic or alkaline soils are not suitable for its cultivation.

Land Preparation

The crop needs minimum field preparations. Only 1-2 ploughings followed by planking provides desirable seed-bed.

Sowing Time

The main season for sowing horse gram is late August-November. As a fodder crop it is sown during June-August. In Tamil Nadu, it is sown in September-November. In Maharashtra, horse gram is sown as a kharif crop, mixed with bajra or sometimes Niger and also in the Rabi in rice fallows. In M.P. it is a Rabi crop. In northern parts it is grown as kharif crop. In West Bengal the sowing period is October-November.

Varieties

Important varieties are given below.

State	Recommended varieties:
Chhattisgarh	Indira Kulthi-1
Rajasthan	KS-2, Pratap Kulthi
Andhra Pradesh	Palem-1, Palem-2, Paiyur-2, PHG-9
Tamil Nadu	Paiyur-2
Karnataka	PHG-9, GPM-6, CRIDA-1-18 R
Gujarat	Pratab Kulthi-1 (AK-42), GHG-5
Uttarakhand	VL- Gahat-8, VL Gahat-10

Seed Rate and Sowing

Generally sown as broadcast with 40 kg/ha seed rate for dual purpose i.e. grain and fodder. For line sowing 25-30 kg/ha is enough for grain crop. Row Spacing: 40-45 cm during kharif and 25-30 cm during rabi and about 5 cm plant to plant spacing.

Seed Treatment

Horse gram seeds are treated with carbendazim (bavistin) 2 g /kg of seed. Now-a-days bio fungicide like *Trichoderma viridi* is recommended for pulses at the rate of 4g/kg of seed. After fungicide treatment seed should be inoculate with Rhizobium and PSB culture @ 5 g/kg of seed.

Manures and Fertilizers

Horse gram requires well-decomposed FYM @ 5-6 tonnes/ha which should be applied 10-15 days before sowing at last harrowing. At the time of sowing, 20-25 kg nitrogen, 25-30 kg phosphorus and 12-15 kg potassium should be applied if soil is deficient in NPK status (Purushottam et al., 2017).

Water Management

To produce a quality seeds, horse gram field must be monitored regularly for any water stress or drought conditions. Irrigation should be applying at before flowering and pod formation stage.

Weed Management

Application of Pendimethalin @ 0.75-1 kg a.i./ha as pre emergence application. After that, one hand weeding at 20-25 days after sowing.

Plant Protection Measures

Insect Pest/Disease/ Causal Organism	Nature of Damage/ Symptoms	Control Measures
Aphids	The adults and nymphs suck the juice from the leaves as a result turn brown and crumpled and the plants look sick	Spray of Imidacloprid 17.8% SL @ 2 ml/liter water .
Pod borer	It is a polyphagous insect. Caterpillar makes hole in pods, sometime also feed seed.	Spray of NPV @ 250 LE/ha. or Quinolphos 25 EC or Chlorpyrifos 20% EC @ 2 ml/liter water.
Yellow Mosaic Virus vector-white fly	The symptoms firstly appear on young leaves in the form of yellow, diffused, round spots scattered on the leaf lamina. The infected leaves turn necrotic. The diseased plants usually mature later and bear relatively few flowers and pods. The	Grown resistant varieties. Destroy the infected plants. Spray of Imidacloprid 17.8% SL @ 2 ml/liter water.

	pods are stunted and mostly remained immature but whenever seeds are form, they are small in size.	
Root rot	Roots rot and plants show yellowing of the lower-most leaves followed by wilting.	Seed treatment with 2 g Captan or carbendazim/ 1 kg of seed. Avoid early sowing in infested areas.

Harvesting & Threshing

Horse gram crop becomes ready for harvesting when pods turn green to straw color. Harvesting should be done in clear sky conditions as rain may damage the seed crop. Seed crop can be harvesting by using sickles. The cut plants should be spread on threshing floor to dry for 1 or 2 days. By beating with sticks, seeds can be separated from the pods. Cleaned seeds should be allowed to dry for some time to reduce the moist content for best storing. Separated dry pods can be used as cattle feed.

Yield

A well-managed crop yields up to 6-10 q/ha of seed depending upon the monsoon behavior.

Recommendation to Achieved Higher Production

1. Deep summer ploughing once in 3 years.
2. Seed treatment should be done before sowing.
3. Application of fertilizer should be based on soil test value.
4. Weed control should be done at right time.
5. Adopt integrated approach for plant protection.

Conclusion

Thus, horse gram as legume crop cultivation in arid and semi-arid regions has great importance for grain, livestock husbandry in low resource availability of small and marginal farmers. It not only increases socio-economic condition of rural people but also helps in providing nutritious grain in balance diet, which help in fulfillment of basic requirement of rural people.

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Emerging Need of Palliative Care Services in India

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Summary

Primary caregivers are a core part of health care and long-term care, it is important to recognize, respect, assess and address family caregivers' needs too. They completely took care of the dependent elderly in the family. Managing a household as well as providing care for the other encroaches on time necessary for their self-care, social activities, and household activities. As the demands mount, they lose time for themselves, become more and more isolated, and grow more fatigued. Therefore, palliative care services can work best as managing the care for the elderly patient as well as their caregivers.

Introduction

Family care is the most important source of assistance for people with chronic or disabling conditions who require long-term care (LTC). Primary caregivers are individuals who primarily responsible to take care of the dependent elderly in the family. They could be family members, relatives, friends, kith and kin etc. Providing care for someone with dependent conditions such as Alzheimer's disease, Dementia, neuro-spinal injuries etc. takes a tremendous toll on the physical and emotional health of the primary caregiver, yet many caregivers often don't recognize the warning signs, or deny its effects on their health. Clipp and George, (1993) found that caring for someone with dementia is associated with a higher level of stress than caring for someone with functional impairment from another type of chronic illness. Many caregivers tend to set their own needs aside while caring for the person with dependent conditions and hope that if they don't think about it; the stress might just go away. Though the care they provide is essential, caregivers often go unrecognized and unsupported. This lack of recognition can have a profound impact on the well-being of the caregiver: they have higher rates of depression, stress and are at risk of burnout. The negative impact on caregiver's health and well-being can deteriorate the quality of care provided to the dependent elderly.

An important key concern is that the continued reliance on family caregivers, without better recognition of their own support needs, could negatively affect the ability of family caregivers to provide care in the future and result in even greater emotional, physical and financial strains (Jette et. al., 1995). This negative impact on the caregiver likely would affect quality of care and the quality of life of the care recipient and the rest of the family. McFall and Miller, (1992) reported that unrelieved caregiver depression, exhaustion, financial concerns and other care-related strain are major contributing factors to institutionalization, often resulting in higher public expenditures for nursing home costs (Gaugler et. al., 2000).

According to World Health Organization, palliative care is an approach that improves the quality of life of patients and their families facing the problems associated with life-threatening illness, through the prevention and relief of suffering by means of early identification and impeccable assessment and treatment of pain and other problems, physical, psychosocial, and spiritual. The idea beyond palliative care is managing pain and thereby improves the quality of life of the patients and their family. This is why it is best administered by an interdisciplinary, multi-dimensional team, comprising doctors, nurses, counselors, social workers and volunteers.

Although the journey of palliative services in India was very tiresome from establishment to development and still continues to face challenges. Palliative care services are generally are available to the patients suffering from chronic illnesses such as cancer, HIV-AIDS. It comforts and enhances the quality of life to the end life of the patients. These services are on rise and also need a shift from its limitations to chronic diseases and cover other dependent conditions of elderly. Therefore, it important to empower these services with proper functioning and managing the work force with adequate training and skill development courses. Studies conducted in developed countries have proved a highly positive impact on caregiver's quality of life along with the patients through palliative care services. Ornstein et. al., (2017) found strong evidence that early palliative care interventions for patients with serious illness improve quality of life and family satisfaction and simultaneously can reduce caregiver burden.

Conclusion

Undoubtedly, extending palliative care services covering other limiting health conditions can bring drastic change in the well-being of the primary caregivers of dependent elderly who somewhere have lost control on their quality of life as largely they are engaged in caregiving. Consequently, with a sufficient amount of support and assistance from formal health services develop confidence and understanding in the primary caregivers.

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Fusarium – A Potential Entomopathogen

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Introduction

Beneficial action of predators, parasites and entomopathogenic microorganisms in managing pest in crops is one among the promising measures of IPM. This method of incorporating living organisms for pest control is termed as 'Biological control'. Entomopathogenic microorganisms include fungi *viz., Metarhizium anisopliae, Beauveria bassiana, Lecanicillium lecanii, Nomouraea rileyi, Hirsutella thompsoni, Aschersonia aleyroides, Pandora delphacis* and bacterial agents like *Bacillus* sp., viral agents like NPV, CPV, GV and protozoans like *Farinocystis* sp. But in recent times, the destructive plant pathogen *Fusarium* has gained generous attention as a potential entomopathogenic organism.

Mode of Action

When spores of the entomopathogenic Fusarium fungus come in contact with cuticle of susceptible insects, they germinate and penetrate the cuticle by germ tube forming appresoria and grow directly through the cuticle. Fusarium proliferates throughout the insect's body, producing toxins like beauvericin, fumonisin and draining the insect of nutrients, thus eventually killing it. Death is caused by tissue destruction due to the toxins produced by fungus. Structures like conidiophores conidia, rich mycelia and survival structures like chlamydospores for longer survival and persistence can be observed on the cadaver's body.

Fusarium as a Potential Entomopathogen

In order to reduce the environmental effect and to ensure safe incorporation of Fusarium species into the group of potential entomopathogens for pest control, both the positive factors and negative aspects ought to be considered keenly.

Positive aspects: High mortality ranging from 80-90 per cent has been reported against insects. 100 per cent mortality was reported after 144 h (Anwar et al., 2017) and after 6th day (Lazo, 2012). Main advantage of Fusarium species over non-fungal biocontrol agents is the ability to attack different life (feeding and non-feeding) stages of insect cycle due to enzymes produced viz., chitinases, proteases, lipases which can break through the integument known as first line of defense. They are known for great persistence, survival potential in field being a facultative pathogen and ease in carrying out mass production. Survival structures like chlamydospores are produced by Fusarium remaining viable for years in environment and also to overcome adverse conditions. It is known to produce several insecticidal mycotoxins, beauvericin being the most strongly insecticidal mycotoxins produced by many Fusarium sp. Beauvericin has broad spectrum activity on insects and no poisonous effect on human and other animal health (Liuzzi et al., 2017). Genetic manipulations are also being carried out to enhance entomopathogenic virulence of potential species.

Target Species

Isolates / Orders	*F. solani sc*	*F. fujikuroi sc*	*F. heterosporum sc*	*F. incarnatum-equiseti sc*	*F. lateritium sc*
Thysanoptera	2	1	0	1	0
Orthoptera	0	1	0	0	0
Lepidoptera	54	11	1	17	1

Hymenoptera	0	2	0	4	0
Hemiptera	5	6	0	46	0
Diptera	1	0	0	1	0
Coleoptera	6	4	0	1	0
Blattodea	2	0	0	0	0
Isolates	*F. redolens sc*	*F. tricinctum sc*	*F. sambucinum sc*	*F. chlamydosporum sc*	Unknown
Orders					
Thysanoptera	0	0	0	0	0
Orthoptera	0	0	0	0	0
Lepidoptera	1	13	7	4	11
Hymenoptera	0	2	2	0	0
Hemiptera	0	0	0	0	1
Diptera	0	0	0	0	0
Coleoptera	0	1	0	0	1
Blattodea	0	0	0	0	0
Sc- species complex, F-Fusarium **(Santros et al., 2020)**					

In biocontrol using microorganisms, production of overwintering structures or mycelia, excess conidiophores conidia are considered as reinforcing feature which is reported in Fusarium (Santos *et al.,* 2016). Dense mycelial growth was observed on insect infested after inoculation of *F. incarnatum-equiseti* species complex isolates (Addario and Turchetti, 2011). When *Sitophilus oryzae* was treated with *Fusarium avenaceum,* macro conidia were reported three days after death (Batta, 2012). Conidiophores and conidia grew on dead third instar nymphal cadavers of *Ronderosia* Berg (Orthoptera: Acrididae) ten days after inoculation of *F. verticillioides* (Pelizza *et al.,* 2011). Similar coniophores and conidia were seen on *Schizaphis graminum* (Hemiptera: Aphididae) nymphs after 24 hrs of inoculation with *F. proliferatum* (Ganassi *et al.,* 2001).

Negative aspects: It is speculated that some of the mycotoxins produced by Fusarium might be highly poisonous or carcinogenic (Strasser et al., 2000). Reportedly toxins like zearalenone, moniliformin, fumonisins, deoxynivalenol and trichothecenes are produced by Fusarium sp. that are greatly hazardous to health and pollute the environment (Nazari et al., 2015). At times the insecticidal toxins produced by Fusarium also leads to host death. There exists no stability about Fusarium possessing high host specificity or no host specificity, hence very limited a little information is known about this species' authentic host range which raises the question if it is safe to non-hosts and non-target organisms (Santos et al., 2020).

Future Thrust

1. To identify and characterize all the available Fusarium species using methods which are combination of morphological, ecological, biological and molecular data. From the last two decades, though molecular phylogenetic methods are available, Fusarium identification is still based on only morphological characteristics which leads to unauthentic identification and information loss.
2. To observe the effect of all the isolates on non-target organisms at both laboratory and field level provided with optimum conditions.
3. To study Fusarium in a strain-by-strain manner because specificity differences are seen within a genus, between genera, even among strains of same entomopathogen species.
4. To conduct more laboratory and field trails in order to increase treatment efficiency and evaluate the application time and methods.
5. To standardize the inoculum concentration.
6. To study in detail regarding secondary metabolites produced, their desirable and undesirable effects, side effects and effect on non-target organisms.

7. To focus on insect-associated Fusarium species for novel breakthroughs in their ecology.
8. To harvest the untapped diversity in entomopathogenic Fusarium groups.

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Removal of Heavy Metal Ions by Phytoremediation

Article ID: 32619

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Abstract

Heavy metals (As, Pb and Hg) are one of the major reasons for contaminations in environment. Cleaning of environment can be done by number of methods but are very costly and with lesser successful. Heavy metals cause the plant to accumulate these metals or affect the plant growth and development and reduce different plant physiology and biochemical activity also cause in human life. Now a day phytoremediation is an operative and affordable technological solution used to remove heavy metal ions to clean soil and water from contaminated environment.

Introduction

Increasing concentration of heavy metals in environment due to fast development of the industrial sectors and various kind of products such as a fertilizers, pesticides and herbicides used in agriculture sectors. Reduced land area for cultivation has led to the need for increasing the production of crop yield that requires usage of different chemicals in higher amount. When this chemical usage is very extreme, plants uptake these chemical substances and some heavy metal ions remain in soil solution (Moosavi and Seghatoleslami 2013). Agricultural and other industries highly use different heavy metals such as a Cu, Pb, Zn, Cd and as which are highly toxic even at very low concentration. These metals are part of natural ecosystem but now entering in to food chain which causes adverse effects on human health (Awa and Hadibarata 2020). For example, the higher amount of phosphate fertilizers increases the concentration of heavy metal ions like Cd, Zn, Cu, and as (Zarcinas et al., 2004).

Table 1: Source of heavy metal due to increase metal in soil:

Heavy metals	Sources
As	Highly used in pesticides and wood preservatives
Cd	Paints and pigments, plastic stabilizers, electroplating of cadmium containing plastics, phosphate fertilizer
Cr	Tanneries, steel industries, fly ash
Cu	Pesticides, more fertilizers supplied in field
Hg	Release from Au-Ag mining and coal combustion, medical waste
Ni	Industrial effluents, kitchen appliances, surgical instruments, steel alloys, automobile
Pb	Aerial emission from combustion of lead petrol, battery manufacture, herbicides and insecticides

High concentration of heavy metals causes the plant to accumulate these metals which affects the plant growth and development. Reduces different plant physiology and biochemical activity also cause in human life.

Remove heavy metal ions and reduction of ions concentration from the soil use different physical or chemical processes which are very costly and difficult. According to Glass et al., the cost of land filling for a contaminated site and chemical recycling of contaminants varies between 100 to 500 US$ per ton, and the cost for electro kinetic monitoring is approximately 20 to 200 US$ per ton, whereas the cost involved in phytoextraction is 5 to 40 US$ per ton. Therefore, phytoremediation is a low cost, eco-friendly and easy to applied techniques.

Mechanisms of Phytoremediation

The mechanisms and efficiency of phytoremediation depend on the type of soil properties, bioavailability and presence of heavy metal ions (Cunningham and Ow, 1996). There are many different ways to clean up contaminated soil. Phytoremediation basically refers to the use of different plant species and combine soil microbes to reduce the concentration of heavy or toxic metal ions that contaminate the environment (Greipsson, 2011). This technology is used in different living organisms, especially plants and microorganisms to reduce, eliminate, transfer, and detoxify product present in soil and environment. Phytoremediation techniques like as a bioremediation method, used by plants as filters for accumulating, immobilizing and transforming contaminants (Vidali M., 2001). Major role of plant preventing toxicity levels and remove heavy metal form soil through plant root system. The root system provides an enormous surface area that absorbs and accumulates water and nutrients essential for growth along with other non-essential contaminants (Raskin and Ensley, 2000).

The term "Phytoremediation" was first time used in 1991 to reduce the quantity and toxicity of contaminants from soil, groundwater and other pollute media by using growing different plants. Plants can help clean up many kinds of pollutants including metals, pesticides, explosives, and oil. The plants also help prevent wind, rain, and groundwater from carrying pollutants away from sites to other areas. Phytoremediation is an in-situ technology that is very effective because it is a low cost and non-destructive can be used to remove heavy metal ions and clean up contaminated soils. This technology mainly uses in tropical region due to favorable environment for plant growth and higher microbial activity (Moosavi and Seghatoleslami 2013).

Types of Phytoremediation

Techniques of phytoremediation include phytoaccumulation, Phyto filtration, Phyto stabilization, phytovolatilization, phytodegradation and Phyto transformation.

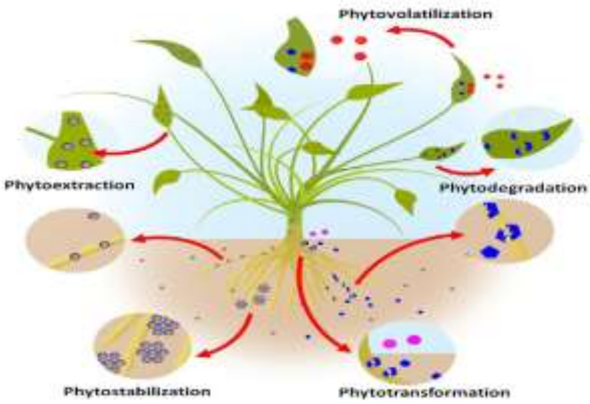

Fig 1: Schematic diagram of phytoremediation techniques (Parmar and Singh 2015).

Phytostabilization

Phytostabilization or phytoimmobilization involves the usage of plants to eliminate toxic metals in soil. It referred to as in place inactivation and primarily used for the remediation of sediment and soil. This technique reduces the mobility of ions and bioavailability of pollutants in the environment which prevents their migration to groundwater and don't allow to enter in food chain (Erakhrumen, 2007).

These techniques are mainly used to remove or stable different metals like Cd, Cu, As and Cr. Phytostabilization is not a permanent solution because the heavy metals will remain in the soil, only their movement is limited.

Addition of different supplements in soil during Phytostabilization improves soil physical and biological characteristics of contaminated soil that is also called as "aided phytostabilization" or "chemophytostabilization". Changing the pH, increasing organic matter content by adding compost, adding essential growth nutrients, increasing water holding capacity, and reducing heavy metal bioavailability facilitate Phytostabilization.

Phytoaccumulation

Phytoaccumulation is a translocation and uptake of metal from contaminated soil or water by plant root and accumulation in above ground biomass. It is also described as Phyto absorption, phytoextraction and Phyto sequestration. Metal accumulation in shoot is an effective biochemical process (Jagetiya and kumar 2020).

Phyto-transformation

It is an also called as Phytodegradation. This is used for mobilization and degradation of organic contaminants taken up by plants from soil and water and subsequently breakdown of pollutants at outside environment by various enzymes like as a dehalogenase and oxygenase that is released by the plant. The characteristics of plants as well as the properties of the contaminants (solubility, hydrophobicity, polarity, etc.) affect the uptake of toxicants. Phyto-transformation is independent on the activities of microorganisms that present around root and in rhizosphere.

Phytovolatilization

Removal of organic contaminants and volatile heavy metals such as Se and Hg, phytovolatilization is a preferred solution. Plants take up the contaminants from the environment and convert these into volatile form or a modified form with release into the atmosphere during transpiration. This process does not take away the contaminants thoroughly for that reason there are chances of re-deposition are always there (Jagetiya and kumar 2020).

Phytoextraction

It is a process of absorption of soil contaminants by plants and stores in the root and shoots. Nickel, copper and zinc are the best members to be absorbed by plants, and over 400 plants can absorb them easily, and they can be "removed permanently" from the soil and water (Upadhyay et al., 2019).

Advantages of Phytoremediation Technology

1. Aesthetically pleasing.
2. Less disruptive than current techniques.
3. Effective in contaminant reduction.
4. Low cost.
5. Applicable for wide range of contaminants.
6. Environment friendly.

Limitation of Phytoremediation Technology

1. Time consuming method.
2. Lesser root depth.
3. Soil structure and texture.
4. Levels of contamination.
5. Age of plants.
6. Concentration of contaminants.
7. Climatic condition.

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Importance of Canopy Management in Fruit Crops

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Introduction

Potential of fruit trees is governed by their planting method, canopy management, plant population per unit area and photosynthetic efficiency. Canopy management in fruit crops deals with the development and maintenance of their structure in relation to the size and shape for commercial productivity of quality fruits. The canopy management, particularly size control, has become a priority for decreasing production cost and increasing of quality. Canopy design and shape influence light interception with assured higher production to fruit growers. Therefore, height control during early stage and tree canopy management are important factors which should be practiced in fruit crops for higher yield. Trees have inherent plant characteristics viz., growth behaviour, flushing pattern, dormancy pattern, and bearing behaviour resulting productivity for yield maximization there are several conditions and resources like: precocious bearing habit and economic performance of young fruit trees may be influenced by nursery plant quality and management in the initial age of their planting. Perennial tree crops fruit growers must balance rapid canopy development with enhancement of precocity in young trees. The High-Density Planting (HDP) technique is a modern method of fruit cultivation which involves planting of fruit trees close together which allows small or dwarf trees, with modified canopy, for better interception of light, distribution and ease of mechanized field operations. The High-Density Planting HDP and meadow orcharding give higher yield along with higher returns per unit area because of an increase in the number of plants per unit area. It is made possible by regular pruning and use of growth regulators so as to maintain the size and shape of the tree.

Canopy Management of Fruits Crops

1. Canopy management is an ‘art’ of fruit growing. It is much more specific than cutting off a few branches.
2. To optimize fruit crop, thoughtful canopy management is one of the most important subjects to master, and the best way to master it is through practice.
3. Canopy of a fruit tree determines to its physical composition comprising of stem, branches, shoots and leaves.
4. The canopy density is determined by the architecture of stem, branches and shoots as well as number and size of the leaves.
5. Canopy management of the fruit tree deals with the development and maintenance of their structure in relation to the size and shape for the maximum productivity of quality produce.
6. The basic concept of canopy management of a perennial tree is to make the best use of the land, the climatic factors for an increased productivity in a different dimensional approach.
7. Tree vigor, light, temperature and humidity play a vital role in the production and productivity of quality of the fruits.

Role of Canopy Management in Fruit Crops

1. Light is an indispensable factor in fruit production. It initiates flower induction as well as in fruit development through carbohydrate synthesis. While increased assimilates in the shoots is a pre-requisite for flowering in mango and other fruits generally, high yield of quality fruits is attributed to high light interception and distribution to whole of the tree. The fruit yield is related to light interception, whereas fruit quality is a function of light distribution.

2. Light interception is influenced by plant spacing, shape, leaf area index and can be raised by increasing the density of foliage in the canopy, the height of the tree and number of trees per hectare.

3. Light intensity decreases, within the tree canopy as the outer portion shades the inner portion proper light exposure influences flower bud differentiation, fruit set, fruit color and quality.

4. Major emphasis is usually given to reduce the excessive canopy shading and increase the air circulation in the fruiting region.

5. Trees have a set amount of energy (created through photosynthesis) that they can use to grow based on external and internal cues, they will produce either reproductive growth or vegetative growth.

Types of Phytoremediation

Techniques of phytoremediation include phytoaccumulation, Phyto filtration, Phyto stabilization, phytovolatilization, phytodegradation and Phyto transformation.

Production Efficiency in Relation to Light Utilization

The ultimate goal of High-Density Planting is to increase productivity so that any fruit production venture becomes more sustainable and lucrative. Intercropping and multi species high-density orchards, as a means to enhance cropping intensity and overall orchard productivity.

It is a well-known fact that the diversity in soil types and climatic conditions in country permits growing of a large variety of tropical, sub-tropical and temperate fruits in different regions, because of which India is called the Horticultural paradise. In recent years, due to problem the concept of fruit production has undergone a sea change where the emphasis is laid on higher production per unit area. The fastest way of reducing the gestation period and increasing the productivity of the orchards is HDP or meadow orchard system. This choice of the system of planting in the orchard depends on the topography of the area, crop, variety, plant density and the production technology to be followed.

Higher productivity could be achieved both in short-duration fruits like banana, papaya, strawberry and pineapple and perennial fruits like mango, guava, ber, aonla, pomegranate, sapota and citrus fruits, by following closer spacing for higher plant population densities. Out of these, only partial success at high-density planting in citrus, mango and guava has been achieved in the country.

Concept of High-Density Planting and Meadow Orcharding in Fruit Crops

High density planting is “Accommodation of the maximum possible number of the plants per unit area to get the maximum possible profit per unit of the tree volume without impairing the soil fertility status”. The principle which underlies HDP is to make the best use of vertical and horizontal space per unit time and to harness the maximum possible return per unit of inputs. In other words, it is the planting of a greater number of plants than optimum through manipulation of tree size.

HDP was first practiced in mango at IARI New Delhi whereas Meadow Orchard System is a new concept of planting which has been developed in guava for the first time in India at CISH, Lucknow. The Meadow Orchard is a modern method of fruit cultivation where small or dwarf trees with modified canopies are used. Better distribution of light within the tree canopies increases the number of well illuminated healthy leaves. Fertilizer dose, spacing, growth regulation by training and pruning, use of various mechanical devices, etc. may also be tried, either singly or coupled with other crop management practices for a successful adaptation of this concept. It also promotes the rate of photosynthesis which leads to a higher yield per unit area. Basically, the availability of a dwarf plant is the first and foremost prerequisite for establishing any high density or meadow orchard.

Different Types of Planting

Low density planting: It is a type of traditional system planting where the trees are planted at wide spacing which accommodate about 100-250 plants per hectare. In this system, the dwarfing root stock is not used. The trees produce commercial production potential only after 10-15 years of planting and hence, the output from orchard during the early 10-15 years is very less. This system of less input and casual care is quite popular among growers.

Medium density planting: It is a type of planting system where the trees are planted at a highly minimized distance with about 250-500 plants per hectare, at a space of 40sqm-20sqm per plant respectively. Proper pruning is done so as to manage the tree in a desirable shape. To obtain a higher yield, more intensive care and laborism required which leads growers to produce short stature fruit crops like pomegranate, citrus, ber, aonla, guava, papaya, banana, etc.

High density planting: It is a type of planting system where the trees are planted very densely with about 500-10,000 plants per hectare which requires 20sqm -1sqm space respectively, depending on the type of fruit crop. In medium high-density planting, 500-1500 plants per hectare are accommodated, in optimum high-density planting,1,500-10,000 plants per hectare are accommodated whereas in ultra-high-density planting, 10,000-1,00,000 plants per hectare are accommodated.

There is need of rigorous and efforts of concerted training and pruning of the plants and the maintenance. Dwarfing rootstocks and chemicals are also used in this system of planting. As a result, fruit yield as well as expenses per unit area is high.

Meadow Orcharding

The planting in meadow grasslands, also known as ultra-high-density Planting, accommodates nearly 10,000-1, 00,000 plants per hectare. severe top pruning is practiced which is very similar to the mowing of grasslands. The plants are expected to produce yield after 2 years of planting. In this type of planting, heavy use of growth regulators as well as pruning are very important factor.

Table 2- spacing at different planting system in fruit crops:

Sr. No.	Crop	Normal spacing (m)	HDP spacing (m)	Meadow spacing(m)
1.	Mango	7.5 X 7.5 - 12.5 X 12.5	3 X 2.5 – 5 X 5	2.5 X 2.5 - 3 X 1
2.	Banana	2 X 2 - 2 X 3	1.5 X 1.5 - 1.8 X 1.8	1.2 X1.2 - 3 X 0.5
3.	Citrus	6 X 6 – 8 X 8	3 -6 X 3 -4.5	-
4.	Papaya	2 X 2 – 3 X 3	1.8 X 1.8	1.2X1.2 - 1X1
5.	Gauva	6 X 6 – 8 X 8	3 X 3 – 3 X 1.5	2X2 - 2X1
6.	Sapota	10 X 10	5 X 5	--
7.	Aonla	10 X 10	5 X 5	-
8.	Apple	10 X 10	3 X 0.75	3 X 0.37 - 0.60

Components of HDP and Meadow

Training and Pruning: Training and pruning in High Density Planting system and Meadow Orcharding. The training begins from a very early stage viz. from the first year of planting which continues throughout its productive life. Proper tree forms, branch angles and limb spacing aid in growth control. First training is done after one growing season.

Plant is allowed to maintain single stem (main stem) with upward growth up to 60- 80 cm and then, four scaffold vigorous branches are allowed in four directions so as to make the proper tree frame. Thereafter, 2 shoots arising from each primary branch at a distance of 60-75cm from main stem are allowed to form secondary branches likewise, the tertiary branches. After the start of bearing in plants, the shoots arising from secondary and tertiary branches are given 15-20 cm deep pruning soon after the fruit harvest. 1 per cent urea combined with 0.2 per cent Blitox-50 or other copper fungicide should be sprayed soon after pruning.

Planting Density: Even though a small canopy with a high number of well-illuminated leaves is efficient in photosynthesis, it is very poor in light interception, which leads to low potential yield per hectare. Light interception can easily be improved by increasing tree density. An optimum tree density is the number of plant population which is required to facilitate optimum light distribution and interception leading to high photosynthesis result high carbohydrates synthesis ultimately maximization of yield. The optimum light interception is a factor of plant form, planting density, tree arrangement and leaf response to light for photosynthesis. Optimum light interception can be defined as a level of light intercepted by an orchard system above or below which, the economic yield will be reduced.

Planting Geometry: Planting system is a combination of tree arrangement and plant form. Tree arrangement in HDP system must have sufficient alleyways for the movement of farm machinery. The way the trees are arranged also determines the light distribution pattern and light interception level. Single hedge row and double hedge row systems and square system having enough alley space has been in practice in developed countries for getting commercial yield per unit area.

Mechanization: Another component in high density fruit planting is the system automation which contributes to high production. One of the most important farm operations that can be automated is irrigation and fertigation vis-à-vis indiscriminate mechanical activity. Certainly, irrigation and fertigation have been identified as the key factors for the success of high-density orchards. Plant should not be kept under stress condition after pruning and therefore assured irrigation along with fertigation are essential after pruning and during fruit development in high density orchards.

Table 13: Comparison between traditional system and HDP/meadow system of fruit growing:

Sr. No	Attributes	Traditional system	HDP/Meadow system
1.	Tree numbers	Few large trees/ha (150-200 trees/ha)	Many small trees/ha (500-1,00,000 trees/ha)
2.	Bearing	After two years	From first year
3.	Production	Lower yield	Higher yield
4.	Management	Difficult to manage due to large tree size	Easy to manage due to small tree size
5.	Labour requirement	Requires more labour	Requires less labour
6.	Production cost	Higher cost of production	Lower cost of production
7.	Harvesting	Difficult	Easy
8.	Quality	Large canopy, poor sunlight penetration and Poor quality fruits.	Small canopy, better air and Sunlight penetration, mini. disease incidence and high-quality fruits with good colour development.

Merits of HDP / Meadow

1. Best utilization of available land and resources.
2. Higher production per unit area with quality fruits.
3. Facilitates better utilization of solar radiation and increases the photosynthetic efficiency of the plant.
4. It is very much responsive to modern input application techniques such as drip irrigation, fertigation, mechanization, etc.
5. Early and precocious economic yield.

Demerits of HDP / Meadow

1. Slightly expensive to conventional system in the initial stages.
2. Economic life span of the orchard is lowered.
3. Chance of reduction in fruit size and weight if proper care is not adopted.
4. Intercultural operation becomes difficult if proper equipment is not available.
5. Maintenance of plant architecture becomes a time-consuming practice.

Management of High-Density Orchards

Soil application of half dose of N and full doses of P and K should be applied in July whereas basal dose rest of the N may be given in two equal doses in March after fruit set and after crop harvest in July. In case of fertigation, the standard schedule should be followed during vegetative and reproductive growth phase and fruit development stage. However, therefore is need of soil sample analysis before application. Leaf litter should be allowed to decompose in the orchard soil. High density litchi orchard should be irrigated as and when required particularly soon after paclobutrazol application during September-October, and from panicle emergence to crop harvest at15-20 days interval. No irrigation is applied from first shower of the rains in June to February-end. Tillage operations should be done in October-November to keep the orchard free from weeds and also to mix fertilizers and leaf litter into the orchard soil. The pest and disease problem in HDP litchi remain similar to normal planting rather sometimes severe in case of some pests. Hence to control the pests and disease, the recommended practices and chemicals should be followed. Weed cause some problems in initial stage of orchard. These should be removed and mulching may be done. Litchi plants under high density planting system start fruiting after 2-3 years. These orchards have a greater number of tertiaries per unit area, hence, orchard become economical earlier than normal planting. There is also better light interception and distribution thus improved fruit quality. An estimated yield of 14-16 tons/ha can be obtained from High Density of guava orchard if proper package of practice for HDP is adopted.

Conclusion

High density planting (HDP) technique is a modern technique of fruit production involving planting of fruit trees closely, allowing small or dwarf trees with modified canopy through training and pruning for better light interception and distribution and ease of mechanized field operation. HDP and meadow orcharding gives higher yield as well as profit/unit area due to increasing the plant population per unit area. It is possible by regular pruning and use of bioregulators for maintaining the size and shape of the tree. It has been observed that HDP is the most suitable technique for some tropical and subtropical fruits accommodating a greater number of plants per unit area viz., Dashehari mango (1333 plants/ha), guava (5000 plants/ha), papaya (6400 plants/ha), etc.

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Seed Health: As you Sow So, Shall You Reap?

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Abstract

Seed health is a major aspect in quality seed production. For doubling the farmer's income availability of quality seeds or disease-free seed in the prime need. Seeds are exposed to different environment from planting to harvesting and storage.

During the entire period, it may be affected by many pathogens like bacteria, virus, nematode, fungi etc. There is specific detection methodology to identify disease causing agent. By following some practices farmers could get rid of pathogen problem during the entire period of seed production.

To harvest good, one should be careful right from the selection of seed. The present article depicts how pathogen gets entry into the seed system and how we can harvest a good crop by following disease management practices during the seed production programme.

Keywords: detection, harvesting, pathogen, quality seed.

Introduction

Seed is the basic, vital and most essential input in any agriculture system. Without seed no agriculture can exist. Soil, water and air become valueless to mankind without seed. Seed is the driving force of all agriculture system. Assurance of quality seed in proper time and in adequate quantity is the basic need of the present-day farmers. Whole agriculture system is depending on quality seed.

The proverb "As you sow so shall you reap" rightly mentioned about the need of healthy seed. The production of healthy or quality seed material is the primary objective of seed technologist. Seed is affected by various foreign entities like bacteria, virus, viroids, nematodes, fungi etc. during production, in the mother plant itself, during harvesting, processing and storage. Seed is also a good carrier of foreign entities from one place to another within a country or outside the country.

How to Identify Seed Transmitted Diseases?

First symptom of disease infected seed is lower germination rate which can be assessed in the laboratory by paper towel method in the germinator. There is specific requirement of minimum germination percentage of each of the crop. Later on, the germinated seedlings develop some symptoms in stems, petioles, fruits thus, decreasing the visual quality of seed produced.

Different Ways of Seed Infection

Seed can be infected in many different ways like:

1. From Mother plant:

a. From ovary wall.
b. Vascular system.
c. Floral parts.

2. From environmental sources:

a. Soil.
b. Plant residue.
c. Storage.

3. From human activities.

Detection Methodology Generally Performed in Seed Health Testing

Seed borne disease detection is the prime need for seed health management. There is certain test to be followed in the laboratory against a particular pathogen. The below mentioned table clearly depicts the different test methods followed to detect seed borne fungi, bacteria, virus and nematode.

Pathogen	Visual observation	Seed wash and observation	Blotter	Agar plate	Grow out test
Fungi	√	√	√	√	√
Bacteria	√	√	√	√	√
Nematode	√	√	-	-	√
Virus	√	-	-	-	√

Moreover, serological technology like ELISA can be used for detection of seed borne bacteria and and RT-PCR is used to detect seed borne virus.

How Pathogen Got Entry into Seed

Seed are exposed to different environment viz., in seed production field, during harvesting, processing and storage condition.

In seed production field, first and foremost work is to eliminate the sources of inoculums by spraying some chemicals. Most of the seed borne pathogen may enter into the seed during anthesis. Smut, bunt, ergot, many viruses and bacteria infect seed during anthesis as because there is a stage in which the embryo is more prone to pathogen attack (Vishunavat K, 2020).

At seed development stages, pathogen may enter through funiculus, micropyle or by direct penetration through seed coat, caryopsis or fruit or pod surfaces. However, the favorable environment like drizzling rain, frost or drought enhances invasion.

Disease Management Practices During Seed Development and Maturation

1. During seed development: Application of pathogen specific fungicide can be advocated in seed production plot during seed development. Pathogen attack at various times during the seed development process. For example, in purple seed stain of soyabean, the pathogen does not infect seed unless seed maturation begins. Different cultural practices like adjustment of sowing time, crop rotation, rouging, proper irrigation and crop rotation with non-host crop may eliminate pathogen attack.

2. During seed maturation: To reduce pathogen attack crop should be harvested at proper time i.e., when the seeds attain its optimum moisture content which may vary from crop to crop. Sometimes it is advisable to change the planting time so that the crop can overcome the adverse environmental affect. Certain fungi like Fusarium, Alternaria, Cladosporium are responsible for seed discoloration by invading seeds under prolonged exposure to wet weather.

3. During seed harvesting, storage and processing: The harvesting process provides opportunities to the pathogen propagules like sclerotia, teliospore and nematode galls etc. to be mixed up with the harvested seed lot. Therefore, one should be very careful during harvesting. Proper cleaning and drying of harvested seed are necessary to eliminate seed contamination during storage. Bruchid in pulses or Aspergillus flavus in maize, groundnut etc. may develop during storage in which the pathogen could get optimum moisture and aeration for germination or multiplication. So, timely harvesting and adequate drying is necessary for storing of seed to maintain seed quality till planting in the next season.

Conclusion

Healthy disease-free seed material is one of the basic key components for doubling farmer's income. All the scientific research would be of little value unless the farmers getting its pure true to type, healthy seed. Seeds with assured quality can be expected to respond all other agricultural inputs like irrigation, fertilization etc. Therefore, to ensure a good harvest, making available of quality seed is the first and foremost criterion of any agricultural system.

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Prospects of Phenological Studies in Fruit Crops: A Biological Indicator of Climate Change

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Phenology is the study of periodicity in the life-cycle events of plants and influenced by seasonal variations in weather factors. Tim Sparks, an eminent phenologist in the UK illustrates the value of phonological data as: 'Historical data are a resource. They were collected at considerable effort in time and money. They do have value, and that value is too great to allow them to be left in obscurity of lost forever.'

Seasonal changes include variations in temperature, rainfall, precipitation, humidity, wind, duration of sunlight, soil temperature, atmospheric circulation, frost, and other life-driving factors. Leaf flush, leaf unfolding, flowering, bud burst, fruit ripening, colour change, and leaf fall are all examples of phonological events or phenophases. In fact, changes in the

timing of phenophases of fruit trees are of great economic importance, because they have direct impacts on yield formation processes and so on, the final fruit yield. Phenological records and models are used in horticultural production because of having extreme sensitivity of phenophases to inter-annual variations in climatic conditions. It is possible to communicate and disseminate climate change issues to the general public effectively through phenological studies and capable of reconnecting people with nature.

Phenology – Nature's Calendar

Phenology is generally described as the observation of the life-cycle phases of plants and their relationship with the environment, especially climate. It involves an investigation of the response of living organisms to seasonal and climatic changes in the environment in which they live.

Factors Influencing Plant Phenology

Most types of plants' growth require sufficient light, water, carbon dioxide, oxygen, mineral nutrients, and temperature. These simple demands involve a large number of environmental factors and physiological processes such as meteorological (light, photoperiod, temperature, precipitation, humidity, wind as well as gases) and edaphic factors (topography, slope, exposure, and soil properties) as well as biotic factors such as pests, diseases, and competition.

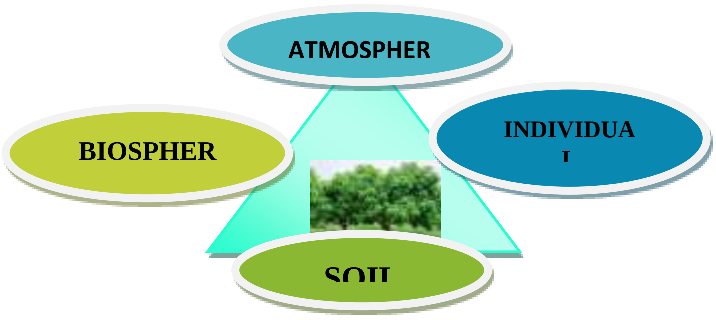

Figure 1. Plants & Environment

Therefore, phenophases are regulated mainly by climatic factors and to a much lesser extent by inner factors of the organism (e.g. genetic regulation, plant hormones). The basic pattern and its plasticity are genetically determined and then modified by the environment. However, the temperature is considered the driving factor determining phenological phases because the commencement of each development period for plants requires certain critical and accumulated temperatures. That's why entrained phenology patterns of fruits trees are expected to be sensitive to short-term fluctuations in typical rainfall and temperature.

The timing of the phenology cycles can be determined concerning seasonal rainfall, temperature, and solar radiation. We can also investigate flower, fruit, and leaf-flushing phenophases all exhibited 12-month cycles. Fruiting peaks occurred in the long dry season, and leaf flushing peaked in the long dry season but continued into the wet season. Deviations from phenology cycles were largely attributable to short-term fluctuations in rainfall and or temperature.

Significance of Phenology in Climate Change Studies

It is now well documented that plant phenology has an important connection to climatic components. Due to its sensitive response to climate, ecologists are now using plant phenology as an indicator for environmental monitoring, particularly in detecting climate change.

It is possible to model the relationship between phenophases and climatic elements due to the availability of long-term phenological data for several plant and animal species. The study of changes in the timing of plant phenophases in response to climate warming is important for two reasons.

1. It demonstrates to the public and policy-makers that climate change is already happening even in response to the current modest increase in temperature.
2. It quantifies the extent of change in natural ecosystems that we can expect in the future. If we want to predict the future response of species to a changing climate, we need to explore how species have responded to the climate in the past.

The use of phenology as a sensitive bio-indicator presupposes a quantitative analysis of changes in phonological time series and a known relationship with temperature or a comparable change in corresponding temperature series over time. Longer plant phonological records that go well beyond the period of instrumental meteorological records can be used as a proxy climate data for temperature.

Due to increased research interest in global environmental change and inter-annual climatic variability, long-term phenological data are becoming essential inputs to climate models. Phenological modelling plays a prominent role in regional ecosystem simulation models and atmosphere general circulation models.

Phenological records and models are used in agricultural production, integrated pest- and invasive species management, drought monitoring, biodiversity, forestry, wildfire risk assessment, and treatment of pollen allergies. Therefore, phenology has recently developed rapidly and globally as an environmental science discipline.

Figure 2. Phenological Applications

Implications for Impacts of Climate Change on Phenology

There may be a very little study on the impacts of climate change on the phenology of the flora and fauna of India. Studies carried out in these areas in Southeast Asian regions are either fragmentary or inconclusive. There is some grey literature on the impacts of climate change on biodiversity and the ecosystem of the country. We have different types of ecological zone in India which are habitat for a variety of species of fruits. Due to climate change, the phenology of those species may be the change that needs to be investigated. It is now evident that delaying or advancing the season is happening and extreme weather events and climate variability are magnifying it. Delay or advance of the arrival of summer, rainy, and winter season in India may disrupt the natural rhythm or synchrony of the ecosystem.

Interestingly, some of the daily newspapers are reporting about the earlier blossoming of mango inflorescence in some parts of India which is the most widely grown fruit crop. The long-term implications of changes in the phenology of various fruits agro-climatic zones may be profound for the different ecosystem in India. It is generally required long term data to find out fingerprint of climate change.

The procedure for observing plant phenology especially fruit trees is given below.

Principles for Observations

1. Phenological observations do not need costly equipment, as the instruments for monitoring the environmental conditions is the plant itself indispensable.
2. Remarkable stages of fruit plant-growth whose start dates can be determined to a specific day are observed.
3. The most important precondition to get homogenous comparable data is an exact definition of the phases.
4. Attention should therefore be paid to making sure that the location of the plant to be observed is representative of the observation area.
5. The observer should carry out the observations on the same plant for as many years as possible.
6. Observations are usually carried out at the same site for all phonological phases during a year.
7. The frequency of observation depends on the growth stage and the weather. Thus, for example, in spring in the mid- and high- latitudes, it may be necessary to make daily observations while during summer and fall (autumn) bi-weekly visits are usually sufficient.

Selection of the Plants

The selection of fruit crop depends on the following things:
1. It should be well known and thus easily identified/recognized.
2. They should have a broad distribution in the region.
3. The phases of which should span the whole vegetation cycle of one year e.g. leaf unfolding, shoot, flowering, fruit ripening, autumn/fall coloration, and leaf fall, etc.

Phenophases

To gain comparable phenological data it is necessary to define exactly the phases which are to be observed. The use of the so-called extended BBCH scale (Growth stages of plants, BBCH Monograph, 1977) is recommended, based on Zadok et al. (1974) cereal code is a system for uniform coding of phonological similar growth stages of all mono- and dicotyledonous plant species. It is a general scale so one can also apply it to those plants for which no special scale is available. For the description of the main (longer-lasting) phonological development stages, called principal growth stages, clear and easily recognized external morphological characteristics are used. The secondary growth stages define a short step of development.

The principal growth stages do not need to proceed in the ascending order of the table but can proceed in parallel, for example, flowering stage BBCH6 can occur before leaf development BBCH1 as it does in some fruit trees or, owing to the very different fruit species, certain stages may even be omitted.

The secondary growth stages define exact points of time or steps in the plant development. They are also coded with the digits 0 to 9. The numbers 0 to 8 correspond to the respective ordinal numbers of percentage valued, 0 defines the beginning, and 9 depicts the end of the principal growth stage (e.g. BBCH60 is the beginning of flowering, BBCH69 the end of flowering).

Table 1. The combination of the numbers of the principal growth stage and the second stage results in a two-digit code:

Principal growth Stages	Description
0	Germination/sprouting/bud development
1	Leaf development (main shoot)
2	Formation of side shoots/tillering
3	Stem elongation or rosette growth/shoot development (main shoot)
4	Development of harvestable vegetative plant parts or Vegetatively propagated organs/booting (main shoot).
5	Inflorescence emergences (main shoot)/ Heading
6	Flowering (main shoot)
7	Development of fruit
8	Ripening or maturity of fruit and seed
9	Senescence beginning of dormancy

Utilization during phonological studies

In general, it is easier to observe the beginning of one phase, i.e. the secondary growth stages 0 or 1.

Table 2. BBCH identification keys for Various fruit crops.

Sr. No.	Fruit Crops	Reference
1.	Pome fruits (Apple, pear)	Meier et al., 1994
2.	Stone fruits (Cherry, peach, apricot, plum	Meier et al., 1994
3.	Currants (Black and red currants)	Meier et al., 1994
4.	Strawberry	Meier et al., 1994
5.	Grapevine	Meier et al., 1994
6.	Citrus	Meier et al., 1995
7.	Pomegranate	Melgarejo et al., 1997
8.	Musa spp. (Two, three- and four-digit scale).	Gonzales et al., 2002
9.	Loquat	Martinez-Calvo et al., 1999
10.	Olive	Sanz-Cortes et al., 2002
11.	Persimmon	Hernandez et al., 2010
12.	Mango	Rajan et al., 2011

Data Management

Observations are the fundament and grounding of all scientific research and analysis. But before you can evaluate them, they must be collected, digitized, quality controlled, archived, and made accessible for the research community.

Future Prospects & Scope

Though it is already late, we should start immediately to collect phenological data on fruit crops especially mango or the major crop of the region, every year from a different ecological zone which will be an important source for interpreting climate signals from those data. On the other hand, we have various climatic data e.g. air temperature, rainfall, sea surface temperature, soil temperature, etc. and these are available in the Indian Meteorological Department. Therefore, both climatic data and phenological data are required to detect climate change trends. We can also explore or investigate obscure phonological data that are required to detect climate change trends. We can also explore or investigate obscure phonological data sources that may be collected by any of the armature naturalists in our country. If we start now, we can select some sensitive and indicator species in the future that will be useful for detecting climate change. This is also required for conservation planning of our critical ecosystem that might be disrupted due to climate-induced factors.

Due to its (phenology) sensitivity to climate warming, the UK government has included phenology in its climate change indicators in 1999. We have yet to set any climate change indicators for India. It is also urgent for us to set Climate Change indicators for India. How such species will respond to longer and warmer summer/rainy season needs to be investigated?

Some fruit trees may flower earlier and produce flowers in advance (mango) than before. This may also result in the appearance of predators who feed on leaves of these trees and pollinators of the flowers earlier than expected. It is not possible to tell anything without scientific investigation and rigorous research work. The different responses may disrupt the complex linkages between different trophic levels in nature and disturb the ecological balance. An understanding of how vegetation responded to past climate is needed for predictions of the response of plants to future climate change.

We urgently need to develop a scientific database on the chronology of major phenological events for various fruit trees. This can be done with the help of the large number of botanist/ecologist/foresters/wildlife biologist in the university departments and colleges, who will generate data at the regional level through close networking. The Ministry of Environment and Forests should initiate the work now for collecting phenological data every year from the different forest and ecological and agro-climatic zone. Those consecutive data would be useful shortly for country conservation planning. It is also important for funding agencies to invest grants in this thrust area so that the effect of predicted climate change on ecosystems and species is studied at regional and local levels, and steps for possible mitigation are planned.

Shifting of phenology does not just affect plants and animal life; they may have serious implications for our agriculture, forestry, fisheries sector. Farmers need to know the timing of flowering, fruiting, seed ripening, harvesting, etc for managing sustainable yield. These may also affect the fruit production of our country.

Restrictions of Phenological Studies

In tropical climates most temperate broad-leaved species exchange old for new leaves within a few weeks in January-February, i.e., their phenology becomes similar to that of tropical leaf-exchanging species. Leaf buds of the southern ecotypes of these temperate species are therefore not winter-dormant and have no chilling requirement. As in many tropical trees, bud break of these fruits growing in warm climates is induced in early spring by increasing day length. In tropical climates, vegetative phenology is determined mainly by leaf longevity, seasonal variation in water stress, and day length. As water stress during the dry season varies widely with soil water storage, climate-driven models cannot predict tree phenology in the tropics and tropical tree phenology does not constitute a useful indicator of global warming.

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Food Insecurity in India During COVID-19

Article ID: 32623

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Perhaps one of the biggest global health crises of our time is COVID-19 which is led extraordinary humanitarian challenges with it. Out of many one major challenge is food insecurity. There is more sever challenge for lower- and middle-income countries where about 135 million people are actually facing hunger due to climate change, mismanagement and economic crises (WFP, 2020a). It is expected to reach 265 million in 2020 (WFP, 2020a). With rise in COVID¬- 19 infection people are losing their jobs, income and heavy interruption in supply chain making matter more complicated. People have to face double crisis food insecurity and Pandemic especially in developing countries. In this article, we will try to analyses major issue faced by people of India in relation with food crises and COVID 19.

To counter the spread of COVID 19 virus Republic of India impose one of the longest and strike lockdowns on 24th March 2020 (BBC News, 2020). This lockdown was required since India is home of 1.3 billion people and this may be effective method to control the spread of virus since India had only 1,31,868 confirmed cases of COVID 19 and 3867 death till 24th March 2020 (Ministry of Health and Family Welfare [Government of India]2020). But this complete lockdown was not good for Indian economy which was already struggling to speed up with resent GDP growth rate 4.7% in 2019 (Trading Economics 2020). This were worst as unemployment was at all-time high after 45 year in 2019 (World Bank, 2020b). Worst some of the states of India was already dried before lockdown hence creating a major food insecurity. India is one of the major countries which is facing hunger due to shortage of food and proper distribution. India's preformation on hunger index is very poor as India ranked at 102 out of 117 countries in Global Hunger Index 2019 (GHI, 2019). Inspire of almost double per capital income then its neighbouring countries, like Bangladesh, Nepal, Pakistan India's performance in Global Hunger index is less than them. (World Bank, 2020a). India is trapped in a major crisis situation between trade loss, damage of lives due to COVID19 and hunger. Lockdown had slower the rate of spread of virus but on same hand it had also slowed many projects and even many projects are predicated showing negative growth rate (Ray, 2020). This harsh prediction had hit the most susceptible sector of India (e,g. Small business, street vendors, migrant labours) with increase in unemployment lowering of income and disruption of supply chain raised food insecurity issue (Gettleman & Raj, 2020). Due to lack of any proper studies to evaluate the impact of lockdown on India's food insecurity issue we have taken media coverage as source of evident. For example, according to an article published by cost analysis 195 people died in lockdown as of 13th April 2020 out of which 53 died due to lack of proper food (Vij, 2020).

Due to unequal economic opportunity and social norms for women had also increased food insecurity at alarming impact on nutrimental states of women and girl child (Jayachandran, 2015) The significances of lockdown on food insecurity can be likely be ever worst. Therefore, state government and central government of India should immediately release some fund to support food affordability and should provide some type of funding on food storage. Government of India has taken significant steps to handle this and has announced 261-billion-dollar economic relief package (NSE India, 2020). However central government is more focusing on liquidity, monetary, and credit measure for cash and food only 19 billion has been allotted. This also include direct cash deposit food distribution of rice, wheat and pulse for three months to over 800 million poor people. Government is also providing free cooking gas to 83 million families' one-time direct cash transfer to 30 million senior citizens and $6.65 dollar transfer to 200 million of poor women for three months (NSE India, 2020). India can take some lessons from previous similar crisis of Ebola in Africa where food production had decreased 12%

and few cases like Liberia, where 47% decrease in farming was recoded (UN, 2020). Disruption in supply chain due to restriction had severely affected agricultural market shortage of food grain hence resulting in increase in food price. Rabi season contribute half total food production in India. Some of the major ravi season crop producing states are Madhya Pradesh, Uttar Pradesh, Bihar all are some of the poorest states of country (KR & Gupta, 2020). So, it a detail guideline along with proper facility should be provided to insure sufficient Labor force used for harvesting season. Government should also focus on those agricultural products those are not stored by Government like Fruit and vegetable. There are lot of repots of wastage of fruits due to lack of man power and proper transport facility. (Pasricha, 2020). A perfect solution to tackle short term food crisis is to cooperate central government with state government along with local bodies and some agencies like world food program (WFP). For long term goal Government have to restructure the National Rural Employment Guarantee Act (NREGA) as soon as lockdown is uplifted. Government have to also ensure survival of micro, small business (MSME). However, thing is not so worst India has more than 60% population under 30 hence its maximum population is young and they can work. Government and Non-government origination have to cooperate. Niger a country with much lower economy and per capital had showed dramatic improvement then why not India.

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Status of Mushroom Production in India

Article ID: 32624

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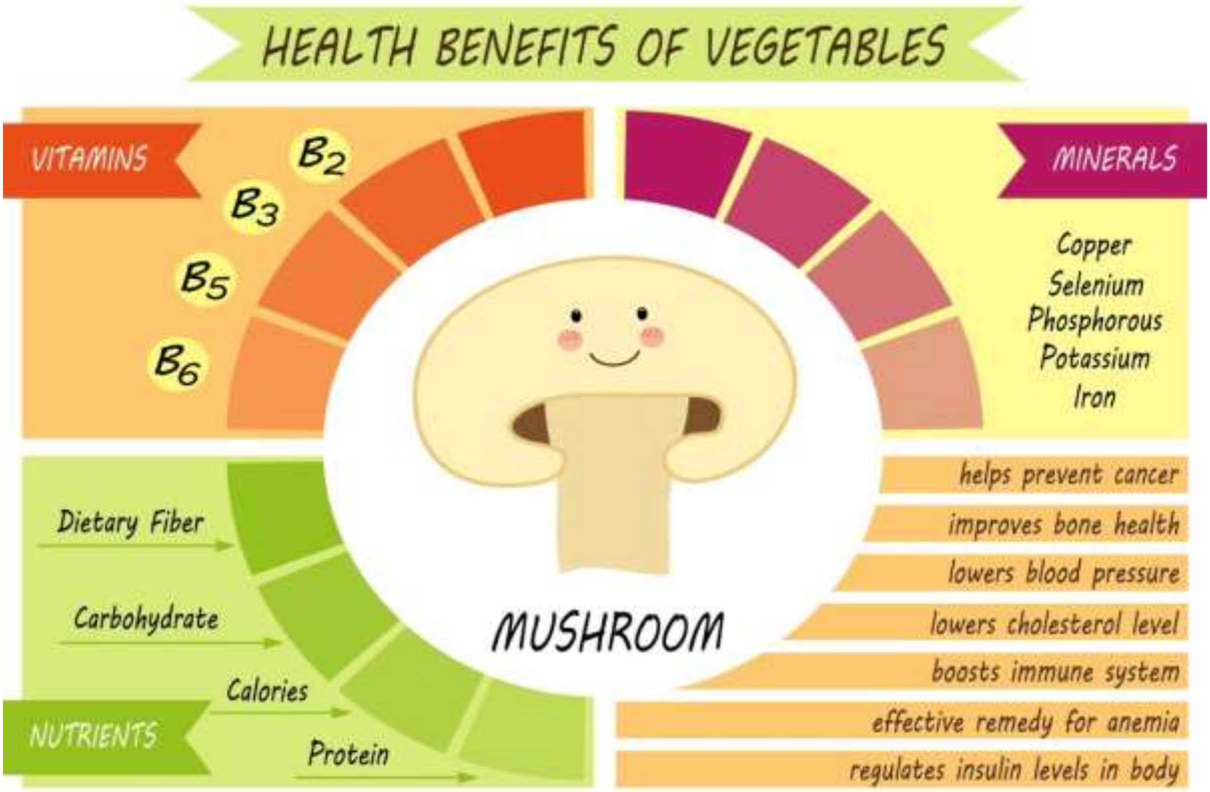
Introduction

Mushrooms have been recognized by Food and Agriculture Organization (FAO) as food item contributing to the protein nutrient to the diet of developing countries like India, where there is heavy dependence on cereal diets. The significant feature of mushroom is that this nutritious and tasteful food is cultivated entirely from waste products and converts a wide spectrum of agricultural and industrial waste into substrate on which the growth of mushroom is supported. After harvesting the mushroom, the solid residual left is organic compost with natural nutrients to further enrich the soil.

Mushroom Production in India

Even as the mushroom production and consumption are on the rise in rest of the world, India witnesses a lukewarm response in its growth. Mushroom industry in India is overwhelmingly focused on white button mushroom which is a highly sophisticated and capital-intensive activity. The recent production data (official data of ICAR-DMR, Solan) showing that, the share of button mushroom in India is maximum amounting to 73% followed by oyster mushroom which contributes about 16%.



There are two main types of mushroom growers in India, those who are growing white button mushroom round the year under controlled conditions and seasonal growers who are growing button mushrooms during the winter seasons in north western part of India. The total white button mushroom produced in India from both seasonal and high-tech cultivation units is estimated at 94676 metric tons. Out of this, approximately 8500 metric tons of button mushroom was produced from the seasonal growing units located in Haryana and Punjab which accounted for 9% of total button mushroom production.

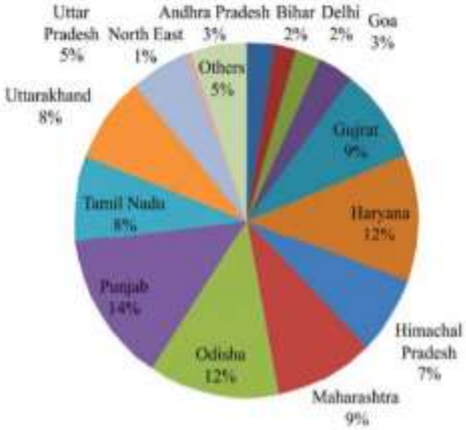


Fig. 1. Major mushroom producing state of India, 2016

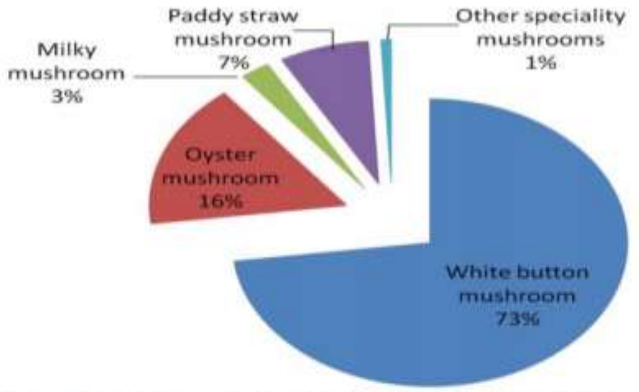


Fig. 3. Relative contribution of different mushroom species in total production

Initially, white button mushroom production was confined to temperate hilly regions of India. However, with the development of short method of composting and optimization of fruiting conditions using the chilling system, there has been a remarkable change in its production scenario and spread to all the corners of the country.

Reason for Slow Progress of Mushroom Industry in India

The retardation of progress is due to the following reasons:

1. Non-availability of funds.
2. Poor harvest management and marketing.
3. No serious efforts have been made in popularizing other edible mushrooms in spite of abundant availability of raw materials, cheap labour force and suitability of agroclimatic conditions.
4. No serious efforts have been made for collection and subsequent evaluation of locally available germplasm suitable for various agro-climatic conditions.
5. Use of unpasteurized compost widely prevalent with small growers.
6. Utilizing locally available substrates for compost preparation has not been fully explored.
7. Pasteurization technique for compost and casing need to be refined.
8. Technology for successful cultivation of Oyster and Paddy straw Mushroom needs to be properly standardized.

Future Scope of Mushroom Industry in India

In spite of all major constraints, face mushroom industry, the current Indian scenario is quite encouraging with an overall increase in production by 5 to 6 times. Mushroom industry has a bright future in India, chiefly because of large quantity of agriproducts and agro-waste generated, as well as availability of large and cheap labor force. This will not only provide a gainful employment to our rural youths, but cost of mushroom production per unit area will be greatly reduced.

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Neem - Nature's Drug Store

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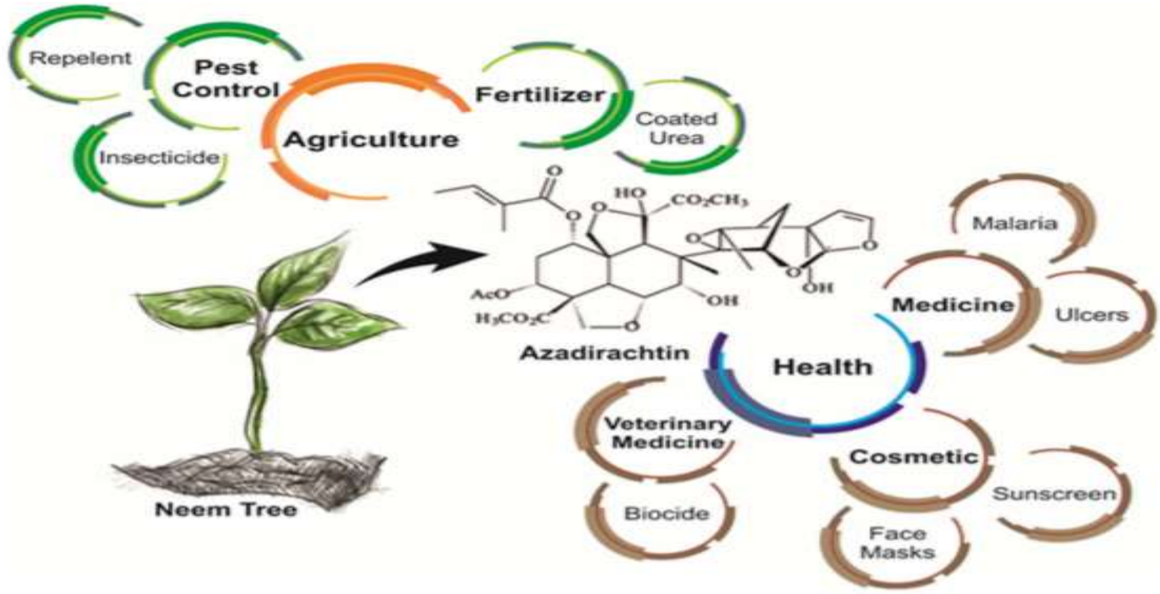
Introduction

A major challenge of agriculture is to increase food production to meet the needs of the growing world population, without damaging the environment. In current agricultural practices, the control of pests is often accomplished by means of the excessive use of agrochemicals, which can result in environmental pollution and the development of resistant pests. In this context, biopesticides can offer a better alternative to synthetic pesticides, enabling safer control of pest populations.

The neem tree *(Azadirachta indica)* is indigenous to India, it belongs to the family meliaceae. All the parts of the neem tree are medicinal. For thousands of years the beneficial properties of neem have been recognized in the Indian tradition. Both leaves and fruit of neem plant are known to have bitter taste having fungicidal, insecticidal and nematocidal properties. It is because of its tremendous therapeutic, domestic, agricultural and ethnic medical significance, and its proximity with human culture and civilization, that it has been called ''the wonder tree'' and ''nature's drug store.''



Neem Seed and Kernel Extract

The active ingredients of the neem plant are located in their maximum amounts in the seed and kernel. The seeds that are used for the preparation of neem kernel extract should be between three and eight months old. When the quantity of Azadirachtin in the seeds is quite high and adequate for efficient pest control (Vijayalakshmi, et al., 1998). Among insects, the Shoot-borer are key forest pests in tropical areas.

Repellents

The extracts prepared from neem plants have a variety of properties including repellence to pests (Prakash and Rao, 1997). According to Shannag et al., (2014), the repellent action of Azatrol, Triple Action Neem Oil and Pure Neem Oil is wholly dependent on the concentration that is used. He showed that the three products at higher concentrations were able to repel aphids feeding on sweet pepper plants. Abubakar et al., (2000) also reported repellent and antifeedant properties of *Cyperus articulatus* against *T. castaneum.*

Conclusion

The need for steady and safe food supply to the world rising population has led to the exploration of neem tree as a bio-pesticide. With the growing knowledge on the use of bio-pesticides it will gradually replace the conventional chemical pesticides presently in use. One of the problems with the use of chemical pesticides has been their impact on “non-target” species. Often, they have been proven to be harmful to various beneficial species in the ecosystem. The practice of farmers making their own neem-based products for pest control would reduce their dependence on external inputs for agriculture. It would also reduce their cost of pest control to almost zero, leaving only labor as a potential expenditure item. Pests can also be controlled without the use of toxic chemical pesticides, which will reduce the harm posed to humans and the environment alike.

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Impact of Fungicides on Physiology of Vegetables

Article ID: 32626

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Introduction

Fungicides are a class of pesticides that are chemical compounds or biological organisms that destroy or inhibit the growth of fungi or fungal spores. The utilization of fungicides for effective control of plant diseases has become crucial in the last decades in the agriculture system since it is estimated that fungal infections cause yield reductions of almost 20% of crops worldwide. Due to their relatively low cost, ease of use, and effectiveness, fungicides became the primary means of fungi control.

Vegetables are an important part of a healthy diet. There are few reports on the physiological effects of fungicides on vegetables, although they have preventive actions, especially in the Solanaceae and Cucurbitaceae families.

Types of Fungicides

Fungicides have been categorized into 2 types: Contact fungicides and systemic fungicides.

1. Contact Fungicides: Contact fungicides have been used to kill or inhibit fungi or fungal spores prior to the growth and development of mycelia within the plant tissues. However, once the infection is developed, this fungicide may not have any function. Thus, these kinds of fungicides can be utilized only as protectants.

Inorganic copper compounds like Bordeaux mixture and copper carbonate and inorganic sulfur in the form of elemental sulfur and lime sulfur are a few examples of the main contact fungicides available to protect plants. Within the organic contact fungicides, for instance, dialkyldithiocarbamates, which include the fungicides thiram, ferbam, and ziram, are a group of fungicides which play a great role in the global control of plant diseases because they are generally more effective and less toxic than the inorganic compounds particularly, sulfur and copper fungicides. These multi-site inhibitors have various sorts of toxic actions in fungal cells as for example, metal chelation, the formation of mixed disulfide, and heavy metals transportation across membranes. Dialkyldithiocarbamates exhibit an inhibitory action on a broad range of fungal enzymes, but pyruvic dehydrogenase in particular, is susceptible to these fungicides. Another group of organic contact fungicide widely used is the ethylenebisdithiocarbamates, which include zineb, maneb, metiram, and mancozeb. The mode of action of this type of fungicide is different from that of the dialkyldithiocarbamates i.e., they get transformed into ethylenediisothiocyanate, which performs inactivation of thiol groups of enzymes and metabolites in fungal cells.

2. Contact fungicides: Contact fungicides are cost-effective and fungal resistance occurs in rare instances. Consequently, they are still largely used for the control of plant diseases although several new, more potent systemic fungicides have been established.

Systemic Fungicides

The second category of fungicides, systemic fungicides, is absorbed by plants and translocated to the site of infection. These types of fungicides have the ability to kill the fungus after the penetration of mycelia into the parenchyma of the plant tissue, ceasing the dispersal or infection within the plant. Systemic fungicides can be used as protectants, eradicants, or both and are the most recently developed and the most promising type of fungicide for the future. However, since systemic fungicides usually have a very specific site of action in the target fungus, fungi may readily develop resistance to them if they are not managed appropriately.

Systemic fungicides consist of a large group of compounds with different modes of action. For example, the largest and most important group of systemic fungicides used to control plant fungal diseases is the 'dicarboximide'. The mode of action of this fungicide seems to be associated with the repression of triglyceride biosynthesis in the fungi. The dicarboximide fungicides - iprodione, procymidone, vinclozolin, chlozolinate, and metomeclan are specifically beneficial for the management of plant diseases caused by species of *Botrytis, Sclerotinia, Monilinia, Alternaria, Sclerotium*, and *Phoma* respectively.

'Benzimidazoles' are a class of organic fungicides with systemic action that are also considerably used in agriculture. These types of compounds control a vast range of fungi at reasonably low application rates. For example, benomyl is one of the most effective and heavily applied benzimidazoles in crop protection. The benzimidazoles namely benomyl, carbendazim, and thiabendazole, and the phenylcarbamate, 'diethofencarb' particularly interfere with the development of microtubules, which take part in various cellular processes, including mitosis and maintenance of cell shape. These fungicides bind specifically to protein subunits called tubulin and prevent their assembly to form microtubules. Since their introduction in the 1960s, systemic fungicides have slowly replaced the earlier non-systemic products, providing higher levels of disease control and establishing modern fungicide markets. Comparatively, systemic fungicides are approximately twice as valuable in terms of sale than non-systemic fungicides.

Physiological Responses to Fungicide Exposure in Vegetables

The widely accepted assumption that fungicide has low phytotoxicity has begun to be outdated with the publication of more detailed analysis at the cell level that demonstrated several damages at the photosynthetic apparatus. Some reports appointed that the application of pesticides has serious consequences on plant physiology, such as growth reduction, perturbation of reproductive organ development, alteration of nitrogen, and/or carbon metabolism.

Physiological studies after fungicide treatments in several crops reported modifications of both photosynthetic activity and chlorophyll fluorescence traits. Decreased CO_2 assimilation in fungicide-treated crops has been attributed to both stomatal (due to stomatal closure) and non-stomatal effects due to a disruption in the capacity of RuBisCO carboxylation, decrease of RuBisCO content, and/or reduction of the ribulose 1,5 bisphosphate regeneration.

Net CO_2 assimilation reductions accompanied by changes in stomatal conductance and intercellular CO_2 concentration were reported in *Cucumis sativus* after fungicide application. The application of pyraclostrobin and boscalid mixture to cucumber plants has increased the activity of antioxidative enzymes and decreased lipid peroxidation. Fungicides such as pyraclostrobin, azoxystrobin, boscalid enhance nitrate reductase activity in vegetables such as cucumber. Several studies suggested that the systemic fungicide, strobilurin may improve the water status and stress management of vegetable crops under drought stress conditions. Stomata may respond to strobilurin-induced alterations in mesophyll photosynthesis either by detecting changes in the intercellular CO_2 concentration or via responding to the pool size of an unidentified C-fixing substrate.

Triforine fungicides strongly inhibit electron-transport reactions of chloroplasts. Moreover, the application of systemic fungicides i.e., benzimidazoles and triazole, and a dithiocarbamate contact fungicide affects the effective quantum yield of PSII as well as the maximal quantum efficiency of PSII. This reduction is due to a decrease in photochemical quenching (qP). Strobilurin fungicides block the transport of electrons between PSII and PSI by binding to the Qi site of the chloroplast cytochrome bf complex.

Fungicides cause a decrease in biomass production in vegetables. In tomato, stem growth is delayed due to the application of fungicides. Benomyl, a systemic fungicide, reduces the growth of cucumber and lettuce. This fungicide also inhibits pigment biosynthesis in crops. A widely used fungicide, 'fluazinam' belonging to the chemical group of the 2,6-dinitroanilines, improves the physiological status of leaves via promoting metabolites, antioxidants, better membrane integrity, and adjustment of the redox status in pepper and eggplants.

Conclusion

The aim of agricultural practices is to increase the productivity and the quality of the final product; therefore, it is quite important to understand the physiological changes that occur after the application of these important groups of fungicides. Further research should be conducted to study the effects of various concentrations of fungicides on the physiology of vegetables.

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Development of Herbal Ice Cream with Aloe Vera

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Introduction

Ice cream is a sweetened frozen dairy product preferred as snacks or dessert made of milk and milk products, that is often added with fruits (raw and/or dried form), along with other essential ingredients like flavors, colors etc. Attempts have been made to make ice cream as functional food by incorporation of probiotics, having several additional advantages, such as improving consumer's health and nutritional value of product along with improvement in ice cream properties.

Aloe Vera is one of the oldest known medicinal plants gifted by nature; Aloe Vera, often called miracle plant is known by many names. There are over 200 types of Aloe Vera and of these only 4 or 5 are commonly used in medicines. The most widely used variety of Aloe Vera is Barbadensis millar. It is perennial, succulent plant with stiff fleshy leaves. Aloe Vera is a clear thin gelatinous material that comes from inside the Aloe Vera leaves. Aloe Vera juice also improves blood circulation due to its ability to detoxify. It is also a natural healer, and hence any internal ulcers or lesions will be soothed and healing will be enhanced.

Aloevera leaves have vital ingredients such as vitamins, minerals, amino acids, polysaccharides, enzymes, plant steroids, saponins, lignin, and anthraquinones, salicylic acid, which are necessary for the human body. Aloe Vera works as anti-septic, antibacterial, antiviral, anti-carcinogenic and anti-inflammatory. It has been reported to cure eczema, diabetes, arthritis and is said to prevent infection. It also improves human immune system and digestive system.

Medicinal Use of Aloe Vera

Alleviates gastrointestinal woes: In addition to relieving constipation, aloe Vera juice improves symptoms of irritable bowel syndrome and ulcers. In fact, dozens of reports from people with ulcers of 10 or more years' duration are being completely healed by drinking aloe Vera juice.

Supports healthy immune and digestive systems: Complex carbohydrates (polysaccharides) from the gel of the inner leaves of the aloe plant have been shown to activate several immune system components. And other compounds, such as enzymes and amino acids, found in aloe help promote overall digestive health. Take advantage of these medicinal uses of aloe Vera by drinking aloe juice or taking supplements that contain aloe extracts.

Speeds healing of wounds, burns, and more: Aloe is best known for its wound- and burn-healing properties. Aloe has antimicrobial properties and has been demonstrated to be effective against many common bacteria and fungi.

Relieves other skin conditions: Another use of aloevera is to soothe the discomfort associated with sunburn and insect bites, as well as dry skin, eczema and psoriasis, when applied topically (in creams or gels).

Standardization of the Product

The product was standardized & the ingredients used were given below:

Ingredients	Quantities
Alovera	25 g
Milk	20 ml
Whipped cream	30 g
Corn flour	5 g

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Sugar	20 g

	
Fresh alovera leaves	**Milk**
	
Whipping cream	**Sugar**

Preparation Procedure of Alovera Ice Cream

1. Alovera leaf was cleaned and peeled out; later the alovera is washed and cutted into small pieces.
2. To reduce the bitterness in alovera the sugar is added and soaked for 24 hours.
3. Gently boiled the milk and allow simmering till it reduces.
4. Added the sugar and stir it continuously till the sugar dissolves in milk.
5. Poured corn flour into the milk mixture and stir continuously until the mixture will thicken.
6. Turn off flame and completely cool the mixture.
7. Add cream into this mixture, again blend it well.
8. Added alovera gel into the mixture and little amount of vanilla essence to enhance the flavour of ice cream.
9. Finally Packed and storage in refrigeration at -18°C.

Table no. 1 Nutrient Composition of alovera ice cream:

Ingredients	Quantity (g)	Protein (g)	Fat (g)	CHO (g)	Energy (K.cal)	Calcium(mg)	Iron(mg)
Alovera	30 g	0g	0 g	0.3 g	0.6 k.cal	3 mg	0 mg
Milk	20g	0.86g	1.3 g	1 g	23.4 K.cal	42 mg	0.04 mg
Corn Flour	25g	2.775g	0.9 g	16.55 g	85.5 k.cal	2.5 mg	0.575 mg
Sugar	15g	0.015g	0 g	14.91 g	59.7 k.cal	1.8 mg	0.23 mg
Whipping Cream	10g	0.205g	3.7 g	0.279 g	34.5 k.cal	6 mg	0
Total	100g	3.855 g	5.9 g	33.039 g	203.7 k.cal	55.3 mg	0.845 mg

The consumer's tendency is to avoid chemicals and synthetic foods and choose therapy and nutrition through natural resources. This has opened up a new era of research and offers an opportunity to develop consumer friendly products. The aloevera leaf was evaluated for proximate composition. The results on proximate composition reveals that the aloevera ice-cream contains energy: - 203.7 k.cal; carbohydrates: - 33.039 g; protein: - 3.855 g; fat: - 5.9 g; iron: - 0.845 mg; calcium: - 55.3 mg.

Organoleptic Evaluation of the Prepared Alovera Ice Cream

Quality is the ultimate criteria of the desirability of any food product. Food quality can be evaluated by sensory and objective methods.

The effective characteristics are not the property of food, but the subject reaction to the sensor's quality of foods. This reaction is highly conditional by a psychological and social factor and the final analysis plays a vital role in the acceptance and preference of foods.

Table no. 2 organoleptic evaluation of developed Alovera Ice cream.

Sno	SENSORY ATTRIBUTES	Mean ± S.D
1	Appearance	8.9 ± 0.31
2	Colour	8.3 ± 0.82
3	Flavour	8.3 ± 0.82
4	Taste	8.1 ± 0.73
5	Texture	8.2 ± 0.78
6	Over all acceptability	8.1 ±0.73

Table no 2 Depicts organoleptic evaluations and mean scores for the developed alovera ice cream. There are several steps involved in a new product development among which taste panel stage is most. In taste panel stage various attributes of the product like appearance, color, flavor, texture, and taste are judged by trained members. The attributes evaluated by panel members for ice cream by using Hedonic (9 point) rating scale include: 9- Like Extremely, 8- Like Very Much, 7- Like Moderately, 6- Like Slightly, 5- Neither like or Dislike, 4- Dislike Slightly, 3- Dislike Moderately, 2- Dislike Very Much, 1- Dislike Extremely.

Conclusion

This study concluded that ice cream with incorporation of alovera gel contains number of vitamins, amino acids, enzymes, sugars that supports in healthy immune system and it contains number of phytoconstituents which reveals it's uses for various therapeutic purposes it can be cured for various disorders such as diabetes, fungal infections, microbial infections and it has calcium for strong bones .so the ice cream is incorporated with aloevera due to more healthy benefits.

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Student Ready: An Overview

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Introduction

The Student READY programme was launched by Prime Minister of India on 25 July 2015. The abbreviation of term READY is "Rural Entrepreneurship Awareness Development Yojana". It is a new initiative of Indian Council of Agricultural Research to reorient graduates of agriculture and allied subjects like horticulture, forestry, sericulture, agriculture engineering, community science etc. for ensuring and assuring employability and develop entrepreneurs for emerging knowledge intensive agriculture. This envisages the introduction of the programme in all the Agricultural Universities as an essential prerequisite for the award of degree. The main objectives of this programme are building confidence and acquire Indigenous Technical Knowledge (ITK) of the locality and thereby, preparing the pass-out for self-employment.

The Components

The Fifth Deans committee has given detailed curriculum of student READY programme for all the disciplines in agriculture and allied sciences. The course curricula are restructured to develop much needed skills and entrepreneurial mind-set among the graduates for self-employment, contribute to enhanced rural livelihood and food security, sustainability of agriculture and be propeller for agricultural transformation. This programme includes five components i.e. Experiential Learning, Rural Awareness Works Experience, In-Plant Training / Industrial attachment, Hands-on training / Skill development training and Students Projects.

These components are very interactive and are conceptualized for building skills in project development and execution, decision-making, individual and team coordination, approach to problem solving, accounting, internal control, marketing and resolving conflicts, etc. with end to finish approach. Experiential Learning is a chance for the scholars to develop top quality professional competence, skill development and confidence to start and manage their own enterprise. This is based on the principle of “Earn while learn”. Experiential Learning aims towards Practical Work Experience in real world situation among the undergraduate students and thus it helps student become “Job Providers instead of Job Seekers”. Rural Awareness Works Experience enable the scholars to realize rural experience, give them confidence and enhance on farm problem solving abilities in real facts and situations. In-plant training of short duration in relevant industry is beneficial to realize the knowledge and understanding of the work culture. In Plant training in reputed organization / MNC’s/ other organized sectors provides an industrial exposure to the scholars for developing their career within the Agro based industries. Skill development component includes use of Agriculture Systems for enhancing functional skills. It is expected that basic infrastructure and Experiential Learning Units within the university will help in boosting livelihood ensuring opportunities among the Agricultural graduates. Student Project is important for college students who have an interest in higher education. Through this they are going to gain expertise for identification of research problem, planning and carried out experiments and writing of reports, etc.

All the components as per suitability in fact are included within the final year of study for two semesters. There are 20 credits for Experiential Learning/ Skill Development Training, 10 credits for RAWE and 10 Credits for Industry Attachment/Student Project. Some of the important components of Student READY programme are as under:

Experiential Learning (EL)

The word ‘experiential’ essentially means that learning and development are achieved through personally determined experience and involvement, rather than on received teaching or training. Experiential learning is a business curriculum-related endeavor which is interactive. The programme has end to end approach. EL provides the students an excellent opportunity to develop analytical and entrepreneurial skills and knowledge through meaningful hands on experience, confidence in their ability to design and execute project work.

The main objectives of Experiential Learning are:
1. To promote professional skills and knowledge through hands on experience.
2. To acquire enterprise management capabilities.
3. To build confidence and ability to work in project mode.

The experiential learning programme offered for 180 days (one semester) period in the final year. As the programme is enterprise oriented, students and faculty are expected to attend the activities of the enterprise even on institutional holidays with total commitment, and without any time limit or restriction of working hours for ELP.

Rural Awareness Works Experience (RAWE)

The Rural Awareness Works Experience helps the students to understand the rural situations, status of innovative agricultural technologies adopted by farmers, prioritize the farmer's problems and to develop skills and attitude of working with farm families for overall development in rural area. The timings for RAWE can be flexible for specific regions to coincide with the main cropping season.

The key objectives of RAWE are:
1. To provide opportunity to the students to understand the actual rural situation in relation to agriculture and allied activities.
2. To make the students familiar with socioeconomic, psycho-personal and situational conditions of the farmers and their problems.
3. To impart diagnostic and remedial knowledge to the students relevant to real field situations through practical training.
4. To develop effective communication skills of students with farmers using latest extension methodologies in transfer of agriculture technology.
5. To acquaint students with on-going extension and rural development programmes.
6. To develop confidence and competence among students to solve complex agricultural problems.

In-Plant Training (IPT)

Technology and globalization are ushering an era of unprecedented change. To augment this, the need and pressure for change and innovation is inevitable. To enrich the practical knowledge of the students, in-plant training is mandatory in the last semester for a period of up to 10 weeks. In this training, students will have to study a problem in industrial perspective and submit the reports to the university. In-Plant training is meant to correlate theory and actual practices in the industries. It is expected that sense of running an industry may be articulated in a right way through this type of industrial attachment mode.

The main objectives of In Plant Training are:
1. To expose the students to industrial environment.
2. To familiarize the students with various materials, machines, processes, products and their applications along with relevant aspects of shop management.
3. To make the students understand the psychology of the workers and approach towards problems and practices followed in industries.
4. To make the students understand the scope, functions and job responsibility in various departments of an organization.
5. Exposure to various aspects of entrepreneurship during the programmed period.

Course Curriculum in Agriculture

The Fifth Deans Committee has recommended the following syllabus for Student READY programmes.

Rural Awareness Works Experience (RAWE) and Agro-Industrial Attachment (AIA): This programme is undertaken by the students during the VII semester for a total duration of 20 weeks with a weightage of 0+20 credit hours in two parts viz., RAWE and AIA. It is consisting of general orientation and on campus training by different faculties followed by village attachment/unit attachment in University/ College/ KVK or a Research station. The students are attached with the agro-industries to get an experience of the industrial environment and working. Weightage in terms of credit hours will be given depending upon the duration of stay of students in villages/agro-industries. At the end of RAWE/AIA, the students are given one week for project report preparation, presentation and evaluation.

Experiential Learning Programme (ELP)/ Hands on Training (HOT): This programme is undertaken by the students preferably during the VIII semester for a total duration of 24 weeks with a weightage of 0+20 credit hours. The students are register for any of two modules, of (0+10 credit hours each) listed below:

1. Production Technology for Bio-agents and Bio-fertilizers.
2. Seed Production and Technology.
3. Mushroom Cultivation Technology.
4. Soil, plant, water and seed testing.
5. Poultry Production Technology.
6. Hybrid Seed Production Technologies.
7. Floriculture and Landscaping.
8. Food Processing.
9. Commercial Horticulture.
10. Agriculture Waste Management.
11. Organic Production Technology.
12. Commercial Sericulture.

In addition to these ELP modules, other important modules may be given to the students by Agricultural University. ICAR has already provided financial help for establishment of two or more Experiential Learning Units in each State/Central Agricultural University.

Conclusion

The Students READY programme is very useful and beneficial to the students in gaining the competence for entrepreneurship, in building confidence, skill and acquire Indigenous Technical Knowledge (ITK) of the locality and thereby, preparing the pass-out graduates for self-employment and play the important role in overall personality development. It will ultimately help in improvement of the Agriculture Education System and sustainable development in the country.

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Cherry Tomato: Neutraceutical Facts and Health Benefits

Article ID: 32629

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Introduction

Vegetables bear all edible plant parts like stems, leaves, roots, flowers, fruits and seeds that are consumed either in raw or cooked form. Vegetables have low content of fats and carbohydrates but on the other side are endued with higher content of vitamins, minerals and dietary fibres. China ranks first in vegetable production in the world, whereas India ranks second producing 175 million metric tonnes of vegetables.

Among economically important vegetables, tomato is the major vegetable whose wild and cultivable species belongs to western South America. Cherry tomato is botanically known as *Solanum lycopersicum* L. var. *cerasiforme* and is a member of Solanaceae family. The demand for cherry tomato is continuously increasing in the domestic as well as foreign markets chiefly because of neutraceutical compounds, good taste and superior quality (Kobryn and Hallmann, 2005). Cherry tomato crop is widely cultivated in Central America and are widely distributed in California, Florida, Korea and Mexico.


Cherry tomato falls under cultivable group of tomato which is not identical to it's the wild relatives. Due to presence of high soluble solid content, a greater number of vitamins and high fruit setting with rising temperature, it is popularising all over the world. (Prema et al. 2011).

Neutraceutical Facts

Cherry tomato is small in size varying from 1.5 – 3.5 cm with a sweeter taste and fulfills several significant nutritional benefits. Cherry tomatoes are rich in antioxidants and phyto-chemical cotent, including essential nutrients like lycopene, β-carotene, flavonoids and vitamin C (Rosales et al., 2010). One cup (149g) of cherry tomato gives about (USDA. 2018).

1. 27 kcal energy.
2. 1.31g protein.
3. 5.80 carbohydrate.

Hence, serving a bowl of cherry tomato as snacks can give up to 200 calories which are much higher than the normal tomato. It has various health benefits, including reduced risk of heart diseases and cancer.

Cherry tomatoes also contain protein and other nutrients in small amounts (1-4%), including other B-complex vitamins, calcium, copper, iron, magnesium, phosphorus and zinc. Besides all these nutrients it contains good amount of flavonoids, carotenoids, lycopene and Vitamin C. Red coloured cherry tomato is rich in lycopene whereas yellow color is rich in carotenoids mainly β–Carotene. The cherry tomato has high sweetness as compare to normal tomato as it has higher level of TSS.

Table 1: Nutrient range in cherry tomato (Chandni et al., 2020):

Nutrient	Range
Lycopene content (mg/100 g)	1.07 to 7.48 mg/100g
β–Carotene content (mg/100 g)	0.36 to 2.49 mg/100g
Vitamin C (Ascorbic Acid)	64.63 to 95.12 mg/100g
Total Soluble Solid (oBrix)	8.07 to 10.81oBrix

Important Varieties

Black Cherry, Cherry Ripe, Small fry, Sun Gold, Sweetie, Tiny Tim, Yellow Pear.

Grown Areas

Cherry tomatoes are widely cultivated in Central America and are distributed in California, Korea, Germany, Mexico and Florida. In India it is widely present in sub-tropical areas of Tamil Nadu, Kodaikanal hills, Shervroy hills, Kalrayan hills and other hills. Usually the crop is grown in open conditions in hills but in plains it is mainly cultivated under protected structures. Cherry tomato cultivation is gaining importance due to its rising demand in urban areas.

Conclusion

Cherry tomato has great demand in urban market for its high nutritional values and attractive colour. It has various health benefits, including reduced risk of heart diseases and cancer. Due to its rich content of bioflavonoid and carotenoids, it has an anti-inflammatory property with wider application in treatment of chronic diseases and as a pain killer. It is widely used in weight control diets as it has fixed calories.

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Water Movement in Saturated, Unsaturated and Vapour Conditions

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Introduction

Soil water is the term for water found in naturally occurring soil. Soil water is also known as rhizic water. Soil water are major three types:
1. Gravitational water.
2. Capillary water.
3. Hygroscopic water - and these terms are defined based on the function of the water in the soil (Hunker, 2017).

Soil water is important to maintain proper levels of soil moisture. When a soil is saturated, both micro and macro soil pores are water-filled, conducting and soil conductivity is maximal. Water flow when macro pores in soil are filled with air is said to be unsaturated. In soil, vapour pressure increases with the increase in soil moisture content and temperature, it decreases with the increase in soluble salt content.

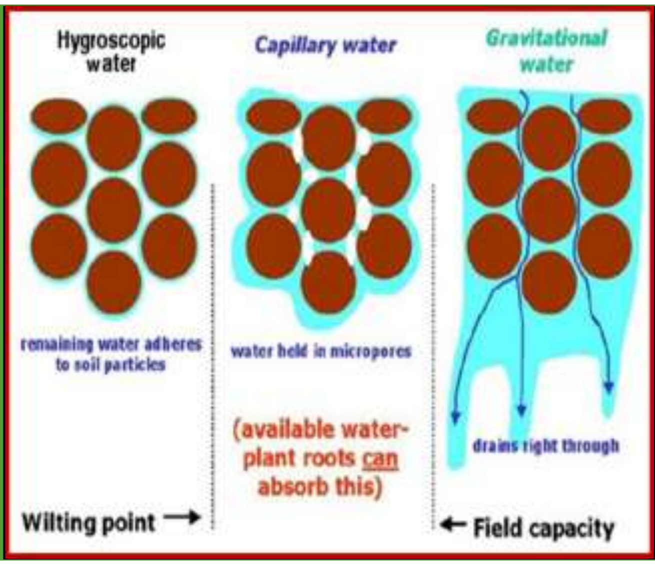
Soil Water Retention

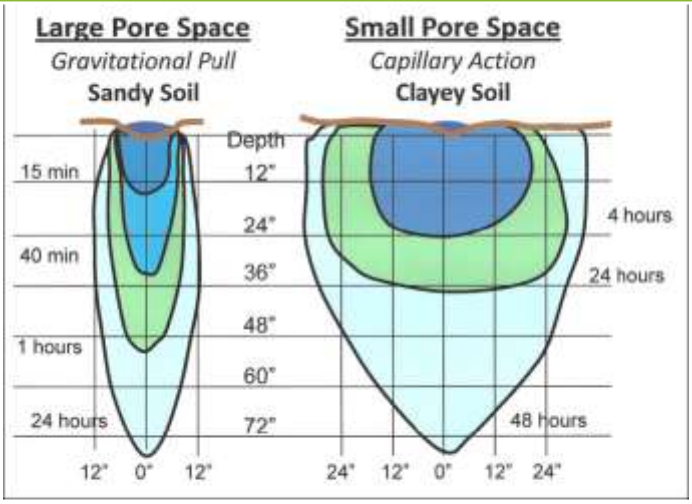
Soil water retention is the ability of soil to hold water inside its pores and hold onto moisture rather than allowing it simply to obey gravity and pour through the earth's surface.

Soil water retention depends on:
1. Particle size.
2. Clay type.
3. Organic content.
4. Soil structure.

Table.1. Types of soil water (SC panda, 2007)

Soil water	pf value	Tension
Gravitational water	0	-1/3 bar
Capillary water	2.5	-1/3 to -31 bars
Hygroscopic water	4.5	10,000 bars





(B Mohamed S. Alhammadi and Al-Shrouf, 2013)

Movement of Water Within Soils

Moves along gradient of decreasing water potential.

Water in the liquid phase:

a. Moves through the water filled pore space under the influence of gravity.
b. Moves under the impact of surface tension forces (under unsaturated soil conditions).

Water in vapour phase: Moves through the air-filled pore spaces along gradient of decreasing vapor pressure.

Flow Rate of Water

1. Gradients in soil water potential (ψm) caused by different in height, pressure, dissolved solutes and soil wetness.
2. Hindrance: friction between water and particle surface as well as pore constructions and other interruption in flow path.

It is generally recognized that three types of water movement occur in soil:

a. Saturated.
b. Unsaturated.
c. Vapour.

Saturated Flow of Soil Water

When a soil is saturated, all its pores (both micro and macro) are water-filled and conducting. In saturated soil condition, water movement occurs through large pores. Water is saturated soil is not under any tension and the flow follows either Poiseuille's or Darcy's law (Majumdar,2018). Saturated flow occurs when soil pores are completely filled with water (i.e. ψm > 33 J/Kg).

Occur in aquifers (water bearing sediments and rock layers) in flooded soil and in lower horizons of soil with limited drainage. Saturated flow occur decreases as the pore size decreases. Generally, the rate of flow in soils of various texture is in the following sequence.

Sand > loam > clay

Poiseuille's law: Soils have small pores and the pores from narrow tube. Started that laminar flow is the rule rather than the exception in most water flow processes in soils (Hillel, 1971).

Dracy's law: The empirical relationship between water flux and energy gradient (Dracy's, 1856).

Unsaturated Flow of Soil Water

Liquid phase of water: under soil water flows through the water filled pore space under the influence of gravity. Moves under the impact of surface tension forces (under unsaturated conditions). Water flow when macro pores in soil are filled with air is said to be unsaturated condition. Negligible effect of solute potential is due to the fact that both solute and water are moving.

Driving force for water flow in these conditions is through the matric potential gradient, i.e. matric potential (ψm)

1. In horizontal movement, only matric potential (ψm) applied
2. In downward movement, capillary and gravitational potentials act together
3. In upward capillary movement matric potential (ψm) and gravitational potentials (ψg) oppose one another
4. For unsaturated flow may be rewritten as (Majumdar, 2018).

$$V = \frac{-k\,\Delta\,(\psi m + \psi g)}{\Delta\, l}$$

5. Darcy's law is applicable if k is regarded as a function of water content. As the soil moisture content and soil moisture potential decreases, the k decreases rapidly, so that ψsoil is -15 bars, k is only 10-3 of the value at saturation.
6. Movement of unsaturated flow ceases in sand at a lower tension than in finer textured soils, as the water films lose continuity sooner between the larger particles. The wetter the soil, the greater is the conductivity for water. In the 'moist range', the range of unsaturated flow in soils of various textures is in the following order:

Sand < loam < clay

Water Vapour Movement

In soil, water vapor transfer increases as vacuous space increases. At a soil moisture potential of about -18 bars, the continuity of the liquid films is broken and water only in the form of vapor. Water vapor pressure of soil moisture increases with the increase in soil moisture content and temperature, it decreases with the increase in soluble salt content.

Water vapor movement is prominent in the 'moist range'. Flux of diffusion of water vapor through the soil is proportional to the square of the effective porosity, regardless of pore sizes. Smaller soil pores, the higher is the moisture tension under which maximum water vapor movement occur.

The amount of water involved in vapor movement is insignificant for any practical purpose. Movement of water in vapor form comparatively more in moist soils than in either dry or wet soils (Majumdar,2018).

Conclusion

The flow of water in saturated zone of soil is primarily governed by Darcy's law which states that the velocity of flow through a porous media is proportional to the first power of hydraulic gradient. Movement of soil water in unsaturated soils involves both liquid and vapor phases.

Darcy's law for flow of water through saturated soils also holds good for unsaturated soils. Water always flows in the direction of decreasing energy. Thus, the equation V = k i is also true tor unsaturated soils. The maximum water vapor movement in soils vapor movement is of greatest importance for the growth and survival of plants.

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Protected Cultivation of Cut Chrysanthemum

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Introduction

Chrysanthemums popularly called as 'Queen of East', are amongst the top three bestselling cut flowers in almost all major flower consuming countries. In India, chrysanthemum occupies a place of pride, as a commercial loose flower crop, as a popular cut flower as well as pot plant.

It is commercially cultivated in Tamil Nadu, Karnataka, Maharashtra, West Bengal, Himachal Pradesh, Punjab, Rajasthan, Gujarat and Delhi. At present, chrysanthemums are grown under greenhouses commercially as a cut flower in Bangalore, Pune, Delhi, Calcutta and Ooty.

It is botanically called as *Dendranthema grandiflora* Tzeuleu and main constituent member of Asteraceae family. The chrysanthemum flower is actually an inflorescence of florets on a head. It is a composite inflorescence that has flowers borne on a receptacle or capitulum.

The flowers of chrysanthemum possess two kinds of florets. The central disc florets are tubular perfect flowers with both stamen and pistil. The ray florets which surround the disc florets are comparatively longer and vary in shape, colour and form; they are pistillate and hence called as imperfect florets.

Varieties

For exhibition	Snow Ball (white), Chandrama (yellow), Bravo (red)
For pot culture	Topaz (yellow), Sharad Shoba (white); Alison (mauve)
For cut flower	Bonfire (Orange, Yellow), Birbal Sahni (white), Flirt (red), Nanako (yellow), Reagan series (yellow, white, pink, etc.)
For loose flower	CO.1, MDU.1
For bedding and borders	CO.2, Indira, Usha Kiran

Climate

Cut chrysanthemums are grown under polyhouses with the following environmental conditions.
Temperature: 16 – 25^{o}C.

Relative humidity: 70 - 85 %.

CO_2: 600 - 900 ppm.

Photoperiod: Long day conditions with 13 hours light & 11 hours darkness during vegetative stage (up to 4-5 weeks from planting) and short-day conditions with 10 hours light & 14 hours darkness during flower bud initiation stage.

Soil

Well drained sandy loam soil with good texture and aeration or growing medium made of 1: 1: 2 of soil, compost and cocopeat with pH of 5.5 to 6.5.

Growing Media

The growing media consists of soil, compost and coco peat in the ratio of 1:1:2. The beds are formed with 1 m width, 0.3m height and at convenient length. The soil pH must be 6.5 with 1 to 1.5 EC (Electrical Conductivity).

Propagation

Terminal cuttings and tissue culture plants are used. Terminal cuttings are widely used for commercial cultivation. Cuttings of 5-7 cm length are taken from healthy stock plants and are induced to root by treating with IBA (1000 ppm).

Planting

Beds of 1m width, 0.3m height and convenient length are formed. Nets (with cell size depending on the spacing adopted) are placed on the beds and planting is done.

Spacing

15x 15 cm (45 plants/m^2) or 10 x 15 cm (67 plants/m^2)

Irrigation

Drip irrigation with 8-9 liters of water/m^2/day.

Nutrition

Basal application of DAP - 50 g/m^2, Weekly schedule - from 3rd week after planting:

Fertilizers	Quantity (g/m2)		
	Vegetative Phase (0 to 6 weeks)	Pre flowering stage (7 to 10 weeks)	Peak flowering stage (11 to 13 weeks)
Tank A			
19:19:19	1.0	1.0	1.0
KNO3 (13-0-45)	2.0	2.0	1.5
MgSO4	1.0	1.0	1.0
Tank B			
CaNO3 (15.0-0-0)	2.0	4.0	4.0
Humic acid (0.3 %)	30 ml	30 ml	30 ml
Apply Single Super Phosphate (SSP) @ 40 g / m2 at the time of planting			
Foliar application of chelated micronutrient mixture @ 0.2 % at weekly intervals after 1 month of planting			

*Fertigation is given twice a week.

Fertilizer Management

NPK @ 20:20:10 g/m^2 is applied through fertigation at weekly intervals.

Growth Regulators

Alar 50 – 150 gm/100 lit water and B 9 at 8 – 25 ml/lit of water is used twice at the growing stage.

Special Practices

Pinching: First pinching - 3 weeks after planting; 2nd pinching - 5 weeks after planting.

Disbudding: In spray varieties, only the large apical bud is removed and the lateral buds are retained. In standard varieties, the lateral buds are removed and only apical buds are allowed to develop.

Support/staking: Since spray and standard chrysanthemums may be as tall as 75 cm to 90 cm, it is necessary to support the stems as the crop matures. Lack of support leads to bending of stems ultimately causing decline in market quality. Various kinds of plastic mesh, strings, bamboo canes, etc. are used for plant support. The nets are usually laid out in 4 or 5 layers.

Light requirement: Chrysanthemum is very much influenced by light and hence photoperiod should be regulated. (Photoperiod should be regulated as detailed under 'climate'.

Growth phase	Weeks from planting	Photoperiod
Vegetative phase	Up to 4-5 weeks from planting till the plant attains 50 to 60 cm height	Long day : 13 hrs light and 11 hrs dark
Flowering	5 -6 weeks after planting till harvest	Short day : 10 hrs light and 14 hrs dark

Growth Regulators

Spray GA3 (50 ppm) at 30, 45 and 60 days after planting to increase flower stem length.

Weed Management

Weeding and hoeing are done manually as and when required.

Pests

Leaf miner: Spray Imidacloprid @ 0.5 ml/l or Acetamiprid @ 0.3 g/l.

Thrips: Spray Fipronil @ 1.0 ml/l. Keep Yellow Sticky Trap 10 nos. for 100 sq.m area.

Aphids: Spray Methyl demeton @ 2 ml/l or Monocrotophos @ 1 ml/l.

Red spider mite: Spray Abamectin 1.9 EC @ 0.5 ml/l or Propargite @ 2 ml/l.

Diseases

White Rust: Spray Azoxystrobin @ 1ml/l or Triflooxystrobin + Tebuconazole @ 0.75 g/l.

Leaf spot: Spray Macozeb @ 2g/l or Azoxystrobin @ 2 ml/l or Difenoconazole @ 0.5ml/l.

Wilt: Soil drenching with Carbendazim @ 1 g/l or Triflooxystrobin + Tebuconazole @ 0.75 g/l.

Powdery mildew: Spray Wettable Sulphur @ 2g/l or Azoxystrobin @ 1ml/l.

Harvest Index

Standard types - Flowers are harvested when 2 - 3 rows of ray's florets are perpendicular to the flower stalk.
Spray types - When 50% flowers have shown color for distant markets; when two flowers have opened and others have shown color for local markets.

Yield

Standard types: 67 flower stems/m^2
Spray types: 260 flower stems/m^2

Post-Harvest Technology

Pulsing	Sucrose 4 % for 24 hrs (Vase life : 18 days; Control : 8.5 days)

Holding solution	BA 10 ppm + Bavistin 0.1 % + Sucrose 2 % (Vase life : 17 days; Control : 8.5 days)
Wrapping material	Polysleeves with holes (50-gauge thickness) (Shelf life: 9.25 days; Control : 6.5 days).

After harvest, the stem has to be cut at equal length (90 cm is the standard), bunched in five, putting a rubber band at the base and sliding them into a plastic sleeve and putting the bunches in plastic buckets filled with water. Early morning on the day of shipment (or night before), the bunches can be packed in boxes.

Physiological Disorders

1. Leaf yellowing.
2. Freezing injury.
3. Floral abnormalities.
4. Quilling of florets.
5. Bleaching of petals.

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Quorum Sensing in Relation to Biofilm Development

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Introduction

It was believed for many years that bacteria, unlike eukaryotic organisms, behaved as self-sufficient individuals and maintained a strictly unicellular life-style. During infections, bacterial mass was considered nothing more than the sum of these individuals. Our perception of bacteria as unicellular life-style was deeply rooted in the pure culture paradigm of Robert Koch's era, when Koch established his "golden criteria" to define a bacterial pathogen by using pure-culture approaches. Indeed, Koch's concept has led to the great success in the identification of bacterial pathogens and development of antibiotic treatments in acute bacterial infections. However, pure-culture planktonic growth of bacteria rarely exists in natural environments. In fact, bacteria in Nature largely reside in a complex and dynamic surface-associated community called a biofilm. If viewing an intact biofilm under microscope, one may immediately find that bacteria in biofilms do not randomly stick together, but rather form a well-organized community with numerous specialized configurations. One may also find that bacterial cells in biofilms physically interact with each other and maintain 'intimate' relationships (Nadell et al 2009). Even without physical contact, bacteria living at the same community likely secrete small extra-cellular molecules to interact with each other. It was not until the last three decades that our view of self-sufficient unicellular lifestyle of bacteria has changed. The advances from at least two major research areas, biofilm development and bacterial quorum sensing, have led us to begin to appreciate, in much more detail for the first time, the concept that bacteria can organize into groups, form well-organized communities, and communicate for coordinated activities or social life that was once believed to be restricted to multi-cellular organisms.

Microbiologists have discovered an unexpectedly high degree of coordinated multi-cellular behaviours that have led to the perception of biofilms as "cities" of microorganisms. Especially, many bacteria have been found to regulate diverse physiological processes and group activities through a mechanism called quorum sensing, in which bacterial cells produce, detect and respond to small diffusible signal molecule. It has long been known that in infectious diseases the invading bacteria need to reach a critical cell density before they express virulence and overwhelm the host defence mechanisms before they initiate an infectious disease (Li and Tian 2012). Since quorum-sensing mechanisms are widespread in both prokaryotic and single-celled eukaryotic organisms such as fungi, it is not surprising that cell-cell communication through quorum sensing has important implications in microbial infections. A connection between quorum sensing and microbial biofilms has brought together investigators who have a common interest in how bacteria function as a group for social activities.

Quorum Sensing in Relation to Biofilm Development in *Pseudomonas aeruginosa*

In 1998, Greenberg and his colleagues first described the role of the las quorum sensing in biofilm formation of *Pseudomonas aeruginosa*, a Gram-negative bacterium that is considered as one of the most common opportunistic pathogens in human infections causing fatal systemic disease under certain conditions. Lung infections with biofilms of this pathogen are particularly common in patients with cystic fibrosis. In this organism, quorum sensing is highly complex and consists of two interlinked N-acyl homoserine lactone-dependent regulatory circuits, which are modulated by many regulators acting both at transcriptional and post-transcriptional levels. These researchers found that the lasI mutant defective in the production of the autoinducer 3-oxo-C12-HSL formed biofilm cell clusters that were 20% of the wild-type biofilm in thickness and were sensitive to detergent removal. When the 3-oxo-C12-HSL was added to the system, the lasI mutant was once again able to form structured biofilms. This finding suggests that quorum sensing plays an important role in the development of biofilms, and more importantly, it makes an inextricable connection between quorum sensing and biofilm formation. Subsequent studies further show that the quorum-sensing circuits in *P. aeruginosa* orchestrate a symphony of several virulence factors, such as exoproteases, siderophores, exotoxins and rhamnolipids, in particular, the QS-controlled virulence expression in P. aeruginosa has been demonstrated both in vitro and in vivo model systems.

Influence of Quorum Sensing and Iron on Twitching Motility and Biofilm Formation in *Pseudomonas aeruginosa*

Reducing iron (Fe) levels in a defined minimal medium reduced the growth yields of planktonic and biofilm Pseudomonas aeruginosa, though biofilm biomass was affected to the greatest extent and at FeCl3 concentrations where planktonic cell growth was not compromised. Highlighting this apparently greater need for Fe, biofilm growth yields were markedly reduced in a mutant unable to produce pyoverdine (and, so, deficient in pyoverdine- mediated Fe acquisition) at concentrations of FeCl3 that did not adversely affect biofilm yields of a pyoverdine-producing wild-type strain. Concomitant with the reduced biofilm yields at low Fe concentrations, P. aeruginosa showed enhanced twitching motility in Fe-deficient versus Fe-replete minimal media. A mutant deficient in low-Fe-stimulated twitching motility but normal as regards twitching motility on Fe-rich medium was isolated and shown to be disrupted in rhlI, whose product is responsible for synthesis of the N-butanoyl homoserine lactone (C4-HSL) quorum-sensing signal. In contrast to wild-type cells, which formed thin, flat, undeveloped biofilms in Fe-limited medium, the rhlI mutant formed substantially developed though not fully mature biofilms under Fe limitation. C4-HSL production increased markedly in Fe-limited versus Fe-rich P. aeruginosa cultures, and cell-free low-Fe culture supernatants restored the twitching motility of the irhlI mutant on Fe-limited minimal medium and stimulated the twitching motility of irhlI and wild-type P. aeruginosa on Fe-rich minimal medium. Still, addition of exogenous C4-HSL did not stimulate the twitching motility of either strain on Fe-replete medium, indicating that some Fe-regulated and RhlI/C4-HSL-dependent extracellular product(s) was responsible for the enhanced twitching motility (and reduced biofilm formation) seen in response to Fe limitation.

Quorum Sensing in Relation to Biofilm Development in *Candida albicans*

Candida albicans is the most frequently isolated human fungal pathogen. The most recent surveys have shown that Candida is the third or fourth most commonly isolated bloodstream pathogen in United States hospitals, having surpassed gram-negative rods in frequency. Notably, yeasts (mainly *C. albicans*) are the third leading cause of catheter related infections, and they have the second highest colonization to infection rate and the highest crude mortality rate overall. Structured microbial communities attached to surfaces, commonly referred to as biofilms, have increasingly been found to be sources of infection by C. albicans (Sordi et al 2009), especially in view of the vast number of biomaterials that are now being used in the medical industry. Biomaterials, such as stents, catheters, and orthopedic joints, for example, serve as excellent substrates for microbial adhesion and subsequent biofilm formation. Biofilms are specific and organized communities of cells under the control of signaling molecules rather than random accumulations of cells resulting from cell division. Cell-cell signaling, particularly quorum sensing, has been the focus of much research over the past decade in the microbiological arena. This molecule, farnesol, was shown to prevent the germination of yeast cells into mycelia, a phenomenon that may be pertinent to *C. albicans* biofilm formation. *C. albicans* has the capacity to switch from a yeast morphology to a hyphal morphology, one of its major virulence determinants. The morphological transition from the yeast form to the mycelial form (dimorphic switching) is induced by many different environmental factors, such as mammalian serum, high temperatures (37°C), and neutral pH.

Inhibition of Candida albicans Biofilm Formation by Farnesol, A Quorum-Sensing Molecule

Farnesol is a quorum-sensing molecule that inhibits filamentation in *Candida albicans*. Both filamentation and quorum sensing are deemed to be important factors in *C. albicans* biofilm development. They examined the effect of farnesol on *C. albicans* biofilm formation. *C. albicans* adherent cell populations (after 0, 1, 2, and 4 h of adherence) and preformed biofilms (24 h) were treated with various concentrations of farnesol (0, 3, 30, and 300 M) and incubated at 37°C for 24 h. The extent and characteristics of biofilm formation were then assessed microscopically and with a semiquantitative colorimetric technique based on the use of 2,3-bis (2- methoxy-4-nitro-5-sulfo-phenyl)-2H-tetrazolium-5-carboxanilide. The results indicated that the effect of farnesol was dependent on the concentration of this compound and the initial adherence time, and preincubation with 300 M farnesol completely inhibited biofilm formation. Supernatant media recovered from mature biofilms inhibited the ability of planktonic *C. albicans* to form filaments, indicating that a morphogenetic autoregulatory compound is produced in situ in biofilms. Northern blot analysis of RNA extracted from cells in biofilms indicated that the levels of expression of HWP1, encoding a hypha-specific wall protein, were decreased in farnesol-treated biofilms compared to the levels in controls. Results indicate that farnesol acts as a naturally occurring quorum-sensing molecule which inhibits biofilm formation.

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Customized Fertilizers: A Boon to Agricultural Sector

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Introduction

The Indian fertilizer market was worth INR 5437 Billion in 2018 and the market is expected to reach INR 11116 Billion by 2024, growing at a CAGR of 12.3% during 2019-2024. This report itself provides a deep insight into all the essential aspects of fertilizer market in India. Fertilizers played an important role in success of green revolution and pulled India out of a stage of begging bowl to a stage of self-dependency in food grain production. India is the second largest consumer of fertilizer in the world with an annual consumption of more than 55 million metric tons (Fertilizer statistics, 2013). Population of India will likely reach 1.67 billion by 2050 and within 2025 only food grain demand is expected to rise to 335 million tons (Majumdar and Prakash, 2018). Since any further increase in the area under cultivation over the present 142 mha is not possible, maximizing food grain production per unit area to feed the expanding population is becoming a national thrust. However, most of the present fertilizers were developed almost 40 years back and no new efficient fertilizer materials has been developed which proved to be helpful for feeding world's growing population, sustaining food security and protecting the environment. The efficiency of fertilizers is also low leading to low return per unit investment on fertilizers. The widening of so-called ideal ratio of 4.3: 2.0: 1.0 for N: P2O5: K2O to 8.3: 3.2: 1.0 in some parts of the India is explanatory itself for nutrient imbalance and low factor productivity (Fertilizer statistics, 2013). The major recommendations emanating from the above discussion calls for site specific nutrient management (SSNM), development of value added and customized fertilizers for major cropping and farming systems in different agro-eco regions of India.

According to FCO, customized fertilizers are multi-nutrient carriers designed to contain macro, secondary and/or micro-nutrient both from inorganic sources and/or organic sources, manufactured through a systematic process of granulation, which satisfies the crop's nutritional needs, specific to site, soil and stage validated by a scientific crop model and developed by an accredited fertilizer manufacturing company. They are unique and ready to use granulated fertilizers, formulated on sound scientific plant nutrition principles integrated with soil information, extensive laboratory studies and evaluated through field research. The manufacturing process of customized fertilizer is complex but the end product is very promising. Farmers have a choice of customized fertilizers based on crop and area specificity and also the advantage of 'ready to use' fertilizer material is available to them. A major consideration during formulation of customized fertilizer revolves around 'a better yield starts with a better mix'. The FAI recommendations for a particular grade of customized fertilizer include that minimum 90% material should pass through 1-4 mm Indian standard sieve and size less than 1 mm should not exceed 5%, foliar application grades should be 100% water soluble with minimum nutrient content of 30 units of all nutrients combined (Rakshit et al., 2012). This system ensures most economical mix of available nutrients and minimized application cost per acreage. In this era of multi-nutrient deficiency being common in soil, the solution lies in the use of multi nutrient carriers, like customized fertilizers, designed specifically to combat such problems.

Importance of Customized Fertilizers

Customized fertilizers are more than just a simple fertilizer. Its concept revolves around plant nutrition and soil fertility, backed up by sound scientific principles. One of the major advantages of customized fertilizers is their suitability to promote site specific nutrient management along with increased efficiency of applied material in a cost-effective manner. Due to indiscriminate use of fertilizers and continuous nutrient mining at least six nutrient deficiencies i.e. N, P, K, S, Zn and B, was observed in India (Majumdar and Prakash, 2018). Therefore, performance of agricultural lands and sustainability of production is now under question. In this context, considering the limitations of soil test based blanket application of fertilizer and benefits of SSNM, customized fertilizers can surely magnify the prospects of precision agriculture in India. Customized fertilizer smiles upon several advantages like:

1. It supplies plant available nutrients in adequate amounts and in right proportions synchronizing plant demand.
2. These products are specific to soil-crop-region therefore less likely to be influenced by climatic anomalies, leading to higher uptake and less loss of nutrients.
3. Being a major component of site-specific nutrient management and precision agriculture, customized fertilizer aims at improved fertilizer use efficiency with compromising soil health.
4. It is produced using profound scientific database, the material is also ready to use and is adaptable to varied field conditions.
5. The farmer need not buy micronutrient separately at extra cost, thus reducing the total cost and helps the farmer to get better benefit: cost ratio.

Status in India

In agriculturally advanced countries, more than 50 per cent of fertilizer is used in the form of customized fertilizers (Parvathi, 2018). China, who is first in agricultural production, is fully dependent on customized fertilizers. In India, mineral fertilizers were included in the Essential Commodity Act (ECA) of 1955 through an amendment by the Government of India in 1973. Customized fertilizer was included in 2006 under clause 20 B of the Fertilizer Control Order (FCO) of 1985. Currently, there are about 36 formulations available in the market which is approved by fertilizer control order of Indian Government. In 22 November 2010, first official customized fertilizer in India was launched by the Tata Chemicals Limited, which is known as 'Paras Farmoola', containing 10% N, 18% P_2O_5, 25% K_2O, 3% S and 0.5 % Zn, specifically targeted at farmers in western-central Uttar Pradesh. In early period, customized fertilizers like zincated urea and boronated super-phosphate did not get popularity among farmers due to single micronutrient deficiency, high cost and fear of indiscriminate use. Even now also farmers prefer to use straight sulphate salts zinc (Zn) instead of Zn fortified fertilizers.

Problems of Customized Fertilizers

Some of the most important constraints of customized fertilizer include:

1. High production cost of customized fertilizer products due to their complex manufacturing process, leading to the high market cost and also not properly subsidized by the government.
2. Different producers make their products with different mixing ratio, leading to confusion among the farmers.
3. Profit centric fertilizer industries do not co-operate well among themselves to make farmers aware about imbalanced use of fertilizers.
4. Raw materials for fertilizer production are also not properly distributed among the fertilizer industries.
5. Less capital investment and absence of a secured policy for a considerable period of time is a big issue.
6. Time consuming manufacturing process and limited awareness among the farmers is also causing a marketing issue.
7. Uncertainty in response when fertility will be restored in the field is still a matter of research.

Conclusion

In a country like India where most of the farmers are small and marginal with less capital availability, it will be very tough and interesting to combat this situation. The government has to restrain non-serious industries to allow healthy competition among those manufacturers only, who are dedicated for development of these materials. More intensive research is required to develop customized fertilizer based on soil type for same crop, as nutrient deficiencies do not act in a similar way in all soils. Accurate GPS-based information for soil fertility mapping indicating extent and deficiency of both macro and micro-nutrients will be prerequisite. Identification of dominant cropping systems, accessing indigenous sources of nutrients, deciding possible yield target must be done. Innovative product like customized fertilizer which is specific to agro climatic condition can be offered to the farmers to correct nutrient deficiency, particularly secondary and micronutrients, for popularizing the concept. Moreover, care must be exercised to strengthen collaboration between the fertilizer industry and research institutes, engaged in developing soil test-based and site-specific nutrient recommendations, to develop soil and crop specific customized fertilizers. In India the concept of customized fertilizer is still at infancy, but considering the negative impact of conventional fertilizers on soil-plant and environment, we have to adopt these new fertilizer materials to immune us from more complicated future problems.

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Bael Fruit – Highly Nutritious, Religious and Medicinal Fruit of India

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Introduction

Bael is an important indigenous fruit of India. The importance of bael fruit lies in its curative properties, which makes the trees, one of the most useful medicinal plants of India. It is Scared tree as the trifoliate leaves are offered to the Lord Shiva while fruits from holy offering during 'havan'. It has a great demand from Indian systems of medicine, such as Ayurvedic. *Marmelosin* is most probably the therapeutically active principle of bael fruit. Fruit pulp used for sherbet and marmalade. It has been isolated as a colourless crystalline compound. The bael fruit is one of the most nutritious fruits, rich in proteins, minerals, CHO, and vitamins (riboflavin 1191 mg). Despite this quality the fruit failed to become popular (as desert) primarily it being seed with hard shell and mucilaginous flesh but the processing quality of this needs to be exploited judiciously. This fruit crop is found in Uttar Pradesh, Orissa, Bihar, West Bengal and Madhya Pradesh.

Botany

Botanical name	Aegle marrmelos
Family	Rutaceae
Chromosome No.	2n=18 (36)
Origin	India
Vernacular name	Sirphal, Wood apple, Bengal Quince

Agel is Greek Origen and specific name marmelos is a Portuguese name and has 2-3 species.

Habit: The tree is deciduous grows to great heights (10-15m) with white grayish stem, can tolerate harsh climate.

Leaves: Alternate, Trifoliate aromatic leaves is traditionally used as sacred offering to 'Lord Shiva'.

Flowers: Inflorescence are axillary racemes, Bisexual borne in clusters, sweet scented and greenish white. Stamens are numerous, sometimes coherent in bundles. The ovary is oblong-ovoid, slightly tapering with numerous ovules in each cell of 8 to 20 in each ovary. Deep root and hardy.

Fruit: It is a hard-shelled berry (Ampisarica), usually globose with a pericarp nearly smooth grayish yellow about 3 mm thick, hard and filled with soft yellow and orange, very fragrant and pleasantly flavored pulp. Fruit is a hard-shelled berry and very well-known for its medicinal properties due to *marmelosin* content. Mature fruits as astringent, digestive and stomachic are usually prescribed for diarrhoea and dysentery. The ripe fruit is tonic, restorative, laxative and good for heart and brain.

Seeds: They are many compressed and arranged in closely packed tiers surrounded by slimy mucilage that become hard on drying, testa has wholly hairs, embryo has large cotyledons.

Varieties

There is no standard name of cultivar of bael. They are generally named after the names of the locality where they are most easily available. Ayodhaya, etawa, faizabathdi local, Daarogaji, Ojha, Rampuri, Mirzapuri, Kagzi Gonda, Kagzi Etawah, Kagzi Banarasi bewan large and Deoria large.

Some of popular clonal selection have been made at NDUAT (Fizabad), GBPUAT (Pantanagar), CISH (Luknow) are recently some selections such as NB-5, NB-9, NB1-5,NB-1-7, NB1-6, NB1-17. Pant Aparna (thorn less type), Pant Urvashi, Pant Sujatha and Pant Shivani. CISH-1 and 2, Goma Yashi.

A number of cultivars have been selected recently and the following are among the best with regards to yield and fruit quality:
Narendra Bael 1: (oblong) and Narendra Bael 2 (spherical) have been found very promising.
NB 5: Fruit size medium, round having smooth surface at maturity, low mucilage, moderately fibrous, soft flesh with excellent taste.
NB 6: Fruit size medium, round, smooth surface, thin rind, few seeds, soft flesh, low mucilage, mild acidic.
Pant Shivani: Mid-season cultivar, shape ovoid oblong, size 2 kg, colour lemon yellow at ripening, fibre and mucilage content medium, rind medium thick, pulp light yellow with very good taste and pleasant flavour
Pant Aparna: Late cultivar, fruit size small (0.6-0.8 kg), globose, seed, mucilage, fibre and acidity low. Flesh yellow, sweet, tasty and having good flavour rind medium thick.

Climate and Soil
Requires subtropical climate. Plants can be grown even up to an elevation of 1,200m. Not damaged by temperature as low as –7°C. Bael can be grown in any type of soil such as sandy, clay, water logged, un-irrigated, acidic or alkaline in the pH range of 5–10.

Propagation
It is propagated both through seeds and vegetative methods like grafting and budding. Budding is becoming popular. The scion shoots should be selected from mother plants which are prolific-bearer for it Patch budding is ideal method with a 90% success rate. June–July is ideal time for it. Air layering is also successful under humid tropical conditions. In vitro propagation has also been standardized but it is not feasible commercially.

Planting
Planted at a distance of 8 m × 8 m (budded plants) or 10 m × 10 m (seedlings). Pit size is 90 cm × 90 cm × 90 cm × 90 cm. February–March or July–August is the right time for planting. 10 kg farmyard manure, 50 g N, 25 g P and 50 g K/plant to one-year-old plants. FYM should be applied in beginning of May. Half dose of N, full dose of P and half dose of K should be given just before flowering. Remaining half dose of N and K should be given in the last week of August.

Training and Pruning
Young plants are trained with the help of stakes, so that they grow erect. Bael trees may be trained in modified central leader. Pruning is done twice in a year, once in May and other in August. Pruning is limited to the removal of dead and diseased twigs/branches in May while in August healthy leaves are pruned for sale.

Harvesting and Postharvest Management
Bael is widely used for preserve-making. Ripe fruits can be processed into quality beverages (ready-to-serve nectar, squash and cider), jam, toffee, powder and other products. Fruits become fully mature 8 months after fruit set. Peel changes from deep green to light green and flesh (pulp) from light yellow to deep yellow. Ripe fruits are mostly used for beverage-making hence they should be harvested at ripe or fall on the ground otherwise a minor crack in the shell can cause spoilage during their storage.

Pests and Diseases
Pest - Fruit cracking is the physiological disorder in some genotypes of Bael which occurs just before ripening. More than a dozen insects have been found feeding on Bael. *Phyllocnistis citrella, Aonidiella aurantii* and *Papilio*

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demoleus are the important insects which can be easily controlled by use of insecticides. Bacterial shot hole, fruit canker and gummosis are the serious diseases.

Diseases - Bacterial shot hole and fruit canker. *Xanthomonas bilvae.*

	
Fruit	**Tree**
	
Trifoliate leaves and spiny branches	**Flowers**
Bael Fruit (Aegel marmelos)	

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Processing and Application of Wastewater for Farming

Article ID: 32635

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Introduction

Ensuring global food security for the ever-growing population that will cross nine billion by 2050 and reducing poverty is a challenging task. Increased food production has to come from the available and limited water and land resources which are finite. Neither the quantity of available water nor land has increased since 1950s, but the availability of water and land per capita has declined significantly due to increase in global human population. For example, in India per capita water availability has decreased from 5177 m3 in 1951 to 1820 m3 in 2001 due to increase in population from 361 million in 1951 to 1.02 billion in 2001 which is expected to rise to 1.39 billion by 2025 and 1.64 billion by 2050 with associated decrease in per capita water availability of 1341 m3 in 2025 and 1140 m3 by 2050, respectively (Wani et al., 2012).

Fresh water scarcity is becoming an increasingly acute problem primarily in arid and semi-arid regions of the world. Treated wastewater is being used in many countries throughout the world as a reliable source of water which can fulfil the gap between supply and demand in water sector (Oron et al., 2007). Advancements in the effectiveness and reliability of wastewater treatment technologies have improved the capacity to produce recycled water that can serve as an alternative water source in addition in meeting water quality protection and abatement requirements (Papadopoulos and Savvides, 2003; Lazarova, 2000; Camargo et al., 2007)

Wastewater irrigation has been practiced for centuries throughout the world (Tripathi et al., 2011). In poor and developing countries raw wastewater used for irrigation, even if this is considered illegal. Wastewater provides with a nutrient enriched water supply (Ullah et al., 2012 and Ghosh et al., 2012) and society with a reliable and inexpensive system for wastewater treatment and disposal (Feigin et al., 1991). The volume of wastewater generated by domestic, industrial and commercial sources has increased with increasing population, urbanization, improved living conditions and economic development (Qadir et al., 2010).

Wastewater Treatment

Wastewater could be treated by two processes: Physicochemical and Biological processes:

1. Physicochemical processes: There is several physicochemical treatment processes used for wastewater treatment are as follow:

a. Coagulation and Flocculation: Coagulation is a process of aggregation of colloidal particles using chemicals such as aluminum sulfate, ferrous sulfate, ferric chloride, aluminum chloride, etc. Coagulation and chemical were used in distillery wastewater treatment. Coagulation is occurring after the reduction of zeta potential and repulsive force which possible by different mechanism such as interparticle bridging, charge neutralization, ionic layer compression and sweep coagulation. Flocculation is also a process of aggregation mostly carried out by high molecular weight compounds like polymers (poly g-glutamic acid, poly aluminum chloride, chitosan, etc.). Coagulation-flocculation was more effective in color removal than chemical oxygen demand (COD) removal of the DWW.

b. Oxidation processes: Organic and inorganic pollutants in the wastewater are degraded by redox reactions. In DWW treatment, complex refractory and recalcitrant compounds are break down into simpler compounds by oxidation processes. Oxidation processes are classified as hydrothermal oxidation processes (wet air oxidation, critical, subcritical and supercritical water oxidation processes) and advanced oxidation processes (photolysis, cavitation, ozonation, photocatalysis, peroxide treatment, persulphate treatment, Fenton's oxidation, etc.). Hydrothermal oxidation processes are useful in the treatment of high strength wastewaters (COD >40 g/L), whereas advanced oxidation processes are used in the treatment of low strength wastewaters (Gogate and Pandit, 2004; Sangave et al., 2007).

c. Adsorption: Adsorption of contaminant on the absorbent due to physical and chemical mechanism is called adsorption. It is one of the most popular and widely used tertiary treatment units due to its low cost, ease of operation, high efficiency and high regeneration capacity of the adsorbents. Activated carbon is one of the most efficient adsorbents.

d. Membrane technology: In membranes technology, different size of filter material can used that filters all the particles having size less membrane size. In this technology, different pressure applied on the membrane plate to filter the wastewater. Membranes are used as a tertiary treatment after biological units for complete removal of color, TDS, nutrients, and organics. Direct application of membrane unit is energy intensive. (Rai et al., 2008).

2. Biological process: In this process, different microorganism such as bacteria, fungi and algae are used to treat wastewater. Microorganism can degrade complex compound to simple compound by oxidation and enzymatic process. Some bacteria can intake heavy metals. Among all living organism, Algae is most commonly used for wastewater treatment. Different kinds of plant are also used to remove contaminant from wastewater.

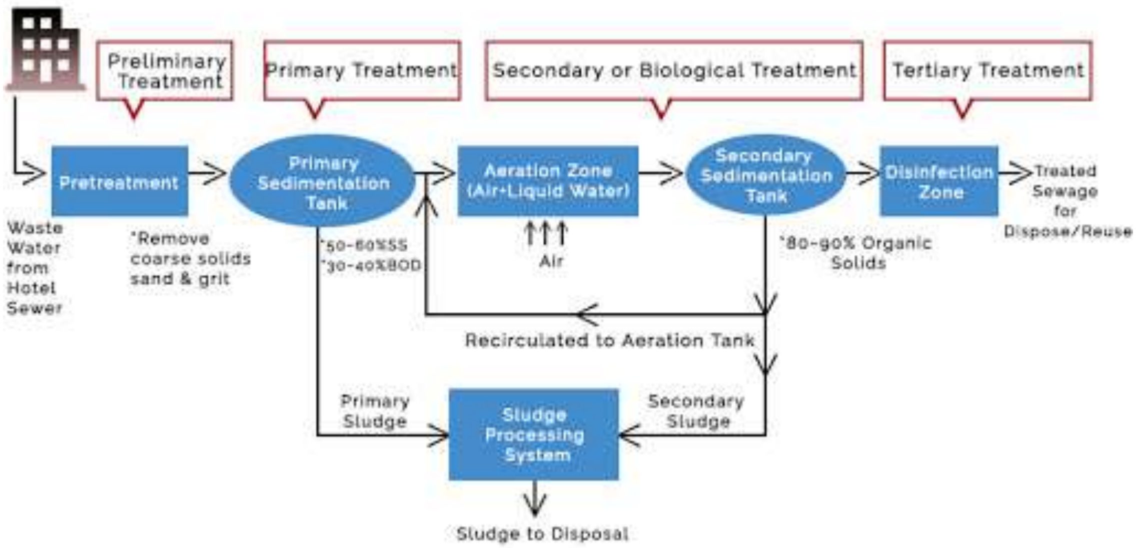

Figure 1. Typical Wastewater treatment processes.

Benefits of Wastewater in Farming

1. Wastewater application can reduce load on fresh water use in agriculture.
2. Wastewater application will increase crop production.
3. Treated wastewater uses in agriculture could decline ground water pollution.
4. Area under various crop can increase around cities.
5. Wastewater can ultimately improve Indian farmer economic.
6. Soil fertility status could be improving with treated wastewater application.
7. Treated wastewater are harmless to the crop.

Conclusion

Wastewater is a poor quality of water use for farming. Wastewater contain essential plant nutrient which can increase grain yield. This water can reduce fresh water usage in farming and also increase water use efficiency. Treated wastewater can reduce water pollution and environmental losses.

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Integrated Farming System (IFS) For Dryland Agriculture

Article ID: 32636

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Definition

It is defined as a system of farming on a particular farm which includes crop production, raising livestock, poultry, fisheries, bee keeping etc. to sustain and satisfy as many needs of the farmer as possible. It gives greater importance for sound management of farm resources to enhance farm productivity which will reduce environmental degradation and improve the quality of life of resource poor farmers and to maintain agricultural sustainability.

Components of Integrated Farming System

There are many components in the integrated farming system viz., cropping unit, livestock, agro forestry, horticulture, border plantations, bee keeping, vermicompost, biogas unit etc.

Dryland Agriculture

Dry land constitutes nearly 62% of the total cropped area of 142 m. ha. in the country contributing about 42 per cent of total food production. It is characterized by highly fragile resource base and productivity of agriculture mainly depends upon the prevailing weather conditions. Among all the climatic factors, rainfall is the major deciding factor. Erratic and ill-distribution of rainfall coupled with high rates of evaporation in dry climate results in periods of water deficit and has serious implications for stability of crop production. The important soil groups are vertisols and alfisols and their associated orders which are characterized by low organic matter and poor nutrient status particularly nitrogen, phosphorus, sulphur and calcium. The main constraints that limit crop production in dry land are moisture stress and deficiency of nutrients. Poor soil fertility coupled with low water holding capacity also lead to poor crop yields in dry farming regions.

Need for IFS in Dryland Agriculture

The disappointing results of conventional cropping systems in advancing the productivity of farm is making the farmers to go for alternative way. The IFS view the whole farm as a system with the integration of crops, animals, soils, workers, other inputs and environmental influences wherein the farm family attempts to produce outputs within the limitations of its capability and resources. Development and adoption of IFS will help in productivity enhancement, employment, income generation and nutritional security both for human and livestock. The different components of the system have complementarities with waste products of one component becoming source of food and energy for other components.

Table 1. Suitable IFS Models for Arid and Semi-Arid Regions of India:

Regions	IFS Model
Semi-arid region of Tamil Nadu	Crop + Poultry (20) + Goat (4) + sheep (6) + dairy (1).
Dryland western zone of Tamil Nadu	Sorghum + cowpea and *C. glaucus* in 0.33 ha intercropped with *Emblica officinalis* + goat (5+1).
Semi-arid Gujarat	Crops +horticulture + dairy buffalo (6).
Semi-arid Harayana	Cropping + buffalo.
Arid Rajasthan	Agroforestry with six adult cattle unit (4 cow, 8 bucks and 4 rams).

(Rathore et al., 2019)

In rainfed regions of Chhattisgarh, crop-livestock integrated farming system resulted in highest net income, B:C ratio and more employment days. Crop + 2 Bullocks +1 Cow + 1 Buffalo + 10 Goats farming system resulted in higher B:C ratio (2.26) whereas Crop + 2 Bullocks +1 Cow + 1 Buffalo + 10 Goats + 10 Poultry + 10 Ducks farming system resulted in highest net returns (Rs 33076) and employment days (316 days) (Ramrao et al., 2006). Economic evaluation of arid land farming system in arid western Rajasthan with different agroforestry practices revealed that high B:C ratio was achieved when Agri pasture farming system (1.87) was followed which was on par with agri-silvicultre (1.69) (Bhati et al., 2004). Tanwar et al. (2018) revealed that including agroforestry, horticulture and silvi-pasture increased the net returns over the arable cropping alone and maintained the stability over the years. Alternate land use systems of integrated farming system yield better net income than arable cropping alone. Agri-horticultural system gave more net returns (Rs. 66100) followed by Silvi-pasture system (Rs. 39600) which was found to be higher than the arable farming with gave net returns (Rs. 11900).

IFS Model for Dryland Ecosystem for 1 ha Area at Shivamogga

Coconut and drumsticks were planted along the borders. The bunds were strengthened with Napier grass cultivation. Segment: 1 – Dairy sector : 2-cows,14- Sheep, 50- Poultry (Giriraja), Segment: 2 – Sapota + Banana + Jack fruit, Segment: 3 – Groundnut, green gram, ragi, maize, red gram., Segment: 4 – Teak wood , curry leaves, fodder + Azolla., Segment: 5 – Compost + Vermicompost + Biodigester, Segment: 6 – Kitchen garden + Poly house + shade net. The overall farm productivity from the different enterprises was significantly higher. The net income generated from the different component in a one year is Rs. 4,89,650/- year per hectare (Dr. B.K. Desai. 2017. RKVY project UAS, Raichur).

Conclusion

Existing cropping systems are not economically viable for farmers in dry land regions. Integrated farming system is highly recommended in dry region which provides the farmers with food, nutritional and economic security along with the employment generation. Integrated farming system with different components helps to address the majority of problems in dryland agriculture.

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Managing Psychological Problems in Post Covid-19

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Introduction

Today the world is facing pandemic situation, the corona virus is sweeping around the globes, Corona virus is new virus which has been discovered with its outbreak in Wuhan in December 2019.

Covid-19 has brought sorrow and loss to forefront of our minds however grief and sorrow is not new challenge for individuals it's always part of life but sudden unexpected death unemployment, social distancing, family crises due to loss of income , political issues in our country in pandemic situation are more challenging.

Some other Covid related challenges pertain to insufficient protection, homelessness, inadequate training and facilities of medical staff, high level of contagious ness of virus that deprived person must deal simultaneously. Above crises in post Covid-19 can also trigger the onset of mood swings ,stress ,anxiety depression and other psychological disorders may also.

Psychological Problems in Post Covid-19

Following psychological problems facing by person which are given below:

1. Frustration and boredom: After 7-8 month of Covid-19 pandemic situation individual facing unemployment, fear of Corona social distancing, isolation etc. which are producing boredom and frustration.

2. Anxiety: Anxiety may be directly related to sensorial deprivation and loneliness due to Covid because of feelings of uncertainty for the future, fear of new and unknown infective thinking for own and family may increase anxiety. In case of lower social support, separation from loved one, loss of freedom, jobless situation which associated to financial crisis are responsible for anxiety and stress also.

3. Depression: Depression and anxiety are different but people with the depression often experience symptoms similar such as- nervousness, irritability, disturb sleeping, lack of concentration etc. Women having more depression in comparison to men. In this pandemic situation low- and middle-income group facing more depression due to financial crisis, some poor also attempted to suicide in lockdown
which having large number of family members.

Signs of Psychological Problems

1. Loss of appetite.
2. Poor concentration.
3. Sad feelings.
4. Energy loss (fatigue).
5. Guilt.
6. Sleeping problem.
7. Sometimes suicidal thoughts.
8. Poor social contact.
9. Anger, fear.
10. Lack of problem-solving ability.
11. Helplessness.
12. Negative self-talk.
13. Upset stomach.
14. Muscles aches.

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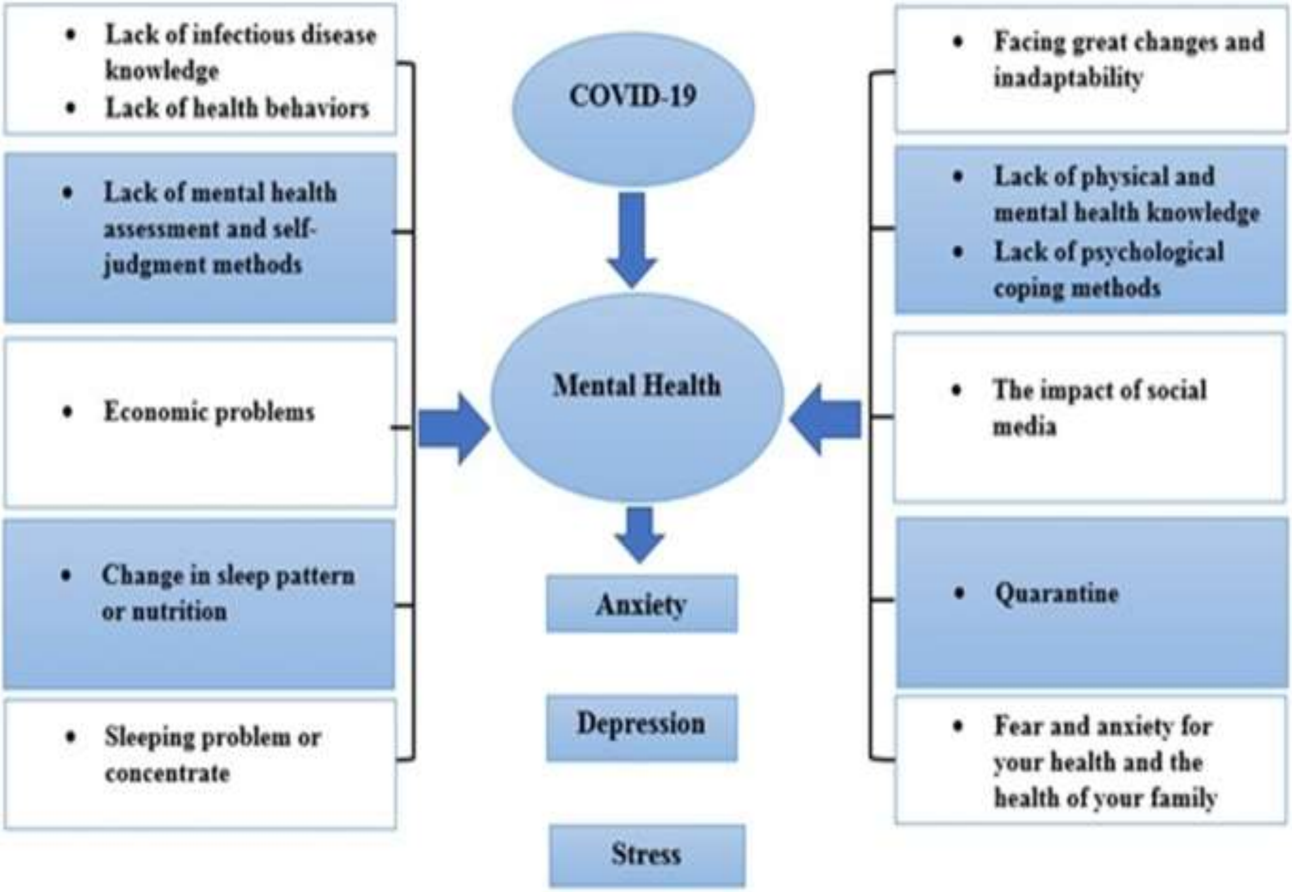

Factors

Some factors are responsible for the psychological problems in post Covid-19, which are listed below:

1. In adequate supply of goods and services and it's higher rate.
2. Inadequate information.
3. Residence.
4. Low social support.
5. Low emotional support.
6. Economic support.
7. Unemployment.
8. Racing thoughts.

How to Manage Psychological Problems

Following preventive measures which are help full to manage these problems, given below-

1. Reduce to fear and unnecessary worry about coronic situations
2. Narcotics like tobacco, alcohol etc. should not use.
3. Take care of family members or loved ones.
4. Community support to each other.
5. Individual if feel fear infection of Covid that firstly contact to health professionals before starts any self-treatment.
6. Should be Emotionally strong to self and family also
7. To reduce boredom and frustration can watch T.V. Mobile game, movies, programs, reading magazines, novels etc.
8. To fight against economical stress should make budget and control on extra expenses.
9. Stay connected with friends and relatives may enhances positive thoughts and overcome of boredom also.

10. Regular breathing exercises like – pragmatic breathing, abdominal breathing, belly breathing, it's helps full in slow heart rating which can feel peacefully and relax.
11. Healthy diet also play vital role to reduce psychological problems such as-dark chocolate, turmeric, yogurt, egg, meat, dairy products, almond, blue berry, are helpful so should take in diet.
12. Anxiety, stress for some times can be prevent by supplements like – Balm, ashwgandha, mint added oil, green tea etc.
13. Stay connected to favorite activities in this pandemic situation.
14. To know exact level of problem can be used Hamilton Anxiety Rating Scale (HAMA) and (HAMD) depression rating scale by professional which are required to overcomes of these problems.
15. If people with mild symptoms that they can manage at home with presence or without fear.
16. Concentrate mind and thoughts on pandemic situation which are continue facing, write on paper as an article, review paper etc. to utilize time to avoid frustration anxiety and boredom also.
17. Mind fullness practices like- cognitive therapy, yoga, meditation can help lower symptoms of psychological problems.
18. Sleeping and eating patterns should be change.
19. Accept situations that can't change and remain hopeful to brighten life again.

Conclusion

After 7-8 month of post Covid 19, situation become not improve totally which are facing by peoples like – unemployment, health, socioeconomic, political etc. Each problem is connected to each other and responsible for psychological illness.

Very few articles have examined in post Covid 19 from psychological problems and managerial perspective so main goal of this article is to provide necessary information and relevant intervention action as well as preventive measures to cope effectively with psychological problems.

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Nutritional and Medicinal Properties of Giloy: (Amrita)

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Introduction

Tinosporacordifolia (Thunb) Miers (family: Menispermaceae) commonly known as “Amrita” or” Guduchi” of “Giloy” a climbing shrub found throughout India. Herbal formulations are medicinal preparation of one or more herbs present in specified quantities to give the benefits meant for cosmetic, diagnose and to mitigate diseases of human beings or animals. It is also known as botanical medicine or phyto-medicine. The stems and roots are an integral constituent of several compound preparations. The World Health Organization (WHO) estimated that up to 80% of people still relay mainly on traditional remedies such as medicinal plants for their medicines. Since the beginning of human civilization, plants have been used as natural medicines. Recently, scientists are showing a great interest in the development of new drugs from traditional medicinal plants. Male flowers are clustered, but female flowers are usually solitary. It has six sepals in two series of three each. If you were looking for a wonder Ayurvedic herb that will treat most of your problems then Giloy is a must try one. Known by many names, this herb offers tons of health benefits including immunity boost up, weight loss, preventing infections etc. to name a few. It is now an active part of both traditional and Ayurvedic patented medications. The plant is designated as Rasayana in Ayurveda and is very well known for building up the immune system and body’s defence against definite infecting Micro-organisms.

Nutritional Composition of Giloy

As is evident from the table the values for different constituents in Giloy are estimated as 17.69 per cent for moisture, 4.13 per cent protein, 3.12 per cent for fat, 12.01 per cent ash, 16.19 percent fibre, 37.90 per cent NDF and 34.65 per cent ADF observed proximate composition as ash (12.41%), moisture (18.34%).

Parameters	%
Moisture	17.69
Protein	4.13
Fat	3.12

Ash	12.01
Fiber	16.19
NDF	37.9
ADF	34.65

Medicinal Properties of Giloy

Popular for its immunity boosting properties, Giloy helps in actively fighting against various pathogens. It is a part of Indian medicine from a very long time. The stems and roots are an integral constituent of several compound preparations. Giloy is an ancient herb that is packed with an array of benefits. Giloy literally means ‘Amrita’, which means the root of immortality. Its abundant medicinal properties have time and again proved that Giloy is one of the most effective natural medicines.

Health Benefits of Giloy

1. Giloy Helpful for Chronic Fever: Also, it can reduce the symptoms of some deadly diseases like dengue, malaria, swine flu etc. So, the next time you have fever, you can opt for a cup of Giloy juice to get rid of it instead of popping up a paracetamol. Being an anti-pyretic in nature, Giloy can prevent the onset of recurrent fever.

2. Boosts Digestion: You can also try Giloy juice with buttermilk. To take care of your digestive system and improve digestion, you can consume half a gram of Giloy powder with Amla daily in the morning. People who are suffering from piles can also consume Giloy this way to get some relief.

3. Manages Diabetes: This herb helps in managing the level by assisting in the production of insulin. Giloy can also burn excess glucose and reduce the level of blood sugar. Used in Indian medicine since ages, the giloy plant has abundant medicinal properties.

4. Giloy shall help us fight off Respiratory Issues: The phenomenal anti-inflammatory powers found in this immortal herb can help fight off any common respiratory issues such as frequent cough, cold, tonsilitis. Other than pesky cold and cough, it can also provide relief to asthmatic patients. While symptoms such as chest tightness, shortness of breath, coughing, and wheezing make it difficult to treat asthma–giloy can help manage these symptoms better.

5. Giloy might just delay the onset of Osteoporosis in Women: An interesting research paper published in Maturitas, the official journal of the European Menopause and Andropause Society, claims that giloy root extracts can have an osteoprotective effect on the body.

Conclusion

Although Giloy plants are abundantly available in India and you don’t necessarily need to pop supplements to reap its benefits, it is always advisable that you talk to your doctor before make Giloy a regular in your life. The plant, for its vast bio-diversity and traditional medicinal importance, it provides a new sight of challenging research for the scientists to isolate pharmacologically active and therapeutic components from the plant to treat several dreadful diseases. *T. cordifolia* is a medicinal plant having various types of compounds. The different bioactive compounds, including alkaloids, steroids, glycosides, sesquiterpenoids, etc have been discussed.

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Bio-Fortification of Rice: An Answer to Fight Micronutrient Malnutrition

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An insidious form of hunger is haunting a large group of people in developing countries like India known as micronutrient malnutrition. Cognitive development, lower disease resistance in children and child death rates are the evident results of micronutrient malnutrition. The costs of these deficiencies in terms of lives lost and poor quality of life are staggering. Primarily poor-quality diets, characterized by high intakes of food staples, but low consumption of animal and fish products, fruits, lentils, and vegetables, which are rich sources of bio available minerals and vitamins is the chief underlying cause of micronutrient malnutrition. A major group of malnourished population is that who cannot afford to purchase high-quality, micronutrient-rich foods or who cannot grow these foods themselves.

The development of nutrient dense staple crops using the best traditional breeding practices and modern biotechnology primarily summed up as Biofortification could be the way out for a mass population. It makes foods more nutritious as plants are growing rather than having nutrients added to plant foods during processing.

For 3/4th of Indian population rice is the most important and staple food accordingly its productivity, quality and profitability have become an integral part of our National Food System. The Rice endosperm (starchy & most edible part of rice seed) is deficient in iron, zinc, iodine and vitamin A. The Aleurone layer of dehusked rice grains is nutrient rich but is lost during milling and polishing. Unprocessed rice becomes rancid or unpleasant in taste in rice micro-nutrient malnutrition is a common phenomenon.

Bio-fortification of rice with micro-nutrient is the only tool to reduce micro-nutrient malnutrition of staple foods whose edible portions are denser in bio available minerals and vitamins. A Global Challenge Programme (GCP) on bio-fortification has just been approved by Consultative Group on International Agriculture Research (CGIAR), aims to support all efforts to improve the nutritional value of rice, especially iron, zinc, vitamin A, calcium iodine and selenium, which are usually low in rice for particularly rice consuming communities. Prof. Ingo Potreykus & Dr. Peter Beyer carried out the Bio fortification of rice Because the rice endosperm lacks vitamin A and; Vitamin A deficiency causes night blindness; impaired vision, epithelial tissue integrity, immune response; hematopoiesis & skeletal growth mostly in young children aged 1-5 years old Biofortification involved introduction of three genes in rice grain via Agrobacterium tumefaciens:

1. phytoene synthase (psy) – daffodil (*Narcissus pseudonarcissus*).
2. lycopene B - cyclase (crt) – daffodil (*Narcissus pseudonarcissus*).
3. phytoene desaturase – bacterium (*Erwinia uredovora*).

Successful production of Golden rice 1 (GR1) and Golden rice 2 (GR2) with a characteristic achievement of GR1 having yield of 1.6µg provitamin A/g in endosperm and GR2 having higher yield of 31µg/g provitamin A in endosperm by replacement of psy gene from daffodil with a psy gene from maize. On an average consumption of 72µg of GR2 could provide the recommended daily vitamin A allowance for 1-3-year olds, because they consume 100-200g of rice per meal.

Though iron (Fe) is the second most abundant metal in nature and fourth most abundant element in the earth crust, about 11% Indian soil are in deficient supply of iron. Because of their iron absorption efficiency, cereals provide an important entry point for iron into the food chain, however, the concentration of iron in the grain are quite low compared to meat-iron sources. In human body, Iron (Fe) is a redox - active constituent of the catalytic site of heme and non-heme iron proteins Metabolic functions of Fe include chiefly as an element in blood production, serving as a component of enzymes involved in synthesis of collagen & some neurotransmitters and providing a transport medium for electrons within the cells in the form of cytochromes. In the Fe-Rice Biofortification process, three genes were introduced into the Japonica rice variety.

1. Ferritin it enhances iron storage in grains & was expressed under an endosperm specific promoter.
2. Nicotianamine synthase which was expressed under a constitutive promoter & produces nicotinamine which chelates iron temporarily facilitating its transport in plants.
3. Phytase it degrades phytate. Among the various Fe- carriers $FeSo_4.7H_2O$ is the most commonly used fertilizer for correcting Fe-deficiency in rice.

Synthetic Fe chelates are generally the most effective Fe sources for soil and foliar applications their cost may be prohibitive but it may be cost-effective if crops are of high value. Most of the researches on methods of iron application have shown the superiority of foliar application over soil application. Soil application of 20kg Fe /ha as $FeSo_4$ proved inferior to 3 foliar sprays with 2% un-neutralized $FeSo_4$ solution in amending Fe deficiency in rice grown on coarse textured soils. New attempts are being made to develop slow-release fertilizers that will gradually release Fe to the soil. Resin-coated soluble Fe materials such as $FeSo_4$ or Fe EDTA were tested as slow-release fertilizers with little success. It was reported that application of 50kg $FeSo_4$/ha alone significantly increased the grain yield of rice by 8.7 q/ha over control. Also, the magnitude of yield response as well as Fe uptake by rice due to $FeSo_4$ or pyrite was enhanced in presence of compost.

Large variation in iron and zinc content in grains of rice varieties, have been observed. The aromatic cultivars have consistently higher concentration of iron and zinc in grain than the non-aromatic types. Zn-efficient varieties with Zn-dense seeds are higher yielding in Zn-deficient soils. Zn is an important micronutrient playing a critical role in tissue growth, wound healing, connective tissue growth & maintenance, immune system function, prostaglandin production, bone mineralization, proper thyroid function, blood clotting, cognitive functions, fetal growth & sperm production. Also, it plays an important role in the health of skin, bones, hair, nails, muscles, nerves & brain function. Zinc is utmost required for metabolic activity of enzymes (as a cofactor) involved in repair & replacement of body cells. In the Zn-Rice Biofortification process, three genes of the OSNAS family were introduced into Japonica rice cultivar *Nipponbarp*. These three genes encode production of nicotianamine (NA) - a chelator of transition metals that facilitates uptake & transport of metal cations including, Zn^{2+}. Specific over-expression of OSNAS resulted in significant increase in NA concentration and Zn. The gene OSNAS 2 activation had 20-fold more NA & 2.7-fold Zn in polished rice grains. OSNAS 3 activation was reported to reverse signs of Fe-deficiency when fed to anemic mice. The density of several micro-nutrients in grain can effectively be enhanced by application of appropriate mineral forms. The sources of micro-nutrients are inorganic, synthetic chelates or natural organic complexes. Foliar fertilization has many advantages over soil application due to lower requirement and immediate crop response. Zn deficiency can be corrected by either foliar or soil applications of ZnSo4 or Zn EDTA. Applications of Zn on soil are more effective than foliar applications. It has been found that significant increase in dry matter yield of rice is possible due to application of Zn @ 2.5 to 5 mg/kg soil as ZnSo4 or 0.3mg/kg soil as Zn EDTA over control. Similarly, it was reported that Zn EDTA treatment, in spite of supplying the lowest amount of zinc, produced the highest yield of rice and the highest Zn mobilization efficiency compared to other Zn sources. The application of 25kg ZnSo4/ha or 10kg chelate/ha significantly increased zinc content and uptake by rice grain as well as straw. It was also reported significant influence on Zn and Fe uptake by hybrid rice due to application of different levels and modes of zinc and ferrous sulphate.

In human nutrition terms, bioavailability is commonly defined as the amount of a nutrient in a meal that is absorbable and utilization by the person eating the meal. The total amount of a micronutrient in a plant food does not represent the actual micronutrient content of the food that is utilizable by the consumer. This quality (i.e. the bio-available amount) must be determined independently using methodologies especially developed for such purposes. However, such human experimentation is costly and long-term in nature. Therefore, initial bioavailability screening of promising lines of micro-nutrient enriched staple food crops was performed using a rat model as rat are more efficient at absorbing Fe and Zn than human from plant food sources. The evil sides of bio fortification include that it involves high production costs .i.e. equipment, technology, patenting, etc; Potential negative interaction of biofortified rice on other plants/ non-GM rice crops causing loss of wild-type rice varieties. Low substantial equivalence- i.e. inability to provide high micronutrient and protein content compared to supplements. Poor rural populations have limited access & resources to purchase biofortified rice. Genetic engineering methods used may compromise immunity in humans .i.e. introduce increased risk of allergenicity are the few to be added.

In the present scenario of pandemic, micronutrient malnutrition is a leading health-care issue in the world today and much more detectable in developing countries. Cereals are often most productive but are generally low in micro-nutrient. In developing countries cereals dominate dietary system and thus appear to be the most likely reasons of micro-nutrient deficiencies in the society. Therefore, it is imperative to increase the micro-nutrient density of the major staple food crops. To an extent it can be rectified by selection of nutritionally rich (aromatic) varieties of rice which can form the basis for a food-based solution to the nutrition needs of the population. Application Zn fertilizers on soil are more effective than foliar. Foliar application (2-3) of Fe containing fertilizers proved more effective as compared to its soil application. Also, the inclusion of organic amendments (FYM) in fertilizer schedule was found promising in improving the Zn and Fe content of rice. Besides, agronomical approach, the bio available amount of Zn and Fe in rice should also be determined with cost effective method.

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Nano-Pesticides: Emerging Opportunities for Crop Protection

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Summary
Pesticides have been one of the ineluctable components of Indian agriculture. The higher dosage of these chemicals per hectare has resulted in many environmental and health hazards. The advancement of a new research field of nanotechnology has contributed to the development of nano pesticides. These chemicals contain nano-sized carrier molecules or active ingredients. The research community has developed many formulations (i.e., nanoemulsions, nanosuspensions, controlled release formulations, solid-based nanopesticides). The smaller size of the chemicals allows to disperse properly on the pest surface and hence to achieve better action than traditional pesticides. In the meantime, we should have a better understanding of the ill effects of these nano-pesticides after their application.

Introduction
The world population is increasing at an alarming rate. Globally, people are engaged in agriculture for the production of essential food crops and many other forms of products including fuels, fibers, and raw materials. Because of the shortage of natural resources and limited crop productivity, there is a growing demand for advanced agricultural techniques that are viable economically and environmentally (Suzuki et al., 2014 and Bouchet et al., 2016). Synthetic fertilizers and pesticides have been developed and used to increase agricultural yields to overcome these issues (Lamberth et al., 2013 and Schreinemachers and Tipraqsa, 2012). Pesticides, including herbicides, fungicides, insecticides, rodenticides and so on, are commonly used because of their efficacy, ease of use, availability and relatively low cost compared to other control methods. Non-targeted beneficial organisms such as insect pollinators, birds or natural pest enemies may be endangered by the use of non-selective pesticides. In addition, persistent lipophilic pesticides that are not broken down in the environment can enter the food chain. Moving the food chain unchanged, they appear to accumulate in fatty tissues. As a result, the concentration of pesticides stored by species increases at each food chain and ultimately becomes a significant threat to animal and human health. Furthermore, pesticides can be ineffective due to the fact they do no longer attain the target organism, being washed off or taken away through wind thereby spreading out in the surroundings and contaminating soil and groundwater in nontargeted areas. Another issue that can have an effect on effectivity is the stability of the pesticide system and of the lively ingredients. Improper timing of application meaning that the pesticide is applied at the wrong stage of pest development also leads to ineffective pest control. All these factors unduly increase the costs of pest management due to the use of much larger amounts of pesticides than those really needed to effectively control pests which in turn negatively impacts the environment by reducing soil biodiversity, reducing nitrogen fixation, and increasing bioaccumulation of pesticides in humans and other living organisms. Nevertheless, it should not be omitted that in response to frequent pesticide applications, pests may develop resistance to pesticides. However, organic farming cannot be the solution to these issues, because it takes more land to produce the same quantity of food as traditional agriculture. The adoption of organic farming as an effective solution to food security is constrained by a number of obstacles, including lack of knowledge, current policies, poor infrastructure, strong vested interests, myths, cultural prejudices and economic challenges. Consequently, the ultimate solution can be sought from the use of advanced techniques such as nanotechnology dealing with nano-scale materials to obtain a multitude of special physicochemical properties. Nanomaterials have novel physical, chemical and

mechanical properties (through their bulk-form conversion) and can overcome a range of limitations inherent in existing products (e.g. in terms of cost, manufacturing techniques, functionality and overall performance). Nanotechnology has the ability to revolutionize agriculture by balancing crop nutrients against their deficit or surplus values, controlling water quality, seed treatment, pest control, germination, pesticide and fertilizer distribution, detecting harmful agrochemicals and reducing the harmful effects of plant protection products. Research efforts have been made to develop nano-based active ingredients of pesticide to achieve higher efficacy with reduced pesticide volumes and economic output with increased yields (Kah et al., 2016). Pesticide nano formulations or nano pesticides must provide a wide range of benefits (including increased efficacy and longevity, good dispersion and wettability, soil and environmental biodegradability, lack of toxicity, photogenerative nature) and have reduced levels of active ingredients with convenient pesticide properties so that they can be used effectively to protect crops from pesticide use. Rapid research in nanopesticides has encouraged researchers to produce nanopesticides that are less toxic to the environment and target-specific without losing their efficacy (Kookana et al., 2014 and Prasad et al., 2017). Target-specific nano pesticides can also help to minimize damage to non-target plants and reduce the amount released to the surrounding environment.

Nanoformulation of Pesticides

Nanoemulsion: Nanoemulsion was established as a promising delivery mechanism for various chemical compounds, including insecticides. Nanoemulsions are also known as isotropic and kineticly stable emulsion systems in which the oil droplets containing the hydrophobic portion are stabilised by a thin layer of emulsifier. They tend to be either transparent (droplet diameter < 200 nm) or milky (droplet diameter at 500 nm) with a mean droplet diameter varying from 50 to 1000 nm. e.g. Oil in water nanoemulsion of neem oil has been developed for insect management using Tween 20 as the surfactant.

Advantages

1. The nanoemulsion is more stable than the normal emulsion. This means that the nanoinsecticides are more effective and stable than the conventional insecticides which have nanoemulsion.
2. The nanoemulsions have a wide surface area and free energy than the normal emulsion; this means that little quantity of nanoemulsion can cover a wide area.
3. The nanoemulsions don't produce the inherent creaming, flocculation, coalescence, and sedimentation. So, nanoinsecticides will be homogenous.
4. Increase the rate of absorption. This means that the nanoactive ingredient was more conjugated with the nanoemulsion.
5. Dispersibility of nanoemulsion is very high compared with normal emulsion because the small droplet prevents the flocculation of droplets, and this process makes the system dispersed without separation and homogenous.
6. Nanoemulsion formulation provides a rapid penetration of active ingredients through the plant leaves. So, this formulation is very effective against sucking insects. These formulations may be used to increase the bioavailability of poor water-soluble insecticides.
7. Nanoemulsion can be formulated into different dosage forms with ease of manufacture and scale-up.

Nano-Suspensions

Nano-suspensions, often referred to as nano-dispersions, are formulated by dispersing the pesticide as solid nanoparticles in aqueous media. In nanodispersions, the surfactant molecules are limited to the surface of the particles where the polar parts extend into the aqueous solution and the non-polar parts associated with the solid pesticide. The main usage of nanosuspensions is for the compounds that are water insoluble (hydrophobic) and soluble in oil. The nanosuspension insecticides have an easy dispersibility, high stability, and high bioavailability. e.g. Pyridalyl nanosuspension is prepared by using sodium alginate two and six-fold more effective as stomach poison against *Helicoverpa armigera* than the technical product and the commercial formulation, respectively.

Advantages

1. Increase the bioavailability of materials used.
2. Easy and simple methods for preparation.
3. Solving the problem of poor aqueous solubility.
4. Suitable for hydrophilic insecticides.
5. Increase the stability of insecticides used.
6. Reduction in insecticide concentrations used.

Nanocapsules

Nanocapsules are vesicular or reservoir-type structures containing an inner central cavity surrounded by a polymer coating or a membrane. The internal cavity containing the active ingredients can be either hydrophilic or hydrophobic. The nanocapsules are described as nano-vesicular structures that showcase a typical core-shell shape in which the compound is constrained to a reservoir or inside a cavity enclosed by a polymer membrane or coating (Letchford and Burt 2007; Anton et al., 2008). Nanocapsules are vesicular structures in which particular substances, solubilized in aqueous or oil cores, are protected with the aid of a single polymeric membrane. (Covereur et al., 2002).

Advantages

1. Longer period of effective action in a single use of any insecticides effectively reduces the level of insect infestation.
2. Operational safety: The active ingredients are gradually and successively released by the core and polymer walls of the capsules. This makes it possible to maintain a low concentration of those ingredients in sprayed places.
3. Easier removal.
4. Nonstain effect of the sprayed surface.

Nanoparticles

Nanoparticles are classified as a small material that acts as a single unit with its transport and properties. The size of the nanoparticles ranged from 1 to 100 nm. The main objective of nanoparticle insecticides is to enhance the delivery of insecticides on the surface of the plant leaf. Silica particles have been converted into nanoparticles for use in insect pest control. e.g. Silver nanoparticles can be used as an effective method in integrated pest management of Drosophila melanogaster and silica nanoparticles against the larvae and adults of *Callosobruchus maculates* and *Corcyra cephalonica*.

Advantages

1. Increased solubility of water insoluble active ingredients.
2. Increased stability of formulation.
3. Elimination of toxic organic solvents in comparison with conventionally used pesticides.
4. Capability for slow release of active ingredients.
5. Improved stability to prevent their early degradation.
6. Improved mobility and higher insecticidal activity due to smaller particle size.
7. Larger surface area which is likely to extend their longevity.

Nanogel

These are formulated by a cross-linking of polymeric particles having hydrophilic groups, thereby absorbing higher concentrations of water. These are also known as hydrogel nanoparticles. e.g. Chitosan nanogel.

Nano-Fibres

Nano-fibres are formed by electrospinning, thermal-induced phase separation. Researchers have developed electrospun nano-fibers filled with chemical, (Z)-9-dodecenyl acetate, a pheromone component that is incorporated in the polymer matrix for the management of many lepidopteran insect pests. e.g. essential oils of *Mentha piperita* and *Salvia officinalis* released from nanofibers used to control Indianneal moth, *Plodia interpunctella.*

Limitations in the Usage of Nano-Pesticides

Despite its many advantages such as quick action, high availability and reliability, traditional pesticides as chemical pest control agents often present a number of significant disadvantages and dangers, the most critical of which are low selective toxicity, low biodegradability and the production of pesticide resistance in target species associated with the excessive and inappropriate use of these compounds.

Future Perspectives

Much work is still needed on nanopesticide formulations before they become more common in pest control by integrating analytical techniques that can detect, classify (e.g. through size, size range, shape or nature, and surface properties) and quantify the active ingredient and adjuvants emanating from the formulations. Nanotechnology can make agriculture eco-friendly and efficient by reducing the use of crop defence chemicals. Smart transport of fertilisers, pesticides and growth regulators, including nanosensors for real-time soil conditions monitoring, crop growth and pest and disease attack, is made possible by the production of nano-devices and products. Nanopesticides seem to have a promising future in creating safer and more efficient chemical pesticide formulations for pest control, which could potentially lead to groundbreaking changes in this field.

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Cisgenesis: A Novel Approach for Crop Improvement

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Introduction

Rising population and food demands necessitate global agricultural production be increased by 50% by 2030 (The Royal Society, 2009). In the meantime, climate change and shrinking environmental resources are restraining agricultural production over the world (Lobell et al., 2008). These challenges bring an urgent need to improve crop productivity. To breed crops with improved yield and resistance to environment stresses, a crucial consideration is how to efficiently utilize genetic diversity. Genetic crossing, natural or artificial mutations and transgenics are the main techniques for genetic improvement in plant breeding.

Traditional plant breeding utilizes crossing and mutagenesis for genome modification to improve crop traits. It introduces new beneficial alleles from crossable species. Crossing barriers, linkage drag and requires several generations of breeding and selection are major limitations of traditional plant breeding. Transgenic breeding uses molecular cloning techniques to identify cloned or synthesized genes of interest and directly transforms the recipient genome. This process manipulates plant genomes through insertion of gene(s) from another species. An organism that is generated this way is considered to be a genetically modified organism (GMO). Many plant species, such as rice, soybean, maize, cotton, canola, potato, cassava, squash, papaya, groundnut and oilseeds have foreign genes inserted in their genomes. However, improving crops through GMO is also often associated with safety concerns, environmental risks and health issues due to the presence of foreign DNA. These limitations have prompted the development of alternative technology like cisgenesis. It has been developed as new tool aimed to modify crops (Espinoza et al., 2013).

What is Cisgenesis?

Concept of cisgenesis introduced by Dutch researchers Schouten, Krens and Jacobsen (2006). They defined cisgenesis as the genetic modification of a recipient plant with a natural gene from a crossable, sexually compatible plant. Such a gene includes its introns and is flanked by its native promoter and terminator in the normal sense orientation. Cisgenic plants can harbor one or more cisgenes, but they do not contain any transgenes (Schouten et al., 2006).

Recent progress in plant genome sequencing facilitates the isolation of plant genes from crossable species. These genes are called cisgenes. Increasing numbers of these cisgenes have been isolated and new transformation protocols have been developed, which do not leave marker genes behind. Cisgenic plants are more likely to be acceptable to the public than transgenic plants.

Why Cisgenesis?

Some plant species difficult to breed by traditional breeding methods like woody plants that don't flower for many years, intolerant to inbreeding and highly heterozygous. Some other plant species viz., potato, apple, grape and banana that are naturally sterile / are part of a highly desired and commercially widespread clone whose genotype needs to remain intact. Escape of foreign genes via pollen flow to natural vegetation can be a problem for transgenesis. However, in case of cisgenesis the genes are taken from wild relatives. To overcome the problem of linkage, drag genetic make-up of the original cultivar is preserved.
To appreciate cisgenesis first we need to understand the problems related to transgenic approach, traditional breeding and translocation breeding.

Problems Associated with Transgenesis are as Follows

Traditional breeding takes more time than other approaches like transgenic breeding and cisgenesis. The wild plant transfer genes of interest to the progeny, but deleterious genes are also passing. Linkage drag tremendously slow down the breeding process, especially if the gene of interest is genetically tightly linked to one or more deleterious genes. To reduce linkage, drag, need successive generations of recurrent backcrossing with the cultivated plant and simultaneous selection for the trait. Quality of crop is ruined.

Problems Associated with Traditional Breeding are as Follows

Radiation treatment causes random chromosome breaks. The majority of translocations resulting from radiation treatments were formed between non-homoeologous chromosome arms. These non-compensating translocations are genetically unbalanced, and lead to reduced agronomic performance.

These all problems associated with transgenic approach, traditional breeding and translocation breeding can be overcome with cisgenesis approach.

The Prerequisites for Cisgenesis

Cisgenic approach requires complete sequence information of the plant and the isolation and characterization of genes of interest from crossable relatives.

Applications of Cisgenesis in Crop Improvement

Stress tolerance like disease and pest resistance (plant incorporated protection, PIP) and improvement of quality traits are currently major goals of plant breeders and researchers working on the development of cisgenic crops. The targeted traits include fatty acid composition (omega-3 fatty acids, reduced saturated and increased unsaturated fatty acids contents, elimination of trans fats), enhanced flavor, fiber quality, improved shelf life, and also optimization for the use as food, feed, biofuel or industrial uses (Dunwell, 2011 and Stein and Rodríguez-Cerezo, 2010).

Vanblaere *et al. (2011*) were produced cisgenic Apple lines of cultivar "Gala". They employed the ORF of the HcrVf2 genomic region from the wild relative *Malus floribunda*, including 242-bp from its 5' UTR and 220-bp from its 3' UTR and conferring scab resistance.

"Cisgenic barley with improved phytase activity" was confirmed by Holme *et al.* (2012). They achieved the marker-free status of the cisgenic plants by using the pClean dual binary vector system that uses hygromycin resistance for selection (Thole *et al.*, 2007). The genomic region belongs to HvPAPhy_a gene comprised of 5208-bp and was amplified by PCR. With the introgression of supplementary copies of the HvPAPhy gene, the accumulation of phytase levels in the mature barley grain will be extremely useful for both the bioavailability of phosphate in the grain and regarding the environmental aspects.

Induction of tolerance to the most important potato disease, late blight caused by the oomycete *Phytophthora infestans.* (Holme *et al.*, 2013).

Kichey *et al.* (2009) reported that the production of barley with enhanced nitrogen use efficiency (NUE). Their cisgenic approach used the genomic sequence of *TIP2* (3532-bp), including promoter (1999-bp upstream) and terminator (564-bp downstream), and the *GS1* gene (*GS1a* isoform) which consisted of a 5.2-kb gene fragment, including 1.5-kb promoter and 491-bp terminator.

Han *et al.* (2010) examined the impact of the introduction of five cisgenes PtGA20ox7, PtGA2ox2,Pt RGL1_1, PtRGL1_2 and PtGAI1 associated with gibberellin metabolism from the genome sequenced clone Nisqually-1 of *Populus trichocarpa* and were transferred into the clone INRA 717-1B4 of *Populus tremula* × *alba*. The growth performance, morphology and xylem cell size were identified under the greenhouse. The genes employed in this study were expressed in the xylem and phloem and identified by microarray expression data.

Limitations of Cisgenic Approach

Although cisgenics technology is exhibiting considerable advantages, but still there are a few limitations associated with this technology. In this technique characters outside the sexually compatible gene pool cannot be introduced and development of cisgenic crops involves extraordinary skill and time, therefore, the required genes or fragments of genes may not be readily accessible but have to be isolated from the sexually compatible gene pool. This technique requires sequence information of the plant. Transformation efficiency of this approach is low to generate large number of transformants. The production of marker free plants usually requires the development of innovative protocols, since such protocols may not be readily available for the crop.

Conclusion

Thus, we concluded that the cisgenesis approach is an important novel genetic tool for improving various plant traits. Application of cisgenic techniques enhances the chance to introgress the preferred genes into the new cultivars, without disturbing their characteristics. Therefore, the most undeniable role of cisgenesis may be expected for the development of monogenic resistance traits. Major advantages could be probable in breeding of plants with long life spans such as trees.

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Agro Textiles – A Growing Field of Technical Textile

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Abstract

Agriculture has been amongst the most primal occupations of the humankind and is still a major industry, globally. In this era of modernization and high technological advancements, it has spread its horizons and started using man-made, non-conventional textiles, called "technical textiles". Textile fabrics have a long history of use in agriculture. The textiles used in Agriculture termed as "agro textiles". The word agro textiles now is used to classify the woven, nonwovens and knitted fabrics applied for agricultural and horticultural uses. These textiles are generally used for various applications including livestock protection, shading, weed and insect control. The essential properties required are Strength, elongation, stiffness, porosity, bio-degradation, resistance to sunlight and resistance to toxic environment.

Keywords: Agriculture, Biodegradation, Nonwoven, Shading, Strength.

Introduction

Food, clothing and shelter are the three basic needs of the human being. The human being started using the fibers as clothing from the Old Stone Age; later due to technological development textiles come up with the large areas of applications. Textiles used in agriculture are termed as "agro textile" and these textiles are used to protect crops from extreme climatic conditions.

An agro textile is one of the growing areas of technical textiles. It is a very much important segment of agriculture. Woven, non-woven and knitted fabrics are used as agro textiles. Agriculture is the largest industry in the world. In this science world, due to modernization and high technological advancements, textiles are used in growing, harvesting, protection and storage of either crops or animals. It also used in aquaculture such as fishing nets and fish lines, ropes, shade fabrics, mulch mats, woven and non-woven covers.

Textile fabrics play an important role to protect, gather and store agro products. Agro-textiles decrease the requirement of fertilizers, water, harmful pesticides and herbicides and render a healthy farming culture. Textiles used in agriculture are technically eco-friendly.

Agro- textile contributes about 1.5 per cent to the total production of technical textile goods in India, while the globally growing demand for agricultural products is expected to boost the need for agro-textile products.

Applications of Agro Textiles

Wide varieties of agro textile products are available and the selection of suitable type of products depends on the protection that the crop. Selection of the agro textile is greatly influenced by the geographical location.
Some of the applications of agrotextiles are as follows:

1. Sunscreens: Shade fabric is absorbing 90% of sunlight. The fabrics made up of polypropylene monofilament strands in both woven and knitted form are used to serve as sunshade fabrics. It creates microclimate for plantation of flowers, ornamental plants and fruits. Woven sunshade fabric is made from 100% polypropylene monofilament strands. Woven sunshade fabric is UV stabilized to hold up under the most extreme solar conditions. Knitted Sunshade cloth is made from 100% UV stabilized polyethylene. Its unique lock stitch construction allows customers the ability to cut the fabric with scissors without further unravelling. Knitted shade fabric is available in a variety of colors and stripes.

2. Windshield: Windshields are used in farming to protect fruit plantations from wind and to prevent damage to plants. It also prevents plants being cooled by the wind.

3. Harvesting Net: Harvesting nets are used to collect the fruits falling from a tree. This helps to keep the cost of cultivation low by eliminating additional labor associated with harvesting. Harvesting nets are predominantly grip structures which can be developed using warp knitting technology.

4. Mulch mat: Mulch mats are used to suppress weed growth in horticulture applications. It covers the soil, blocking of light and preventing the competitive wheat growth around seed links. This also reduces the need for herbicides required for weed control. Needle punched non-woven and black plastic sheet are used for this application. Bio degradable and non-biodegradable types of mulch mats are available.

5. Horticultural benefits: Using these ground cover in display areas, nurseries and greenhouses will provide a clean, free draining and hard-wearing surface. While the pre-marked white grid aids spacing. In orchards and fruit beds the fabric is regularly used to maintain a clean crop and reduce maintenance and disease problems.

6. Insect meshes: Clear, woven, and knitted, polyethylene monofilament meshes to exclude harmful insects from greenhouses and tunnels, or to keep pollinating insects inside. The fine woven screens protect plants from insect attack (without the use of insecticides). Insect meshes can also be placed over the openings of greenhouses to prevent pollinating insects, such as bumblebees, from escaping.

7. Ground cover: Ground cover is an extremely versatile landscaping and horticultural fabric for long-term weed control, moisture conservation and separation. It is mainly used in planted areas. It provides weed suppression and ground moisture conservation, whilst allowing roots to breathe and water, air and nutrients to permeate through. This maintains higher soil temperatures and promotes more rapid and even plant growth.

8. Packing materials for agricultural products: Nets can be used for packaging of farm products for many ends uses. It includes-Packing sacks for vegetables, Tubular packing nets for fruits, Wrappers for Christmas trees etc. Net structures are preferred because of their high strength, low weight, air permeability and cheapness.

9. Animal husbandry: Nylon and Polyester identification belts are used in cows. Textile nets are used to support the large udders. Nonwoven fabrics are used to filter the milk in automatic milking systems. Nonwoven fabrics are used as an underlay to reduce mud on cattle paths and trails.

10. Turf protection net: Nets are put over the grassy areas on river banks, dykes etc., so that lumps of earth are not removed while animals are grazing them. This will help in minimizing soil erosion loss and improve conservation.

Conclusion

The need of textile goods in the field of agriculture has been stressed and their role in the reduced usage of harmful pesticides and herbicides. Unique manufacturing techniques and properties of this blend of agro-textile sector products whose cost is lesser than that of pesticides and chemical herbicides have been emphasized. Textiles prove to be flexible in their suitability for specific geographical locations. So, now it is our turn, to carefully and beautifully shape this infant technology, to developed economy and thus a developed country.

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Homa Organic Farming (Agnihotra)

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Introduction

The intensive chemical agriculture that has been followed after successful green revolution in our country is causing heavy pollution of our soil, food, drinking water and air. To solve these problems, the modern science normally considers two areas namely, improvement in soil and water quality. According to *vrikshayurveda*, the ancient plant science, atmosphere is the biggest single factor which affects plant kingdom, soil and water quality. *Agnihotra* or *homa* is the science of healing the atmosphere through pyramid fires to eliminate pollution & contamination. It is part of *vrikshayurveda,* the chronicles of Indian healing medicine. Derived from two Sanskrit terms "*agni*" means fire and "*hotra*" means healing. This fire technique is of *Vedic* origin but has a scientific background. When *Agnihotra* is applied in agriculture it is called *homa* organic farming. India is origin of *Agnihotra.* Over 69 countries are taking advantage of *homa* organic farming technique. The leader among them is South American republic of Peru. Among the state agricultural universities (SAU) in India, two SAUs namely TNAU, Coimbatore and CSK Himachal Pradesh Krishi Vishwavidyalaya, Palampur have initiated experiments with this investigation, the university of agricultural sciences, Dharwad has joined the list of *homa* practicing SAUs.

Types of Homa

1. Agnihotra Homa: It is most important and should be practiced exactly at sunrise and sunset time daily.
2. Vyahruti Homa: It can be performed at any time except sunrise and sunset.
3. Om Tryambakam Homa: It should be performed at least 4 hours every day. It can be performed for 24 hours on full moon and no moon days.

Materials Required for Agnihotra

1. Copper pyramid of fixed size.
2. Ingredients (dried cow dung cake, cow ghee, unpolished rice).
3. Mantra (vibrations).

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4. Timesheet exact to the second of sunrise/sunset and watch.

Procedure

1. A few minutes before the actual time of sunrise and sunset, preparation should be started.
2. Place a piece of dried cow dung at the bottom of the copper pyramid.
3. Arrange pieces of dried cow dung cake in the pyramid in such a manner as will allow air to pass.







4. Apply a little Ghee to a small piece of cow dung and light it. Insert this lighted piece of cow dung in the middle of the pyramid.
5. Soon all dried cow dung in the pyramid will catch fire. A hand fan can be used to blow the air and help the flame.
6. Exactly at sunrise utter the first mantra and after the word swaha add a few grains of rice to the fire.
7. Utter the second mantra and after the word swaha add a few grains of rice to the fire. This completes morning Agnihotra.
8. At sunset do the same by using evening mantras. This completes evening Agnihotra.

Agnihotra Mantra

1. Sooryáya Swáhá Sooryáya Idam Na Mama: Prajápataye Swáhá Prajápataye Idam Na Mama (morning Agnihotra)
2. Agnaye Swáhá Agnaye Idam Na Mama: Prajápataye Swáhá Prajápataye Idam Na Mama (evening Agnihotra)

Agnihotra Ash

Ash is collected from the pyramid after completion of Agnihotra and passed through a fine sieve, collected and stored in an earthen or glass container. The bigger, harder parts that remain in the strainer can be given to plants, put in water sources like rivers or lakes, or put in the compost pile.


Effect on Plants

1. Plants grown in Yagna atmosphere evolve networks of veins that are cylindrical and larger than normal, permitting water and nutrients easier movement to all parts of the plant.
2. If slides are prepared, they will show the difference in cellular structure in plants bred in Yagna atmosphere as compared to those which are not.
3. By practice of Agnihotra much of the nutrition, taste and above all a new highly beneficial ingredient are packed into a small area, giving satisfaction (in the sense of quality and quantity) and health.
4. The taste, texture, colour, size of the seed improves.
5. The root system in plants changes due to homa atmosphere. Roots stay small and less troublesome due to extreme quality of nutrients the plants extract from the soil.
6. Fruit trees will yield double the usual size of fruits if Agnihotra is performed regularly in the orchards.
7. Overall plant growth, yield and quality of harvest is improved in homa atmosphere.

Effect on Soil

1. When Agnihotra ash is added to the soil, it increases the availability of soluble nitrogen in the soil.
2. Stabilize the amounts of potash, nitrogen, and trace elements in it.
3. Increases the amount of water-soluble phosphorus available to plants in the soil. This has a great effect on their growth and reproductive cycles.
4. Earthworms proliferate in this environment due to increases in their hormonal production; they distribute moisture in the soil and provide it with humus.

Effect on Atmosphere

1. Agnihotra contribute to environmental protection because they purify the atmosphere.
2. improve the quality of air by minimizing the harmful effect of poisonous gases present in the atmosphere.
3. Harmful air born bacteria are killed due to germicidal effect of smoke which is generated during Agnihotra.

Effect on Insects

1. Bees are attracted to homa atmosphere as the amount of energy they receive from Agnihotra fire helps them perform at a greater level of efficiency.
2. When this is translated to pollination, they can help to increase the yield of crops like corn, tomatoes, berries and other fruits.
3. If homa is going on round the clock in proximity to a garden, that itself is an effective aid to insect control.

Medicinal Properties

1. The healing effects of Agnihotra are locked in the resultant ash.
2. It is recommended to take Agnihotra ash orally three times a day to counteract atmospheric pollution, environmental toxicity, and to protect oneself from disturbing frequencies that may exist from microwaves, cell phones, computers, etc.

3. Reduce head ache, stress and relieve tension.
4. Reduce sinusitis, respiratory problem and asthma.
5. Beneficial for depression and insomnia.
6. Beneficial for hyper active children.
7. Renew brain cell and revitalize skin.
8. Purify blood and circulatory system.
9. Reduce smoking and drinking.
10. Cures cancer.

Conclusion

Performance of homa organic farming with the use of sacrificial fire in specific time as prescribed by Vedic science and ash collected from the homa improves the overall plant growth, purify atmosphere and harmonise the body mind and inner peace of human beings which leads to overall sustainability.

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Role of Biochar in Agriculture

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Introduction

Depletion of Soil Organic matter and soil nutrients, decline in agricultural productivity and changes in climate due to anthropogenic activities are posing great threats to the sustainability of agricultural production. Chemical fertilizers have undoubtedly played a vital role towards increasing the agricultural productivity over past half century. Although the global population has been fed owing to these practices have become unsustainable and are also unable to satisfy the needs of population. So, it is becoming important to restore the contaminated sites by using organic fertilizers. Among organic fertilizer application of biochar to soil as a technique to improve the quality of soil has emerged in recent years.

The expression "Biochar" is a moderately contemporary improvement, evolving in combination with soil managing, carbon confiscation or sequestration matters and immobilization of contaminants. The property of biochar can change extensively, depending on what the biochar is prepared from and how it is complete. Some biochar can have characteristics which make them an excellent amendment in one soil but not the biochar can be simply awful. Biochar is material formed by natural organic biomass burning creates black which forms a considerable proportion of the soil's organic carbon due to black carbons aromatic structure, it is recalcitrant and has the potential for long term carbon sequestration in soil.

Influence of Biochar on Soil Physical Properties

Soil physical parameters such as wettability of soil, water infiltration, water retention, macro-aggregation and soil stability are critical importance in tropical environments in combating erosion, mitigating drought and nutrient loss and in general to enhance ground water quality.

Influence of Biochar on Soil Chemical Properties

Application of biochar improves soil quality, including pH increase, organic carbon and exchangeable cations.

Influence of Biochar on Nutrient Use Efficiency

Longer term benefits of biochar application on nutrient availability mainly due to greater stabilization of organic matter, concurrent slower nutrient release from added organic matter and better retention of all cations due to a greater cation exchange capacity.

Influence of Biochar on Soil Microbial Activity

1. Many studies exclaimed that the application of biochar on the soils can enhance the content of organic matter in soil and improves the fertility of soil.
2. Biochar provides a suitable habitat for a large and diverse group of soil microorganisms. Symbiosis between effective microbes and plant root through the medium of charcoal that promotes the growth of plants

Biochar Production

Biochar can be manufactured on a small scale using lower modified stoves (or) kilns, cost-intensive production, which utilizes larger pyrolysis plants and higher amount of feed stocks. Biochar is produced from several biomass feed stocks through pyrolysis, generating oil and gases as by-products. The dry waste obtained is simply cut into small pieces to less than 3cm prior to use. The fees stock is heated either without oxygen or with little oxygen at temperatures of 300-700ºC. Pyrolysis is generally classified by the temperature and time duration for heavy last pyrolysis takes place at temperature above 500ºC and typically in seconds. This condition maximizes the generation of bio-oil. Slow pyrolysis, on the other hand, usually takes more time, from 30 min to few hours for the feed stock to fully pyrolyze and at the same times yields more biochar. The yield of biochar from slow pyrolysis of biomass has been stated to be in the range of 24.77% where the yield of biochar from fast pyrolysis is 10.20%.

Perquisites of Biochar

1. It increases cation exchange capacity.
2. It improves soil water holding capacity.
3. It supports soil microbial life and biodiversity.
4. It helps plants resist diseases and pathogens
5. It stimulates symbiotic nitrogen fixation in legumes.
6. It enhances plant growth and crop yields.
7. It reduces soil acidity by raising soil pH.
8. Application of biochar reduces leaching of nutrients.

Disadvantages

1. In some cases, yields may decline because of the absorption of water and nutrients by the biochar, which reduces the availability of these resources for the crops.
2. The sorption of pesticides and herbicides by the biochar can reduce their efficacy.
3. Some biochars can acts as a source of contaminants such as heavy metals, volatile organic compounds, dissolved organic carbon.
4. Long term removal of crop residues like stems, leaves and seed pods to be used for production of biochar can reduce overall soil health by diminishing the number of soil microorganisms and disrupting internal nutrient cycling.
5. The increase in cation exchange capacity depends on the composition of the soil it is minimal in soils with high clay (or) organic matter content.

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Lemongrass: A Valuable Crop for Soil Erosion Management

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Introduction

Lemongrass *(Cymbopogon flexuosus)* is one of the most important essential oil yielding grass of the Poaceae family. The genus *Cymbopogon* comprises various species that are widely distributed in tropical and sub-tropical regions of Asia, Africa and America. In India, it is commercially cultivated in Maharashtra, Kerala, Karnataka and Tamil Nadu states besides foot-hills of Arunachal Pradesh and Sikkim. But recently its cultivation is gaining importance in other parts of India due to its various uses and hardy nature for its survival. It can grow wide range of temperature and pH under rainfed or irrigated condition. Lemongrass oil extracted from the plant has wide applications in food, perfume, medicine, soaps, detergents, insecticides, preservatives, etc. Furthermore, the lemongrass cultivation is also important like other perennial grasses that work as vegetative barriers to reduce soil erosion from farm and nonfarm lands is increasing world-over because of fibrous root system.

Under the present circumstances, the degradation of land is largely recognized as a serious problem throughout the world. The losses of soil dominantly caused by water and wind action results in land degradation and declining soil productivity. The losses of soil greatly affected by various factors, i.e. coverage of vegetation, land slope, soil texture, soil structure, etc. Among the conservation practices, vegetative measures are preferred over mechanical ones. Natural vegetation covers the land and protects from the beating action of rain drops, helps to reduce the velocity of flowing water and also encourage quick infiltration of water into the soil. Moreover, vegetation coverage helps to protect the soil by wind erosion. Vegetative barricade hinders the movement of soil along with water in down slope resulting in slower movement of water and prevents soil loss. The roots of plants mainly grasses are known to serve as reinforcement to the soil and thereby improving their stability. Earlier research work reported that pennisetum hedges reduced soil loss by 84% and overland flow by 68% while Arundinella hedges reduced soil loss and overland flow by 55% and 38%, respectively (Xiao et al., 2010). Hence, soil erosion caused by water and wind can be managed by covering the bare land surface either growing vegetation or using organic matter.

What is Lemongrass?

Lemongrass (*Cymbopogon* spp.) is a tall perennial grass belongs to family Poaceae. The genus *Cymbopogon* comprises more than 100 species in all over world. In India, commonly three types of lemongrasses are under cultivation viz. East Indian lemongrass *(C. flexuosus)*, West Indian lemongrass *(C. citratus)*, and Jammu lemongrass *(C. pendulus)*. At present, East Indian lemongrass *(C. flexuosus)* is mainly cultivated in the western part of India. The Cymbopogon species that produce volatile oils are called aromatic grasses. Lemongrass grows with clumped, bulbous stems bearing leaf blades and branched cluster of stalked flowers up to 2.0 m height. It is a native to warm region and grows in almost all tropical and sub-tropical countries.

Importance of Lemongrass

Generally, lemongrass grown for its oil and conservation practices. The importance of lemongrass as given under:

1. The oil is distilled from the leaves of lemongrass and contains 0.6-0.8% w/w oil that has high content of citral (65-85%) and gives strong lemon-like odour.
2. The citral rich oil has germicidal, insect repellent, medicinal and flavoring properties.
3. The oil is used in various industries viz. perfumery, cosmetics, insecticides, food processing, pharmaceutical, etc. for preparation of different products.
4. The lemongrass oil has medicinal value because of enriched with flavonoids which have an antioxidant and antifungal activity. Flavonoids in lemongrass contain licochacone-A and licochacone-B which have equal antioxidant activity of vitamin E, and glabrene which is 3 times as active when compared with vitamin E. (Okuda et al., 1989).
5. Lemongrass has good soil binding nature and can be grown as vegetative cover over naked eroded lands to reduce the soil loss by water and wind action.
6. The fresh and dry leaves of lemongrass used for preparation of herbal tea and added during cooking of foods for enrichment of flavor.
7. After extraction of oil, the plant residues (spent grass) can be used as cattle feed, mulching, compost preparation, etc.

Soil Erosion

Soil erosion is a naturally occurring process and it occurs when removal of the most fertile surface layer of soil through various factors viz. water, wind, tillage, etc. Soil erosion is one form of land degradation, it leads to the loss of topsoil and soil organic matter, which are essential for the growing of plants. The degradation of land is widely recognized as a serious problem worldwide. In India, 187.8 million ha area is under various forms of degradation (Sehgal et al., 1994). The leading agents of soil erosion are water and wind, each contributing a significant amount of soil loss in every year. Soil erosion by water is one of the major causes of land degradation under high rainfall areas with higher slope of the landforms that have high erosive capacity. The various forms of water erosion like splash, sheet, rill and gully remove the fertile top soil along with flowing water. However, wind erosion is also a serious problem in many parts of the world and generally worse in arid and semi-arid climates. The loss of soil by the wind action depends on various factors like soil texture, surface coverage, wind velocity, tillage, etc. and loose particles transported from one place to another place by suspension, surface creep and saltation process.

Soil and Water Conservation through Cultivation of Lemongrass

Soil erosion is accelerated by various factors like landscape slope, vegetation coverage, soil tillage, etc. and dominantly caused by wind and water. Mechanical measures help in minimizing erosion and controlling the localized runoff by reducing the length and/or degree of slope and dissipating the energy of flowing water. The grown of grass family plants is very effective due to its fibrous root system and surface coverage that helps to minimize the velocity of flowing water on uneven landscape. Ranade et al. (1995) reported that both mechanical and vegetative barriers were effective on mild slopes in reducing the runoff by 18–24%.

Lemongrass cultivation benefitted as various uses of leaves specially for extraction of aromatic oil and also has the added advantage because of its economic part is the leaf rather than the root, hence does not disturb the soil during harvest. Thus, lemongrass helps to protect the soil loss by wind and water erosion. The tillers and the fallen leaves reduce the velocity of runoff permitting more time for infiltration. The fine fibrous roots that extend far and deep enmeshing the soil particles encourage soil aggregation and consequent greater porosity which further helps in infiltration and permeability. Thomas et al. (2012) found that the soil loss as suspended sediment due to intense rainfall during south-west monsoon in Kerala, the runoff plots was effectively reduced to 80% by the cultivation of *C. flexuosus* as compared to control. Lemongrass, especially *C. flexuosus* could control runoff and soil loss very effectively; it produced enough shoots and roots to achieve this performance.

Accordingly, soil loss by the wind action managed through using various techniques, viz. stabilizing with various materials; producing a rough surface; reducing field width with strips and barriers; establishing and maintaining sufficient vegetative cover. Vegetation cover protects soil from wind erosion by reducing the wind speed at the soil surface. The land surface coverage can be enhancing by growing crop, standing stubble or other crop residues. Most soils require a 30% ground cover to prevent wind erosion.

Cultivation of Lemongrass

The genus *Cymbopogon* comprises various species that are widely distributed in tropical and sub-tropical regions. But recently its cultivation is gaining importance in other parts of India due to its various uses and it can grow under harsh condition.

Lemongrass can easily grow under rainfed condition with annual rainfall of more than 500 mm and with limited availability of good quality irrigation water. It can cultivate temperature between 15 to 40°C in well drained poor soils or light textured soils with a wide range of pH 4.5 to 8.5.

Lemongrass is commercially propagated by seed and also by slips of the clumps (suckers). In general, locally available cultivar seeds or clumps from old plantation are used under cultivation specially for soil conservation practices. For higher production, the seeds or clumps of improved varieties like CKP-25, RRL-16, OD-19 and others are used for cultivation. If propagated by seed, 4-5 kg of seed produced enough seedlings for one-hectare area. About 7 to 8 weeks old or 15 cm height of seedlings are ready for transplanting. Plantation gives potential production for the period of 5 to 6 years after that the clumps can be used for re-plantation. The digging out clumps divided into small units that called slips. Slips placed in holes on ridges or flat beds about 8-10 cm deep with proper pressing of soil and watering should be done. Generally, the spacing for plantation at 45 cm x 45 cm or 60 cm x 60 cm or 90 cm x 90 cm used depending upon soil fertility status and availability of irrigation water. A wider spacing 60 cm x 45 cm for seedling and 90 cm x 60 cm for slips has been recommended for fertile, irrigated land under North Indian condition (Farooqi et al., 1999). Commonly the closer spacing is used for soil and water conservation practices. The suitable time of plantation is onset of monsoon.

In general, lemongrass can grow without application of nutrients but higher yield can be obtained by the application of sufficient organic manures and fertilizers. The application of NPK- 100:50:50 kg/ha with 6 tonne/ha of lime in chromate overburdened soil gives higher herb yield of *C. pendulus* (Behura et al., 1998). Regular irrigation is required to maintain soil moisture for good growth and generally 7-8 irrigation is sufficient during rain free period under sub-tropical area.

The harvesting of lemongrass depends on the age of plantation. In newly established plantation, the crop harvesting started from 120 to 140 days after planting then subsequent harvesting is done at the interval of 80 to 100 days.

Conclusion

Lemongrass is a perennial grass naturally growing as wild and also cultivating from ancient times for its various uses and especially for aromatic oil extracted from leaves. The oil is rich in citral and used in different industries, viz. perfumery, cosmetics, insecticides, food processing, pharmaceutical, etc. for preparation of different products. Lemongrass is also gaining importance for its usefulness to protect the soil loss by wind and water erosion due to fibrous root system. Some species of lemongrass are under cultivation in wide range of climatic condition and soil types for their commercial use. Considering the high returns from lemongrass oil, it is to be encouraged as a choice for its cultivation in soil and water conservation, especially under the areas having problems of land degradation. In addition, more research inputs and development of modern cultivation techniques and machineries are necessary to enhance the quality and applicability of lemongrass.

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Feeding Future with Vertical Farming

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Vertical farming is the practice of growing crops in vertically stacked layers. It often incorporates controlled environmental agriculture, which aims to optimize plant growth, and soilless farming techniques such as hydroponics, aquaphonics, and aerophonics. Some common choices of structures to house vertical farming systems include buildings, shipping containers, tunnels, and abandoned mine shafts.

The modern concept of vertical farming was proposed in1999 by Dickson Despommier, professor of Public and Environmental Health at Columbia University. Despommier and his students came up with a design of a skyscraper farm that could feed 50,000 people. Although the design has not yet been built, it successfully popularized the idea of vertical farming. Current applications of vertical farmings coupled with other state-of-the-art technologies, such as specialized LED lights, have resulted in over 10 times the crop yield than would receive through traditional farming methods.

Techniques of Vertical Farming

Hydroponics: Hydroponics refers to the technique of growing plants without soil. In hydroponic systems, the roots of plants are submerged in liquid solutions containing macronutrients, such as nitrogen, phosphorus, Sulphur, potassium, calcium, and magnesium, as well as trace elements, including iron, chlorine, manganese, boron, zinc, copper, and molybdenum. Additionally, inert (chemically inactive) mediums such as gravel, sand, and sawdust are used as soil substitutes to provide support for the roots.

Advantages of hydroponics: The advantages of hydroponics include the ability to increase yield per area and reduce water usage. A study has shown that, compared to conventional farming, hydroponic farming could increase the yield per area of lettuce by around 11 times while requiring 13 times less water. Due to these advantages, hydroponics is the predominant growing system used in vertical farming.

Aquaponics: The term aquaponics is coined by combining two words: aquaculture, which refers to fish farming, and hydroponics—the technique of growing plants without soil. Aquaponics takes hydroponics one step further by integrating the production of terrestrial plants with the production of aquatic organisms in a closed-loop system that mimics nature itself. Nutrient-rich wastewater from the fish tanks is filtered by a solid removal unit and then led to a bio-filter, where toxic ammonia is converted to nutritious nitrate.

While absorbing nutrients, the plants then purify the wastewater, which is recycled back to the fish tanks. Moreover, the plants consume carbon dioxide produced by the fish, and water in the fish tanks obtains heat and helps the greenhouse maintain temperature at night to save energy. As most commercial vertical farming systems focus on producing a few fast-growing vegetable crops, aquaponics, which also includes an aquacultural component, is currently not as widely used as conventional hydroponics.

Aeroponics: The invention of aeroponics was motivated by the initiative of NASA (the National Aeronautical and Space Administration) to find an efficient way to grow plants in space in the 1990s.Unlike conventional hydroponics and aquaponics, aeroponics does not require any liquid or solid medium to grow plants in. Instead, a liquid solution with nutrients is misted in air chambers where the plants are suspended. By far, aeroponics is the most sustainable soil-less growing technique, as it uses up to 90% less water than the most efficient conventional hydroponic systems and requires no replacement of growing medium. Moreover, the absence of growing medium allows aeroponic systems to adopt a vertical design, which further saves energy as gravity automatically drains away excess liquid, whereas conventional horizontal hydroponic systems often require water pumps for controlling excess solution. Currently, aeroponics systems have not been widely applied to vertical farming, but are starting to attract significant attention.

Types of Vertical Farming

Building-based Vertical Farming: Abandoned buildings are often reused for vertical farming, such as a farm at Chicago called “The Plant,” which was transformed from an old meatpacking plant. However, new builds are sometimes also constructed to house vertical farming systems. For example, a company named "Vertical Harvest" built a three-story hydroponic greenhouse next to a parking lot in Jackson, Wyoming, and aims to grow 100,000 lbs of produce annually.

Shipping-container Vertical Farms: Recycled shipping containers are an increasingly popular option for housing vertical farming systems. The shipping containers serve as standardized, modular chambers for growing a variety of plants, and are often equipped with LED lighting, vertically stacked hydroponics, smart climate controls, and monitoring systems. Moreover, by stacking the shipping containers, farms can save space even further and achieve higher yield per square foot. Currently, there are many commercial shipping- container vertical-farming units on the market, such as the “Greenery” from Freight Farms and the “Terra Farm” from Local Roots.

Deep Farms: A “deep farm” is a vertical farm built from refurbished underground tunnels or abandoned mine shafts. As temperature and humidity underground are generally temperate and constant, deep farms require less energy for heating. Deep farms can also use nearby groundwater to reduce the cost of water supply. Despite low costs, a deep farm can produce 7 to 9 times more food than a conventional farm above ground on the same area of land, according to Saffa Riffat, chair in Sustainable Energy at the University of Nottingham. Coupled with automated harvesting systems, these underground farms can be fully self-sufficient.

How Vertical Farming Works?

There are four critical areas in understanding how vertical farming works:

1. Physical layout
2. Lighting
3. Growing medium
4. Sustainability features.

Firstly, the primary goal of vertical farming is producing more foods per square meter. To accomplish this goal, crops are cultivated in stacked layers in a tower life structure.

Secondly, a perfect combination of natural and artificial lights is used to maintain the perfect light level in the room. Technologies such as rotating beds are used to improve lighting efficiency.

Thirdly, instead of soil, aeroponic, aquaponic or hydroponic growing mediums are used. Peat moss or coconut husks and similar non-soil mediums are very common in vertical farming.

Finally, the vertical farming method uses various sustainability features to offset the energy cost of farming. In fact, vertical farming uses 95 percent less water.

Advantages of Vertical Farming

Having greater output from a small cultivation area is not the only advantage of vertical farming. Following are some of the major benefits of vertical farming:

Preparation for Future: By 2050, around 80 percent of the world population is expected to live in urban areas, and the growing population will lead to an increased demand for food. The efficient use of vertical farming may perhaps play a significant role in preparing for such a challenge.

Increased and Year-Round Crop Production: Vertical farming allows us to produce more crops from the same square footage of growing area. In fact, 1 acre of an indoor area offers equivalent production to at least 4-6 acres of outdoor capacity. According to an independent estimate, a 30-story building with a basal area of 5 acres can potentially produce an equivalent of 2,400 acres of conventional horizontal farming. Additionally, year-round crop production is possible in a controlled indoor environment which is completely controlled by vertical farming technologies.

Less use of water in cultivation: Vertical farming allows us to produce crops with 70-95 percent less water than required for normal cultivation.

Not Affected by Unfavorable Weather Conditions: Crops in a field can be adversely affected by natural calamities such as torrential rains, cyclones, flooding or severe droughts—events which are becoming increasingly common as a result of global warming. Indoor vertical farms are less likely to feel the brunt of the unfavorable weather, providing greater certainty of harvest output throughout the year.

Increased Production of Organic Crops: As crops are produced in a well-controlled indoor environment without the use of chemical pesticides, vertical farming allows us to grow pesticide-free and organic crops.

Human and Environmentally Friendly: Indoor vertical farming can significantly lessen the occupational hazards associated with traditional farming. Farmers are not exposed to hazards related to heavy farming equipment, diseases like malaria, poisonous chemicals and so on. As it does not disturb animals and trees inland areas, Limitations of Vertical Farming.

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NeVOmics: A Tool for GO, FNA and Visualization of OMICs Data

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Abstract

The advent of sequencing technologies has boosted research in genomics and related areas. High-thruput sequencing techniques have the potential to generate a huge amount of data from the different experimental setup. This sequence data needs to be analyzed to generate useful information which is comprehensive and easy to understand. Many software and tools have been developed for functional annotation but without limitations. Most of the software provide annotation as a long list of genes and proteins with difficult terminologies. They also lack good visualization of output data as a result of using only bar diagrams and pie charts. In contrast, NeVOmics (Network-based Visualization for Omics), is a bioinformatic tool that facilitates the functional characterization of data from OMICs technologies such as transcriptomics and proteomics. NeVOmics has been developed in programming language Python. NeVOmics integrates, over representation-analysis (ORA) methodology and network-based visualization with R packages. It allows the generation of four different types of graphical visualization to show the enrichment results. NeVOmics uses a hypergeometric statistical test to identify significantly enriched Gene Ontology (GO) terms and pathways in a list of genes or proteins. Facilitate the analysis and interpretation of large amounts of data, such as those obtained by high-throughput OMICs techniques, from a very wide range of organisms. Therefore, NeVOmics can become simple, handy and comprehensive tools for functional annotation of OMICs data.

Introduction

Since inception humans are trying to understand the functions of each component of the ecosystem in its proper functioning and maintenance, through the development of various tools and technologies. Humans have come up the long-distance in this journey, but still, a lot remains to be known. Development of the area of genomics has accelerated our efforts and boosted understanding of individual functionality at a genomic level along with enabling us to play with an organism's genome to create something new from it. The advent of sequencing technologies has a great impact on genomic studies as it helps rapid and high throughput sequencing of genomic DNA and RNA transcripts, which are the basic starting material in any genomic study. Sequencing presents us with a huge amount of data, which needs to be analyzed to generate useful information. Functional annotation of data from these approaches is essential to reduce the huge complexity of lists with hundreds to thousands of genes/proteins to a few processes or pathways in which they are involved, which will have more explanatory power than a simple list of identifiers. It is said that without annotation this data is of no use, and to solve this problem, many annotation tools have been developed, but not without limitations. In many cases, the results are presented as a long list of gene/ proteins and their function with various biological terms which are difficult to understand. Most of the tools present their data in the form of bar graph and pie charts, which does not provide significant comprehension about the functions and pathways involved and also lack graphical visualization, not allowing insights into the functional relationship existing between the identified genes/ proteins and the enriched Gene Ontology terms and pathways. For example, we can consider a protein having a role in three to four relevant processes and a bar graph or pie chart cannot explain this relation significantly. Network analysis has become an increasingly popular tool to deal with the complexity of large datasets of all sorts. The importance of using networks lies in their ability to reveal relationships between factors, rather than seeing them as isolated entities. Intersection networks are bipartite networks which, when applied to biological systems, allow detection of multifunctional proteins, i.e., genes/proteins with more than one function and involved in more than one process or pathway. To overcome above-mentioned problems and provide with a better tool for functional annotation, a tool named NeVOmics is developed.

What is NeVOmics?

NeVOmics (Network-based Visualization for Omics), is a bioinformatic tool that facilitates the functional characterization of data from OMICs technologies such as transcriptomics and proteomics. NeVOmics has been developed in programming language Python. NeVOmics integrates, over representation-analysis (ORA) methodology and network-based visualization with R packages. Over-representation or Enrichment analysis is a technique for determining if a set of genes/ proteins are presently more than would be expected (over-represented) in a subset of gene or protein data. It is used in finding gene ontology terms or pathways over-represented in a particular subset of transcriptome data. It allows the generation of four different types of graphical visualization to show the enrichment results. NeVOmics uses a hypergeometric statistical test to identify significantly enriched Gene Ontology (GO) terms and pathways in a list of genes or proteins. A hypergeometric statistical test is a concept in probability theory and statistics, where it is a discrete probability distribution that describes the probability of success in draws, without replacement, from a finite population of the size that contains exactly objects with that features, wherein each draw is a success or failure. This tool supports all organisms deposited in UniProt Knowledgebase (UniProtKB) and KEGG (Kyoto encyclopedia of genes and genomes) databases and incorporates functionality to assign pathways to organisms with no annotated genome information available from orthologous gene pathways deposited in the KEGG database. NeVOmics can be used in both Linux and Windows operating systems and it provides 13 additional protein lists from diverse organisms for the user to have the optionality to test the tool.

Using updated databases NeVOmics is designed to perform three different analysis, Gene Ontology using all information stored in UniProt-GOA (Complete GO Annotation) and UniProtKB Annotations. Uses all annotations stored in the KEGG database to find relevant pathways. Identify KEGG pathways from protein sequences by performing identity searches, and thus independent of the availability or not of annotated genome information for a particular organism.

The Workflow of NeVOmics

The overall tool is divided into three main sections comprising Input data list, enrichment analysis/ statistics and last, is a visualization of output data. Different type of experimental data which includes, transcriptome, proteome, secretome, phosphoproteome, subproteome, acetylome, methylome etc. are used as an input data list. In enrichment analysis, a connection is made to the UniProt-GOA and KEGG databases, and then the content of the input list is analyzed. Retrieval of information for all genes or proteins in the list and the results are stored n files in .xlsx format. Visualization of output data in four types of graphical representation in .png format.

Comparison and Advantages of NeVOmics over Other Function Enrichment Analysis Tools

NeVOmics is a well-designed Functional enrichment analysis tool that uses information from two different annotation tools i.e. GO and KEGG. It has the versatility to use UniProt-GOA and UniProtKB separately as databases, to obtain complete (electronic + manually-curated) and only manually-curated information, respectively, to get as much information as possible. More frequent update of GO information compared to other tools, which makes them less reliable. Some of the tools do not offer graphical representations as do NeVOmics to aid in the visualization of results. Very versatile regarding the organisms that can be submitted to analysis, it supports all organisms deposited in UniProtKB and KEGG and also any organism's genome can be used whose annotated genome is not available. In contrast, other tools such as g: Profiler, Gorilla, GOEAST and WebGestalt have the limitation of excluding non-model organisms. Unlike NeVOmics and WebGestalt, Gorilla, and g: Profiler present flexibility limitations in the adjustment of some parameters during the analyses, for instance, they control the p-value threshold not allowing to set up other custom-chosen FDR values. NeVOmics attained greater coverage of identified GO terms in comparison to other tools. With NeVOmics some GO terms were detected which went undetected to other tools, and the opposite also occurred in some cases. On the other hand, NeVOmics, GOrilla, and WebGestalt did not detect GO terms related to response to an environmental stimulus which appeared highly enriched in g: Profiler. Therefore, there are differences between tools in the number and identity of detected GO terms and also in the number of proteins that each program identifies. Three possible reasons that could determine these differences are: Source of annotation and GO definitions, Regularity with which these databases are updated, statistical approach to obtain enriched terms.

Conclusion

NeVOmics is an enrichment analysis tool executable in the command line. Can analyze from five to thousands of identifiers in gene/protein datasets. It can perform three different types of analyses i.e. Gene Ontology annotation, finding relevant pathways by using KEGG annotations and identify KEGG pathways from protein sequences by performing identity searches. No need to download additional databases or any other resources. Uses ORA methodology. Facilitate the analysis and interpretation of large amounts of data, such as those obtained by high-throughput OMICs techniques, from a very wide range of organisms. Allows the inclusion of expression/abundance data or any other experimentally-obtained quantifiable value, such as phosphorylation or other protein modifications, which provides information about how genes/proteins are up/downregulated in different biological conditions, thus allowing a better understanding of their role in the processes and pathways that are enriched.

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Vertical Farming: Future of Mankind

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Introduction to Vertical Farming

Hydroponics is a method of growing plants without soil. Instead of having their roots supported and nourished by soil, the plant is supported by an inert growing medium like coco-peat and are fed via a nutrient-rich water solution and uses about 70% less water than traditional farming. Hydroponic systems may be as simple as a glass of water filled with pebbles and water containing fertilizer or as complex as a large greenhouse structure containing beds of clay pellets/troughs filled with coco peat that are periodically supplied with a nutrient solution. Nutrient Film technique (NFT) is also a kind of hydroponic farming that is adopted by many commercial farmers these days.

Vertical farming is the practice of growing crops in vertically stacked layers or integrated in other structures with use of less water and no soil instead of soil various other growing medium are used such as Coco peat, Perlite, Vermiculite. Mainly coco-peat is used on a larger level as a growing medium. The modern ideas of vertical farming use indoor farming techniques and controlled environment agriculture (CEA) technology, where all environmental factors can be controlled such as artificial control of light, humidity, temperature.

History of Modern Farming

1. Hydroponics is not known as a technology at that time but known as a different way of farming. The famous hanging garden of Babylon (Iraq) in around 600 B.C. are the earliest record of Hydroponics.
2. Floating garden of Mexico (700) B.C.
3. Vertical farming as a concept was developed in the recent years (1999) through the advances in technology by Dickson Despommier, an Emeritus Professor of Microbiology at the Columbia University.

Need of Vertical Farming

1. Vertical farming is the urban farming of crops inside a building in a city or urban center, wherein the floors are designed to accommodate certain crops.
2. Less area and more no of plants can be accommodated.
3. Less input and more output in terms of water, nutrients.
4. Can get leafy crops throughout the year.
5. Crops will be protected from harsh weather conditions like floods, droughts and Snow.

How does Vertical Farming Work?

1. Firstly, the primary goal of vertical farming is producing more foods per square meter and so the crops are stacked vertically to grow.
2. Secondly, a perfect combination of natural and artificial lights is used to maintain the perfect light level in the room. Technologies such as rotating beds are used to improve the lighting efficiency.
3. Thirdly, instead of soil, we will employ hydroponics (bathing the plant roots in a nutrient bath).
4. Finally, the vertical farming method uses various sustainability features to offset the energy cost of farming. In fact, vertical farming uses 95% less water than traditional farming.

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As you can see above images are of vertical tower consist of:

1. Main pipe.
2. Inlet pipe attached to submersible pump.
3. Tank.
4. Net cups.

Here, a tank is used which is filled with water (nutrient) and pump is kept the bottom. Initially when the pump is provided electricity it pump the water to the top with the help of inlet pipe and this inlet pipe is attached to water dispenser box .here the water dispenser box equally distributes the water (as box contains holes in equal proportion) and with gravitational force it walls over the surface of over net cup where the coco-peat absorbs the water and reaches to the root zone the crop. Here cycle of irrigation is maintained according to the requirement of the crop. Proper amount of water, sunlight, nutrients is given for the optimum results.

India on Change

Institute of Himalayan Bio resource Technology (CSIR-IHBT) Director Sanjay Kumar said that as majority of the rural regions in India is experiencing population shift in recent years due to animal menace and poor returns from traditional farming system, it is high time our youth adopt new techniques of agriculture like hydroponics and aeroponics. In India as the urban population is expected to rise by 50 per cent 2030, the overall hydroponics system market is projected to grow at a CAGR of 12.1 per cent by 2025. MSME-DI Nagpur organized 2-day Workshop on Hydroponic and Organic Farming and Fruits and vegetables processing during 16th-17th December, 2019 at MSME-DI, Nagpur. Hydroponic farming has become the need of hour. It can increase the productivity of farmers as production cost is low. With this object, this workshop was organized. It has covered all aspects of hydroponic and organic farming and farmers as well as entrepreneurs took the benefit of the programme. Such type of programmes will be taken up for all districts of Vidarbha region by MSME-DI.

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Low Cost Technology and Non-Monetary Inputs for Sustainable Agriculture

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The technology that does not need high cost or more investment is called Low cost technology. These are defined as those cultural operations which help to achieve high yield no extra cost and whose cost does not change with the level of output.

Use of Low-Cost Technology / Non-Monetary Inputs is Important for Agriculture because

1. In the 1960s, the first green revolution was aimed to increase the agricultural productivity with higher levels of inputs such as pesticides, fertilizers, use of farm machinery etc.
2. No doubt with excessive levels of these inputs we have achieved the objective to feed our ever increasing population which is expected to hit 9.7 billion in 2050 (FAO, 2019) but in the process for short term improvement various forms of ecological stresses like loss of biodiversity in agricultural lands, salinization, alkalization, nitrate pollution in groundwater, pesticide residues in food etc. have aggravated the situation more.
3. Intensive input agriculture uses higher levels of chemicals, machinery, capital, labor etc. to maximize produce. Hence affecting environment in multiple ways like: Soil and water pollution due to excessive use of chemicals and fertilizers. Heavy use of pesticides killing beneficial organisms and affecting biodiversity of the ecosystem. Soil erosion and land degradation due to use of heavy machinery and tillage implements. Exploitation of fossil fuels for various cultural operations and adding to greenhouse gases.
4. New alternatives for agricultural production which would combine both biological and ecological processes in the wake of devastating climate change should be the urgent need of the hour.
5. Due to intensive cultivation the inherent capacity of land to produce more has been disrupted and natural resources like soil, water etc. has been exploited to a dangerous level.

Some of the Low-Cost Technology and Non-Monetary Inputs in Crop Production

1. Conservation tillage: According to CTIC (The Conservation Tillage Information Centre,1990 and 1995) “Any tillage or planting system that maintains at least 30% of the soil surface covered by residue after planting to reduce water erosion or where wind erosion is a primary concern, maintain at least 1000 kg/ha of flat, small grain residue equivalent on the surface during the critical wind erosion period”.

Due to different conservation tillage practices following benefits are observed:

a. In the case of zero tillage, better aggregation and pore size distribution were observed.
b. Better soil structure, resulting in more water-stable aggregates, decreases soil crusting and erosion by allowing water and air to penetrate the soil, thereby enhancing the establishment and germination of seedling.
c. Water infiltration rate was higher in permanent beds and zero tillage system than the conventional tillage.
d. Up to eight-fold increase in hydraulic conductivity in zero tillage stubble retained have been reported over treatments where stubble was removed by burning.

e. Conservation tillage practices with crop residues on soil surfaces reduces evaporation rate and conserves soil moisture.

f. Accumulation of crop residues in the soil under zero tillage and minimum tillage results in more organic matter content and thereby improving the fertility of the soil.

2. Sowing:

Sowing time: Optimum sowing time varies according to crop, variety, agro-climatic zones etc. It is well known that if sowing of wheat is delayed beyond 25th of November the yield reduction is expected to be 30 kg/ha/day. (Directorate of Wheat development). Correct age of seedlings should be used for transplanting. For e.g. – 3-4 weeks old seedling for short duration rice.5-6 weeks old seedling for long duration rice. A difference in sowing date has relatively improved the yield and yield attributes of wheat as reported by Singh *et al.,* (2016). Optimum time of sowing/ planting. E.g. Cotton – August 15^{th} Turmeric- End of the May.

Any fluctuation in optimum sowing time results in drastic yield reduction. E.g. Wheat. Correct age of seedlings should be used for transplanting E.g. Ragi/sorghum – 16 to 18 days.

Sowing depth: Depth of sowing varies with:

i. Crop: Optimum depth for most field crops is 3-5 cm but it varies from crop to crop. Like: Rice 3-4 cm, Maize 5-6 cm, Wheat 5-6 cm, Pearl millet 2-4 cm.

ii. Soil type: In sandy soils deeper sowing, whereas in heavy soil shallow sowing is recommended.

iii. Moisture availability: In dryland condition crops should be sown in deeper layers.

iv. Seed size: Bold seeded crop should be sown deeper (upto 10cm), small seeded crop should be sown upto (3-4 cm).

3. Plant population: Plant population is the total number of plants growing per unit area. Plant population has significant effect on growth and yield of crops. Plant population should not be so much higher that there is intraspecific competition for nutrients, soil moisture, light, etc. so that yield per unit area of the crop is hampered. Likewise, it shouldn’t be too low to achieve economic yield.

To maintain optimum plant population following approaches should be taken:

i. Preparation of proper seed bed.

ii. Arrangement of rows and beds.

iii. Maintenance of row spacing.

iv. Accurate planting time and methods.

v. Seeds of good quality and health.

4. Choice of crops: Choice of crops should be done in such a way so that it can maintain ecosystem diversity, fertility, resilience and at the same time enabling farmers to yield remunerative crops throughout the year. At least one leguminous crop should be incorporated in a cropping system so as to improve the soil fertility. Exhaustive high feeding crops like rice, potato should be followed by restorative crops like cowpea, green gram, black gram etc, Perennial and long duration crops like sugarcane should be followed by seasonal crops like green gram, groundnut etc. Deep rooted crops like cotton, should be followed by shallow rooted crops like lentil, potato etc. so that mining of nutrients takes place from different layers of soil so that nutrients are not exhausted from a particular single layer.

Selection of crops by a farmer depends on a number of factors:

i. Agro-climatic conditions of the region: In regions where rainfall is higher crops like rice can be grown. Less water requiring crops like millets, pigeon pea, sorghum etc should be grown in dry areas. High feeding crops should be grown in soils having high fertility whereas leguminous crops like chickpea, lentil etc should be grown in poor fertile soils. In cold climates low temperature loving crops like wheat, mustard, lentil should be grown whereas in high temperature areas crops like sorghum, pearl millet etc should be grown.

ii. Irrigation water availability: Areas where irrigation water availability is assured multiple cropping systems can be followed. Eg: Rice-potato-groundnut, rice-potato-jute.

iii. Market demand: For example: Areas having high market demand for mustard oil farmers should cultivate mustard crop. Likewise, a high market demand for vegetables commands the farmers to grow vegetables more.

iv. The economic conditions of farmer: Rich farmers can go for high value crops like cocoa, tea, coffee plantations which require high maintenance, labour, skill and infrastructure. Whereas poor farmers can go for less value crops like rice pulses, wheat.

v. Cropping system options: Depending on the opportunities available farmers must decide whether to go for intercropping, mixed cropping, crop rotation, relay cropping etc.

vi. Availability of post-harvest, storage and processing facilities: It depends on whether primary processing and storage facilities are available or not.

vii. Appropriate government policies and schemes: It depends on government policies and schemes favouring a particular crop in the region and whether the farmers are eligible for it.

5. Plant protection: On the context of sustainable agriculture and growing awareness of food and environment quality it is quite imperative to find alternative solutions to keep pest population under control. Better understanding of bio-ecological relationships of cropping systems holds the key for more appropriate environment designs and skill-intensive eco-friendly management techniques so as to maintain balance in pest -predator population at the same time growing a healthy good quality crop. Therefore, switching from extensive use of pesticides to a more natural way of controlling pest population has become the need of the hour. Some of the practices which make the environment less attractive and favourable for the pest to survive, grow and reproduce are as follows: Use of clean, disease free and certified seeds for sowing. Harvesting of potato tuber only after defoliation of leaves helps to prevent tuber rot due to late blight disease. Preparation of clean main field and nursery bed by removing plant debris, deep summer ploughing, trimming of bunds etc so that pests and diseases of various stages can be obliterated.

Use of pest/disease tolerant varieties of crops. For example: Rice stem borer resistant variety- Jagannath, Ratna, VL-Dhan 61. Rice blast resistant variety-Jaya, Rasi. Wheat resistant variety for leaf rust and blight –Karan Vandan

Diseases which spread very fast under higher plant density can be checked by wider spacing of crops. For Eg: *Cercospora* on pulses.

6. Weed Management: To control weeds effectively by keeping harmony with crop environment the following measures can be followed:

Preventive measures like using weed free seeds for sowing, cleaning the farm equipment while moving it from one location to other etc can be followed.

Cultural practices like: Crop rotations like growing legumes/crucifers/sorghum in rotations due to their allelopathic effect and competition brings shift in weed flora and control weeds. Growing cover crops like cowpea/sorghum/alfalfa which covers the ground and suppresses weed population by their resource competition. Stale seed-bed preparations so that weed flushes can be controlled before growing of the main crop. Soil solarization by increasing the soil temperature to control weed population

By flooding the field- Sowing crops in higher density so that it has competitive advantage over weeds, should be followed.

Conservation and use of natural enemies of weed plants should be one of the foundations of sustainable weed management so that germination of weed seeds or the spread of the established plants can be controlled in an eco-friendly way. For example:

i. Leaf beetle (*Octotoma sp*) feeding on *Lantana camara.*

ii. Common carp and chinese carp feeding on aquatic weeds.

iii. *Cactoblastis sp*. laying eggs on *Opuntia sp.*
iv. *Rhizoctonia solani* for controlling *Eichornia crassipes.*

Some practical low-cost technology and non-monetary inputs:

i. Mulching and irrigation in tea is a practical example for low cost technology. The mulching was done with coir pith. Instead of that mulch crops are grown in the field and then cut and incorporated it as mulch and then tea plantation is taken up.
ii. Usage of Neem leaves for cereal storage is another low-cost technology.
iii. Sun drying is a common non-monetary input which has got lot of prospects in the processing industry also.
iv. Use of biofertilizer like *Azospirillium* for cereals, millets, cotton, sesame and *Rhizobium* for pulses.

Conclusion

In modern time of agriculture, the cost of inputs is very high and marginal farmer cannot use these inputs at regular basis. To attain one of the goals of sustainable agriculture e.i. low input and high output low cost technology and nonmonetary techniques can be highly efficient.

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Constraints of Nanotechnology Application in Agriculture

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Introduction

To address the growing challenges of food security and agricultural sustainability, several researches on application of nanotechnology in agriculture have been carried out in last two decades. Nano-products in agriculture has gained popularity over conventional agricultural products because of its higher efficacy in controlled nutrient release, smaller dose, higher nutrient use efficiency in plants, lower content of filler materials, and negligible waste products. The revolution of green nanotechnology has therefore vividly changed the global farming canvas. Agricultural applications are boon to have various nano-based products like nano-fertilizers, nano-pesticides, nano-sensors etc.

Constraints

These nano-enabled products have been playing as crucial agents for sustainable agriculture by maintaining environmental balance. However, application of nanotechnology in agricultural sector possess several constraints which are discussed below.

1. Lack of uniform legislative framework: There is no specific and uniform legislative framework and guidelines for applications and usage of nano-products in agriculture in many countries including India. This is the major constraint in rapid development and adoption of nanotechnology in agricultural sector.

2. Phytotoxicity: Besides, better germination, vigour, protection against pathogens and abiotic stresses, nano-products were reported to be toxic to plants. Extent of these phyto-toxicities vary with several factors like composition, reactivity, higher surface area, concentration, size of nanoparticles (NPs), plant types, different crop growth stages etc. Positively charged NPs are more toxic than negatively charged NPs. Engineered metal-oxide based nano-fetilizers accumulate in different edible plant-parts which may shows impaired physiology in plants, but upon consumption, pose detrimental human health hazards. Micronutrients are crucial for every field crop, but in some cases, nano sized oxides of Zn, Cu, and Ti have shown to inhibit germination by oxidative damage during seed incubation period (Phogat *et. al*., 2016). TiO_2 NPs cause toxicity in micro tubular networks of *Arabidopsis thaliana* and wheat during movement through plasmodesmata (Larue *et. al*., 2012). Alumina NPs have contrasting results on plants upon application. Though alumina NPs have less harmful effect in crops, Yanik *et. al*., (2017) had shown programmed cell death due to integrity loss in plasma membrane, deformations of nucleus, irregular aggregation of microtubules, and chromosomal abnormalities in wheat upon exposure to Al_2O_3 NPs in high concentrations; while Hayes *et. al*., (2020) reported higher macro-nutrient uptake after application of Al_2O_3 NPs but reduced the micro-nutrient uptake through roots of lettuce. Plants, because of its lower trophic level position serve as bridge for transportation of NPs and their accumulation in high trophic-level consumers through the food chain.

Nano-pesticides, carrying Cu as active ingredients (a.i.), showed differential anthocyanin varieties (high and low) of basil. In contrast to elevating fungicidal properties and increasing photosynthesis, higher concentrations of Cu NPs had been shown to pose toxicity effects on green gram and wheat, reduced biomass and root length in *Cucurbite pepo*. Silver (Ag) NPs are widely used in formulation of a.i. in different agrochemicals because of its antifungal and antibacterial properties; however, phyto-toxicities were associated with its accumulation in root cells in high concentration (Choudhury *et. al*., 2016).

3. Genotoxicity: The Dose-dependent genotoxic and phytotoxic effects of cerium oxide (CeO_2) and titanium oxide (TiO_2) NPs was also established on barley (Mattiello *et. al*., 2015). Cellular accumulation of ZnO NPs through repetitive exposure to human stem cells can induce cyto- and geno-toxicity (Ickrath *et. al*., 2017); while exposure to CuO NPs results in geno-toxicity in pulmonary epithelial cells of human through oxidative stresses (Ahamed *et. al*., 2010).

4. Mammalian toxicity: Faulty handling of nano-sized agricultural chemicals might cause unwanted skin penetration, followed by toxicity. The interactions between animals and metal NPs are not well established but Ze *et. al*., (2014) in an experiment on mice found that TiO_2 NPs can accumulate in the brain; while Wu *et. al*., (2010) observed that on an exposure to TiO_2 NPs, there had been inhibited cell cycle and apoptosis in PC12 cells (dopaminergic model neuron cells). Combined exposure of Ag NPs and F in human fibroblasts resulted in cellular damage through cell-membrane penetration and accumulation in mitochondria (Inkielewicz-Stepniak *et. al*., 2014).

5. Others: Besides toxicities, low loading efficiency of nano-carriers, high cost involved in synthesis process, difficulty in synthesis process, and persistence of NPs in environment are also questionable issues.

Conclusion

Potential health and environmental hazards are identified in post green revolution era due to injudicious application of agrochemicals resulting into eutrophication, greenhouse gas emission, pesticide resistance, ground water contamination etc. Nanotechnology based products may therefore serve as an alternative viable option for better effective applications of agrochemicals due to reduction of possible economic losses and environmental hazards. However, common challenges related to commercialization of nano-based agro-products are high processing costs, concerns about human health, environmental and safety issues. Further research is therefore need of the hour to develop biodegradable carrier matrixes and cost-effective synthetic routes. Moreover, the Government should frame common and specific regulatory guidelines regarding development, packaging, transportation and use of nano-products in agriculture.

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Aromatheracy

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Introduction

Aromatherapy:
Aroma – fragrance.
Therapy – treatment.

Aromatherapy derived its name from the word aroma, which means fragrance or smell and therapy which means treatment. This therapy is a natural way of healing a person's mind, body and soul. Aromatherapy is the treatment or prevention of disease by use of essential oils. Aromatherapy is one of the complementary therapies which use essential oils as the major therapeutic agents to treat several diseases (Babar et al., 2015).

1. Essential oils: are concentrated extracts taken from the roots, leaves, seeds, or blossoms of plants. These are secondary metabolites produced by plants. These are volatile in nature.

2. Aromatherapiest: A practitioner of aromatherapy.

Among the different phytomedicines essential oils are important source for curing several diseases and also psychological disorders. The genetic diversity of plants has potential treatment for various diseases. They continue to be of paramount importance until the present day.

Alternative Medicine

Is any practice that is put forward as having the healing effects of medicine, but is not founded on evidence gathered using the scientific method. It consists of a wide range of health care practices, products and therapies

Ex : Homeopathy, Naturopathy, Ayurvedic medicine.

Complementary Medicine

Is alternative medicine used together with conventional medical treatment in a belief, not proven by using scientific methods, that its "complements" the treatment.

Father of Aromatherapy

Rene-Maurice Gattefossé advanced the new science of aromatherapy and opened the door for thousands of peer-reviewed studies of these marvelous oils. Gattefossé is credited with coining the word "aromatherapy".

Mode of Application

1. Diffusers and Atomizers: Essential oil mist into the air.
2. Inhalations: Essential oil are mixed into a bowl of steaming water by which vapors are inhaled.
3. Massage: It is an age old, tested and reliable way to reduce stress. A dilution of 3% E.O. to carrier oil is recommended.
4. Lotions and Oils: E.O. applied over skin to increase circulation at the surface of skin, opening up the pores.
5. Vaporization: E.O. are antiseptic and evaporates easily, so they make very good air fresheners.
6. Baths: Using oils in bath is a simple, effective and pleasant way to relax and receive therapeutic effects.
7. Perfumes: These are another effective way of practicing aromatherapy.

Types of Aromatherapy

There are three types of aromatherapy benefits which can be experienced in a variety of ways:

1. Cosmetic aromatherapy: Essential oils used for facials, body, hair care products and for skin problems like acne and pigmentation. A few drops of the appropriate oil in warm bath will create a rejuvenating and revitalizing experience.

2. Massage aromatherapy: This is more popular in health spas and resorts in Europe and USA. Worlds 1st health farm is in Kerala at Kairali Ayurvedic Health Resorts Pvt. Ltd., Palakkad. E.O. supplement the healing touch of massage therapy.

3. Olfactory aromatherapy: The benefits are experienced when essential oils are inhaled or orally taken. Direct inhalation will enhance emotional wellness, feel of relaxation and rejuvenates. Essential oils bring the body back into harmony.

Benefits of Aromatherapy

1. Enhance mood and general feeling of well-being through massage and the use of essential oils
2. Strengthen the immune system by helping to kill viruses, bacteria and fungal infections.
3. Reduce pain.
4. Encourage restful sleep.
5. Improve digestion.

Future of Aromatherapy

1. Although essential oils have been used for centuries, few studies have looked the safety and effectiveness of aromatherapy in people.
2. Scientific evidence is lacking, and there are some concerns about the safety and quality of certain essential oils.
3. More research is needed before aromatherapy becomes a widely accepted alternative remedy.

Conclusion

In the increasing instances of modern day's stresses, depressions and psychosomatic disorders, aromatherapy has come to stay and proliferate. With all the convincing application of aromatherapy in place, it has still a long way to go from emerging as a powerful alternate medicine. With more rigorous scientific studies on the properties of the ingredients, large scale clinical studies on the benefits and risks involved and standardized protocols for treatments can probably get aromatherapy the place it rightfully deserves, in the modern scientific world.

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"Caralluma" - An Underexploited Medicinal Plant, its Importance and Uses

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Scientific name: *Caralluma* sps.
Family: Asclepiadaceae.

Distribution

Grows wild in India, Africa, and Europe and was cultivated in Britain as far back as 1830 Common source in Sri Lanka, Nepal and in India, hilly regions of Orissa, Andhra Pradesh, Tamil Nadu and in Karnataka. *Caralluma umbellate*: - Grows wild in dry and arid regions of Chittoor District and several District of Andhra Pradesh, in India.

Common Names

Sanskrit name: Dugdhika, Uttamphalini.
Telugu (Tribal) it is known as Kundete kommulu.
Tamil Nadu it is known as Eluman or Elumanpuli.

Botany

Caralluma, a cactus plant belongs to family Asclepiadaceae is a succulent, perennial herb, grow to a height of 1 to 10 ft and grow in different regions of India. The members of genus Caralluma are erect and fleshy. They have quadrangular stem, devoid of leaves and small flowers in several varieties of dark color. Flower during January and June. The species of Caralluma found in India are edible and form a part of traditional medical system of country.

Caralluma fimbriata

Caralluma umbellata

Uses

1. This succulent Cactus contains glycosides, hydrocarbons, saponins as major phytoconstituents and reported for various biological activities such as rheumatism, diabetes, leprosy, antipyretic, anti-helminthetic activities.
2. It is widely consumed as a food, appetite suppressant and treatment for diabetes. A standardized extract of *C. fimbriata* containing pregnane and metastigmane gly-cosides is marketed as a supplement for weight loss.
3. Previously the tribal people of Chittoor District used stem juice warmed and mixed with turmeric powder for stomach disorder and abdominal pains.
4. Caralluma species for their biological activities such as anti-oxidant, anti-obesity, anti-inflammatory and anti-microbial.
5. The extract of *Caralluma fimbriata* in the form of capsules has been released under the trade name GENASLIM for body weight control.

Chemical Constituents

1. The medicinal properties of *Caralluma umbellata* have been attributed to glycosides contained therein. The glycosides contained in Caralluma belong to pregnane group of glycosides. Some pregnane glycosides are found in Caralluma plants includes, but are not limited: Carumbelloside-I, Carumbelloside-II, Carumbelloside-III, Carum-belloside-IV and Carumbelloside-V.

2. Pregnane glycosides, saponins and flavonoids are the main constituents of Caralluma species, in which saponins are mainly ascribed to their specific interaction in their cell membrane causing changes in cell permeability. Studies also revealed on the antimicrobial potential of saponins from various other medicinally important plants. Presence of sugar in saponin molecule has a stronger hemolytic property.

3. Saponins are typical secondary metabolites widely present in the plant kingdom which include steroidal and triterpenoid glycosides classified according to the nature of their aglycones. Most saponins are hemolytic and display a range of various biological and pharmacological properties, such as molluscicidal, anti-inflammatory, anti-microbial and cytotoxic activities.

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Betelvine Production Technology

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Introduction

1. Botanical Name: *Piper betel*.
2. Family: Piperaceae.
3. Origin: Betelvine is a perennial dioeciously creeper native of Malaysia.

Importance

Betelvine leaves have a strong pungent aromatic flavor and are widely used as masticatory. Mature leaves are used for chewing with smeared hydrated lime plus catechu, arecanut, clove, cardamom, fennel etc. Leaves has-religious importance.

Composition

Moisture 85.4%, protein 3.1%, fat 0.8%, carbohydrate 6.1%, fibre 2.3%, minerals 2.3%, reducing sugars 0.38% to 1.46% and all vitamins and Iodine also. It also contains almost all amino acids. The aromatic value is determined by the nature of oil content in leaf. Oil content varies from 0.7 to 2.6%, the oil consists of phenols and terpenes.

Soil and Climate

Well drained fertile clay loams are suitable. It does not tolerate saline and alkaline conditions. Betelvine require a cool humid with considerable humidity and regular supply of moisture in the soil is essential. It flourishes in areas with a rainfall of 225 to 475 cm.

Varieties

Karpurakodi, Kallarkodi, Revesi, Karpuri, SGM 1, SGM (BV) - 2, Vellaikodi, Pachaikodi, Sirugamani 1, Anthiyur kodi, Kanyur kodi, Bangla, Deshi, vali, nalekatj Kurche, Sanchi, Remtaks, Pangara, Kapufi, Banaresi, Calcutta, Madres, Malpari, Chandan, Kali type are under cultivation.

Propagation

The vines are propagated by terminal stem cutting or setts about 30 - 45 cm long. Setts obtained from the top portions of the vines are easy to root and hence best for planting.

On an average 1,00,000 setts are required for planting one hectare. Setts with vigorous apical buds and nodal adventitious roots are selected and planted at the base of the live supports, which are to be planted 4 to 5 months earlier.

Row spacing	Vines/hectare	
	Single vine	Double vine
20 cm	50,000	1,00,000
30 cm (1 ft)	30,000	60,000
45 cm (11/2 ft)	22,500	45,000

Season

November - December and January – February are optimum for cultivation.

Preparation of the Field

The field is prepared to a fine tilth and beds of 2 m wide are formed to a convenient length. Provide drainage trenches of 0.5 m width by 0.5 m depth in between two adjoining beds. Plant the seeds of the live supports i.e. Agathi *(Sesbania grandiflora)* in long rows. About 750 banana suckers are planted at the edges of the beds, which are used, for tying the vines on the live support and for packing the betel leaf. When the Agathi plants reach 4 m height, they are topped off for maintaining the height. The crop is planted in two rows in beds of 180 cm width on Agathi plants with a spacing of 45 cm between plants in the row.

Irrigation

Irrigate the field immediately after planting and afterwards once in a week.

After-Cultivation

Training of the live standards: Before the establishment of vines, the side branches of Agathi trees up to a height of 2 m are removed for early creeping of the vines.

Training of the vines: Training is done by fixing the vine at intervals of 15 to 20 cm along the standards loosely with the help of banana fiber. Training is done at every 15 - 20 days interval depending upon the growth of vines.

Lowering of vines: Under normal cultivation, the vines grow to height of 3 m in one-year period. When they reach this height their vigor to produce normal size leaf are reduced and they need rejuvenation by lowering during March - April. After the vine is lowered, the tillers spring up from the nodes at the bends of the coiled vines at the ground level and produce many primary vines. Irrigation should be given after each lowering.

Manuring: Apply 150 kg N/ha/year through Neem cake (75 kg N) and Urea (75 kg N) and 100 kg P2O5 through Super phosphate and 30 kg Muriate of potash in three split doses first at 15 days after lifting the vines and second and third dose at 40 - 45 days intervals.

a. Apply on beds shade dried neem leaf or Calotropis leaves at 2 t/ha and cover it with mud (2 t in 2 split doses).

Time of application	N	P	K
	(kg/ha)		
Basal dressing	37.5	100	50
Top dressing @ 3 split doses	112.5	0	0

Harvesting: Harvesting of betel leaves was done throughout the year. Expert hands were needed for harvesting. The leaves which were sufficiently ripe were plucked along with a petiole about one cm. length. Leaves were plucked by hand and by artificial nails kept at the thumbs. Harvesting started after three to four months after plantations and one to one half months after lowering. During rainy season harvesting went continuously at fifteen days intervals. Harvesting was done according to market conditions and the financial needs of cultivators. Each betelvine was picked at six to ten times in a year. Pickings were so arranged that all vines were not to be picked at the same time. Three types of pickings were practiced. Leaves of main stem were called as fapada. The leaves that were borne on branches of vine were called as kalli. The leaves that had lower parts of vine and one betelvine coils were known as hakkal or Gabal. But they did not fetch better price. Fapada leaves were older, thick, and dark green which fetched high price as compared to kalli leaves. In every day, approximately, a single labor was able to cut one or two dags (12,000 to 24,000 leaves).

Packaging: The method of packing and package materials used varied from region to region. Packing was dependent upon quality of leaves, season and the availability of packing materials. The branches of mulberry were used for packing betelvine leaves. Banana fiber and leaves were also used as a packing materialBamboo baskets also used to pack small contains up to three thousand leaves. This package was locally called a Karandi. About six thousand leaves were packed in the banana fiber with the help of branches of mulberry. They were called as Dappa. In the Dappa and Karandi, Kalli leaves were packed. Fapada leaves had large size and were packed in dag containing twelve thousand leaves. The bottom and top of the Dag was made-up of ring of mulberry branches. The dag, dappa and karandi were tied with the help of string or plastic rope. The package was cushioned on top and at the bottom with moist sugarcane leaves and fresh banana leaves. The betelvine leavers were arranged in circular rows in the Dag.The rows were arranged from the periphery in the dag and closed towards the center. Thus, rows upon rows were arranged. In case of fapada dag, there was a hole in the center with 10 to 15 cms diameter allowing free aeration. Commission agents drew leaves samples from any part of the dag.

Yield: The economic life of betelvine garden lasted for eight to ten years. In the first year, yield of leaves was less. From the second year on wards, the yield was increasing proportionately up to five to six years. From seven year on wards yield started to decrease. In the first year the supervision or management was regular and effective; twenty-five to thirty-five dags were obtained. On an average 428 dags, containing 12,000 leaves per dags were obtained per year. They were three types of leaves which were as follows:

a. Fapada leaves: Fapada leaves were old leaves on main stem. On an average 35 Fapada dags were produced per year per acre.

b. Kalii Leaves: Kalli leaves were born on branches. On an average 338 Kalli leaves dags were produced per year during the year in an acre.

c. Hakkal or Gabal Leaves: The leaves which were bom on the coils of vines or at the bottom of vines were called as Hakkal or Gabal leaves. On an average 55 Hakkal leaves dags were produced per year during the year in an acre.

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Scientific Cultivation of Karonda

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Abstract

Karonda *(Carissa carandas)* belongs to family of Apocynaceae. Karonda is an evergreen shrub or short stature tree. It grows naturally in the Himalayas and Western Ghats at elevations of 300 to 1800 meters. It is found grown in wild in India, Malaysia, and South Africa. It produces berry-sized fruits that are commonly used as a condiment or additive to pickles and spices. Plant is a very hardy and drought-tolerant that thrives well in a various type of soils. There are more than 25 species in genus Carrissa.

Out of these, 5 species are indigenous to India. Plant is a medium sized, thorny shrub. Plant has a greenish white bark on young shoots and greyish brown on mature stems. The spines are straight and with 1-3 cm long. The leaves are opposite, commonly 2-3 cm x 1-1.5 cm and ovate. They are green with shine above and a dull green shade below. The Old leaves have shedding throughout the year.

Karonda fruit is potential source of iron and keeps a fair amount of Vitamin C. Mature fruit keeps high amount of pectin. The fruits are mostly used for pickle making. It is also used for Jam, Jelly, Squash, Syrup and Chutney etc. There are good demand Karonda products in market.

Introduction

Karonda (*Carissa carandas*) belongs to family of Apocynaceae. Karonda is an evergreen shrub or short stature tree. It grows naturally in the Himalayas and Western Ghats at elevations of 300 to 1800 meters. It is found grown in wild in India, Malaysia, and South Africa. In India, it grows in Bihar, West Bengal, Maharashtra, Karnataka and other states.

It is cultivated in Rajasthan, Gujarat, Uttar Pradesh states of India. It produces berry-sized fruits that are commonly used as a condiment or additive to pickles and spices. Plant is a very hardy and drought-tolerant that thrives well in a various type of soils. There are more than 25 species in genus Carrissa. Out of these, 5 species are indigenous to India. Plant is a medium sized, thorny shrub. Plant has a greenish white bark on young shoots and greyish brown on mature stems.

The spines are straight and with 1-3 cm long. The leaves are opposite, commonly 2-3 cm x 1-1.5 cm, and ovate. They are green with shine above and a dull green shade below. The Old leaves have shedding throughout the year. New buds also have sprouting through the year, though more during spring. Peak time of flowers in karonda from February to June. The flowers of karonda are white, scented and produced in clusters of 2 to 5 flowers. The corymbose cymes appear at the ends of twigs. The fruit type of karonda is a globose berry. The fruits appear from March to August and ripen between May to December. Immature fruits are green in colour and turn in white to reddish purple at the time of maturity. The fruits are round to oblong, sweet, though slightly acidic, juice when fully ripe. Its wood is hard, straight-grained and use for firewood purpose. The green plant serves as a protective hedge around agricultural holdings. Apart from Karonda, Natal plum (*Carissa grandiflora*), *Carissa bispinosa*, *Carissaedulis*, *Carissa ovata* and *Carissa* are other cultivated species.

Importance of Karonda Fruit

Karonda fruit is potential source of iron and keeps a fair amount of Vitamin C. Mature fruit keeps high amount of pectin. The fruits are mostly used for pickle making. It is also used for Jam, Jelly, Squash, Syrup and Chutney etc. There are good demand Karonda products in market. It has good nutritional value. It is richest source of

Iron. The fruits also keep vitamin C and it is antiscorbutic and very useful for cure of anaemia. Karonda fruits are used in various ayurvedic formulations and us to their nutritional values. The extract of root is used for Chest pain. The extract of leaves is used for fever.

Climate

It is a handy fruit. It can be successfully cultivated in tropical and subtropical climate condition. The growth of plant is affected in high rain fall and waterlogged areas. High temperature and arid climate are favorable for karonda cultivation. Temperature climate with high frost and snowfall areas are not favorable for this fruit. The plants are sensitive to low temperature and frost injury. The water-logged areas of tropical and subtropical regions are not suited to it cultivation.

Soil

Karonda can grow well in all types of soils from sandy loams, laterite, alluvial sand and calcareous soil even it is found well growing in stony, rocky and less fertile soils. But the better growth and higher yield is obtained in alluvial sandy loam soils with well drainage. The performance of orchards is very poor on clay soil with poor drainage. It can be grown in wide ranges of soil pH ranging from 5.0 to 8.0.

Varieties

Varieties	Specific characteristics of varieties
Pant manohar	• It is developed from GB Pant University of Agriculture and Technology (Uttarakhand) in 2007. • The plants of this cultivar are medium-sized dense bushes. • Fruits are dark pink blush on white background, • Average weight of fruit 3.49g, number of seeds 3.94 / fruit, fruit flesh 88.27%, dry weight 12.77%, TSS 3.92%, total titrable acidity 1.82% and yield 27 kg / plant.
Pant Sudarshan	• This cultivar is developed from GB Pant University of Agriculture and Technology (Uttarakhand) in 2007. • The plants of this variety are medium- sized dense bushes. • Fruits are pink blush on white background. • Average fruit weigh 3.46 g, seeds 4.68 / fruit, flesh 88.47%, dry weight 11.83%, TSS 3.45%, titrable acidity 1.89% and yield 29 kg / plant
Pant Suvarna	• It is developed from B Pant University of Agriculture and Technology (Uttarakhand) in 2007. • Plants have upright growing and sparse. • Fruits are produced dark brown blush colour on green background. • Average fruit weight 3.62 g, seeds 5.89 /fruit, flesh 88.27%, dry weight 12.39%, TSS 3.836, titrable acidity 2.30% and average yield 22 kg / plant.
Konkanbold	• The plants are medium in size and vigorous. • Its flowers in the month of February-March and fruit ripe in the month of May-June under Coorg conditions. • Fruits are oblong in shape and average weight of fruit 12-154g. • The colour of fruits is dark purple. • The fruits are sweet with 10-12° Brix Total soluble solid. • The tree is prolific bearing and produced 2000-2500 fruit per year. • This variety is suitable for table purpose.
CHES- K-II-7	• It is promising line identified from the seedling population at CHES Chettalli.

	• The plants are medium size and flower borne in the month of February to March and fruits ripe in the month of May-June. • Fruits are oblong in shape and average weight of fruit 12 -13 g. • The colour of fruits is dark blackish violet in colour and thin fruit skin. • The fruits are seedless (0.3 seeds/fruit). • A four-year-old trees yield around 1800-2100 fruits per plants per year. • Fruits are sweet with TSS 15° Brix and acidity - 1.08%. • This variety good for table purpose and processing.
CHES- K- V-6	• It is promising line identified from the seedling population at CHES Chettalli. • The plants are medium in size and flowering start in the month of January to February and the fruits ripe in May-June. • The average weight of fruit around 13-15 g, dark blackish red in colour with red pulp and very less seeds. • The Total soluble solids of fruit are around 16° Brix with 1.18 % acidity and 21 mg vitamin-C/100g pulp. • The four-year-old tree yield 1200-1500 fruits per year. • Fruit are also rich source of Vitamin B. • This variety is very suitable for table purpose.

Propagation

Karonda is propagated through seed and vegetative propagation methods such as cutting, layering and budding.

Seed Propagation	• The plant can be multiplied through seed very easy. • Seed propagation is commercially used methods in karonda. • The seeds are collected immediately after harvesting. • The seeds sown immediately after extraction give better germinated. Seeds are shown in trays and these seedlings are transplanted in poly ethylene bags at 3-4 leaf stage. • The plants are ready for planting in 8-10 months after sowing. • The germination percent in seedless or less seeded varieties are low. The plants produced from seeds have lot of variability with respect to fruit size, colour, taste etc. • Thus, it is not preferred for multiplication of varieties and elite lines.
Vegetative propagation	• Stem cutting, air layering and budding are used for multiplication of varieties / elite's lines to produce true type planting material.
Cuttings	• The semi hard wood cuttings are very suitable for multiplication of plants. Commercially, 25-30 cm long and 1' diameter cuttings may be used for propagating plants. • The best time for planting cutting is June to July month. • The semi hard wood cutting planted during July - August gave 30 -40 % success as compared to hard wood cutting and soft wood cuttings.
Air layering	• Air layering in karonda plants was found successful good performing during June to July. • The success rate was variable from 30-60% in different years. • The air layers were removed the plants in the month of September and planting in polythene bags and they become ready for planting after 6-7 months.

Planting

The soil should be leveled before planting and all the old plants required to be removed. The pits filled with FYM and soil mixture to one by one various time of planting of this June-July. The table purpose variety of karonda should be planted at 3× 3-meter distances in square. The method of planting the pits of 3×3 feet. The Size should be prepared at least one month before planting. These pits should be filled with equal amount of FYM and soil mixture. The proposed time of planting of this is June-July. The land should be cleaned and leveled with a mild slope in the opposite direction of the water source. The hedge plating of karonda is done at 2 fit distances. The hedge planting trench of 1× 1 feet size is done. The pits of 1×1 foot can be also made instead of trench. For planting of orchards, the planting is done at 3×3 m distance with square system. The pits of 2x2 feet size should dug before rainy season. The rocky soil pits of should be opened. Pit opening is normally recommended in April-May. These pits are filled with topsoil mixed with about 510 kg decomposed compost, 1 kg neem cake, 50 g single super phosphate and 50g muriate of potash before the onset of monsoon. Then the soil is allowed to settle with the first few rains and leveled properly. Planting is done during June to July. At the time of planting a hole the size of ball of earth is made in the center of the pit at the marked point where the plant is fixed and the soil is pressed remove air. Watering is done immediately after planting for proper establishment. Subsequently the plant is regularly irrigated till it is properly established.

Manure and Fertilizer

The Balanced nutrition's are well-considered to be very important which determines productivity and quality of fruit. Karonda responds to exogenously applied manure and fertilizers and response varies depending upon variety, climatic conditions and types of soil. Since soil and climate of different places are highly diverse, there is wide variation in the response of fertilizer application. One-year old plant should be applied 5 kg of FYM and 100 gm mixture of Nitrogen, Phosphorus and Potash. The growth should be increase in same ratio up to 3 years. The four and more than 3-year-old plants should give 15-20 kg of FYM and 400 g of mixture of NPK. The best time of fertilizer application is June-July after harvesting of fruits.

Recommended Doses of Fertilizers

Year	Quantity /tree/year			
	FYM(Kg)	Nitrogen (g)	Phosphorus (g)	Potash (g)
1	5	50	25	25
2	10	100	50	50
3	15	150	75	75
4 onwards	20	200	75	125

Training and Pruning

Karonda plant has comparatively weaker stem in initially years. Thus, it is obligatory to provide support after planting. The plant has tendency to produce various branch just above ground surface. The branches which are emerging near the ground surface require to be removed for convenience in cultural operations. Training of the plant in the initial stage is necessary to provide the needed framework. The unwanted branches should be pruned to provide definite shape and to promote growth of the trunk and crown of the tree. Three to four branches 30-45 cm from ground opposite to each other are allowed to form the proper frame of the tree. The branches should be trained in open center system for good production. The training of plant is performed only in first two years. The plant is big the pruning is needed to maintain the size of the plant. The karonda plant grows slowly in arid areas and needed comparatively less pruning but in humid and tropical region of the plant grow very vigorously. Heavy pruning is needed each year. This help in maintaining tree size and producing regular yield. Further, water suckers, crowded and crisscross branches are removed to facilitate better growth. The branches with narrow angles are also avoided. Dried and diseased branches should also be periodically removed. Pruning is generally performed in the month of October in Coorg conditions. Karonda planted for hedges purposes need not be trained in this manner and 3-4 branches are allowed to near ground level to make a compact hedge. The hedges are trimmed after harvesting of fruits.

Intercropping

Karonda is usually grows in dry soil where water facilities are not available some vegetables are can be growing during rainy season. During the initial period of establishment, the space between the plants can be utilized for planting of intercrops. These give better additional income in the initial stage of planting without competing with the main crop. Cowpea, French bean, okra, brinjal or other suitable crops of the regions are grown as intercrops. In the mature karonda orchards, green manure crops may be grown and incorporated into the soil, which improves its fertility, moisture holding capacity and physical condition.

Water Management

Karonda is a hardy plant. The newly planted plants should be given irrigation. Young plants should be irrigated at 10-15 days interval in the winter and 6-7 days in summer season. The basin or flood method of irrigation is commonly practiced. However, adoption of drip irrigation has been found to be effective in the economic use of water and increased growth. The adult's orchards are usually not irrigated. Mulching with dry leaves or residues in the basin helps in moisture conservation.

Pests and Diseases

Pests	Characteristics
Leaf eating caterpillars	• Caterpillars cause large damage, mostly by eating leaves. • It affects the growth of the plants. • Caterpillars may be controlled by spraying of pesticides and use of biological control or cultural practices. • The chemicals, monocrotophos (2ml/l may be used for control of leaf eating caterpillars.
Control	• Caterpillars may be controlled by spraying of pesticides and use of biological control or cultural practices. • The chemicals, monocrotophos (2ml/l may be used for control of leaf eating caterpillars.
Fruit fly, *Bactrocera dorsalis, Bactrocera caryeaea*	• Fruit fly infests the ripened fruits. Its infestation is much in southern states. • The female fruit fly lays eggs on the mature fruits with the helps to its pointed ovipositor. • After hatching the maggots feed on pulp of these fruits and the infested fruits starts rotting and fall down. • As a result, brown patch appears around the place of oviposition. The maggots come out of the affected fruit and pupate in the soil.
Control	• Preharvest IPM combined with sanitation (Collection and destruction of fallen/infested fruits) + Placing Methyl eugenol trap @ 4-6/acre + In severe infestation spraying of bait spray (Decamethrin (Decis) 2ml+ 100g of jaggery in 1 litre of water) is recommended.
Diseases	
Anthracnose	• In the karonda plants are affected by Anthracnose. • The symptoms are developed in the leaves as Irregular size black, brown, lesions. • These spots increase in size and decreasing the size of the leaves. The disease affects fruits and branches.

Control	• The diseases may control by spraying of copper-based fungicide copper oxide, copper trioxide in the initial stage. • The orchards sanitation like burning of fallen leaves and fruits help to reduce inoculums.

Harvesting and Yield

Karonda plant starts bearing after 3rd year. The maturity of fruits is judged on the basis of change in color. All fruits generally do not mature at one time therefore harvesting is generally done 3-4 times. Harvesting is done manually. The harvesting of fruits with stock helps to minimum the oozing of latex by fruits and improves quality and storage shelf life of fruits. The average yield of the plant is 4-5 kg fruits. The promising lines planted as orchard may yield 10-15 kg per tree. The fruits can be stored for 3-4 days under room temperature.

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Black Wheat Farming: Incredible Benefits

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Abstract

Black wheat contains antioxidants, B vitamins, folic acid, selenium, magnesium, manganese, zinc, calcium, iron, copper, potassium, fibre, and amino acids, which make this wheat rich in nutrients. Coloured wheat is rich in anthocyanins, has created interest among the breeders. The nutritional and advanced, high yielding and regionally adapted coloured wheat lines, exhibited higher anthocyanin content and antioxidant activity than donor wheat lines and it varied in the order of white ,purple ,blue and black wheat. Interestingly, the purple wheat extract showed highest anti-inflammatory effect and followed the trend of white, blue and black wheat. Nutritional and processing parameters in relation to end-use quality of advanced coloured lines were similar to high yielding white wheat cultivar. Coloured wheat lines showed high iron and zinc content compared to white wheat indicating double bio-fortification. The advanced coloured wheat lines with high anthocyanin, iron and zinc contents showed antioxidant and anti-inflammatory activity and possessed desirable features for product making and commercial utilization.

Keywords: Black wheat , Farming, Health benefits.

Figure1: Black wheat

Introduction

Cereals take an important place among all the food items and play key role for a healthy diet. Among the cereals, wheat is the leading one, devoted to multiple uses. Wheat is a good source of starch, proteins, minerals and dietary fibre and is major contributor towards daily caloric requirements of wheat consuming population. Its nutritional value is expected to increase on consumer demands regarding health, nutrition and convenience.

Anthocyanins are normal constituents in coloured fruits and vegetables. These can act as antioxidants and help in prevention of cardiovascular diseases like diabetes, inflammatory. Common wheat cultivars across the world are white (amber) in colour. The coloured wheat, rich in anthocyanin is quite uncommon. Purple colour is localized to the per carp, whereas blue colour to the aleurone . Black wheat resulted by the combination of genes for both purple and blue colours. Coloured wheat has attracted the attention of many breeders across the world. Coloured wheat lines were characterized for anthocyanin content and antioxidant activities.

Figure 2: Barley of Black wheat

A few years back, a post went viral over social media platforms saying that a new type of wheat has been produced after seven years of research and it has the capacity to cure health issues like cancer and diabetes. As per reports, some farmers of the Neemuch region, Malwa and Indore district had sown this new type of wheat in the Rabi season last year. While the farmers were curious about the production of black wheat, but the final result showed that it is being produced like any normal wheat.

Moreover, this new type of wheat comes with so many health benefits and even has the capacity to prevent some major diseases like Diabetes and Cancer which in reality is very difficult to cure through medical science.

According to Mr. Govind Nagda, a progressive farmer of Kanakheri village that comes under the Neemuch district, he had obtained 40 kg of black wheat seed with the help of a friend from Nabi Research Center in Mohali, which was sown in three bighas of land. When this wheat was weighed after harvesting and cleaning, its weight came out to be 36 quintals. However, production remained just like normal wheat. Normal wheat also produces 10-12 quintals on an average bigha.

Black wheat is also known as Buckwheat and categorized under cereals. As we know the wheat is one the major source of nutrition for our body. In India along with nutrition, wheat is also a major source of income due to its huge cultivation. The black wheat is a healthier option to adopt than brown wheat. The reason is instead of just color difference, the black wheat possesses more nutritional values when compared to normal wheat. Apart from black, buckwheat is also available in purple and blue colors.

The Reason of Color

Some pigments give color to fruits or vegetables that are nothing but the – Anthocyanins. Their concentration level also plays a major role in colors. In ordinary wheat, the concentration of these anthocyanins is 4 to 5 ppm whereas in black wheat it is around 100- 200 ppm. This makes the wheat black. Hence the variation in this concentration level contributes different colors to the fruits and vegetables.

The meaning of this shloka goes as– Qualities of wheat (Godhuma) are –sweet in taste, cold in potency, heavy to digest, subsides Vata- Kapha dosha, increases strength, improves the quality of sperms, unites fractured bones, rejuvenates the whole body, enhances complexion, increases appetite, provides firmness to the body.

1. As stated earlier, black wheat also has these properties; in addition to that, it also has some more nutritional qualities. That is why the nutritional status of black wheat is compared to Blueberries or Jamun.
2. Rich Source of antioxidants.
3. It is a Gluten-Free Cereal and helpful for those who are allergic to gluten.

4. Great source of amino acids, vitamins, and minerals
5. Rich source of vitamin B, that means has a higher level of vitamin B6, B12, and folic acid. In minerals zinc, iron, copper, magnesium, phosphorus, and potassium are present in it.
6. Amino acids and lipids are the main components that form our tissue, hence in body build up we can use them. It provides all the essential amino acids to our body.

Figure 3: Choice of Black with other colors

Benefits of Black Wheat

This wheat is much more nutritious than ordinary wheat and in terms of quality; it is kept equal to the fruit called Blueberries:

1. Beneficial in reducing Stress Level: In today's era, every individual is suffering from stress and leading a stressful life. To manage that stress everybody is searching for some solution in the form of medications but such medicines have side effects, even persons are becoming addicted to these medicines and their conditions go worst. But a better way to tackle the stress is our diet. Black wheat is coming as a boon for them. At present researches are going on black wheat, which shows efficient results in certain conditions.

2. Beneficial in Obesity: In this competitive world, everybody is busy in attaining their goals and forget to give time to their health. The lack of physical activity leads to obesity. Not only our activity, our improper diet which mainly includes stuff like – junk food, oils, and fatty acids results in obesity. Black wheat is a protein and fiber-rich food and has fewer fats and carbohydrates. It is rich in antioxidants which helps to remove toxins from the body.

3. Benefits for Cardiovascular System: Buckwheat contains unsaturated fatty acids that are ideal lipids that help to prevent and use in cardiovascular disorders. It is effective in reducing low-density lipoprotein, triglycerides and increases the HDL level (High-Density Lipoprotein). Research on cardiac patients has yielded very meaningful results in the individuals who consumed black wheat.

4. Beneficial in reducing Constipation: It is a fiber-rich food, hence helps to relieve constipation. Even it improves the intestinal peristalsis, which is a major cause of constipation. Those who usually suffer from constipation, they can add this in their daily diet.

5. Beneficial in Hypertension: Along with cholesterol levels, it also manages high blood pressure. So it is recommended to have food in hypertensive patients, which is made up of black wheat.

6. Beneficial in Diabetes: Diabetes is also a disease that has spread and affected the huge population throughout the world. The prognosis of this disease is also very poor. Along with medications, the major treatment part includes our diet and lifestyle modifications. For this, black wheat is a natural excellent choice for diabetic patients, if used.

7. Helpful in Cancer: Cancer is considered among the deadly diseases, and the medicines that are used to treat cancer have shown various side effects on our body. Most of the food items are restricted while treatment, in that case, black wheat has become a boon for them. Thus, it helps to rejuvenate the affected cells in cancer patients. In research, it has been noticed that blackbuck contains enterolactone, a precursor for breast cancer.

8. A Great Choice for Wheat Allergy Patient: It is a gluten-free food. Gluten is found in wheat, oats and also in some other grains. It is a protein that has an adhesive property. There are some persons who are allergic to wheat, also in some individuals, it will trigger gut inflammation and may worsen the digestive disorders. Hence, in digestive disorders mostly gluten-rich diet is restricted but black wheat is a great choice for those patients because it is gluten-free.

Conclusion

Biofortified crops have huge market potential. Advanced high yielding black, blue and purple wheat lines in high anthocyanin content, antioxidant and anti-inflammatory activities. Apart from features required for commercial product development, paving way for their industrial utilization. The expanded utilization of black wheat will increase its production. This will result in the social development of the region by creating job opportunities and opening new markets. Black wheat is nutritious and easy to be prepared and can be used to provide food security, nutrition, and sustainability in populations.

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Romanomermis culicivorax - An Obligate Mosquito Killer

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Introduction

The mermithid nematode, *Romanmermis culicivorax*, is an obligate parasite of many species of larval mosquitoes. During the 6 to IO day parasitic phase, the nematode obtains all of its nutritional requirements from the host hemolymph. The parasite then leaves the host, molts, and mates, and the female lays eggs to complete the life cycle. After infection by *R. culicivorax preparasites*, mosquito host larvae are, in effect, "members of the living dead." Usually, the parasitized host does not die until shortly after parasite emergence and may exert competitive pressure on uninfected conspecifics for the six or more days that it survives.

Geographic Range

Romanomermis culicivorax is naturally found in the American continents. However, humans have distributed the species around the world.

Habitat

Romanomermis culicivorax live in slow-moving freshwater and in the substrate at the bottom of these bodies of water. These include ponds and lakes (Levy et al. 1979). Larval stages parasitize larval mosquitoes. (Levy, et al., 1979).

Physical Description

These parasitoids range in size from 5-25 mm (Nickle 1972). They are colorless except when food is present in their intestinal tract. They are unsegmented and bilaterally symmetrical with a circular cross section. The circular body is bluntly rounded anteriorly and tapers posteriorly. Regions are not easily divided into head, neck, and truck or tail. The oral opening is terminal and is followed by the stoma, esophagus, intestine, and rectum. Females have separate genital and digestive tract openings. In males, the reproductive system joins posteriorly with the digestive tract to form a cloaca. *Romanomermis culicivorax* also have a protoplasmic extension from the somatic muscles that reaches for synapses with the central nervous system (Maggenti 1997). (Maggenti, 1997; Nickle, 1972).

Development

Eggs develop within 7 to 10 days at 26°C. Egg development is temperature dependent, and it may take several months for eggs to develop if the temperature is less than 10°C. Eggs inhabit temporary bodies of water that dry up periodically. Mature eggs in a moist environment devoid of free-water hatch and remain in a latent stage until they are exposed to the free-water. Eggs that mature in free-water hatch as they mature. Upon hatching, the preparasite is active and swims around until it finds a host, a larval mosquito. Upon successful contact with a host, it uses its stylet to attach to it and then enters the host's hemocoel via the hole made in the host's cuticle. The preparasite stage lasts less than 9 minutes. The parasitic stage begins when the nematode enters the host. It remains inside the host for 7-9 days and continues to develop. Afterwards, it molts into the postparasitic stage. In the postparasitic stage, the nematode ruptures the host's cuticle and emerges. This is fatal to the host. The nematode then burrows into the substrate and remains there for seven or more days to mature into the adult stage. After molting, the adult's mate, and the females lay their eggs. They can lay 2,500 eggs within a time-span of 10-15 days. This life cycle occurs in 3-6 weeks (Nickle 1972; Nickle 1984). *R. culicivorax* undergo four molts between the first stage and the adult. At each molt, the cuticle of the body, esophagus, and the rectum is shed (Maggenti 1997). (Maggenti, 1997; Nickle, 1972; Nickle, 1984).

Reproduction

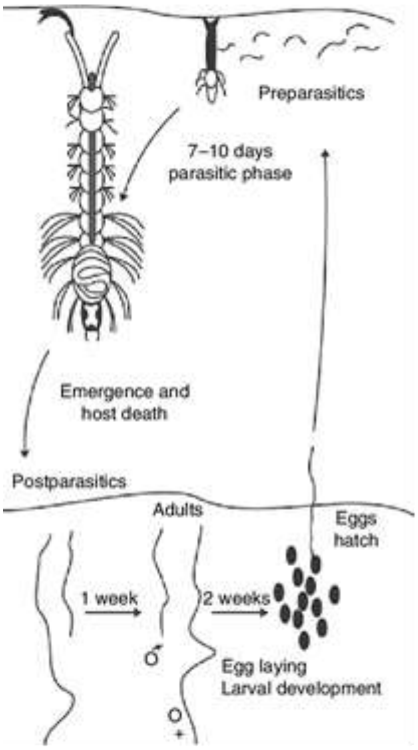
R. culicivorax have separate sexes, with females being oviparous. *R. culicivorax* undergo four molts between the first stage and the adult(Maggenti 1997). After molting to the adult stage, the adult's mate, and the females lay the eggs in the substrate at the bottom of a body of water. They can lay 2,500 eggs within a time-span of 10-15 days. This life cycle occurs in 3-6 weeks (Nickle 1972; Nickle 1984). Studies support cross-fertilization is the only mode of reproduction of *R. culicivorax*. They also have no distinguishable sex chromosomes (Hendry et al. 1986). (Hendry, et al., 1986; Maggenti, 1997; Nickle, 1972; Nickle, 1984).

Lifespan / Longevity

The entire life cycle may take 3-6 weeks, depending on water temperature. (Nickle, 1972; Nickle, 1984).

Behaviour

In the parasitic stage of the nematode, six stages can be identified. The first stage is host detection. *R. culicivorax* cannot detect the host from relatively remote distances. The second stage is orientation to the host, a larval mosquito.



The third stage is attachment, and this is aided by secretion of an adhesive material from the anterior region of *R. culicivorax*. This adhesive material is also used as a cleansing or sterilizing factor for the nematode cuticle during host penetration. The fourth stage is the search-boring stage, characterized by spear thrusting and salivary secretions. The fifth stage is host immobilization. Here, the nematode's esophageal injections temporarily paralyze the host and cause temporary cardiac arrest. The immobilization of the host ensures cuticle penetration by reducing excess host activity that might dislodge the nematode. The last stage is cuticle penetration. The six stages occur in less than nine minutes (Shamseldean and Platzer 1989). (Shamseldean and Platzer, 1989).

Communication and Perception

Nematodes in general have papillae, setae and amphids as the main sense organs. Setae detect motion (mechanoreceptors), while amphids detect chemicals (chemoreceptors) (Barnes, 1987).

Food Habits

Romanomermis culicivorax reside in the hemocoel of larval mosquitoes (Jagdale and Gordon 1994). They feed only when in the parasitic stages and feed on haemolymph. These nematodes penetrate their hosts' cuticle by aid of a stylet along with glandular secretions (Shamseldean and Platzer 1989). (Jagdale and Gordon, 1994; Shamseldean and Platzer, 1989).

Predation

These parasites are probably not preyed on directly. Larval mortality is high as most of the parasites do not reach appropriate hosts.

Ecosystem Roles

Larval stages of *Romanomermis culicivorax* are parasitic on larval mosquitoes.

Economic Importance for Humans: Positive

Romanomermis culicivorax is the only nematode that has been proven an effective control for a wide range of mosquito species. It provides a rapid, control measure for mosquito pests and is best used for permanent control in areas where it can be established by inoculative release. This is notable in ponds in Florida, as well as in rice fields (Levy et al. 1979, Petersen and Chapman 1979, and Winner et al. 1978). *R. culicivorax* parasitize larval mosquitoes, including Aedes aegypti and Culex pipiens. (Levy, et al., 1979; Petersen and Chapman, 1979; Winner, et al., 1978).

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Noxious Effect of Food Dissipation

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Summary of Article

Food is the most basic need of any living organisms. Production of huge amount of food is one of the challenging matters for feeding the entire human population. But now days, food wastage is a global problem. So, it is our responsibility to consume food as per our need and care should be taken to avoid food loss. By reducing food waste, we can feed hungry and needy peoples, so that we can reduce the problem of hungry and malnutrition.

Introduction

Food, Clothes and Shelter are the three fundamental needs of human. From the time of human civilization in this earth till today the first basic need of human is the food. Once human beings can adjust with its sick body but cannot survive without food. With the modernization and development of agriculture, we are able to increase the food production to feed the rapid growing population. Although we have sorted the problem of food production but wastage of food is a severe problem now a days for which many people remain empty stomach. According to a study by World Resources Institute (WRI) in association with the Rockefeller Foundation and Food and Agriculture Organization (FAO) of the UN says that about one-third of the food gets waste and remain uneaten which is about 1.3 billion tones and contributes more than $940 billion Global economy. About 30 to 50 percent of the world's food is not consumed (Agrawal1 and Nag, 2013). Around 48 million peoples can be feed which is equal to the grain lost by the sub-Saharan Africa only. About 900 million peoples are hungry and approximately one billion peoples are overfed in the current situation. To feed the huge population by 2050 it is estimated that the Global food production must be increase to 60 % over the present situation. Food wastage in India is more horrible in comparison to the Global basis; approximately Indians are waste food equal to the food consumption by the United Kingdom and presently India ranks seventh in World in terms of overall food wastage of agricultural produce, poultry and milk. India is the second largest populous county and about 22% of Indian population is below the poverty line. In a report of FAO in 'The State of Food Security and Nutrition in the world, 2017' found that about 190.7 million peoples in India are undernourished. 190.7 million Peoples of India representing about 14.5% of Indian population which are undernourished making the country as the home of largest undernourished population in the World. Saving of one-fourth portions of currently produced food will be sufficient to feed around 870 million peoples of the World. In estimation by UN, it is found that Indians waste around 40% of the produced food which is costs about one lakh crore rupees every year. In India food gets waste from household, hotels, restaurants, weddings and institutions like universities and school (Sahoo, 2017). So, it is our primary duty that to save food and distribution of food among the hungry peoples.

What is Food Wastage?

The plant and animal produce which are produce or prepare for the human consumption but not consumed by the people or not timely deliver to the people is called food waste. In other way we can say that food which is in good condition and quality, fit for consumption and not consumed by the people, discarded either before or after its spoil which is the negligence or the conscious decision to throw food away is also called food waste.

Reason of Food Waste

1. Mishandling of harvesting, transporting, processing, packaging and consuming leads to the wastage of large amount of food.

2. Indian weddings having gathering of huge population and excess preparation of cooked food which leads to the huge food loss.
3. Hostels and restaurants preparing huge food for good income if not sell leads to loss of cooked food which is served to the needy people (Singh and Amandeep, 2018).
4. Household loss due to the luxuries and negligence of family member if taste is not good, they directly discard to the dust bin and this is a common problem in the rich family.
5. Continuous party, birth day celebration and other celebration in the high-class family prepared large amount of food more than the requirement leads to the huge food loss.
6. Another cause of food loss is found in the student communities of the hosteller and boarders residing in the school, college and university wasting large amount of cooked food.



Ill Effect of Food Waste

Food wastage has very negative impact on the land, water, climate and biodiversity which causes natural resources degradation.

1. Land: excess cultivation causes more soil erosion and soil pollution by application of pesticides and herbicides which decreases the soil quality. In a survey in 2007, it was estimated that 1.4 billion hectares of land which is equal to combined surface area of Canada and India, used for food production which is not consumed.

2. Water: excess food production needs excess water and the agriculture sector uses around 70% of the Global fresh water. Use of insecticides, pesticides, herbicides and fertilizers causes water pollution which harmful for both humans and the aquatic livings.

3. Climatic change: for agricultural operation, fertilizer and pesticides industries and food processing industries needs bio-fuels for their operations and proration of the products which releases large amount of smokes to the environment causing the climatic changes. In rice cultivation releases huge amount of methane causing greenhouse effect.

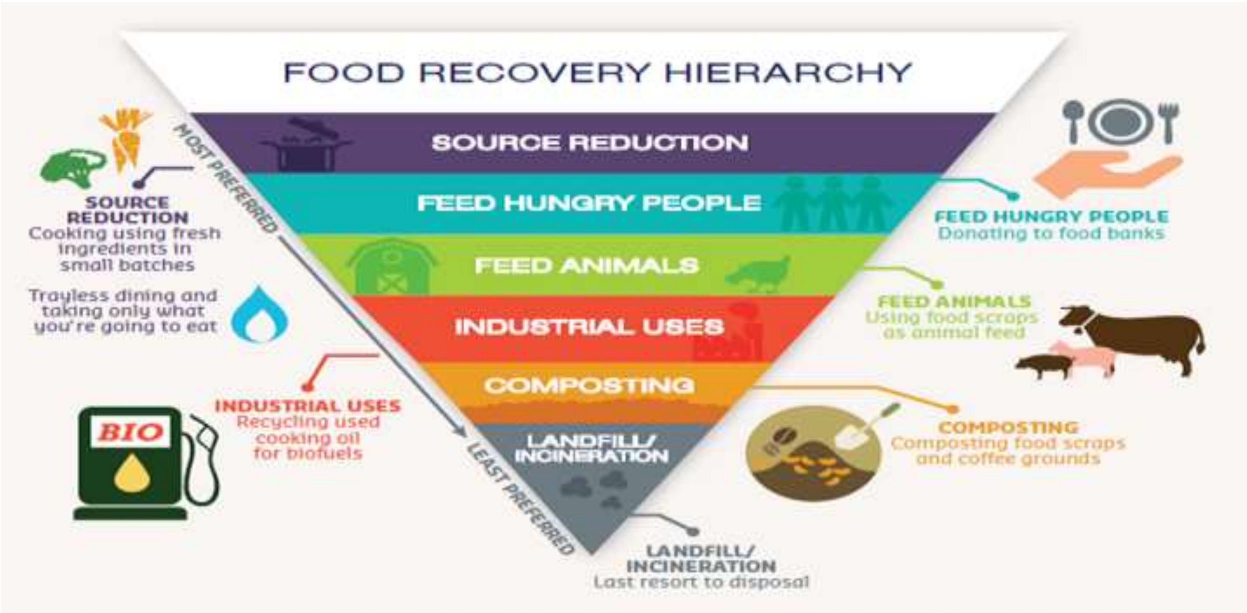
4. Biodiversity: deforestation of large area for more food production causes loss of many crucial plants having high medicinal and aromatic value and animals which leads to the huge loss of biodiversity.




Management

wastage of foods has a very tremendous negative impact on the economy of any country, so it is our duty to save food and care should be taken for the minimum loss food during production, processing and preparation of food.

1. Plan your meals and shop according to your need.
2. Before cooking plan your meals according to your needs.
3. Buy according to self-life of vegetable.
4. Use refrigerator for excess food.
5. Use as compost of the excess food.
6. Care should be taken in marriages, hostels, hotels etc.
7. Make a habit of finishing the plate.



Conclusion

Food production needs excess resources and energy from the nature. Wastage of food means indirectly we are damaging to our environment in terms of land, water and biodiversity loss. Loss of these natural resources has a highly hazardous effect on the human beings. So, it is our duty to save the food and also, we should aware others not waste the food and the nature.

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Low Cost Nutrient Management through Green Manuring

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In Asian wetland for paddy there had been wide practice of Green manuring but with the increase in cropping intensity and the low cost and ready availability of chemical fertilizers farmers interest decreased in the practice of greem manuring during the past few decades. However, the concern for pollution and conservation of energy and increased fertilizer costs, green manures have again become important, both to researchers and low-input farmers in particular. In the changing environment there is a need to adopt sustainable agriculture for which green manuring is a best option. Green manure is created by sown crop parts or leaving uprooted to wither on a field so that they serve as a soil amendment and mulch. Conventional farming systems largely rejected green manuring but this practice has been used in traditional agriculture for many years. For good soil health it is imperative to refill the loss of organic matter by supply of nitrogen and also increase the microorganisms in the soil for nutritional and subsequent crop is must which can easily be achieved through green manuring. In problem soils like at high pH to decrease the alkalinity of alkali soils by generating humic acid and acetic acid, green manure acts as soil-acidifying matter.

Generally, grain legumes are considered to be most suited as green manure such as green gram, groundnut, cluster bean, cowpea, pigeon pea and soybean etc. pulses have ability to fix atmospheric nitrogen in their root nodules i.e. legumes are preferred over non- legumes. Many of perennial woody legumes like subabul *(Leucaena leucocephala)*, Forest Lilac *(Gliricidia sepium)* and cassia *(Cassia siamea)* are used in abundant followed by non- legumes like Rye *(Secal cerale)*, perennial ryegrass *(Lolium perenne)*, Mustard (Sinapis alba), Buckwheat *(Fogopyrum esculentum)*, Chicory *(Chichorum intybus)*. The group of crops like *Dhaincha (Sesbania aculeate)*, Moong bean *(Vigna radiata)*, Berseem *(Trifolium alexandrum)*, Sunhemp *(Crotolaria juncea)* includes the widely used green manure crops.

One of the most widely used green mannure crop Dhaincha *(Sesbania aculeata)* has been reported that its incorporation at succulent stage in the soil adds 60-90 kg per ha nitrogen and helps to improve the physical and biochemical structure of the soil, prevent leaching losses of nutrients, enhancing water holding capacity, preventing weed growth, reducing residual effect of chemicals and also help in minimizing occurrence of the disease and pests.

Any crop could not fit in the criteria to be used as green manure crop. The crop to be used as green manure must be able to fix atmospheric nitrogen in which legume crops have good nodulation habit. The time period between the sowing of crops is too short and farmer could not bear a loss of season by keeping the field under green manurring only so it's essential that within short period of time crop to be used as green manure could give a more quantity of green material. With the scarcity of recourses, a crop to be used for green manure should require less of nutrient and water for its growth and must be having capacity to grow fast and accumulate high nutrient. Last but not the least, the crop to be used for green manure should be easily incorporation to the soil.

The practice of widely adopted Green manuring is in-situ and ex-situ or Green leaf manuring. In the former practicing of green manuring the green manure crops are grown and incorporated into the same field. Mostly it is used in northern India widely used leguminous crops like Dhaincha, Green gram, cowpea, berseem, sunhemp etc. while, in the later practicing of green manuring consists of gathering green biomass like leaves, tender twigs of shrubs and trees from nearby location, waste land, forest area are collected and incorporated into the cultivable fields. In Central & Eastern India this system is followed crops like Subabul, Neem, Gliricidia etc. are included.

Primarily green manure crops grown for their contribution to soil fertility but now it is effective tool for weed control. A fast growing, easy to incorporate, short term green manure between crops will smother weed seedlings and the cultivations necessary to incorporate the green manure will further reduce and restrict the weed burden. This reduces the labour cost for weeding, hoeing and also cost of herbicide use. Green ssmanure like small leaves White clover, which will smother weed plants, protect the soil surface, add biomass and fix nitrogen for following crops. Mustards are also very emphatic at suppressing weeds preventing the germination of weed seeds in the soil, they destroyed and incorporated their presence in the soil is called “Allelopathic”. Particularly those crops that are direct drilled, green manureing must be managed carefully as it can also inhabit the establishment of the next crop. Almost six weeks must be left after green manureing if drilled a cash crop next, so as for incorporation of green manure and drilling for the allelopatic effect to subside.

Green manure can affect the availability of other nutrients like P, K, Mn and Zn rather than N which can affect the disease tolerance. It is also letting more air into the soil and improving drainage system. Organic matter helps to sandy soil to hold more water and not drain so quickly as a concluded aggregate stability and porosity. Organic matter reduces runoff and soil erosion. For efficient green manuring there is a need to farmer’s awareness for beneficial impact of them. In intensive agriculture green manuring can represent the sustainable tools for the improve soil fertility and soil health. It has multiple effects on soil management as well as crop performance. For the soil rehabilitation and reclamation of land, understanding the relative importance of green manuring and apply it as a part of cropping system might be able to applicable. On other hand it restores the all the negative impact of ecosystem. To the current and traditional crop production approaches it may be alternative. Without the provision of its multiple services such as weed, diseases management, pest management and nutrient supply at a glance, the use of green manure crops may not be economically viable.

It is well established that the practice of green manuring not only provides a number of nutrients and organic matter to the crops at a very cheap cost but also helps in ameliorating soil health. Several of the human and animal health as well as the environmental pollution problems are an outcome of the excessive use of chemical fertilizers which have now forced us to search for the possible alternative with the least or no hazards and have a longer effectiveness. To the above, returning to nature through the sustainable practices like green manuring could be an answer. Therefore, more research should be needed to developed new technologies, find new species for cultivation of the use of green manure as soil supplements.

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Petunia: Most popular Flowering Annuals

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Introduction

Petunia is a genus of 20 species of flowering plant origin from South American with diploid chromosome number (2n=14).Pretty Petunia is grown as annuals in most areas. The flowers come in many different colours and patterns, and bloom from spring till frost.

These colourful annuals had a beautiful impact to a front lawn of the garden which is the heart of every garden. It's often used as borders, containers and hanging baskets and sometimes even in seasonal ground cover. Some even have a slight fragrance.

Height can vary from 6 inches to 18 inches. Spread can be from 18 inches to 4 feet.
Petunias are divided into different groups, mainly based on flower size:
1. Multiflora Petunia is the most durable and prolific. They have smaller, but more abundant flowers and are ideal for summer bedding or in a mixed border (because they are more tolerant to wet weather).
2. Grandiflora Petunia have very large flowers and are best grown in containers or hanging baskets (because they are more susceptible to rain damage). These large petunias often do not fare as well in the south because they're prone to rot during humid, hot summers.
3. Floribundas: Floribundas are intermediate between the grandiflora and the multiflora groups. They are free-flowering like the multiflora varieties and produce medium-sized blooms.
4. Millifloras: Milliflora Petunia are much smaller than any other petunias on the market. The flowers are only 1 to 1½ inches wide, but they are prolific and last all season!
5. Spreading or Trailing Petunia: These are low-growing but spread as much as 3 to 4 feet. They form a beautiful, colourful groundcover because the flowers form along the entire length of each stem. They can be used in window boxes or hanging baskets.

Most Recommended Varieties of Petunia

1. Lime Light.
2. Cascadias Rim Magenta.
3. Fortunia Early Blue Vein.
4. Mini Rose Blast Pink.
5. Prism Sunshine.
6. Potunia Plus Red.
7. Wave Blue.
8. Surprise Lime.

Planting

1. Petunia need full sun or they will become spindly. They don't tend to flower in the shade.
2. They are quite versatile, growing in different types of soil, but it is important that the soil drains well and doesn't stay wet.
3. Petunia is grown from the seeds, but it is better to grow them from transplants. Petunia seeds are very small (dust-like) and required a lot of light in order to germinate.
4. Petunia can tolerate harsh conditions and hot climates. They need at least five hours of sunlight.

5. Maximum growth of the flowers occurs in late spring.

Fertilizer Requirement

Garden Petunia like a balanced fertilizer such as 8-8-8, 10-10-10, or 12-12-12. In early to mid-July, start using a liquid fertilizer every two to three weeks. Spreading petunias may need weekly fertilization, while container-grown plants will respond well to a time-release fertilizer.

Irrigation Management

Petunia are tolerant of heat so you don't have to water them regular. The spreading types of petunias and those in containers require more frequent watering. In winters irrigation is required after every 3 to 4 days whereas in summers irrigation should be done at every second day.

After Planting Care

1. Petunia are tolerant of heat so you don't have to water them regularly. A thorough watering once a week should be sufficient (unless there are prolonged periods of drought in your area). Avoid watering shallowly as this encourages shallow roots.
2. Petunia must be applied with a monthly balanced fertilizer to support their rapid growth and heavy blooming and a better growth.





Pest / Disease

Petunia has few serious pest and diseases .Avoid wetting the foliage and flowers when watering to help prevent disease.

Mites are nearly microscopic pests that suck the juices directly out of petunia cells. Spray your petunias with neem oil once a week until all signs of mites are gone. Caterpillars chew through foliage and buds, sometimes causing extensive damage in no time.

Disease	Symptoms	Pathogen/Cause	Management
Botrytis Blight	Flowers have small translucent, or dead spots.	Botrytis cinerea	Maintain low relative humidity. Apply a fungicide to protect plants.
Phytophthora Crown Rot	Branches wilt and the plant rapidly dies as the crown. Young plants are quickly killed. Outdoors if the weather is dry, the stem at the soil line may have a dry rot.	Phytophthora nicotianae	Use pasteurized potting mix or soilless mix known to be free of pathogens. Discards flats containing infected plants. Apply a fungicide to protect plants.
Stunt	Young plants are stunted and thick.	Lack of boron	Maintain a soil pH below 7. Have a water test done to be certain calcium and sodium are not too high.
Virus	Small etches on the leaf are surrounded by a dark halo.	Impatiens necrotic spot virus (INSV)	Destroy infected plants. Take steps to control western flower thrips. Examine other plants in the greenhouse for INSV symptoms and destroy them

Conclusion

Petunia is one of the most beautiful and colourful flowers which are capable of producing lots of blooms all seasons long as it has a wide variety of colours and patterns which attract a lot. It's one of those flowers which every garden lover wishes to have in its Lawn (Heart of Garden). It can be easily beautifully planted in baskets as a hanging basket or can be grown in Pots, containers and as ground cover as well. Some flowers will be in one solid colour while others have the contrasting veins or edges and in some varieties the flower even has a star pattern. This variety of Petunia makes them quite versatile in landscaping.

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Systemic Acquired Resistance in Plants

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Introduction

The ability of plant to overcome wholly or in part the effect of the pathogen or other harmful factors is called resistance. Plants are resistant to certain pathogens either because they belong to taxonomic groups that are outside the host range of these pathogens (non-host resistance) or because they possess the gene for resistance (R genes) directed against the a virulence genes of the pathogen (true, cultivar-specific, or gene for gene resistance), or because, for various regions, the plants escape or tolerate infection by these pathogens (apparent resistance).

One reaction of plants to pathogen infection is the induction of the long-lasting, broad spectrum, systemic resistance to subsequent infections. This induced disease-resistance has been known from many years under different names such as Physiological Acquired Immunity or Induced Resistance; for the purpose of these update we will refer it as a SAR.

Our perspective is that SAR is one component of plants integrated disease-resistance repertoire. SAR appears to be distinct from pre-existing disease mechanisms such as physical barriers or protein cross-linking and also from other inducible resistance mechanisms such as phytoalexin biosynthesis, the hypersensitive response and ethylene induced physiological changes. Furthermore, SAR is not related to responses induced by wounding or osmotic stress. In this update we will provide a brief history of SAR research and review recent results important to our understanding of this response. We will also resent a working model of the critical steps that lead to induction and maintenance of the resistant state and point out steps in the response that need further experimentation to extend our understanding of SAR.

What is SAR?

It is widely known that plants can defend themselves against pathogen through a variety of mechanisms that can be local, constitutive or inducible. SAR confers quantitative protection against a broad spectrum of microorganisms in a manner comparable to immunization in mammals although the underlying mechanisms differ. This natural protection of plants against pathogen or insects is partly based on a variety of consecutive barriers already present in plant before the actual attack. The combined effect of all these barriers is referred to as constitutive resistance.

In addition, plants can activate protective mechanisms upon contact with the invader; this is termed induced or acquired resistance. SAR is the phenomenon where plant's own defence mechanisms induced by prior treatment with either biological or chemical agent. If resistance is expressed locally at the site of primary inoculation but also systemically in tissue remotely located from the initial treatment. This form of induced resistance called systemic acquired resistance (SAR) (Ryals et al., 1992).

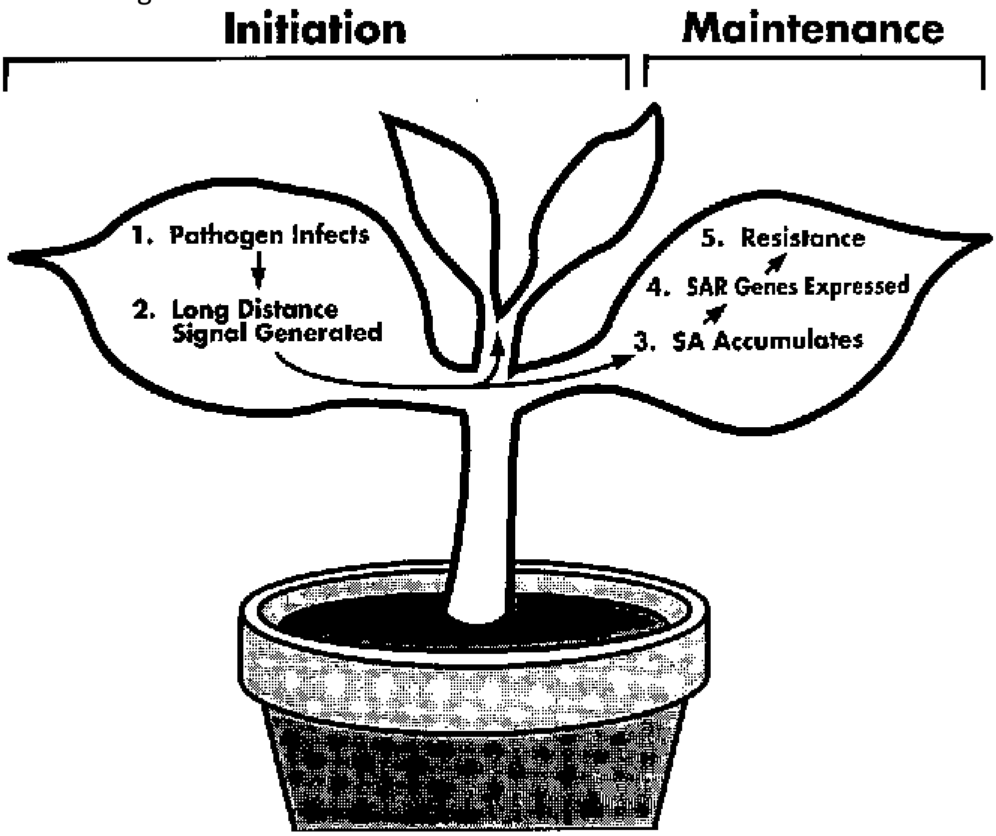
History of SAR

For over 90 years, scientists and naturalists have observed that when plants survive pathogen infection, they develop an increased resistance to subsequent infections. In 1933, Chester described a phenomenon termed as physiological acquired immunity; at least 3 different processes were being investigated called acquired immunity; viral cross protection, antagonism and what we now refer as SAR. The first systematic study of SAR was published by A. Frank Ross in 1961 by using TMV on local lesion hosts, demonstrated that of TMV were restricted by a prior infection. Ross for the first time coined the term SAR to refer to Induced Systemic Resistance (ISR) or Localized Acquired Resistance (LAR).

In the past 30 years SAR has been demonstrated in many plant species against not only bacteria and viruses but also many phytopathogenic fungi (Kuc, 1982). In 1997, Kees Van Loon showed the accumulation of PR proteins correlates with onset of SAR. Ray White demonstrated in 1979 that SA and certain BA derivatives could induce both resistance and accumulation of PR protein. Recently, significant progress toward understanding SAR has been made with application of mol. biology, genetics and enhanced biochemical tools. Nevertheless, our knowledge is still rudimentary and future programme will depend on use of modern biological techniques.

Working Model of SAR

This model is not intended to be complete it simply serves as a scaffold on which test hypotheses is build. SAR can be conceptually divided into two phases; Initiation phase and Maintenance phase. The initiation phase may be transient and includes all of the events lead to establishment of resistance and the maintenance period describes the resistance stage results from initiation.



Systemic acquired resistance in plants is incited by biological and chemical factors. The biological factors include weakened or avirulent strains of microorganisms whereas; chemical factors are natural or synthetic INA, SA, etc. When such biological and chemical factors contact the leaf surface of host plants the systemic signals transfers throughout plant and the process begins. First of all, the receptor site of host plant activates which leads to the conversion of lipase enzymes towards conversion of fatty acid, linolenic acid, etc. The enzymes are responsible for conversion of linolenic acid into chemical derivatives and chemical derivatives into jasmonic acid.

Further, the jasmonic acid activates the genes, which result in biochemical and morphological changes. The biochemical changes may be as Phytoalexin synthesis, Peroxidase synthesis, Resin production etc. whereas, morphological changes may be as increased lignification, enhanced papilla formation or accumulation of cell wall protein.

Characteristic of SAR

1. It is induced by agent/ pathogens causing necrosis e.g.: Local lesions
2. There is delay of several days between induction and full expression.
3. Protection conferred on tissues not exposed to inducer inoculation.
4. Expressed as reduction in lesion number, size, spore production, etc.
5. Protection is long lasting, often even foe weeks or even months.
6. Protection is non-specific i.e. effective against pathogens unrelated to inducing agents.
7. Development of SAR associated with expression of several gene families for ex. PR Proteins.
8. Signal for SAR is translocated and graft-transmissible.
9. Protection not passed on to seed progeny, transmission to clonal tissues unresolved.

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Effect of Pruning in Pomegranate (*Punica granatum* L.) for Shoot Growth, Flowering and Fruit Yield

Article ID: 32661

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Abstract

The present experiment was carried out during December 2018 to May 2019 in Central Research Field, Department of Horticulture, SHUATS, Prayagraj. it is concluded that treatment T_2 (20 cm pruning) was best in terms of vegetative growth parameters like plant height, plant spread, number of branches etc. and treatment T_4 (40 cm pruning) was best in terms of earliness and fruit yield parameters, in terms of quality treatment T_3 (30 cm pruning) was best. In terms of economics treatment T_4 (40 cm pruning) recorded maximum benefit and cost benefit ratio.

Keywords: Treatments, Vegetative parameters, yield and quality.

Introduction

Pomegranate (*P.granatum*L.) belongs to the family Punicaceae, subclass Rosidae and order Myrtales, is the only known genus of the family. It is a genus of large shrubs or small trees with 2 species. One is *Punicaprotopunica* which is wild type found in Socotra Island of the Arabian Peninsula, and is considered as an ancestral species (Shilikina, 1973) and the other is *P. granatum* cultivated in tropical and subtropical parts of the world. *P. granatum* has been classified into two sub species chlorocarpa and porphyrocarpa, each having two varieties. To check these a research trail on "Effect of pruning in Pomegranate for Shoot Growth, Flowering and Fruit yield" was conducted in central research field of Department of Horticulture, SHUATS, Prayagraj. The main obectives are to study the effect of different levels of pruning on growth, yield and quality of pomegranate and to work out the economics of different levels of pruning in pomegranate.

Materials and Methods

The Experimental was conducted in Randomized Block Design (RBD) with 8 treatments and 3 replications in Central Research field, Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during the year 2018 - 2019. Total number of treatments were eigth*viz.*T_0 (control No pruning), T_1 (10 cm pruning), T_2 (20 cm pruning), T_3 (30 cm pruning), T_4 (40 cm pruning), T_5 (50 cm pruning), T_6 (60 cm pruning) and T_7 (70 cm pruning).

Table 1: Effect of Pruning on Number of Branches, Days to first flower, Number of flowers/plants, Days taken to first fruit, Number of fruits/plant and Fruit Yield/Plant (kg) Fruit yield/ha (q) AVG.Frt. Wt, TSS, Acidity, Ascorbic acid, Cost benefit ratio of pomegranate *(P. granatum)* cv. (Bhagwa).

Treatment Symbol	Treatment Combination	Plant height (cm)		Plant Spread (cm)		No.of Branches		Days to first flowering	Number of Flower/plant	Days taken to first fruit	Number of fruits per plant	Fruit yield/plant (kg)	Fruit yield/ha (q)	Average fruit weight (g)	TSS (oBrix)	Acidity (%)	Ascorbic Acid (mg/100 g)	Cost benefit ratio
		Initial	180 DAP	Initial	180 DAP	Initial	180 DAP											
T0	Control (No pruning)	187.89	214.57	142.20	155.62	7.33	9.03	138.04	50.63	181.38	10.54	1.01	4.04	95.53	9.87	0.56	8.29	1.04
T1	10 cm pruning	201.64	225.47	156.84	169.20	7.06	8.66	132.94	62.57	172.83	15.49	1.79	7.16	116.53	11.63	0.45	8.50	1.85

T2	20 cm pruning	239.46	271.30	195.52	212.50	7.79	10.24	128.98	62.80	168.41	16.07	2.07	8.28	129.45	11.95	0.46	9.80	2.14
T3	30 cm pruning	217.35	238.80	172.27	183.23	6.61	8.21	123.73	70.40	165.77	20.07	2.26	9.04	113.21	13.63	0.37	10.77	2.34
T4	40 cm pruning	220.55	240.85	174.68	185.47	6.29	7.87	105.49	95.16	147.80	26.67	3.82	15.28	143.30	12.17	0.42	9.46	3.96
T5	50 cm pruning	230.11	249.78	181.95	192.85	6.56	8.03	121.05	82.83	162.71	18.09	2.06	8.24	114.49	11.32	0.45	9.15	2.13
T6	60 cm pruning	232.15	251.42	187.04	196.98	5.69	7.08	125.13	75.67	169.46	15.58	1.72	6.88	111.02	10.38	0.49	8.95	1.78
T7	70 cm pruning	202.54	218.42	157.87	166.13	5.52	6.85	130.02	68.52	171.70	12.14	1.24	4.96	102.98	10.79	0.51	8.53	1.28
F-Test		S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
SE(d)		4.472	5.049	4.276	4.368	0.493	0.398	7.421	3.698	1.068	1.068	0.146	0.582	4.154	0.653	0.029	0.698	
C.V.		2.530	2.589	3.062	2.927	9.141	5.911	7.232	6.373	7.772	7.772	8.929	8.929	4.393	6.971	7.542	9.311	
C.D. at 5%		9.685	10.935	9.260	9.458	1.068	0.862	16.071	8.009	2.313	2.313	0.315	1.261	8.995	1.413	0.062	1.512	

Conclusion

Treatment T_2 (20 cm pruning) was best in terms of vegetative growth parameters like plant height, plant spread, number of branches, and treatment T_4 (40 cm pruning) was best in terms of earliness and fruit yield parameters, in terms of quality treatment T_3 (30 cm pruning) was best. In terms of economics treatment T_4 (40 cm pruning) recorded maximum benefit and cost benefit ratio.

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Aphid (*Myzus persicae* Sulzer) Menace in Bell Pepper (*Capsicum annuum* L.)

Article ID: 32662

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Capsicum annuum L. is native of Mexico with secondary centre of origin in Guatemala. It is a valuable crop with excellent prospects both for the domestic and export market. The majority of commercial production area is based on red (85%), followed by yellow (10%) and orange (5%). *Myzus persicae* Sulzer. is an extremely polyphagous species which has been reported to feed on more than 500 species of host plants from 40 plant families including several agriculturally important crops under field as well as in green house conditions.

The aphid is capable of transmitting more than 150 viral diseases in different hosts particularly in Solanaceous vegetables. The adult females produce abundant sweet 'honeydew', which pollutes the leaves. Saprophytic sooty mould fungi develop on the honeydew, causing blackening of the leaves.

Introduction

Sweet pepper (*Capsicum annuum* L.), also known as Bell pepper belongs to the family Solanaceae. It was introduced in India by the Britishers during 19th century in Shimla hills. Bell pepper is looked upon as luxury vegetable as its consumption is more in and around the cities. It is richer than tomato in vitamins especially A and C.

It contains 92.4 per cent water and the food value per 100 g edible portion is: energy 29 calories, protein 1.2 g, calcium 11 mg, vitamin A 870 IU, ascorbic acid 175 mg, thiamin 0.06 mg, riboflavin 0.03 mg and niacin 0.55 mg. Compared to green peppers, red peppers have more vitamins and nutrients and contain the antioxidant lycopene. The level of carotene, like lycopene, is nine times higher in red peppers. Red peppers have twice the vitamin C content of green pepper.

Besides, it has medicinal properties and is recommended for the treatment of dropsy, colic, toothache and cholera. It is used as salad, cooked as vegetable, pickled or processed and is appreciated worldwide for its flavour, aroma and colour. It is a valuable crop with excellent prospects both for the domestic and export market. In India *capsicum* production has gone up to 493.0 thousand tones under the area 32.0 thousand hectares in 2018-19 (http://nhb.gov.in/). The majority of commercial production area is based on red (85%), followed by yellow (10%) and orange (5%), however these percentages are subject to change to meet shifts in consumer demand.

Economic Importance and Losses

Several polyphagous aphid species, such as *Myzus persicae* Sulzer, *Macrosiphum euphorbiae* (Thomas), *Aphis gossypii* Glover and *Aulacorthum solani* (Kaltenbach) (Hemiptera: Aphididae), are among the most problematic aphids in protected crops and pepper in particular. Among the insect-pests attacking sweet pepper, *M. persicae* is the most serious.

Myzus persicae has been reported to feed on more than 500 species of host plants from 40 plant families including several agriculturally important crops under field as well as in green house conditions. In addition to direct losses caused by sucking the vital cell sap from the plant-parts by both nymphs and adults, the aphid is capable of transmitting more than 150 viral diseases in different hosts particularly in Solanaceous vegetables. The adult females produce abundant sweet 'honeydew', which is grows saprophytic sooty mould fungi, causing blackening of the leaves, thus, greatly diminishing the quality of the host (Plate: 1).

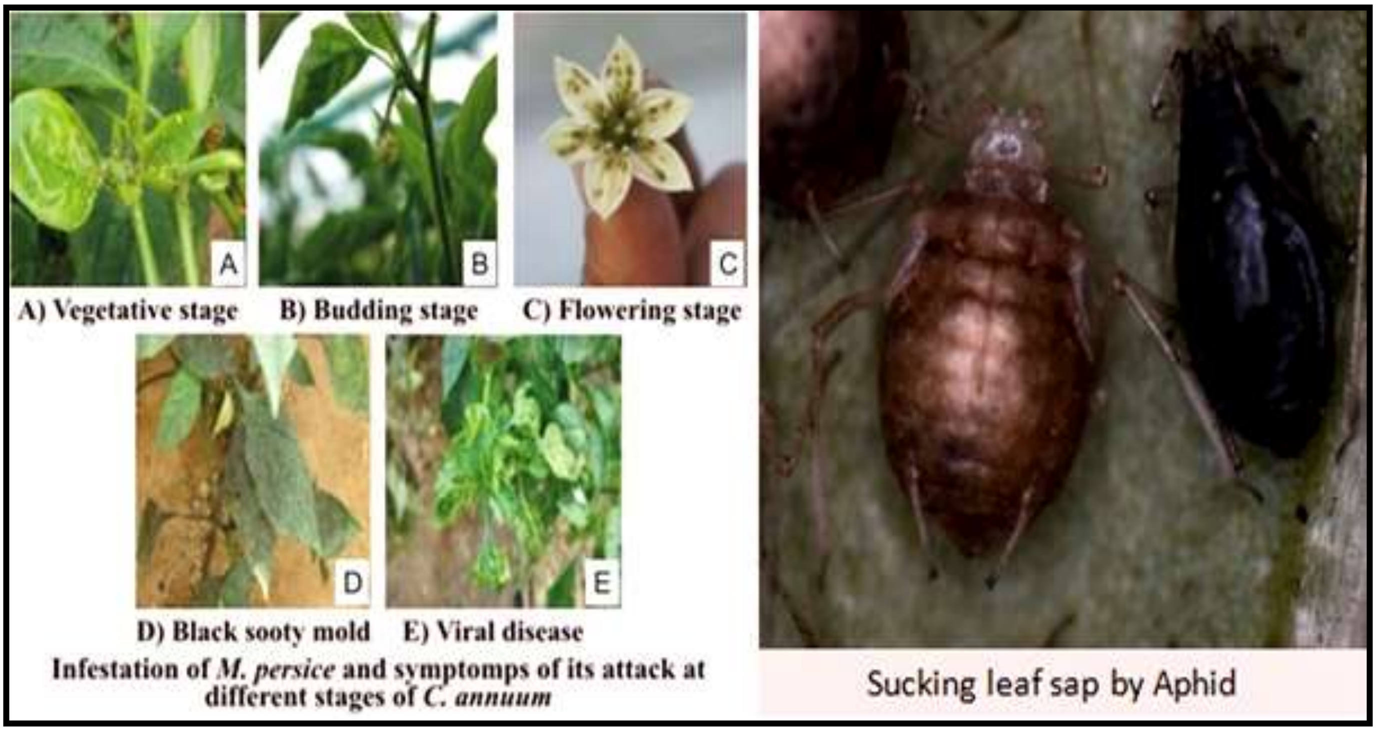

Plate 1: All parts of capsicum infected by Aphid

Life Cycle

Aphids reproduce parthenogenetically, i.e., all the insects present are females, and each female gives birth to more females without the need to mate. Young aphids are called nymphs. They molt, shedding their skins about four times before becoming adults. These adult females give birth to living nymphs rather than lay eggs. Populations can increase explosively - new-borns can reach adulthood and begin to reproduce in as little as 7 days. Young nymphs mature very early and produce the next generation of young ones again viviparously and parthenogenetically. Total life cycle complete within in 22-25 days. Female produce 80-85 young ones in total life span.

Management

1. Before planting, check surrounding areas for sources of aphids and remove them.
2. To maintain weed free zone around the crop.
3. Check transplants for aphids and remove them before planting.
4. Early sowing escapes the peak pest incidence.
5. Application of balanced nitrogen fertilizer is also one of the components in aphid management.
6. Intercropping with onion or garlic, or coriander or marigold reduces the aphid population.
7. Uses of yellow water pan/sticky traps 15 cm above the canopy for monitoring aphids @ 4-5 traps/acre.
8. Planting nectar-producing flowering plants that attract adults of natural predators and parasitoids. Provide suitable habitat that will encourage predators to remain in the vicinity.
9. Application of Econeem plus (Azadirachtin (1.0%) @ 4 ml/l or 2 per cent Neem oil and 5 per cent Neem Seed Kernel Extract (NSKE) effective.
10. Ladybird beetles viz., *Coccinella septempunctata, Menochilus sexmaculata, Hippodamia variegata and Cheilomones vicina* are most efficient predators of the mustard aphid. Adult beetle may feed an average of 10 to 15 adults/ day.
11. Several species of syrphid /hover fl y i.e., *Sphaerophoria* sp., *Eristallis* sp., *Metasyrphis* sp., *Xanthogramma* sp. and *Syrphus* spp.
12. The braconid parasitoid, *Diaeretiella rapae*.
13. The lacewing, *Chrysoperla zastrowi sillemi*.

14. Predatory bird *Motacilla cospica*.

15. Commercially available formulation of insect-pathogenic fungi i.e. Mycotrol or Biosoft or Biopower (*Beauveria bassiana*) @ 3.0g/l, Vertalec or Inovert or Biocatch (*Verticillum lecanii*) @ 3.0g/l, Prioroty (*Paecelomyces fumosoroseus*)@2.5ml/l should be apply.

16. Application of Cohigan (Imidacloprid 17.8 SL) @ 1ml/l or Aktara or 7-Star (Thiamethoxam 25 WG) @1 g/3 liter of water or Polar (Acetamiprid 20SP) @0.5g/l should be applying. Two applications of foliar sprays, a week apart, are often needed.

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Impacts of Climate Change on Agriculture and Livestock

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Introduction

Indian agriculture is predominantly a rainfed agriculture under which both dry farming and dry land agriculture are included. Out of the 143 million ha of total cultivated area in the country, 85 million ha (68%) area are rainfed. It contributing 44 percent of food grains and supporting 40 percent of the population. Since climatic factors serve as direct inputs to agriculture, any change in climatic factors is bound to have a significant impact on crop yields and production. The change in climate variables is challenging the Indian agriculture. (IPCC, 2007).

Dry land Agriculture is extremely vulnerable to climate change. Increased temperature reduces crop yield promoting weed and pest proliferation. (Darwin, 2004). Pests management become less effective, meaning that higher rates of pesticides will be necessary to achieve the same levels of control. Heat waves can cause extreme heat stress in crops, which can limit yields the overall impacts of climate change on farming are expected to be negative, threatening global food security and it should be addressed through policy perspective at the earliest to avoid short term effect such as yield and income loss and long-term effects such as quitting agricultural profession.

Agriculture is highly dependent on the climate prevailing in a particular area. Climate change affects agriculture through changes in average temperature, rainfall and climates. Higher temperature and carbon di oxide improve some crop yields in some places. The nutrient levels, soil moisture, water availability and other conditions should be met out to yield the benefits of cropping. Changes in the frequency and severity of droughts and floods could pose challenges for farmers and ranchers and threaten food safety (Ziaska et al., 2016). Meanwhile, warmer water temperatures are likely to cause the habitat ranges of many fish species to shift, which could disrupt ecosystems. Climate changes causes difficulty in growing crops and raising animals. Hence, the effects of climate change along with other factors have to be considered that affect agricultural production, such as changes in farming practices and technology.

Impacts of Climate Change on Crops

Changes in temperature, atmospheric carbon di oxide, the frequency and intensity of extreme weather could have remarkable effects on the yield of crops. For any particular crop, the effect of increased temperature will depend on the crop's optimal temperature for growth and reproduction (Hatfield et al., 2014). Higher temperature reduces the yield of crops promoting the growth of weeds and pests. In some of the areas, warmer climate may beneficially influence the types of crops grown and it allows farmers to shift to crops that are currently grown in warmer areas. On the other hand, when the higher temperature exceeds the crop's optimum temperature, crop yield will be reduced.

Increased carbon di oxide levels may have impact on yield of crops. It is been stated that higher carbon di oxide levels will cause increased plant growth. Still factors such as temperature change, ozone and water and nutrient constraints may hinder these potential increases in yield. For instance, when temperature is more than the crop's optimal level and if sufficient water and nutrients are not available, then the increase in the crop yield may be reduced. In alfalfa and soyabean plants, higher carbon di oxide levels may cause decrease in the protein and nitrogen content of the plants leading to loss of quality.

Although higher carbon di oxide level promotes the growth of plants, it may also reduce the nutritional value of some of the crops. Higher carbon di oxide levels in the atmosphere may reduce the amount of essential nutrients in the plant species like rice, wheat and soya etc which in turn causes potential threat to human beings.

More extreme temperature and precipitation may hinder the development of crop. Utmost events like flood, drought may negatively influence the crop growth and reduce the yield of crops. Some of the weeds, pests and fungi can thrive well under warmer temperatures, wet climates, and with higher carbon di oxide levels in the atmosphere. Changes in climate may positively influence the growth of weeds and pests leading to poor crop yield.

Heat waves cause heat stress in crops limiting the yield of crops. Heat waves also cause wilted plants resulting in reduced crop yield if irrigation facility is not provided. Even though increased irrigation facility is possible in some places, there may be reduced water supply in other places leaving less water available for irrigation when more water is needed.

Impacts of Climate Change on Livestock

Changes in climate may affect the animals both directly and indirectly. The impact of climate change negatively influences the production performance of the livestock. Some of the climatic changes are heat stress, increase in the atmospheric carbon di oxide and temperature etc., These climatic changes will cause changes in the livestock production.

The major climate change that affects the livestock health is the heat stress in animals during extreme temperature. It affects the animals either directly or indirectly. It may cause reduced feed intake, lower the milk production, meat production, affect reproductive efficiency. Changes in the climate may also increase the incidence of parasites and causes diseases in livestock. The parasites and pathogens survive in the spring and winter seasons.

Climate change particularly global warming may affect the production performance of farm animals worldwide. Another important climate change that affects livestock is the drought. Drought affects the pasture and in turn reduces the fodder supply. The amount of forage that is available to grazing animals is reduced.

Increase in atmospheric carbon di oxide levels may increase the productivity of forages and pastures decreasing the quality of pastures affecting the production performance of livestock.

Conclusions

Impact of climate change on dry land agriculture will be one of the major deciding factors influencing the future food security of mankind on the earth. Understanding the weather changes over a period of time and adjusting the management practices towards achieving better harvest is a challenge to the growth of agricultural sectors. Several adoption methods can be followed to reduce the negative impacts of climate changes in agriculture and livestock.

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Kashmiri Saffron Got G.I Tag

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Introduction

Saffron is a spice from the *Crocus sativus* flower, which is a cousin of the lily. The saffron derives from the stigma and styles — called threads — within the flower itself. Saffron is very expensive due to the difficulty of harvesting it. Farmers must harvest the delicate threads from each flower by hand. They then heat and cure the threads to bring out the flavour of the saffron. This extra labour makes saffron one of the most expensive spices in the world.

Geographical Indication

On July 25, Kashmir saffron joined the likes of Darjeeling tea, the Alleppey green cardamom, black rice from Manipur and the Guntur chilli in getting the Geographical Indication (GI) tag. According to Article 22 (I) of the World Trade Organisation (WTO) Agreement on Trade-Related Aspects of Intellectual Property Rights Agreement (TRIPS), GI tags are "indications which identify a good as originating in that territory, where a given quality, reputation or characteristic of the good is essentially attributable to its geographic origin." And Kashmir saffron, grown in Pampore at an altitude of 1600 metres, with its long strands and deep colour, clearly fulfilled the criterion. The Jammu and Kashmir lieutenant governor, G.C. Murmu, has hailed this as a "momentous decision", one which is likely to put the spice on the world map.

Those who hail from the valley feel that this has been a long time coming. Prateek Sadhu, executive chef and co-owner, Masque, Mumbai, recalls that while growing up in Kashmir, saffron was treated like a precious ingredient in the house. His mother would keep it in a "dabba within a dabba". Over the years, he has used saffron from Spain and Iran, but nothing comes close to the high-grade varietal from Kashmir. "Two strands are all you need. It is so potent with a deep rich colour," says Sadhu.

So, is the GI tag is the shot in the arm that saffron production in the valley needs? According to a recent report in the Hindu, saffron production has seen a steep decline of around 65 percent in recent years. Shubra Chatterji, culinary researcher and director of award-winning shoes such as Chakh Le India for NDTV and Lost Recipes for Epic Television Networks, attributes this downward spiral to several reasons. She says that political instability, change in weather patterns and the youth not interested in taking up the profession of their forefathers all play a part in this decline. "The GI tag will instil a sense of pride in the people of Pampore to take this up again," says Chatterji, who has visited the region in the past for research.

Kashmir Saffron in Crisis

Major factors responsible for decline of saffron industry in Kashmir include the lack of availability of good-quality corms as seed material, poor soil fertility, lack of assured irrigation, infestation by rodents and diseases, poor postharvest management, and improper marketing facilities, increased urbanization on saffron land, helplessness of the Government in checking adulteration and clandestine smuggling of cheap saffron (allegedly from Iran), which is then sold in the name of Kashmir saffron6 . The most serious challenge is to check the adulteration of saffron by way of adding some nature-based adulterants like maize silk, saffron stamens, ray florets of marigold, dyed tender roots of Salix sp. (willow), fibrous roots of various grasses, fibres of shredded meat coloured with saffron water, or synthetic adulterants like liquid glycerine, codeine phosphate (cough syrup), dyed newspaper clips, nylon fibres, etc. (pers. commun.) The good news however is that recently, the

Government of India initiated a National Saffron Mission with a financial outlay of Rs 3.74 billion for resolving the saffron crisis in Kashmir through different programmers, which include rejuvenating saffron farms by corm re-planting, digging bore wells for irrigation, and setting up of a modern Saffron Park with quality control laboratory for providing adequate marketing cover to saffron growers, thus eliminating exploitation by middle-men. There are mixed reactions from saffron farmers about the approach followed in Saffron Mission, and therefore the net results of this massive initiative remain to be seen.

Conclusion

At last it can be concluded that Getting G.I tag to Kashmiri saffron is a big boost to those farmers who are in saffron cultivation. This will increase demand in local as well as international market for export. Government have to focus slightly more too give proper training along with proper facility to new farmer who want to get into this farming.

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Insect Pest Modelling System: A Novel Archetype for Integrated Pest Management (IPM)

Article ID: 32665

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Pests and diseases are the primary agents in reduction of crop yield. To reduce the yield-loss, a timely and need based application of remedial measures are indispensable which is only possible with the prior knowledge of the time and severity of the outbreak of pests and diseases. Thus, factors affecting crop yield and infestation of pest and diseases need to be looked in to. Successful pest and disease control programmes require efficient monitoring of pest populations, host–parasitoid ratios, starting densities of parasitoid, timing of parasitoid releases, dosages and timing of insecticides application and level of host feeding and parasitism. Modelling is an effective mathematical tool that can help in the design of appropriate control strategies and assist in management decision-making (Tang and Cheke 2008). In devising strategies for the control of pest populations, pest management specialists have attempted to make use of mathematical theories of population dynamics to aid in their task (Plant and Mangel 1987). Forecasting of insect and diseases incidence is considered to be a one of the crucial components in Fulfilment of Integrated pest management programme. Pest forecasting assist us in knowing the actual timing of pest incidence. Prediction of pest incidence has been meticulously made by certain mathematical models which are specifically designed for the forecasting purpose. Models apart from forecasting, has been exemplary in terms of decision making regarding actual time of pest control by chemical methods. This decision-making process can lead to sustainable pest control with little or negligible hazards to non-target organisms and environment.

What is Model and System?

Manetsch and Park (1982) defined a model as an abstract representation of a real-world system that behaves like the real-world system in certain respects whereas system is something that has a set of characteristics common to all systems and it has parts called units or components, which are interdependent and interact with one another (Miller and Miller 1984).These components are then expressed in mathematical functions and suitable mathematical expression is formulated on the basis of the relationship between these components. This is why these models act as a reliable tool in prediction and decision making.

Modelling in Insect Pest Management

Mathematics has been capable enough to model the pest population. Agricultural crops which are considered to be managed ecosystems require the timely management of insect pests. In this regard pest control experts have given due emphasis to the mathematical theories of population dynamics to aid them in their task (Plant and Mangel 1987).

Pest Forecasting

Pest forecasting guides the farmers regarding the timing of pest incidence to eliminate any possibility of blanket application of pesticide and reduce pesticide amounts along with achieving effective pesticide results (Mahal et al 2011). Pest forecasting models are very helpful in these predictions which involve using statistical procedures like ANOVA, factorial analysis, regression and multiple regression. For a pest management expert, prediction of pest pressure along with its timing and level is important for planning and decision making (Maelzer and Zalucki 2000).

Pest Forecasting Models

Table 1: Various Pest forecasting models around the world

Forecasting Models	Insect	Parameters	Country	Reference
Ordinal logistic Model	Whitefly, Pyrilla and Fruit fly	Max temp. , Min temp. and RH I	India	Agrawal and Mehta (2007)
CLIMAX	*Helicoverpa* sp.	Temperature and humidity	Australia	Zalucki and Furlong (2005)
SOPRA	*Dysaphis plantaginea* and *Grapholitha lobarzeweskii*	Air and soil temperature	Switzerland	Graf et al (2002)
FLYPAST	*Aphis fabae*	Suction trap data	UK	Knight et al (1992)
NAPPFAST	*Scirtothrips dorsalis*	Degree days and cold temp. survival	USA	Nietschke (2008)

FRUFLY Model

A dynamic population model, FRUFLY, for complete life cycle of fruit fly, *Ceratitis capitata* (Messousi et al 2008). This model determines an optimal behaviour of different system components during the life cycle of fruit fly with an adjustment by a limiting factor like temperature, humidity, parasitism and predation. The effects of the temperature on immature stage developmental times of medfly, *Ceratitis capitata* were used to study the dynamics of population with FRUFLY degree day model. To test the model in the field, flight activity was studied using para-pheromone traps. The FRUFLY model simulations agree with experimental data results of the insect collected by para-pheromone traps and predicts the appearance of the various generations of adults with time. FRUFLY simulation modelling is an important tool for identifying insect pest's population size and can help to determine the exact time of taking the management options.

Non-Linear Models

As linear models can only estimate the lower threshold temperature (Tmin) for insect development but not the upper threshold temperature (Tmax) and optimum temperature threshold (Topt) limits. So, various workers (Lactin et al. 1995; Briere et al. 1999) have come up with various temperature dependent development rate non-linear models to estimate these temperature limits. Optimum threshold temperature, Topt is the temperature where the development rate of the insect is highest whereas at both Tmin and Tmax the development rate ceases to zero. Several workers have fitted the development rate to non-linear models which furnished the details of estimates like Tmin, Tmax and Topt. Recently, Noor-Ul-Ane (2017) have been able to successfully estimated the temperature threshold estimates of both *H. armigera* and its parasitoid Habrobracon hebetor using non-linear models.

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Honey, Did We Shrink the Bees, Bugs, Butterflies and Beetles that Feed Us?

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Introduction

Insect apocalypse is the worldwide decline of Entomofauna. The insects, a six-legged companion are in the case of castotrophic population collapse. Several studies have reported what appears to be a substantial decline in insect population. Some of the insects mostly affected includes: Bees, Butterflies, Moths, Beetles, Dragonflies and Damselflies. Anecdotal evidence has been offered much greater apparent abundance of insects in the 20th century. The recollections of the windscreen phenomenon are examples.

Events of Insect Decline

Insects have originated about 480 million years ago during Ordovician period of Paleozoic era. The origination and extinction of species will occur sequentially that defines the biological trajectory of life. The insect evolution is characterised by adaption of selection pressure exerted by the environment, more generation in short time, higher fecundity, etc., which are all the reasons that the insects occupies the ecological niches.

The sixth mass extinction will occur not because of volcanic eruption or asteroid impacts but mainly by the impact of humans. The climate change is often noticed day by day which is 10- 1000 times faster than normal and the main victims of the sixth mass extinction will be the humans.

Ravages of Insect Decline

1. Habitat loss: Habitat losses are the prime cause of insect decline. It includes: Habitat destruction (49.7%), Agricultural conversion and intensification (24%), urbanisation (11%) and deforestation (9%).

a. Lepidopteran mortality in Roadways: McKenna and McKenna (2001) found that at the traffic volume of 1000, 13,500 and 19,700 vehicles/day at the speed of 55-65 kmph affect the lepidopterans. Nearly 20 million lepidopterans were killed at different areas of survey and the monarch butterflies along contribute 5 lakh individuals. This is due to the fastest driving of car and because of the high Wind current catapulated over the car.

b. Pesticide use: In Recent days, the use of Neonic pesticides are the significant driver of insect apocalypse. The enormous rise in toxicity matches the sharp decline in Bees, Butterflies, Pollinators as well as Birds. Neonics are like New DDT because they are 1000 times more toxic to bees than DDT. This may lead to the evolution of 'Second Silent Spring' 40% of all insect species face extinction due to pesticides. Not only bees but also offer pollination are linked with pesticide use.

c. Pernicious side of Genetic Engineering: The pollen from the Bt corn plant are dispersed and land on the milkweed plant nearer to that and the monarch that feed on the milkweed was severely affected. Losey *et al*, (1999) done this experiment under greenhouse condition and found 44% mortality of larvae. Another study in 2016, conducted that, monarch decline 20% due to the usage of glyphosate on GMO crops. The glyphosate declines the milkweed abundance where monarch lays egg and declines the population.

d. Modern Culture that declines Insects: Two studies highlighted the Impact of Paper Cups on bees. The left-out paper cups with beverages in coffee shops acts as a death trap of Insect. The bees are attracted to the sugary residues into the cup and they drown into it leading to death and also instead of visiting the flower for foraging they learnt and continue to do so regularly. Chandrasekaran *et al,* (2011) noted that Indian bees visited the Coffee shop and nearly 168 bees/day were drowned and 25, 211 dead bees were observed in 30 days. Sandilyan, 2004 observed the dammer bees drowned, 48 bees in single cup within 10 minutes were observed.

2. Pollution:

a. Heavy metal pollution: Bees suffer from dementia. The bees rely on their brains to navigate to flowers and to collect pollen. The scientists found that high amount of aluminum contamination in bees at levels that would carve brain damage in humans. The aluminum contamination was found in the pupae with level of 13 and 200 ppm. This will affect the cognitive function and foraging behavior of ants.

b. Light pollution: The light pollution around the world is increasing 1% and the Artificial Light at Night (ALAN) causes 60% insect decline. The nocturnal insect uses the celestial light from stars and moon for the navigation, reproduction etc. The ALAN at night disrupts their action and causes death of Insects and reduction in population.

3. Biological Factors:

a. Pervasive effects of Invasive alien Organism: The invasive alien's organism like alien rat (*Ratus ratus*) was accidently introduced into Lord Howe Island of Australia. There was shipwreck in 1910 and the ship contains hordes of rats that quickly invade the island. In that Island, there is no larger mammal than this rat so the population invaded. These rats found to feed to Giant Stick Insect – *Dryocecelus australie* and it became extinct. Now the scientists found it in nearby Island and put it under critical endangered category.

b. Effects of Classical Biological Control: The generalist parasitoid tachnid fly - *Compsiliura coccinata* caused a general decline of saturnid caterpillar. *Hylophora cecropia* causes 36% mortality, *Callosomia prometha* caused 70% mortality and *Hemileuca maia mala* by 81%.

c. Climate Change: As of 2018, the warming of earth has reached 1°C. But according the prediction, the temperature will raise to 3.3°C by 2100. At 1.5°C of the rise in temperature 6% of Insect Species will lost their life and at 2°C 18% lost and raise up to 3.2°C half of the Insect population will lost their life. When the concentration of CO_2 in the atmosphere increases, there will be decline in nitrogen concentration in the plant due to increased plant metabolism, reduced transpiration, decreased N_2 mass flow etc. The bee longevity was severely affected because of the reduced N_2 content in the pollen.

d. Impact of Electromagnetic radiation on Insects: The insects are continuously exposed to Radiofrequency electromagnetic fields. Presently, the wireless telecommunication system uses 2G, 3G, 4G and Wi-Fi with the frequencies of 6 GHz. But now China is stepping towards the fastest 5G technology which uses 120 GHz. Four insects were used Australian stingless bee, Italian bee, Desert locust and beetles for the study. At above 6 GHz the Insects are known to absorb increase radiofrequency power to observe the changes in Insect behaviour, physiology and morphology over the time due to the increased body temperature from dielectric heating. The current frequency does not affect the insects much but when 5G is implemented the Insect population will decrease severely.

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Carbon Dioxide Fertilization in Crop Production-Unravelling the Facts

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Introduction

Carbon dioxide (CO_2) plays an important role in vital plant and animal process such as photosynthesis and respiration. It serves as the primary source for photosynthesis in green plants. The concentration of the gas in the atmosphere remained around 300 ppm for several years, but has escalated in the recent years, and as per the reports (NOAA, 2020), the concentration has increased from 370 to 412 ppm during the past two decades. This represents approximately 11 per cent increase since 2000 and is projected to reach 550 ppm by the year 2050. Scientists attribute this increase mainly to anthropogenic activities. The increasing temperature as a consequence of enhanced CO_2 is definitely a matter of concern and adequate measures should be taken to save the earth from excessive heat due to greenhouse effect. Most environmentalists are concerned with the climate change effects associated with increasing CO_2 concentration. But on the other side, it enhances the rate of photosynthesis in plants, through the phenomenon called CO_2 fertilization or carbon fertilization.

Carbon Dioxide Fertilization

Carbon dioxide fertilization indicates the increased photosynthesis in plants as a result of enhancement of CO_2 concentration in the growing environment. This has been reported to be useful for improving both quality and quantity of the produce. The elevated levels of CO_2 play a triggering role in improving crop growth and yield. It is especially useful for colder regions and can be used for growing almost all types of vegetables, green house fruits as well as certain ornamentals. Even so, the CO_2 fertilization effect may not be expressed under conditions when some other growth factors are limiting.

Carbon Foot Print

Carbon foot print represents the amount of greenhouse gases, primarily carbon dioxide released into the atmosphere by a particular human activity. It can be viewed as a broad measure, i.e. it can be applied to the actions of an individual, a family, an event, an organization, or even the entire nation. Carbon foot printing is contemplated as a primary strategy to reduce carbon emissions. Increase in carbon foot print of an individual ultimately leads to enhanced atmospheric CO_2 levels, thereby over heating the earth atmosphere. The present priority in research and policy decisions is to develop procedures for reducing carbon foot print and CO_2 fertilization has been put forth as an effective tool to reduce carbon foot print.

Effect of CO_2 Fertilization on Plants

The response of plants to the increased levels of CO_2 varies depending on plant species, temperature and availability of water as well as nutrients. Sujatha *et. al.,* (2008) reported an increase of 31, 18 and 15 % in photosynthetic rate of basmati rice cultivars at vegetative, heading and ripening stages respectively with CO_2 enrichment compared to the cultivars grown at ambient CO_2 concentration. Similarly, CO_2 enrichment and a consequent increase in the photosynthetic capacity per unit leaf area in crops like tomato, potato, mung bean and soybean have been documented. The positive response is more applicable to plants with C_3 photosynthetic pathway and not necessarily to plants with the C_4 photosynthetic mechanism. Enhanced CO_2 concentration shifts the activity of RUBISCO in favor of the carboxylation reaction and declines its oxygenation capacity. Since C_4 plants have an internal CO_2 concentration mechanism, they are less responsive to elevated levels of CO_2.

Maize being a C_4 crop, elevated CO_2 could not stimulate the photosynthesis compared to ambient CO_2 levels (Leakey *et. al.*, 2006).

Rising atmospheric CO_2 considerably increased leaf photosynthesis through CO_2 fertilization effect even under mild and moderate water stresses (Fan *et. al.*, 2020). The boosted leaf photosynthesis under water stress could be attributed to the increased stomatal number. But the CO_2 fertilization effect on crop growth and photosynthesis was negligible under severe water stress condition.

A boost in CO_2 concentration enhances the efficiency of water utility in plants**.** Soybean plants grown under high CO_2 concentration recorded 28 % increase in intrinsic water use efficiency than control plants grown at ambient conditions (Madhu *and Hatfield*, 2014). Plants retain narrow stomatal openings under high CO_2 levels and thereby reduces water loss. Leaf-level water use efficiency was enhanced due to the stimulated leaf photosynthesis and the reduced leaf transpiration under high CO_2 concentration. The increase in water use efficiency with rising CO_2 has led to increased foliage cover in warm arid environments, resulting in a phenomenon called greening of globe observed in recent decades.

Photoassimilates are usually allocated to vegetative shoots, root system or reproductive organs during the growth period. While portioning photosynthates, under elevated levels of atmospheric CO_2, plants distribute a greater proportion to roots than to shoots. Roots being the economic produce, tuber crops are more benefited with rising levels of CO_2. Aien *et. al.*, (2014) recorded that potato cultivars grown under elevated CO_2 concentration (570±50 µmol mol^{-1}) recorded higher dry matter production. High CO_2 increased the partitioning of dry matter towards the tubers during all sampling stages as compared to ambient CO_2. Greater portioning of photoassimilates to below ground portion especially in legumes results in better root production, which increases the development of mycorrhizal associations and fixation of nitrogen in root nodules and thereby helps the plants to grow even in soils with low nutrient status.

Reproductive biomass growth as well as vegetative biomass is increased by elevated carbon dioxide. Growing of plants at a CO_2 concentration of 550 ppm improved the yield of chick pea, green gram, ground nut, mustard, potato, rice and wheat, the effect being more pronounced in chick pea (22 % increase in yield) as documented by Singh *et. al.*, (2013), while it was less evidenced in rice and wheat (15 % yield increase). Groundnut, green gram, mustard and potato exhibited 20 % yield improvement. During all the growth stages, stem dry weight was 1.5-2.8 times higher under elevated CO_2 than ambient conditions (Saha *et. al.*, 2013).

Overall quality of the produce is also enhanced by the lift in CO_2 concentration. Several plant species accumulate greater part of non-structural carbohydrates, particularly starch, in their edible portions under elevated CO_2. Increased sugar content and reduced sugar: acid ratio was observed in fruit crops. Nutritional quality in terms of fructose, glucose, soluble sugar, antioxidant activity, flavonoids, ascorbic acid, and calcium in the edible part of vegetables were improved with elevated atmospheric CO_2. In addition, the taste fruits as well as vegetables were found to be improved with high CO_2. However, it is less likely to improve all the parameters of nutritional quality simultaneously. On the other hand, content of magnesium, iron, and zinc were lowered with rising CO_2. Elevated CO_2 reduced N content of maize kernel by 11 % and P content by 19 %. but increased K content by 5 % compared to ambient CO_2 (Abebe *et. al.*, 2016).

Even though enhanced CO_2 have several advantages, prolonged exposure of crop plants may lead to some defects. For example, long term exposure of potato plants to high CO_2 resulted an inhibition in carbohydrate synthesis. Since the response of plants to CO_2 varies according to species, growth stage, concentration of CO_2 etc, optimum concentration must be ensured at different growing periods to obtain good quality product.

Suggestions for Optimising the Advantages of Enhanced CO_2

In order to obtain better quality produce, elevated CO_2 concentration should be coupled with other growth factors.

1. Select species or cultivars that respond well to enhanced CO_2

2. Provide optimum growing environment like moderate light intensity and adequate crop nutrition while growing plants under elevated CO_2
3. Harvest vegetable products earlier than done normally at ambient CO_2
4. Combine high CO_2 with mild environmental stress in instances when it enhances vegetable quality.

Cultivation of crops under controlled environmental conditions with elevated CO_2 concentrations can serve to augment production but has to be recommended with a vision to reduce the carbon foot print and thus mitigating the adverse effects of the greenhouse gas.

Conclusion

Even though rising atmospheric carbon dioxide possess a threat to the earth by global warming and associated climate change, it benefits the community through the process of carbon fertilization. Elevated CO_2 levels enhances the growth, yield as well as quality of the product. In this context, the phenomenon of CO_2 fertilization can be used as a tool to feed the increasing population in future as the levels of CO_2 increases day by day due to anthropogenic activities.

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Seed Drying Techniques to Minimize the Storage Loss

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Summary

Quality seed is the vital input in agriculture to achieve excessive yield with good quality. Seed moisture plays important roles in maintaining the seed viability and vigour during storage. Before storage seeds should be dried to optimum moisture required for storage it varies crop to crops. The seeds must be stored in well sanitized rats free godowns for the maintenance of seed qualities.

During storage, major losses of seeds are caused by various biological and nonbiological factors. Improper seed drying will lead to major loss of seeds through high respiration and metabolic activities which also invades pest and mold growth in seeds. The quality of seeds can be maintained by using careful postharvest handling techniques. This includes seed drying to get reduce high seed moisture into optimum storage moisture.

Introduction

Physiological maturity attained by the most of the agricultural crops at moisture content between 35 and 45 % is crop dependent. Temperature affects the storage of seeds at moisture content between 10 and 14 %. For high-quality yield of crops with good quality of seeds is attained by timely harvesting and proper drying are necessary. Biologically active seeds deteriorate readily under most of the circumstances due to fungal contamination and attack of insects and other pests. The main purpose of drying is to reduce the respiration in seeds. The process also impedes qualitative damage due to fungi and other insect pests. Drying can itself affect the quality of the seeds. Extensive drying under very high temperature can damage the seed through seed coats cracks and cell wall damages in seeds. In summer season, simple drying methods are used through exposure to sun and adequate wind. The alternative drying methods have been devised for high-yielding varieties and improved farming practices and irrigation to deal with increased production or harvesting in wet season in multi-cropping.

Sun Drying

Sun drying of seeds is the drying method in the tropical developing countries. The method is employed when crop is ready for the harvest. Some seeds like maize can be sun dried although during drying, crops get sensitive to insect infestation, rodent or birds' attack, and mould damage.

A threshed seed drying by spreading on sheets or tray is a common phenomenon but has a risk of soil or stone contamination. Paddy is dried on especially build drying floor that allow easy run off of rain water. The seeds are dispersed in thin layer and turned at regular intervals to facilitate drying and covered at night with the help of sheets.

There are some disadvantages of the process that temperature is an uncontrollable factor. In paddy rice, high temperature can cause stress or cracks in the seeds which lead to high level of damage during milling. Yield can be contaminated by dust, atmospheric contamination or insect infestation, or human or animal disturbance.

Solar Drying

It is the modification of sun drying in which sun rays are collected in an especially designed unit for air removal in adequate ventilation system. The unit has 20-30° higher temperature than open drying, and less time is consumed in the process. In solar dryers, solar collector is used to heat air which then allowed to pass to the seed beds. It comprises two basic designs: natural convection dryers use thermal gradients and forced convection dryers force the air through solar collectors and seed layers. These dryers are suitable for farm use. The former design of the Asian Institute of Technology in Bangkok has been used as blueprint for several convection dryers and comprises a drying bin, a solar chimney, and a solar collector. The solar collector consists of black polythene sheet or layer of burnt paddy husk; it is covered with clear polythene sheet. Perforated platform presents in drying bin. The disadvantages of the process are as follows: high structural profile, stability problem in windy condition, and the need of replacement of polythene sheets at regular intervals.

Mechanical Dryers

The same principle of drying is used by mechanical dryers as forced convection solar dryer; the dryer forced the air through the seed bed and the air is heated with the help of a flat plate instead of conventional means.

In modern automated storage system, drying takes place at one of the two points either in pre-storage dryers (prior to loading seeds in freestanding loading) or in store dryer (after loading in final storage compartment). In pre-storage dryers, ambient air is used in continuous flow dryers, and heat is generated by thermostatically controlled furnace which is powered by electricity, diesel, or gas.

Heat may be supplied by direct or indirect way. Indirect way is preferred due to the separate outlet for the combustion product not through seeds. In the batch dryers, seeds are fed into properly defined batches, whereas in continuous flow dryers, the grains are flowed into the system and recovered at desired moisture content.

Tray Dryers

Tray dryers are batch dryers of flat beds. The seeds are dispersed on the mesh tray at the depth of 600-700 mm, and warm dried air is passed through seeds to sufficiently dry them.

Radial Drying Bin

Radial drying bin comprises two vertical metal mesh cylinders, one inside the other. Seeds are loaded between these two cylinders, and air is blown to the inner cylinder and passed from the inner to the outer mesh cylinder. By reversing air through seeds, air can be sucked from the central cylinder. However, there is the risk of over drying of seeds in the inner cylinder which are in direct contact with the hot air. Air is wetter and cooler at the leaving side toward outside.

Continuous Flow Dryers

Moisture content of the seeds can be removed by sucking or blowing hot air by top-to-bottom passage through the system. Bin is present at the top of the drying section with cooling system at the base. Seed beds can be horizontal, vertical, or inclined. Seeds are moved by conveyors, scrapers, vibration, or gravity. The degree of drying depends upon the speed, size, and rate of flow of outlet conveyor of the dryer. Continuous flow dryer is varied by relative direction of air stream and seed flow. Several continuous flow dry techniques are described below.

Cross Flow

The seed passes through the two perforated sheets downward to the column by allowing horizontal passage of air through the seeds. The advantage of the dryer is that the moisture gradient can be defined at any stage of drying seeds.

Counterflow

A round bin is used to unload seeds with the upward flow of air. Little evaporative cooling takes place when hottest air passes through the driest seeds.

Concurrent Flow

In concurrent flow, wettest seeds are exposed to the hottest air during passage of air through seed bed. High temperature improves the efficiency of the dryer and cools the seeds by moisture evaporation.

Cross Flow

Cross-flow dryers have been used widely in recent years, but mixed-flow dryers have advantages over cross-flow dryers. Mixed flow dryers, combination of concurrent, counter and cross flow dryers has great advantage of efficient fuel consumption. But reduction in output because of uneven flow of seeds leading to uneven drying is one biggest hindrance in adaption of mixed flow drying.

Tower (Mixed Flow)

They consist of tall rectangular bins for storage, and triangular ducts are present along the width of the dryer at horizontal position. Half of the ducts are used for induction of warm air and removal of damped and cooled air is done by remaining ducts. It has multiple directions of seed flow and air flow.

Louvered Bed Dryer

The seeds are passed through different types of batches; the hot air is blown to the seeds to dry them. The dryers work on the principle of cross-flow dryer. The speech and depth of the drying beds depends upon the degree of drying. The two basic designs of the dryers are conveyor dryer and cascade dryer. The cascade dryers are gravity fed cross-flow dryers. The seed depth is controlled by roller dams and speed is controlled by output elevators. There can be incorporated changes to vary the length of the dryer. In conveyor dryer, air is blown to seeds through inclined louvered bed and the seed flow is controlled by variable speed, roller chain conveyor and heavy duty. These dryers can be one directional, two directional, or multidirectional; the variation in direction assists in removal of waste material and reduction in size of the dryer.

In Store Drying

This is an alternative method of drying in which seeds are load into bulks floor storage or in bin and then they are dried in stores.

Bulk on Floor Storage

They consist of especially strengthened wall which can bear the weight of seeds. The seeds are loaded in uniform depth. At one side of the building, fan is present for the aeration purpose and the plenum chamber runs along the centre of the store or walls with perforated lateral ducts, below or above the floor level under the bulk of seeds.

In Bin Drying

This type of drying comprises one or more bins for drying purpose and other bins for storage. The dryers reduce the chance of physical damage due to the lesser handling. The shallow layer of seed along the bins for drying reduces time consumption and makes the process safer. The semi-dried batches free the space for incoming seeds and consist of lateral ventilated system or ventilated floors about 0.5 m above the base.

Bag Dryers

The drying in bags is difficult because there is not proper insurance of passage of air through the seeds. In sack platform dryers air is blown through the floor of air duct whereas in fan blowers heated air is blown from the floor apertures and sacks are placed on them. Larger bags are stacked in the centre of tunnel in moisture extraction unit. Through the air ducts, hot air is blown with the help of a fan. One must be careful of correct dimension to avoid uneven drying. However, this system is not appropriate for even drying of seeds because of short circuit over certain areas.

Conclusion

Its concluded that proper drying is essential for maintaining the seed quality with high vigour without losses during seed storage. Drying through natural and artificial methods are recommendable for seed drying. Artificial drying is a quick and easy methods, huge quantity of seeds can also be dried in short period of time.

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Bioherbicides and Weed

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Introduction

In agriculture, weed control generally through chemical herbicides. The herbicide Spray drift which adversely affects the environment besides, pesticide residues (herbicides) in food commodities, directly or indirectly also affect human health. These lead to the search for an alternate method of weed management, which is eco-friendly. In this regard the bioherbicide approach may be a very suitable approach to control weed.

A bioherbicide is a biologically based control agent for weeds. Bioherbicides are made up of microorganisms (e.g. bacteria, viruses, fungi) and certain insects (e.g. parasitic, lady butterfly) that can target very specific weeds. A bioherbicide based on a fungus is called a Mycoherbicide.

Characteristics of Bioherbicides

1. Bioherbicides are living entities / inoculum of plant pathogens mainly fungi since the potential of bacteria is hardly explored and viruses prove difficult to handle on the ground of their host specificity and dependence on vectors.
2. They are capable of in vitro culturing in artificial media and mass production.
3. They are applied directly to the targeted weeds to kill or reduce their population and growth.

Synergism Between Bioherbicides and Chemical Herbicides

Combinations of some bioherbicides and synthetic herbicides can be synergistic, resulting from lowered weed defence responses caused by the herbicides, thus making the weeds more susceptible to pathogen attack. Commercial bioherbicides first appeared in the market in USA in early 1980s with the release of the products.

1. Devine.
2. Collego.
3. Biomal.
4. VELGO.
5. ABG 5003.

Product, year and country	Bio-herbicide description	Target weed and disease caused	Crop where used and reference
Devine, 1981, USA	*phytophtheracitrophthora* p.v. palmivora, soil borne and can remain for 3-4 years in soil by one spray.	Moreniaodorata (strangler vine), lethal root-rot)	Citrus, USA: (Kenny,USA)
Collego,1982,USA	*Colletotrichumgleosporiodies*	Aeschynomenevirginica(northern joint vetch), (stem and foliage blight)	Rice and soyabean,USA (Bowers,1982)
Biomal, CANADA	*Colletotrichumgleosporiodies*	Malvapusilla (round leaved mallow), (anthracnose)	Cotton, Canada (Makowski and Mortenson,(1992)

Biomal No. 1 & 2	*Colletotrichumgleosporiodies*	Malvapusilla (round leaved mallow), (anthracnose)	Wheat and small-grain crops in USA
VELGO	*Colletotrichumcoccoides*	Abtilontheophrasti	Cotton, Canada
ABG 5003	*Cerosporarodmanil*	Eichhorinacrassipes (Leaf spot)	Water-ways,USA

Bioherbicides have Greatest Potential for Control

1. Weeds infesting small specialized areas where chemical herbicide development would be too costly.
2. Weeds that have been intransigent to chemical control.
3. Crop mimics.
4. Parasitic weeds.

Since potential return on investment is critical to industrial involvement in bioherbicide development, major weeds, presently not controlled by available technology, in major crops are perhaps the ideal targets for the bioherbicide approach.

Limitations in Use of Bioherbicides

1. Biological constraints: (host variability, host range resistance mechanisms and interaction with other microorganisms that affect efficacy).
2. Environment constraints (epidemiology of bioherbicides dependent on optimum environmental conditions).
3. Technical constraints (mass production and formulations development of reliable and efficacious bioherbicide).
4. Commercial limitations (market size, patent protection, secrecy and regulations).

Bioherbicides will not solve all of the environmental and weed management problems associated with synthetic herbicides, nor will replace the current synthetic herbicides Their role will probably be complimentary components in successful IWM systems, and in the discovery of novel phytotoxins with new chemistries and new molecular sites of action.

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Role of Biofertilizers on Growth, Yield and Quality Attributes on Brinjal Crop

Article ID: 32670

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Introduction

Solanum is a large and important genus of the family Solanaceae. The eggplant or brinjal or aubergine (Solanum melongena L.) represents the non-tuberous group of Solanum species (Narasimha Rao, 1979). Brinjal is the most common, popular and widely grown vegetable crop of both tropics and sub-tropics of the world. It is being grown extensively in India, Bangladesh, Pakistan, China, Philippines, France, Italy and United States. Brinjal is highly productive and usually finds its place as the poor man's vegetable (Som and Maity, 2002). Except in higher altitudes, it can be grown in almost all parts of India, all the year round. Large number of cultivars are grown throughout the country depending upon the consumers preference for the colour, size, shape and the yield. Consumers preference for shape and colour are specific which changes with region.

According to Zeven and Zhukovsky (1975), it is originated in India, but has a secondary centre of variation in China. Though, it is being cultivated extensively in some of the Asian countries viz Pakistan, China, Phillippines and Bangladesh however it is also popular in France, Italy and United States. The brinjal is staple vegetable in almost all tropical countries in the world and liked by both poor and rich. Since there is a common belief that it is not good vegetable. However, it is quite high in nutritive value and can well be compared with tomato (Choudhary 1976a).

Biofertilizer

Definition: Bio fertilizers are preparations containing micro-organisms, with capability of mobilizing nutritive elements from non-usable form to usable form through biological processes.

How do these Fertilizers Work?

1. These microbial cultures fix atmospheric nitrogen, helps in phosphate solubilization or producing hormones, vitamins and other growth factors required for plant growth.
2. These are called biological instruments and play a very significant role in the augmenting of the productivity.

Advantages

1. Less expensive.
2. Make soil more productive
3. Eco-friendly and sustainable.
4. They do not require non-renewable source of energy for their production.

How to Apply Bio-Fertilizers in Vegetables

There are 4 methods for applying bio-fertilizers in vegetables:
1. Seed treatment.
2. Cut piece/set treatment.
3. Seedling treatment.
4. Soil application.

Seed Treatment

1. About 200g of bio-fertilizers is required to treat 10-14 kg of seed.
2. Suspend one packet of 200g in approximately 400ml water and mix it thoroughly.
3. Pour this mixture on seeds and mix with hands to obtain uniform coating on each and every seed.
4. Spread the seeds in shade for drying for 10-15 minutes then sow them immediately.

Cutting / Set Treatment

1. Prepare a culture suspension by mixing 1 kg of culture in 50-60 litres water.
2. The cut pieces of planting material required for 1 acre are kept immersed in the suspension for 10-15 minutes.
3. Then bring out these cut pieces and allow to dry for sometimes before planting.
4. Cut pieces method is applicable for crops like potato.

Seedling Treatment

1. Seedling treatment is recommended for tomato, chilli, onion etc.
2. Prepare the suspension by mixing 1 kg of culture in 10-15 litres of water.
3. Get seedlings required for 1 acre and make small bundles of seedlings.
4. Dip the seedlings in the suspension for 15-20 minutes.
5. Transplant these immediately.
6. Generally the ratio of inoculants and water should be 1:10 approximately, i.e. 1 kg packet in 10 litres of water.

Soil Application

1. Prepare the mixture of 2-3 kg of bio-fertilizer in 40-60 kg of soil/compost.
2. Broadcast the mixture in one acre of land either at sowing time or 24 hr before sowing. The application of phosphate-solubilizers is very common.

Role of Biofertilizer on Growth, Yield and Quality of Brinjal Crop

In India, in spite of its great potential the yield per unit area is very low than that of developed countries, mainly due to lack of proper production technologies especially, the nutrient management. For harnessing higher yield, balanced application of nutrition is a prerequisite.

The continuous application of chemical fertilizers alone without use of organic manures has deteriorated soil health in terms of chemical, physical and biological characters resulting index line in crop yield. On the other hand, organic manures such as farm yard manure, poultry manure, and compost are known to have beneficial effect on soil health but their limited nutrient content and their availability in large amount is a constraint for their wider usage.

This indicates that sole application of organics or inorganic fertilizers are in no way a suitable solution for maintaining soil health and enhancing crop productivity. The use of chemical fertilizers and organic manures for obtaining sustainable crop production, better nutrient availability and efficient nutrient use, besides reducing nutrient losses (Hegde, 1997) and improving fruit quality (Singh *et al.,* 2000).

Biofertilizers also protect plant from salinity and drought stress. Biofertilizers are inexpensive and safe inputs which provide a wide scope for research in the areas of organic farming and development of stress-free environment. Overall, the significant role of biofertilizers in plant growth productivity and protection against some stresses makes them a vital and powerful tool for organic and sustainable agriculture.

This article describes various kinds of biofertilizers and their impact on different crops. The various biofertilizers which are described in this chapter are *Azotobacter, Azospirillum, Rhizobium*, Blue green algae, phosphorus and potassium solubilizing micro-organisms and Mycorrhizae. Vermicomposting and a possible mechanism of action of various biofertilizers have also been described.

Biofertilizers help to increase quality of the soil by providing nutrients and natural environment in the rhizosphere. The micro-organisms present in biofertilizers are important because they produce nitrogen, potassium, phosphorus and other nutrients required for benefit of the plants. Most biofertilizers also secrete hormones like auxins, cytokinins, biotins and vitamins which are essential for plant growth.

Some Major Biofertilizers Found Effective in Brinjal Crop

Bio-fertilizers have definite advantage over chemical fertilizers. Chemical fertilizers supply over nitrogen whereas bio-fertilizers provide in addition to nitrogen certain growth promoting substances like hormones, vitamins, amino acids, etc, crops have to be provided with chemical fertilizers repeatedly to replenish the loss of nitrogen utilized for brinjal growth. Some major Biofertilizers benefiting the brinjal crop production are Azotobacter, Azospirillum, Blue green algae, Azolla, Phosphous Solublizing Bacteria (PSB), and Vesicular Arbuscular Mycorrhiza (VAM).

Azotobacter: Azotobacter represents the main group of heterotrophic, non-symbiotic, gram negative, free living nitrogen-fixing bacteria. They are capable of fixing an average 20 kg N/ha/year. The genus Azotobacter includes 6 species, with A. chroococcum most commonly inhabiting in various soils all over the world.

Azospirillum: Use of Azospirillum spp. appeared among the new the technologies for optimizing plant implantation, Azospirillum is growth promoting Rhizobacteria (PGPR) capable of colonizing the root and stimulating root growth thus enhancing mineral and water uptake plants.

Phosphous Solublizing Bacteria (PSB): Soil and seed inoculation with phosphate solubilizing bacteria (PSB) improves solubilization of fixed soil phosphorus and of applied phosphates, resulting in higher crop yields [67-72]. The increase in growth characters might be due to stimulative effect of PSB on P solubilization leading to higher P availability and uptake by plant.

Vesicular Arbuscular Mycorrhiza (VAM): The mycorrhizal fungi mobilize phosphates and other micronutrients like zinc, boron and molybdenum from adjacent soil to the root system through hyphal network. Enhanced uptake of phosphorus and increased plant growth due to inoculation of soil with VAM fungi in Brinjal Crop.

Need of Biofertilizers in Agriculture

Bio-fertilizers are known to make a number of contributions in agriculture.

1. They supplement fertilizer supplies for meeting the nutrient needs of crops.
2. They can add 20-200 kg N/ha (by fixation) under optimum conditions and solubilise /mobilize 30-50 kg P_2O_5/ha.
3. They liberate growth promoting substances and vitamins and help maintain soil fertility.
4. They suppress the incidence of pathogens and control diseases.
5. They increase crop yield by 10-15%, N-fixers reduce depletion of soil nutrients and provide sustainability to the farming system.
6. They improve soil physical properties, tilth and soil health in general.

Conclusion

Bio-fertilizers combined with organic manure influences the plant growth by enhancing root biomass; total root surface facilitates higher absorption of nutrients and increase in yield by reducing consumption of natural sources of energy. The organic fertilizers have proved that their application has the potential to increase the biomass and productivity of a wide range of crops.

Fertilizers play an important role in enhancing crop productivity. However, chemical fertilizers are expensive, non-eco-friendly, cause eutrophication, reduce organic matter and microbiotic activity in soil and are hazardous to health.

Therefore, the use of biofertilizers is desirable as they are natural, biodegradable, organic and more cost-effective than chemical fertilizers. Biofertilizers consist of plant remains, organic matter and some special class of micro-organisms.

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Why Organic Farming?

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Abstract

Organic farming yields such vital benefits as preservation of soil's organic composition. It maintains and improves the soil fertility, soil structure and biodiversity, and reduces soil erosion and toxic material. Organic farming is not only a farm practice but also a philosophy of working together with nature. More precisely, organic farming is based on managing the agro-ecosystem rather than relying on external farming inputs, such as pesticides, artificial fertilizers, additives, and genetically modified organisms. Yet they are emerging as widely approved concepts in the developed countries as a result of years of harmful industry chemicals.

Introduction

Organic farming is defined as the system of production that is capable of avoiding the use of pesticide, synthetically compounded fertilizers, livestock feed additives and growth regulators. To the paramount extent, flexible organic farming system relies upon crop residues, green manure, pest weeds, crop rotations, off- farm organic wastes, legumes, aspects of biological pest control insects, animal manures, and etc. Methods of organic farming are used widely in developing countries, majorly because of economics and a fewer resource of chemicals.

Current Farming Process

The technology of Green revolution, especially in India, has led to multi-fold aggrandizing in the production of food grains, but simultaneously it has asked for demands on farm power, water, and fertilizer. The intensive cropping effect has shown results through deteriorating of the tilth of the soil and decreasing content of organic matter. Apart from this, the high levels of chemical inputs are contributing to pollution and resulting in further deterioration of soil health. Also, the rising use of agro- chemical is constantly resulting in water pollution and deterioration in healthy atmospheric conditions. It has affected the production of crops and degraded human health as well. To avoid these problems and also for maintain the soil fertility organic farming is very important now days.

Principles of Organic Farming

Organic farming is strictly regulated in each country, with a few common principles:

1. The principle of health claims that organic farming is intended to protect and enhance the health of soil microorganisms and humans

2. The principle of ecology, which is based on the fact that organic farming should protect and benefit the environment like landscape, climate, natural habitats, biodiversity, air, water, and soil.
3. The principle of fairness aims to provide socially and ecologically appropriate management over environmental resources, as well as provide a sufficient supply of quality food and other products.
4. The principle of care stresses precaution and responsibility as the key concerns in organic farm management.

Methods of Organic Farming

1. Soil management: After cultivation of crops, the soil loses its nutrients and its quality deplete. Organic agriculture initiates the use of natural ways to increase the fertility of the soil. Hence, it focuses on the use of bacteria that is present in animal waste. The bacteria help in making the soil nutrients more productive and fertile.

2. Weed management: Weed is the unwanted plant that grows in agricultural fields. Organic agriculture focuses on lowering weed and not removing it completely. The two most widely used weed management techniques are:

- **a. Mulching:** A process where we use plastic films or plant residue on the surface of the soil to block the growth of weed.
- **b. Mowing or Cutting:** Where there is a removal of weeds top growth.

3. Crop diversity: Monoculture is the practice used in the agricultural fields where we harvest and cultivate only one type of crop in a particular place. Recently, polyculture has come in existence, where we harvest and cultivate kinds of crops. To meet the increasing crop demand and produce the required soil microorganisms.

4. Controlling other organisms: There are both useful and harmful organisms in the agricultural farm which affect the field. So, we need to control the growth of such organisms to protect the soil and the crops. We can do this by the use of herbicides and pesticides that contain fewer chemicals or are natural.

Importance of Organic Farming

1. The environment benefits because natural habitat sources are less threatened.
2. It provides healthier food for people.
3. The soil is in better condition because of the manure used.

Advantages of Organic Farming

1. Organic farming helps to prevent environmental degradation and can be used to regenerate degraded areas
2. Organic manures produce an ideal condition in the soil for high yields and good quality of crops.
3. They cut the need for purchased inputs.
4. They improve the soil chemical properties such as supply and retention of soil nutrients and promote favourable chemical reactions.
5. Organically grown plants are more resistant to diseases and insect and hence only a few chemical sprays or other protective treatment are required.

6. Poison – free.

Disadvantages of Organic Farming

1. Production costs are a high error because farmers need more workers.
2. Food illness may happen more often.
3. Organic food is more expensive because farmers do not get much out of their land as conventional farmers do.
4. Organic farming cannot produce enough food that the world's population needs to survive.

Conclusion

Organic farming not only helps preserve more natural habitat areas but also encourages birds and other natural predators to live happily on farmland, which assists in natural pest control.

Additionally, animals who live on organic farms are exposed to clean, chemical-free grazing that helps keep them naturally healthy and resistant to illness. As a perk for organic farmers, happy and healthy organic animals are productive organic animals. Additionally, reduced biodiversity may directly correlate with a rise in infectious diseases, which of course, isn't good for people or the planet.

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Regenerative Agriculture for a Better Future

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Introduction

Regenerative agriculture refers to a set of agricultural techniques that improve soil health by increasing soil organic matter and the carbon content of soil. It is a system of farming principles and practices that increases biodiversity, enriches soils, improve watersheds, and enhances ecosystem services. It aims to capture carbon in soil and above ground biomass, reversing current global trends of atmospheric accumulation. At the same time, it offers increased yields, resilience to climate instability and higher health and vitality for farming and ranching communities. The system drawn from decades of scientific and applied research by the global communities of organic farming, agro-ecology, holistic management and agroforestry.

Soil plays an important role in the global carbon cycle. Because plants absorb carbon from the atmosphere, convert it to plant tissue, and return it to the soil as plant residue, soils globally act as the world's largest sink of active carbon. Farming practices influence how much carbon soils retain and how much is released into the atmosphere.

Regenerative agriculture not only improves soil health, productivity, and resilience to weather extremes, raising farm yields and income while strengthening regional food security in the face of a changing climate, but can also form part of a region's broader climate strategy. Under improved management, soils have the potential to absorb hundreds of millions of tons of atmospheric CO_2 more than they do today. Soil organic matter (SOM) refers to plant and animal matter in soil in various stages of decomposition as well as the cells and tissues of soil microbes. SOM makes up 2-30% of the soil's mass and is critical for its health because it provides nutrients and improves soil fertility, water retention, structure, and nutrient recycling.

Soil organic carbon (SOC) is a component of SOM and refers to the carbon content of soils. High levels of carbon improve soil structure, increasing physical stability. This in turn improves soil aeration, water drainage and retention, and reduces erosion and nutrient leaching. SOC content is also important for the soil's chemical composition and biological productivity, improving soil's fertility and nutrient holding capacity.

Regenerative agriculture practices are guided by 4 principles, which are uniquely applied to each specific climate and bioregion.

1. Progressively improve whole agro-ecosystems (soil, water and biodiversity).
    a. Minimize soil disturbance.
    b. Maximize crop diversity.
    c. Keep soil covered.
    d. Maintain living roots year-round.
    e. Integrate livestock.
2. Create context-specific designs and make holistic decisions that express the essence of each farm.
3. Ensure and develop just and reciprocal relationships among all stakeholders.
4. Continually grow and evolve individuals, farms and communities to express their innate potential.

Regenerative agriculture relies on inputs from the land itself and is easy to engage in. It has many other benefits include:

1. Maximum utilization of land since the landscape design of a farm garden uses a diversity of both tree and annual crops.
2. Building soil health.
3. Reduced dependence on any one crop and little risk.
4. Increased food security and diets that are diverse, nutritious and chemical free.
5. Improved water management and minimizing the impact of draught or flood.
6. Increased organic matter in the soil through mulching reduces soil erosion, decreases evaporation of moisture from the soil and increase moisture retention.
7. Increased water infiltration and thereby recharge ground water.
8. Reduced cost of production since all inputs are sourced from the farmer's garden or in close proximity to it.
9. Maintains crop yield.
10. Improve farm profitability.
11. Helping solve climate change.

Regenerative Agriculture Techniques Include

1. Biochar: A highly infertile substance generated from burning organic matter in an anaerobic environment. When added to soils, bio char is a source of nutrients, helping to create a fertile soil.

2. Organic mulch and crop residue: Wood chips, straw, or crop residue used to cover soil around plantings to prevent carbon losses. As the mulch and crop residue decompose, soil organic carbon and soil organic matter increases.

3. Compost: A nutrient-rich substance made from animal, plant, and food waste that replenishes soil organic matter, supporting soil health and productivity. Compost can be spread ion top of fields or mixed with soil and reduces the need for fertilizers, thus decreasing emissions associated with fertilizer manufacturing.

4. Cover crops: Fast growing plant species used to cover the soil between growing seasons. Cover crops protect soils and prevent soil erosion. They increase soil carbon pools, improve water and nutrient cycling, and promote biodiversity.

5. Perennial crops: Perennial crops are crops that are planted year-round. They develop thick root systems that improve soil water retention. When used as cover crops between growing seasons, perennials increase biodiversity and ensure that the soil's integrity is maintained between seasons.

6. Agroforestry: The use of trees in agriculture and livestock production: planting rows of trees between crops, planting trees in livestock pastures, or creating canopies over cropland or pastures. Agroforestry improves biodiversity, sequesters carbon, protects the plants from extreme weather, and improves water retention.

7. Managed grazing: Rotating livestock through different parts of a pasture. This permits crops to develop strong root systems, provides livestock constant food, and allows manure to be integrated into the pastures.

8. Reduced or zero tillage: Tilling mixes soil with air, causing the soil carbon to oxidize into the atmosphere. It also degrades the soil structure and decreases soil fauna such as earthworms that contribute to soil health through nutrient cycling. Reduced tillage means avoiding mechanical seedbed preparation or soil disturbances.

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Studies on Economic Feasibility and Suitability of Inter Cropping of Aonla (*Emblica officinalis* Gaertn L.) Plantation

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Abstract

The present investigation entitled "Studies on economic feasibility and suitability of inter cropping of Aonla (*Emblica officinalis Gaertn* L.) plantation" was carried out during 2019 at the Department of Horticulture, SHUATS, Prayagraj.

The result of the present investigation, regarding the effect of inter crops in Aonla plantation on tree growth and fruit yield of Aonla. The experiment was laid out in Randomized Block Design (RBD), replicated thrice with the six intercropping system treatment combination of T_0:Sole crop, T_1:Spinach, T_2:Radish, T_3:Tomato, T_4:Coriander, T_5:Okra and T_6:Fenugreek.

From the present investigation the treatment T_2 Radish is best maximum growth, fruit yield and quality of Aonla tree and was recorded. In the treatment T_1 is the best for Intercrop Yield (q/ha) (198.53) under Prayagraj agro-climatic condition.

Keywords: Aonla, growth, intercrops, quality and yield.

Introduction

Aonla or Indian gooseberry (*Emblica officinalis* Gaertn L.) is an important indigenous fruit crop in India, which belongs to the family Euphorbiaceae and subfamily phyllanthoideae. It is native of Tropical South-East Asia. Its commercial cultivation is common in India, particularly in Uttar Pradesh, Haryana, Punjab and Gujarat etc.

Gujarat occupies 12481 ha area with 121514 million tons [M.T.] productions, Where as in Middle Gujarat cover 7197 ha area with the production of 75559 [M.T.] (Anonymous, 2011). It is the richest source of vitamin C (400-1300 mg/100 g from pulp) among the fruits next to Barbados cherry (Mandal *et al.,* 2013).

"The intercropping of short duration seasonal crops under available interspace between Aonla plantation under wasteland conditions have shown significant impacts on soil and crop management. However, no information is available are available in literature as per the suitability of selective intercrops including, oilseed, cereals, such as pulses vegetable species, medicinal and aromatic crops and other short-duration fruit species.

To check these a research trail on "Studies on economic feasibility and suitability of inter cropping of Aonla plantation" (*Embilica offcinalis Gaertn* L.)" was conducted at the Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom Institute of University Technology and Sciences, Prayagraj. The main objective is to study the effect of intercrops on growth and bearing of aonla trees and to work out the economic feasibility of intercrops.

Materials and Methods

The experiment was laid out in Randomized Block Design (RBD), replicated thrice with the six intercropping system treatment combinations and 3 replications was conducted during 2019 – 2020 at the Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom Institute of University Technology and Sciences, Prayagraj. Total number of treatments were 6 viz. T_0: Sole crop, T_1: Spinach, T_2: Radish, T_3: Tomato, T_4: Coriander, T_5: Okra and T_6: Fenugreek.

The observation was recorded on growth, yield and quality of Aonla crops *viz.,* Plant height (m), Plant spread (m), Fruit set (%), Fruit length (cm), Fruit width (cm), Fruit weight (g), Yield (kg / tree), T. S. S. (^{0}Brix), Ascorbic acid (mg/100g) and Acidity. The data recorded during investigation were subjected to statistical analysis as per the method of analysis of variance**.**

Tables & Figures

Table-1: Effect of intercrops in Aonla plantation on growth:

Treatments combination		Plant height (m)	Plant spread (m)	Fruit set (%)	Fruit length (cm)	Fruit width (cm)	Fruit weight (g)
T0	Sole crop	3.83	4.04	67.73	2.14	2.20	30.47
T1	Aonla+Spinach	4.53	4.83	71.52	2.84	2.72	38.31
T2	Aonla+Radish	5.66	5.49	74.64	3.70	3.45	42.42
T3	Aonla+Tomato	4.24	4.72	68.77	2.64	2.51	36.34
T4	Aonla+Coriander	4.41	4.30	72.35	3.15	2.79	32.30
T5	Aonla+Okra	5.14	5.14	70.43	2.63	3.08	38.20
T6	Aonla+Fenugreek	4.88	4.90	71.63	2.75	2.63	36.32
F-test		**S**	**S**	**S**	**S**	**S**	**S**
C. D. at 0.5%		**0.185**	**0.450**	**0.960**	**0.424**	**0.214**	**0.733**
S.Ed. (+)		**0.085**	**0.206**	**0.441**	**0.195**	**0.098**	**0.336**

Table-2: Effect of intercrops in Aonla plantation on yield characters:

Notation	Treatments combination	Intercrop Yield (q/ha)	Aonla yield (q ha-1)
T0	Sole crop	0.00	129.01
T1	Aonla+Spinach	198.53	171.43
T2	Aonla+Radish	164.41	189.38
T3	Aonla+Tomato	28.57	138.65
T4	Aonla+Coriander	148.67	146.20
T5	Aonla+Okra	94.66	156.45
T6	Aonla+Fenugreek	165.69	158.57
F-test		**S**	**S**
C. D. at 0.5%		**0.733**	**0.252**
S.Ed. (+)		**0.336**	**0.116**

Conclusion

From the present investigation it is concluded the treatment T_2 Radish is the best maximum growth, fruit yield and fruit quality of Aonla tree. It may be concluded that the treatment T_2 and T_5 recorded better growth and yield of Radish and Aonla tree.

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The Potential Use of Earthworm Species for Making Quality Vermicompost

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Summary

The growth, reproduction and feeding activity of different earthworm species has shown widely different, so their ability to convert organic materials into vermicompost also has been found distinct quality changes. For successful vermicomposting, selection of suitable earthworm species according to the prevailing climatic conditions, organic materials available, habitat and other traits is an important step. Additionally, the suitability of different waste for worm growth and its activity should be taken into consideration. For this, information about the habitat, characteristics, types, and beneficial traits of different earthworm species should be known for obtaining quality vermicompost.

Introduction

India generates on an average 500 Million tons of crop residue per year. Majority of this crop residue is in fact used as fodder, fuel for other domestic and industrial purposes and the remaining is burnt each year. To overcome these obstacles, vermi-composting is one of the best solutions as it recycles organic wastes and converts it into useful compost for plant growth and improving soil properties while its harmful effects on environment is reduced.

Many earthworm species like *Eisenia fetida, Eisenia andrei, Perionyx excavatus, Eudrilus eugeniae, Amynthas cortices, Amynthas gracilis, Eisenia hortensis, Eisenia veneta* and *Lampito mauritii* are used for vermicomposting. This entirely different earthworm species have different ecology, biology, behavior, activities and distribution of earthworm populations along with its ability of converting organic waste into nutritive cast. Thus, for efficient recycling of organic waste into good quality cast can be produced through vermi-composting with different earthworm species.

Some Important Earthworm Species Used in Vermicomposting

Eisenia fetida

Eudrilus eugeniae

Perionyx excavatus

Lampito mauritii

Species	Ecological category and niche	Characteristic features	Beneficial traits
Eisenia fetida, and *Eudrilus eugeniae, Perionyx ceylanensis*	Epigeic species, Superficial soil layers, leaf litter, compost	Smaller in size, body uniformly pigmented, active gizzard, short life cycle, high reproduction	Efficient bio degraders and nutrient releasers, efficient compost

		rate and regeneration, tolerant to disturbance, phytophagous	producers, and early decomposition
Lumbricus terrestris, L. *polyphenus*, *Apporrectodea longa*	Anecic species, Permanent deep burrows in soil	Large in size, dorsally pigmented, forms extensive, deep, vertical permanent burrows, low reproductive rate, sensitive to disturbance, phytogeophagous, nocturnal	Forms vertical burrows affecting air- water relationship and movement from deep layers to surface helps in efficient mixing of nutrients

Case Study

The Vermicomposting by *Eudrilus eugeniae and Eisenia fetida was found more efficient earthworm species and produced better quality of vermi-compost as compared to control reported by* Khobragade *et al.* (2017). However, vermi-compost produced by *Perionyx ceylanensis* showed highest total nitrogen, available phosphorus and total potassium content as well as amountof Bacteria, Yeast, and Actinomycetes reported by Raphael and Velmourougane (2010). *This species also showed highest enzyme activity of amylase, cellulase, invertase, phosphatase and protease (Jayakumar et al, 2009)* The *Eisenia fetida earthworm used for production of vermi-compost showed highest available nitrate nitrogen, ammonical nitrogen, phosphorus and potassium content than the other earth worm spcies repoted by Manna et al. (2003).*

Conclusion

1. Disposal and management of organic waste is a serious issue in our country. For this, vermi-composting is one of the best eco-friendly technologies and can be used for converting organic waste into vermi-compost efficiently.
2. Different earthworm species which is adoptedto different favourable feed mixtures, climatic conditions and other traits significantly affect production, properties as well as nutrient content of vermicompost produced by them.
3. *Eudrilus eugeniae* followed by *Eisenia fetida, Perionyx excavatus* and *Perionyx ceylanensis* were found better earthworm species for making good quality of vermi-compost in terms of physico-chemical and biological properties as well as plant nutrients.

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Japanese Quail Farming- An Alternative to Native Chicken Farming

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The poultry industry has emerged as the fastest growing segment of the livestock sector both globally as well as in India (Lisa and Shukla, 2015). According to the 19th livestock census (2012), the total number of poultry in India (729.2 million) increased by 12.39 per cent over the previous census (648.8 million). The total number of quails in India is 2,66,590 and in Tamil Nadu it is 23,759 respectively, the state representing nearly 9 per cent of total quail population in India.

Japanese quails are rapidly gaining popularity for its commercial exploitation and in near future may acquire an important segment in Indian poultry industry. Quail farming is advantageous over other poultry since they require less space for rearing and require less capital. Birds can be sold at an early age of five weeks and they mature at the age of six to seven weeks to lay eggs. As per the nutritional criteria, the quail eggs are highly nutritive compared to that of chicken eggs. It has low cholesterol percentage. Quail meat and eggs are good for pregnant women and infant feeding women. Thus, the scope of quail farming is increasing throughout India (Mishra and Shukla, 2014).

Quails are small type of birds belonging to Pheasant family. Quails are locally known as 'Kaadai' in Tamil and 'bater' in Hindi. They were first domesticated in Japan. Two important species are found in India. They are black breasted quail and brown coloured Japanese quail. The Japanese quails are commercially reared for meat and egg.

Advantages of Rearing Japanese Quails

1. Japanese quail rearing does not require specially designed house as they can be comfortably reared even in vacant rooms meant for human habitation.
2. The floor space required for rearing Japanese quails is less and therefore the capital requirement is also less.
3. The market age for Japanese quails is five weeks of age.
4. The Japanese quail birds start laying eggs from six weeks of age.
5. Japanese quails are more disease resistant compared to chickens and hence they do not require vaccination and deworming.
6. Management of Japanese quails is easier compared to other birds.
7. Due to their small body size, feed requirement is also less. Therefore, the cost incurred on maintenance and feed is also less.

Therefore, Japanese quail farming can be undertaken with less initial investment and less skill yielding more returns.

Japanese Quail Rearing

Japanese quails can be reared on the floor in the deep litter system or can be reared in specially designed cages. In floor rearing system, the roofing can be made of thatch or tiles while the floor has to be made of cement or concrete flooring to facilitate easy cleaning and disinfection. About 5 quail can be reared per square foot area. In a shed with 100 sq. ft. about 500 Japanese quail can be reared up to 5 weeks of age.

Japanese Quail Eggs

Japanese quails weigh around 250 grams and lays around 250 eggs per year. Japanese quail's eggs are mottled in appearance. But some strains lay white in colour. The quail egg weighs around 10 g which is one fifth of the weight of chicken egg. The incubation period for Japanese quail eggs is 18 days.

Housing of Japanese Quails

Japanese quails can be reared in cage or deep litters. In deep litter system, in one square feet of floor space, 6 birds can be reared. After 2 weeks of age, the quails are transferred to cages. In cage system, 75 sq.cm per bird is required for birds of age 0 to 4 weeks. About 150 sq.cm per bird is required at the age of 5 to 6 weeks. About, 175 sq.cm per bird is the floor space required for birds from 6 weeks onwards. The feeding and watering space is around 2 sq. cm and 1 sq.cm per bird.

Feeding of Japanese Quails

A 5-week-old Japanese quail consumes around 500 g of feed. A 6-month-old quail consumes around 30 to 35 g of feed per day. Commercial feeds are available for quails which are formulated based on their nutrient requirement and nutrient composition. Japanese quail's broiler feed can be classified as brooder and grower mash. Brooder mash is from 0 to 3 weeks, grower mash from 4 to 5 weeks. Layer feed can be classified as brooder, grower and layer mash.

Common Diseases of Japanese Quail

Japanese quails are hardy birds that are able to tolerate high weather conditions. Japanese quails are resistant to infectious diseases compared to chickens. Some of the diseases that affect Japanese quails are fowl cholera, coli bacillosis and enteritis etc., but death may more frequently occur in earlier age due to managemental problem in rearing chicks. As Japanese quails are more disease resistant compared to chicken, vaccination is not necessary.

Japanese Quail Egg and Meat

Japanese quail eggs are edible. They contain more yolk than chicken eggs. They contain higher proportion of high-quality protein and fat. Japanese quails can be sold at the market age of five weeks as live birds or dressed

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meat. The quails can be marketed when the average body weight is around 200 g. Quail eggs and meat have more nutritive value compared to chicken. Thus, rearing of Japanese quails has gained more popularity among the farmers due to its several advantages.

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Insect Pests of Pomegranate and their Management

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Pomegranate Fruit Borer *(Deudorix isocrates)*

Pomegranate fruit borer is distributed all over India and Asia. It is the most widespread, polyphagous and destructive pest of pomegranate. The adult female lays egg on buds, flower and young fruits. On hatching, the caterpillar bores into the fruit and feeds on the pulp. The fruits then rot and drop off on the soil. The adult males are glossy bluish and brownish violet and in case of females a conspicuous orange patch on the forewings is seen. The damage of fruit borer is seen throughout the year irrespective of the bahar.

The female butterfly lays eggs on flowers, buds and the calyx of developing fruits, after hatching, caterpillars enter the fruit and feed on the pulp. The striking symptom is the odious smell and excreta of caterpillars coming out of the entry holes ultimately leading to fruit rot.

			
Larva	**Pupa**	**Bored hole on fruit with excreta**	**Fruit borer Adult**

Eggs are laid singly on tender leaves, stalks and flower buds. Full-grown larvae are dark brown with short hair and white patches all over the body and measures about 16 to 20mm long. Pupation occurs either inside the damaged fruits or on the stalk holding it. Adults are glossy bluish in the case of male and brownish violet in the case of female with a conspicuous orange patch on the forewings.

Adults lay eggs on the stalks or flower buds with incubation period lasting 7-10 days. The larva hatches and bores into the fruit with the larval period lasting for 18-47days. Pupation lasts for 7-34 days and the life cycle is completed in 1-2 months.

Management

1. Remove and destroy the affected fruits.
2. Clip off calyx cup immediately after pollination followed by two applications of neem oil @ 3 %.
3. Before maturity, bag the fruits with butter paper.
4. At flowering stage, spray NSKE 5% or neem-based formulations @ 20 ml/10lit.
5. Spray deltamethrin 2.8EC (15ml/10lit. water) at fortnightly interval from the stage of flowering to fruit development.
6. Spray Azadirachtin 1500ppm @ 30ml/10lit. at 15 days intervals commencing from initiation of flowering upto the harvesting subjected to the presence of fruit borer.

Thrips (*Scirtothrips dorsalis* and *Rhipiphorothrips cruentatus*)

Thrips, *S. dorsalis*, always prefer feeding on new growth of plants. This species is pale yellowish in colour and seen with two black stripes on the body. *S. dorsalis*, remain associated during all the three bahars of the pomegranate. Nymphs and adults lacerate and suck the contents of buds, flowers, leaves and fruits.

Leaf tips turn brown and get curled due to the feeding of thrips on the underside of the leaves by rasping the surface and sucking the oozing cell-sap leading to drying and shedding of flowers. Scrapping on fruits leads to scab formation, reducing market value.

			
Adult thrips	**Dried tips**	**Scrapping on fruit**	**Leaf curling**

Eggs are dirty white bean-shaped. Newly hatched nymphs are reddish and turn yellowish brown as they grow. Adults of *Rhiphiphorothrips cruentatus* are minute, slender, soft bodied insects with heavily fringed wings, blackish brown with yellowish wings and measure 1.4 mm long, whereas, Scirtothrips dorsalis is straw yellow in colour.

Female lays on an average 50 eggs on the under surface of leaves. The incubation period is 3-8 days. Pupal period lasts for 2-5 days.

Management

1. Do not inter cultivate crops like chilli and onion.
2. Remove and destroy affected plant parts.
3. Use of blue sticky traps @ 1trap /10 plants.
4. Spray with acetamiprid 20SP @ 0.005% to 0.01% i.e., 25 to 50g/100lit. or spinosad 45SC @ 0.25 ml/lit. i.e., 25ml/100lit. or NSKE 5% or *Lecaniicillium lecanii* (2x108 cfu/gm) @ 200g/100lit. starting from prior to flowering at the interval of 10 days.
5. Spray chlorpyriphos 20EC @ 0.02% or imidacloprid 17.8SL @ 0.04% or deltamethrin @ 0.15% or dichlorovos 76EC @ 0.05% as prophylactic or on observing the symptoms.
6. Spray dimethoate 30EC @ 0.06% prior to flowering.
7. In severe conditions, spray methyl o- demeton 25EC @ 0.05% and repeat after fruit set.

Stem Borer (*Coelosterna spinator* and *Zeuzera* sp.)

It is a polyphagous pest of minor importance boring the stems and trunk of pomegranate trees. It prefers breeding in dead wood but also attacks the living branches. The grubs of stem borer bore into the cambium then girdle the stem or branch causing death of the tree.

Holes made by grubs are seen on bark of main stems. Grubs feed internally on sapwood while adult beetles are active by the day and feed by gnawing the green bark of shoots. Usually, excreta and dry powdered material is seen near the base of plants.

Beetles *C. spinator*, have pale yellowish-brown body with light grey elytra and are 30 to 35 mm long.

		
Larva of Zeuzera sp.	**Bored hole**	**Excreta on soil**

Egg period is 12 to 15 days, grub 9 to 10 months and pupal period is 16 to18 days. There is only one generation per year and longevity of beetles is 45 to 60 days.

Management

1. Treat the holes by injecting with fenvalerate 20EC @ 5ml/L. or dichlorvos 76EC @ 10ml /L. and seal holes with clay.
2. Spray quinalphos 25EC @ 0.05% or chlorpyriphos 20EC @ 0.05%.

Bark Eating Caterpillar (*Indarbela* sp.)

Peak activity period of bark eating caterpillar is September to October. *Indarbela* sp. is a polyphagous insect that feeds on a range of trees. The caterpillar bores the stem and feeds the bark of the tree at night. Several holes can be seen on the trunk at the joints of the branches. Neglected and ill-managed orchards witness the heavy infestation of this pest. The tunnelling causes weak points on the trees where breakage occurs affecting the vitality of the trees badly.

Holes or zigzag tunnels are bored by the caterpillar on the tree trunk and it feeds inside the bark. Around the affected portion wood dust and excreta pellets can be found hanging in the form of a web. Beneath fresh webbing, brownish larvae can be seen. Severe infestation may damage the whole stem/plant and lessen production.

	
Excreta with web around bored hole	**Larva**

Eggs are oval, reddish in colour and caterpillars are pinkish white with brown spots and are about 40 mm long. Pupae are chestnut-brown in colour and 22 to 28 mm long. Moths are white with pairs of small black dots on thorax, numerous small black spots and streaks on fore wings and few black spots on posterior edges of hind wings.

Eggs are laid in clusters of 15-25 under loose bark or in cracks and crevices from April to June. They hatch in 8-11 days with the larval duration of 9-10 months. Pupal period extends to 3 to 4 weeks. Total life cycle lasts 4-5 months in south India and more than a year in north India. It completes one generation per year.

Management

1. Maintain clean orchards by avoiding overcrowding of trees.
2. Clean the webs around the affected portion and inject kerosene oil into the holes and seal with mud.
3. Inject larval holes with quinalphos 25EC @ 0.01% or fenvalerate 20EC @ 0.05%.
4. Spray with dichlorovos 76EC @ 0.08% on the stem or on affected part.

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Pests of Medicinal and Aromatic Plants and its Management

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Belladonna

Cut worm, *Agrotis flammetra* (Noctuidae: Lepidoptera): Larva infests tender seedlings during early summer months. Apply Lindane 25g/sq.m of nursery beds before sowing on soil. Plough field after harvesting crop to expose hibernating pupae on the surface.

Leaf feeder, *Archipsinca ceana:* Larvae completely defoliate plants. Spray endosulfan 2ml/lit.

Senna

Green leaf eating caterpillar, *Catopsilia pyranthe* (Pierdae: Lepidoptera): Greenish caterpillars feed on young leaves. Adult is a snow-white butterfly.

Pod borer, *Etiella zinckenella* (Phycitidae: Lepidoptera): Caterpillars make minute holes on the pods and attack seeds.

Long Pepper

Mealy bug, *Dysmicoccus* sp. (Pseudococcidae: Hemiptera): Mealy bug infests healthy roots and underground vines. The affected plant shows yellowing and stunted growth. Severity is more during summer months. Soil drenching of the root zone with dimethoate 30 EC at 3 ml /l is useful.

Tea mosquito bug, *Helopeltis theivora (Miridae: Hemiptera)*: Nymphs and adults severely infest plants by feeding on tender foliage. Necrotic lesions develop around feeding puncture leaving shot holes on lamina. Adults are black and red, elongated insects with long legs and a dorsal process on the scutellum. Apply NSKE 5% or malathion 2ml/lit.

Medicinal Yams

Aphids, *Aphids gossypii, Pentalonia nigronervosa* (Aphididae: Hemiptera): In *D. floribunda*, aphids caused damage to young seedlings as well as leaves and stems of young vines. As a result, new growth formation is adversely affected.

Red spider mite, *Tetranychus* sp Tetranychidae: Acarina: Red spider mites are found to infest laminary base adjoining petiole resulting in development of necrotic areas, which become sites for fungal infection in D. floribunda and D. composita.

Aswagandha

Cut worm, *Agrotis* sp (Noctuidae: Lepidoptera): Larva attacks tender seedlings. It was first reported in Anamalai Hills of Tamil Nadu. Apply Lindane 1.3 D at 25 kg/ha and fork the soil.

Epilachna beetle *Epilachna vigintioctopunctata* (Coccinellidae: Coleoptera): Both grubs and adults feed by scrapping chlorophyll from epidermal layers of leaves which get skeletonized and gradually dry away. Grub is yellowish in colour, stout with spines all over the body. Adult is spherical pale brown and mottled with black spots. Do mechanical collection and destruction of eggs, grubs and adults. Spray NSKE 5% or carbaryl 50 WP or malathion or endosulfan 2 ml/l.

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Grasshopper, *Trilophida annulata* (Acrididae: Orthoptera): Nymphs and adults feed on leaves from the margins. Adult is brown with black spots and terminal with darker band.

Ash weevil, *Myllocerus viridanus* (Curculionidae: Coleoptera): Adult causes irregular notching of leaf margins. Adult is small light green in colour.

Weevil, *Blosyrus maegualis* (Curculionidae: Coleoptera): Adult weevil makes perforations on leaves.

Cow bug, *Gargara mixta* (*Membracidae*: Hemiptera): Cow bugs suck the sap from tender shoots. Adult is brownish with white smoky patches.

Mealy bug, *Coccidohystrix insolita* (Pseudococcidae: Hemiptera): Mealy bugs suck the sap from leaves. Mealy bugs are small, oval, soft-bodied and covered with white mealy wax.

Leaf hopper, *Penthina* sp. (Cicadellidae: Hemiptera): Nymphs and adults suck the sap and cause hopper burn, bronzing and drying of leaves.

Sarpagandha

Leaf feeder, *Glyphodes vertumnalis* (Pyraustidae Lepidoptera): Greenish caterpillar defoliates the plant.

Sphingid caterpillar, *Deilephila nerii* (Sphingidae: Lepidoptera): Larva is green and stout with a horn at the anal region. Adult is a robust green moth with yellow marking.

Cock chafer grub, *Anomala polita* (Rutelidae: Coleoptera): Grubs cause root damage and adults feed on foliage.

Opium Poppy

Root weevil, *Sternocarus fuliginosus* (Curculionidae: Coleoptera): Grubs feed on roots. Apply lindane 1.3D 25kg/ha on soil at planting.

Cutworm, *Agrotis suffusa* (Noctuidae: Lepidoptera): Larva cuts younger plant at the base above ground level. Larva remains concealed in cracks in the ground and become active at night. Larva is dark with red coloured head.

Aphid, *Myzus persicae* (Aphididae: Hemiptera): Both nymphs and adult suck the sap on leaves. Body colour of apterous form is yellowish green and rarely reddish.

Capsule borer, *Helicoverpa armigera* (Noctuidae: Lepidoptera): It feeds on flower head and seeds. Adult is a medium sized moth with 'V' shaped speck and dull black border on hind wing. Full- grown larva is greenish with dark brown grey lines along sides of body. Spherical, yellowish white eggs are laid singly on buds and flowers. Larval period lasts for 15 – 20 days. It pupates in the soil and pupal period is 10 – 15 days. Hand pick and destroy larvae. Use pheromone traps to attract and kill adult moths. Spray endosulfan 2ml/l.

Geranium

Termite, *Odontotermes* sp (Termitidae: Isoptera): Crop is prone to termite attack occasionally, which can be easily controlled by mixing lindane 1.3 D 25kg/ha in to soil.

Vetiver

White grub: *Holotrichia serrata* (Melolonthidae: Coleoptera): Damage is more in areas where pearl millet is also grown. Adult beetle is dark in colour. Grubs cut root and cause sudden wilting of healthy plants during hot months. Install light trap between 6 and 9 pm to attract adult beetles. Plough deep at the time of land preparation to expose grubs and kill them. Collect and destroy adult beetles attracted to trees like neem, Ailanthus and Acacia near the vetiver fields on the receipt of monsoon.

Termite, *Odontotermes* sp (Termitidae: Isoptera): In dry tract, termite attack roots which result in wilting. White ants are creamy in colour and with dark coloured head. They resemble like ants.

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Canna indica - Environmental and Health Perspectives

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Introduction

Canna indicia (Indian Shot) is a tropical aquatic or a wetland plant belongs to the family Cannaceae. This plant is commonly called as Indian Shot, Sierra Leone arrowroot, Purple arrowroot and African arrowroot. It is widespread throughout the world in the countries viz., Mexico, West Indies, Central and South America, South east Asia, and Sub-saharan region. This is used as minor food crop by indigenous people of America thousand years ago. Being a moist tropical plant, it can be seen in a region at height of up to 2,000 metres. It can also be cultivated in the subtropical and warm temperate zones. It grows best in areas where annual daytime temperatures are within the range 12 - 32°C.The plant is named as Indian Shot because the seeds of the plant are very small, black in color, spherical in shape, hard and dense and resembles the shotgun pellets and hence called as Indian shot. This plant has numerous health and environmental benefits within it which will be discussed briefly in this paper.

Morphology

Based on the varietal difference, the total height of this perennial plant ranges from 0.5 to 2.5m. The large, simple leaves of this plant is arranged in two lines i.e., alternate spiral arrangement. Leaf portion of this plant is divided into three parts: Leaf sheath, petioles and leaf blades. The unbranched, upright stems of the plant form a pseudo trunk through the overlapping of leaf sheaths. The length and width of the leaf blade ranges from 30 to 60 cm and 10 to 20 cm respectively. The branched rhizomes of the plant are 60 cm long. The propagation is by using rhizomes. Rhizome surface of canna plant is covered with scales, and from its lower portion the rootlets emerges and finally grows into numerous stems. Flowers of the plant is hermaphrodite in nature i.e., it has both stamens and carpels within itself. Many of the ornamental and gardening plants falls under this category. Floral parts are unequal in size (zygomorphic). Colour varies from yellow, orange and reddish pink. The flowers normally bloom from August to October and the pollination is done by insects. Chestnut coloured fruits are 1.5 to 3 cm long with black hardy seeds. Though the seeds are hard, it will survive and germinate.

Composition of Rhizome of *Canna indica*

The rhizome composition of the Canna indica plant is given below:

S.No	Content	Percent (%)
1	Water	73
2	Starch	24
3	Protein	1
4	Crude Fiber	0.6
5.	Minerals	1.4

Food Perspective

Rhizome portion of the plant is cooked and consumed as food. This plant is called as Achira in Spanish. The starch content in the rhizome portion is easily digestible and hence utilized as a health and enriched baby food. The tubers of this plant can be consumed as raw or in cooked form. Once it's cooked, the rhizomes are sweet and translucent. Similar to banana leaves, the leaves of this plant are used for wrapping food items as packaging material, in South America. Seeds are used for ornamental and jewellery making purposes. People of the

Chuquimayo valley, Peru cultivated Canna as a most important food crop during 16th Century. The people used to wrap the rhizomes of this plant with its leaves and place it in a pit, which is filled with dirt and heated rocks; the rhizomes will be baked slowly in the underground.

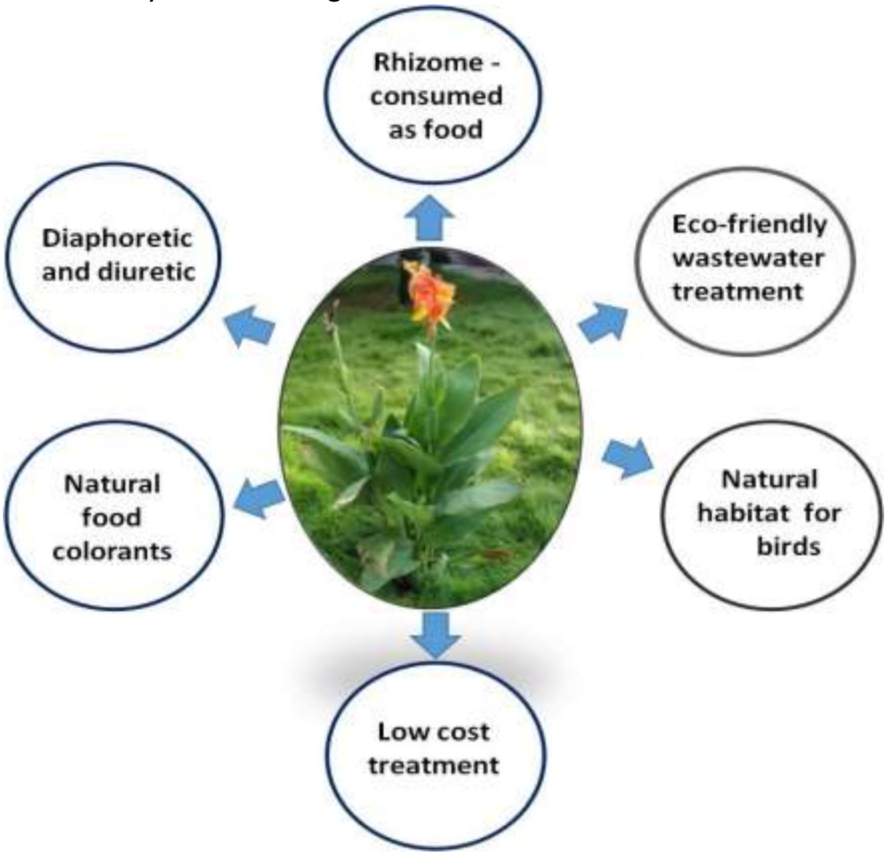

Fig 1: Environmental and Health prospective of *Canna indica*

Health Perspective

The plant parts are used for various medicinal purposes and for healing various diseases. Indian shot is used for the treating various women's complaints. Sometimes the roots are eaten raw; the young tender tubers of this plant are very sweet and fibrous. Since the starch content is nearly 25% in roots, they are used for manufacturing of flour. The medical benefits of the plant include roots as diaphoretic and diuretic, treatment of fevers, root decoction for treatment of amenorrhoea and gonorrhoea, powered seeds and leaves are mixed together for treating dermatosis. Seeds are used as remedy for headaches. Other benefits are the plants is used for curing fever, sedative, laxative urine, reducing the blood pressure, rectifying problems in menstrual cycle and vaginal discharge, as a hepatitis drug and used as natural colorants for food colouring.

Environmental Perspective

In general, aquatic plants are important in reducing the pollution level of aquatic ecosystems. These plants have the ability to eradicate the toxic heavy metals and organics, suspended solids, excess nutrients and other pollutants from any type of wastewater (Choudhary *et al*.,2011) The oxygen released by the hairs of the plant's root will help for growth of aerobic bacteria which will decompose the organic matter in wastewater and provide nutrients to the plants. Due to presence of oxygen, nitrification process is by *Nitrosomonas Sp* and *Nitrobacter Sp*, so that the ammonia present in the water will be converted to nitrates. These nitrates will be converted to atmospheric nitrogen in the presence of any denitrifying bacteria *viz*., *Thiobacillus denitrificans, Pseudomonas Sp.*

The oxygen transport from shoot to root occurs in both aquatic and non-aquatic plants. But the aquatic plants have the aerenchyma cells, which facilities the ease transport of oxygen from roots and rhizomes of the aquatic plants. These parenchyma cells also help to reduce the root zone hypoxia by transporting oxygen to rhizosphere.

Suganya and Paul Sebastian (2017) based on their research investigation reported that *Canna indica* was effective in reducing the Biological oxygen demand (BOD), Chemical oxygen demand (COD), Total suspended solids (TSS), total dissolved solids (TDS) and heavy metals in the sewage effluent under constructed wetland technology. They also found that root oxidation activity (ROA) of the plants was higher in maturity stage. The ROA of *Canna indica* was higher compared to other aquatic plants like *Typha angustifolia* and *Eicchornia crassipes* which may be due to the higher root growth and increase in the aerenchyma cells which could contribute to the increase ROA activity. This plant also helps to improve the aesthetic appearance of any place when it is used for landscaping. This plant has the ability to trap natural birds, when it is planted on large scale thereby providing them a suitable niche for their survival.

Conclusion

Canna indica a tropical aquatic plant has numerous health and environmental benefits. Widespread cultivation of these plants in highly contaminated and polluted areas will help to reduce the pollutants load as well as health benefits of the plants could be making use of by the human community for their sustainable future.

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Supercharged Food for Fat Loss – Indian Diet

Article ID: 32679

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No single food will automatically target your turkey neck (fat loss only happens when you burn more calories than you ingest, leading your body to preferentially break down lipid stores for energy). But alongside a proper fitness regimen, what fat burning foods you eat will help you torch body fat.

Whether it's turning off fat genes, helping to build muscle that robs energy from adipose cells, revving your metabolism and ability to burn fat, or helping you feel fuller longer so you consume fewer calories, these foods have been proven to show an increased rate of fat loss. So, stop these bad habits that give you belly fat, and instead, incorporate these healthy fat burning foods into your diet to whittle your waist and bring your midriff back in line.

1. Peanut Butter: Peanut butter packs 8 grams of protein and up to 4 grams of fiber per serving, making it an ideal snack to help you fill up and stay satisfied (particularly in stabilizing a glycemic load). A published review of research in the Journal of Food Science and Technology highlights the fact that peanut butter can help people feel more satisfied compared to "carbohydrates snacks like race cakes in equal quantities." Peanuts in particular contain an amino acid that improves blood flow throughout your body by helping blood vessels "relax" — all of which can help to mitigate fluid retention.

2. Chickpeas: They're filled with fiber and plant-based protein, as well as immune-boosting antioxidants and bloat-busting minerals. Chickpeas easily go in soups, stews, salads, and side dishes. Plus, chickpea flour is a great baking alternative for a more nutrient-dense and filling end result.

3. Potatoes: Believe it or not, air-fried potatoes (yes, really!) are an excellent source of potassium, which can help manage bloating and counterbalance sodium. They're high in fiber as well, meaning potatoes can be a nutrient-dense food — just as long as they're not served the french-fry way.

4. Pumpkin Seeds: Pumpkin seeds provide tons of immune-boosting zinc, but more importantly, are a significant source of fiber (quite a filling snack!). With about 7 grams of protein per snack-sized serving, pepitas are a great addition to most diets.

5. Oats: Probiotics introduce useful bacterial to your system, but the prebiotics in oats feed the good bacteria already living there, helping it proliferate. Plus, there's a hefty punch of dietary fiber in oatmeal, a common oats item: Just a half cup has 4 grams, helping you stay full until lunchtime.

6. Beans: Beans are a staple of many vegetarian dishes because they're packed with plant-based proteins, as well as minerals and some B-vitamins. They're also a significant source of soluble fiber, which will help your body take longer to process a meal that's bean-based, helping you to consumer fewer calories throughout the day.

7. Lentils: These little protein-filled bites of plant-based goodness make for excellent soup bases or salad additions to make a meal feel so much more substantial. The fiber and resistant starch within lentils can help you consume fewer calories between meals

8. Whole Grains: Grains get a bad rap when it comes to weight loss, but that's because refined grains (read: processed foods!) are linked to wider waists. 100% whole grains are bloat-busting superstars, however, as they're packed with minerals and counter balance sodium intakes throughout the day. Stick to pantry additions like brown rice and farro for the biggest benefits.

9. Quinoa: A notable whole grain to load up on is quinoa, which is extremely high in fiber, but more importantly, it is a complete protein in a diet — meaning it contains amounts of all essential amino acids. It doesn't totally disrupt blood sugar levels due to its low glycemic index, either. All in all: Quinoa is a must-add to any kitchen to promote sustained weight management.

10. Spinach: Plant-based omega-3s belong in any healthy eating plan, but leafy greens like spinach are especially helpful for tightening up. Spinach is loaded with minerals like potassium, which can help offset the bloat-inducing effects of sodium.

11. Cruciferous Vegetables: Fiber is synonymous with crunchy veggies that you can easily find fresh in any produce aisle: Broccoli, cauliflower, Brussels sprouts, and kohlrabi, to name drop a few. Prepared simply in a sauté or baked on a sheet pan, these veggies are low in calories; but eaten raw, and they retain all of their phytonutrients, including a slew of minerals and vitamins (from calcium to zinc!) that may be short elsewhere in your diet.

12. Bananas: Filled with potassium and magnesium, bananas offset the bloat caused salty processed foods and pack in plant-based prebiotics, "feeding" your good bacteria. Snack on one a day with a tablespoon of nut butter, or slice it into your morning cereal

13. Tomatoes: Tomatoes, mushrooms, carrots, cucumber, and other salad staples all help you stay hydrated due to their high H2O content. That extra water can offset fluid retention caused by excess salt.

14. Citrus Fruits: The potassium in citrus helps combat bloat while the antioxidants fight inflammation, which is associated with belly-fat storage. Since a key part of beating the bulge is proper hydration, adding citrus to your H2O can help non-water drinkers to sip up and ultimately slim down.

15. Onions: You already know that alliums like garlic, onion, leeks, scallions, and shallots add lots of flavour, but they also provide tons of pre- biotic fibre. Sneak them into savory dishes, like omelettes and healthy salads.

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Silicon– "Silver Bullet"

Article ID: 32680

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Summary
As the name indicates silicon as a silver bullet which means it predominantly fights against various biotic and abiotic stresses. From the very ancient days fly ash has been used for the pest management but the science behind it is a rich source of silicon and causes the death of the insect pests. Silicon which causes the mandibular wear, as an induced resistance in plants against herbivory. They also act as an antagonistic effect on the various plant pathogens with the reference to root rot diseases. Silicon based nutrients or a silica rich fertilizer adds both the need to the Integrated Nutrient Management (INM) and also a component on Integrated Pest Management (IPM).

Introduction
Silicon which is considered as non–essential nutrient for plant growth and silicon has its own importance in mitigating biotic and abiotic stress. Exploration of these benefits from silicon is still at bay. Under abiotic stresses the various properties have been reported such as creating lodging resistance in rice, UV tolerance in crop plants by the deposition of Si in the epidermal cells by which the cell degradation is been prevented. Drought tolerance by the formation of the thick cuticle, also in case of salt tolerance they play a vital role in the inhibition of uptake of Na++ and Cl-- ions. Heavy metal toxicity is also been reduced when incorporated with ample of silica-based nutrients.

With reference to biotic stress such as pests and diseases their mode of action against these agents should be valued. This chapter deals with the crucial role of silicon against major pests are been circumscribed here.

Damage by Borers
The borers are most alarming and the destructive pests of various crops of agriculture importance. They cause a huge yield loss from 10 to 90% are been reported. Insecticide application is considered as an inefficient method since these borers persists and remains inside the stem or at the boring sites. So, the silicon application along with the fertilizers or silica-based fertilizers and with the organic amendments along with silica are quite interesting in managing various borer pests such as rice stem borer, sugarcane borer complex is retreated. The main strategy and the strong point are that the borer pest usually have the strong mandibles as right and left mandibles, these silicas may cause the disruption of mandibles and also pronounced to cause the impairment in the midgut epithelium.

Sources of Silicon
1. Baggase ash.
2. Sodium silicate, Calcuim silicate, Slag silicate.
3. Silicic acid, Orthosilicic acid.
4. Biochar.

Rice Pests
Rice yellow stem borer(YSB) *Scirpophaga incertulas* it is known to cause about 20 – 90% of losses in yield. The application of silicon-based fertilizers to paddy causes the thickness of stem by accumulation of silica causing

the stem thickness and reduction of the stem diameter by more deposition of lignin and the cellulose deposition which initially fails the neonate larvae to bore inside. In the grown up or third instar larvae it causes the mandibular wear and also damages the digestive tract by disrupting peritrophic membrane

In case of Rice leaf folder, *Cnaphalocrocis medinalis*, *Marasmia patnalis* they exclusively scrap and feeds on the leaf mesophyll tissues and chlorophyll content, it's quite different in the case of stem borer. The silicon which cause the formation of double layer of silica in the leaf sheath and also recorded with high deposition of silicon is seen in the epidermal tissues of leaves.

Sugarcane Pests

Sugarcane crop has coupled with the borer pest complex such as Early Shoot Borer (ESB) *Chilo infuscatellus*, Internode borer (INB) *Chilo sacchariphagus* and Top Shoot Borer (TSB) *Scirpophaga excerptalis*. Since sugarcane crop also belongs to the poaceae family the uptake of silicon is more. It is been reported that application of calcium silicate 4 tonnes/ ha is required to reduce the borer incidence in sugarcane ecosystem.

Miscellaneous

They also play a main role in the production of Herbivore Induced Plant Volatiles (HIPV) they are involved in the production of jasmone acid and salicylic acid as a signaling compounds to the predators and parasitoids of various pests. In the management of root rot disease complex such as *Macrophomina, Phythium*, Fusarium their roles are been valued. They act on the root cortex region by depositing the silica and does not allow the pathogenesis to occur

Conclusion

Silicon is considered as a second most abundant element in the earth crust contributing about 30%. Application of silicon-based fertilizers along with conventional fertilizers is considered as one of the pest management strategy and should be included as a part of Integrated Pest Management (IPM). Silicon has bounded more numerous values in crop protection aspects. The works on silica are been restricted only with rice, sugarcane, cotton and groundnut pests still there should be tested with various range of pests. Silica which is a lavish available nutrient and use of these compounds are eco-friendly when compared to the conventional pesticides also they donot have any residual effect on soil health.

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Fighting Dengue with Wolbachia - a Bacterium

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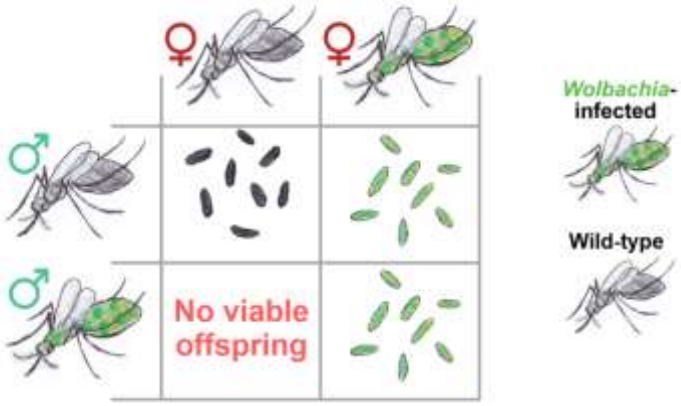
Introduction

Mosquitoes are among the deadliest creatures on earth. They are found in tropical and subtropical climates around the world. Specially, Aedes aegypti mosquito is responsible for transmitting viruses such as dengue, zika and chikungunya around the globe. About half of the world's population is at risk of contracting the disease.

Aedes aegypti mosquitoes originated in Africa, but they have spread through tropical and subtropical regions around the world. Aedes aegypti mosquitoes spread through slave trade with Asia during the 18th and 19th centuries, and then again following troop movements in World War II. A. aegypti, which is recognizable by the white stripes on its legs and the lyre pattern on its thorax, can breed in any pool of standing water, which makes it particularly hard to control.

About Wolbachia Bacteria

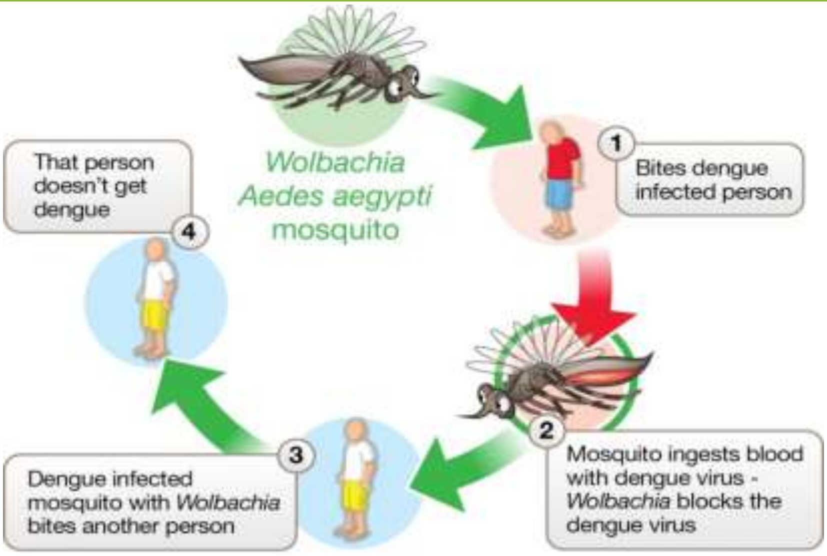
Wolbachia bacteria are safe, natural bacteria present in up to 60% of insect species including some mosquitoes. However, it is not usually found in the Aedes aegypti mosquito (responsible for transmitting viruses such as zika, dengue and chikungunya). Wolbachia was first identified in 1924 during dissections of household mosquitoes. Interest in the bacterium waned until the 1970s, when researchers noticed that under certain circumstances, it could prevent mosquito eggs from hatching, which suggested the bacterium could be used for insect control. In the 1990s, scientists learned that some strains of wolbachia could also shorten insect life span, which presented another way to limit disease transmission by insects. Wolbachia bacteria are also safe for humans, animals and the environment.



How Dengue Spreads?

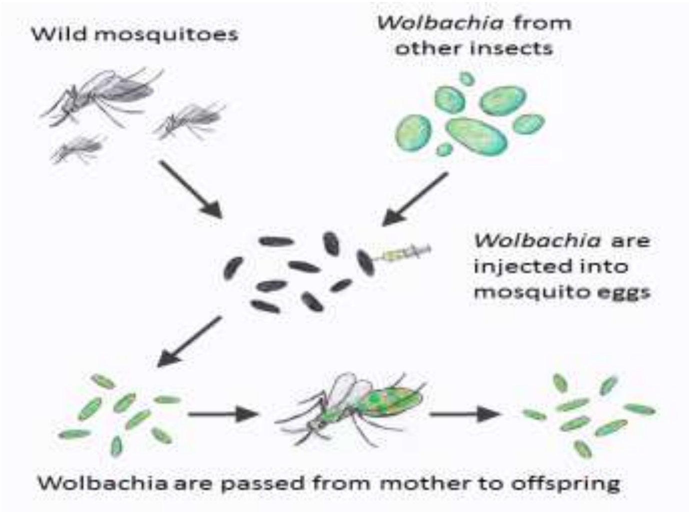
Mosquitoes do not naturally carry viruses; they can only get them from infected people. The mechanism of dengue infection is simple. Female mosquitoes bite humans because they need the protein found in our blood to produce eggs (Male mosquitoes do not bite). If the mosquito bites dengue infected person and then, after the viruses roughly 8 to 12 days replication period, bites someone else it passes dengue into its next victim's bloodstream.

There is no vaccine against dengue, but infecting mosquitoes with a natural bacterium called wolbachia blocks the insect's ability to pass the disease to humans. The microbe spreads among both male and female mosquitoes. Infected females lay eggs that harbor the bacterium, and when wolbachia free female mate with infected males, their eggs simply do not hatch.



How Wolbachia Method Works?

The method involves introducing wolbachia into populations of Aedes aegypti. When the wolbachia-infected mosquitoes bred with their wild counterparts, the percentage of mosquitoes carrying the bacterium grows. This means that when Aedes aegypti mosquitoes carry natural wolbachia bacteria, the transmission of viruses like dengue, zika, chikungunya and yellow fever is reduced because this bacterium makes it harder for viruses to reproduce inside the mosquitoes. And the mosquitoes are much less likely to spread viruses from person to person.



Conclusion

Wolbachia bacteria are safe for humans, animals and the environment and present in up to 60% of insect species including some mosquitoes. It could prevent mosquito eggs from hatching, which suggested the bacterium could be used for insect control. Some strains of wolbachia could also shorten insect life span, which also limits the disease transmission by insects. Scientists are fighting dengue fever with the help of wolbachia bacterium that stops the virus from replicating inside the mosquitoes that transmit the disease. So that the transmission of viruses like dengue, zika, chikungunya and yellow fever will reduce in globe.

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Optimisation of the Nutrient Density of a Population's Diet an Example Based on Diets of the Industrial Workers

Article ID: 32682

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Introduction

The complexity of the physical, chemical, and biological changes that occur during food and bio-product processing render experimental investigation is infeasible due to lack of time, resources, labor, and skills. Modeling techniques can overcome these limitations, but choosing the correct one for a given application can also be quite a chore. The advent of powerful computers has tremendously increased the speed, power and flexibility of numerical computing especially in the field of operations research. It includes statistical, physical, probabilistic, Monte Carlo, artificial neural network, fuzzy logic, fractal, genetic algorithm, and data mining techniques.

Mathematical Modelling

Mathematical modeling is a discipline, which consists of translating real world problems into mathematical problems and interpreting the derived solutions in the language of the real world. Review of literature on recent studies focusing on Food consumption surveys are often used to detect inadequate nutrient intakes but not to determine whether inadequate nutrient intakes are due to suboptimal use of locally available foods or to insufficient availability of nutrient-dense foods.

Hossein Eghbali (2012) describes low price and good taste of foods are regarded as two major factors for optimal human nutrition. By prescribing a diet merely based on crisp data, some of the realities are neglected. For the same reason, he dealt with human diet problem through fuzzy approach. Results indicated uncertainty about factors of nutrition diet -including taste and price, amount of nutrients and their intake-would affect diet quality, making the proposed diet more realistic.

Kramer et. al (2017) objective is to find diets optimized on nutrition and environmental impact close to the current Dutch diet and to identify the most effective and acceptable options for mitigating environmental impact. Linear programming was used to optimise diets of Dutch men and women aged 9–69 years, divided into ten age–gender groups. Van Dooren C (2018) in his study reviewed the Use of Linear Programming to Optimize Diets, Nutritiously, Economically and Environmentally.

Thus, the objective is to describe the use of linear programming tools as a method to design nutrient-adequate diets of optimal nutrient density and to identify the most stringent constraints in nutritional recommendations and food consumption patterns in a population of industrial workers' diet. In the present study, optimization models are used to design a nutrient-dense diet, i.e., a diet meeting specific nutrient intake recommendation at the lowest energy content achievable.

The diet identified is represented by a set of food weights, subsequently called food variables, each representing a decision variable for the models. To obtain the optimal nutrient density in the diet, the total energy content of the diet is chosen as the objective function and this function is minimized. The value obtained after optimization is the minimal amount of energy required satisfying all the constraints with use of foods habitually consumed by the population of industrial workers. The foods selected in the optimized solution by linear programming should be considered as an average daily food basket to be eaten over several days and not necessarily every day.

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Mathematical Approaches to Optimal Nutrient Density in the Diet

A diet model is to minimize the cost of a diet subject to constraints on nutritive requirements, variety, palatability, and menu-function is constructed and the rates of increase in a strict minimum cost model and an expanded constraint model are measured Let x_i be the units of diet i = 1,2,3…n and these diets are locally available and the diet meeting specific nutrient intake recommendations at the lowest energy content achievable, ci are the cost per unit of the ith diet., ie. available locally. a_{ij} - is the level of the ith nutrient in the jth diet and b_i be minimum required level of the ith nutrient per day ignoring the interaction of the nutrients the associated linear programming problem is

Minimize $Z = c_1x_1 + c_2x_2 + c_3x_3 + ... c_nx_n$

subject to the constraints

$a_{11}x_1 + a_{12}x_2 + ... + a_{1n}\, x_n \geq b_1$

$a_{21}x_1 + a_{22}x_2 + ... + a_{2n}\, x_n \geq b_2$

$a_{31}x_1 + a_{32}x_2 + ... + a_{3n}\, x_n \geq b_3$

$a_{m1}x_1 + a_{m2}x_2 + ... + a_{m\,n}\, x_n \geq b_m$

and the non-negativity restrictions

$x_1, x_2, x_3, ... x_n \geq 0.$

The following problem was formulated using the secondary data collected on consumption surveys of Cotton and related industrial workers to illustrate the above. “A dietician is planning menus for Cotton and related industrial workers. Workers in a specified area during non-harvest season. The dietician wishes to provide a diet, which has a minimum of 120 units of fat, 60 units of carbohydrates, 90 units of protein and a maximum of 70 units of cholesterol per children per month. These goals can be met using two types of food. Type I contains 3 units if fat, 2 units of carbohydrates, 6 units of protein and 2 units cholesterol per kg, while each kg of type II contains 12 units of fat, 4 units of carbohydrates, 3 units of protein and 3 units cholesterol. The cost of type I food is Rs. 3 per kg and type II food is Rs. 3.75 per kg. How many per month of each type of food should be used to minimize the cost”. The related linear programming model is

Minimize $Z = 3.00X_1 + 3.75X_2$

Subject to $3X_1 + 12X_2 \geq 120$; $2X_1 + 4X_2 \geq 60$;

$6X_1 + 3X_2 \geq 90$; $2X_1 + 3X_2 \leq 70$; $X_1 \geq 0, X_2 \geq 0$

Microsoft Excel 12.0 Answer Report
Worksheet: [Book1]Sheet2
Report Created: 10/21/2020 3:00:36 PM

Target Cell (Min)

Cell	Name	Original Value	Final Value
$G$9		0	67.5

Adjustable Cells

Cell	Name	Original Value	Final Value
$E$8	x1	0	10
$F$8	x2	0	10

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
$G$11		150	$G$11>=$H$11	Not Binding	30
$G$12		60	$G$12>=$H$12	Binding	0
$G$13		90	$G$13>=$H$13	Binding	0
$G$14		50	$G$14<=$H$14	Not Binding	20
$E$8	x1	10	$E$8>=0	Not Binding	10
$F$8	x2	10	$F$8>=0	Not Binding	10

Using Microsoft Excel solver package, we solved the problem. The following result gives that the Cotton and related industrial workers have to consume 10 Kgs of food type I and 10 Kgs of food Type II, diet meeting specific nutrient intake recommendations at the lowest energy content achievable.

Conclusion

This analysis suggests that nutrition education may help improve the diets of Cotton and related industrial workers in the harvest season, whereas changes in the range of available foods might be needed in the non-harvest season. Linear and nonlinear programming can be used to formulate recommendations with the use of data from local food consumption surveys.

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Papaya and Mulberry Mixed Fruit Jam Preparation

Article ID: 32683

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Jam is a product prepared by boiling fruit pulp with sufficient sugar to a reasonably thick consistency, firm enough to hold the fruit tissues in position. Apple, sapota (chiku), loquat, papaya, karonda, plum, strawberry, raspberry, mulberry, mango, grapes etc are used for preparation of jams.

SELECT RIPE FIRM FRUITS OF PAPAYA-650gm
SELECT RED RIPEND FIRM RED FRUITS OF MULBERRY-350gm

↓

WASHING

↓

PEELING OF PAPAYA

↓

CUT PAPAYA FRUIT INTO PIECES AND GRINDING
RED MULBERRY FRUIT GRINDING NAD STRAINING

↓

ADDITION OF SUGAR-750 gm
(add water if necessary)

↓

BOILING
(with continuous stirring)

↓

ADDITION OF CITRIC ACID-2.5 gm

↓

ADDITION OF PECTIN-4 gm
(with continuous stirring)

↓

JUDGING OF END-POINT
BY FURTHER COOKING
UPTO 105^0c OR 68-70% TSS OR
BY SHEET TEST OR FLAKE TEST OR DROP TEST

↓

FILLING HOT INTO STERILIZED
BOTTLES

↓

COOLING

↓

WAXING

↓

CAPPING

↓

STORAGE
(at ambient temperature).

Judging of End-Point

Boiling of jam should not be prolonged, because excessive boiling results in a greater inversion of sugar and destruction of pectin. The end-point of boiling of jam can be judged in the following way:

1. Sheet or flake test: A small portion of jam is taken out during boiling, in a spoon or wooden ladle and cooled slightly. It is then allowed to drop. If the product falls off in the form of a sheet or flakes instead of flowing in a continuous stream or syrup, it means that the end-point has been reached and the product is ready, otherwise, boiling us continued till the sheet test is positive.

2. Drop test: A drop of the concentrated mass is poured into a glass containing water. Settling down of the drop without disintegration denoted the end-point.

3. Temperature test: A solution containing 65 per cent total soluble solids boils at 1050C. Heating of the jam to this temperature would automatically bring the concentration of solids to 65 per cent. This is the easiest way to ascertain the end-point.

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"Sustainable Agriculture" - The Key Strategy for Second Green Revolution

Article ID: 32684

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Introduction

Current state of agriculture in India is result of green revolution which was in place since late 1960's. This progress and security had its own cost in terms of environment and economic viability. It is realized that original means adopted by green revolution are to some extent exhausted if adopt such technologies continuously. The yield of crops on Indian lands is still far below world average and current state of agriculture is not sustainable at all. Consequently, for achieving self-sufficiency in food production along with stable ecosystem, India introducing new agricultural policies which aim at sustainable agriculture, which is popularly called as 'second green revolution' or 'evergreen revolution'.

Why India Needs Second Green Revolution?

India needs second green revolution to bring food security to its massive populations, to remove affliction of farming community and to make its agriculture globally competitive. High productivity and better soil condition are its key parameters. The above objectives require new technologies and better farming practices. In this venture, marginal and small farmers and raising agricultural productivity in dry areas need special consideration without compromising on preserving soil, water and other natural resources.

Components of Sustainable Agriculture

Sustainability refers as the perpetual ability and is a systems issue. A sustainable agriculture system is one that persists through emerging stresses and shocks owing to the interactive nature of its different components. Realizing the negative impact of continuous reliance on technologies those are having negative impact on climate, sustainable agriculture with due care for the factors that are impacted by agriculture, such as

1. Productivity: The twin challenges of decreasing per capita arable land and limits to intensification through the current practice of increasing external inputs have necessitated a search for new, alternative paradigms for increasing both production and productivity with acceptable level of adverse ecological and socio-economic impacts.

2. Economic viability: though economic viability is directly linked to the productivity; it varies with the dynamics and specific needs of a human population and with the agricultural and non-agricultural policies. Along with ecological stability economic profitability for the farmer is essential in sustainable agriculture.

3. Ecological viability: Conserving the production resources and maintaining environmental safety and quality are the basic criteria for the ecological sustainability of agricultural production.

4. Social acceptability: Social justice and equity of any agricultural system will impact on the farming practices and level of adoption of technologies acceptable to the social norms in the farming community and it also linked to the macro-economic policies of the government.

How it Changes the Concept of Farming?

There is need for continuously evolving adaptive technologies and institutional support for conservation and sustainable use of natural resources. All the components of sustainable agriculture together form the foundation of agricultural sustainability by:

1. Strengthening the immune system of agricultural operations: stabilizing the pests and nurturing natural pest control.
2. By decreasing chemical toxicity in the system and environment through optimum use of external synthetic chemicals and maximum use of farm products.
3. By enhancing the metabolic functions of plants as well as microorganisms in nutrient cycling and organic matter recycling processes.
4. Balancing regulatory systems like nutrient cycles, water balance, energy flows, population regulation.
5. Helps in conservation and regeneration of natural resources and biodiversity.
6. Increasing and sustaining long term productivity.

Conclusion

The rapid depletion of ecological system is predicting an alarming scenario for the survival of future generations. The realization of the shrinking carrying capacity of the environment to support humanity constantly is essential to avoid overexploitation with the resultant protection of the natural resources. So, sustainable agricultural techniques enable the higher resource use efficiency while using lesser land, water, energy and other inputs, ensuring economic profitability to the farmer and also ecological stability. Consequently, sustainable agricultural practices are critical, both for our present as well as for posterity. So, India needs second green revolution to bring food security to its huge population to remove torment of farming community, to make its agriculture globally competitive accompanying with greater ecological stability.

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Biological Nitrogen Fixation

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Introduction

All plants, including forage crops, need relatively large amounts of nitrogen (N) for proper growth and development. Nitrogen is the important component of chlorophyll, it plays key role of formation of amino acids, building blocks of proteins and nucleic acids. The major source of nitrogen element is atmosphere nitrogen (N_2 gas) which is fixation by different types of micro-organism such as (*Rhizobium*, *Azotobacter*, *Bacillus*, *Clostridium*, and *Klebsiella*). These N_2 gas come in atmosphere by different sources such as:

1. The addition of ammonia and/or nitrate fertilizer and manure to the soil.
2. The release of nitrogen during organic matter decomposition.
3. The conversion of atmospheric nitrogen into the compounds by natural processes, such as lightning.
4. Biological nitrogen fixation (Vance 2001). The biological nitrogen fixation (BNF), discovered by Beijerinck in 1901 (Beijerinck 1901), is carried out by a specialized group of prokaryotes.

Process of Nitrogen Fixation

The nitrogen molecule present in atmosphere, two nitrogen atoms joined by a triple covalent bond, thus making the molecule highly inert and nonreactive. The reduction of atmospheric nitrogen to ammonia is a complex process that requires large amount of energy which is provided various micro-organism. Nitrogenase catalyzes the breaking of this bond and the addition of three hydrogen atoms to each nitrogen atom. Microorganisms that fix nitrogen require 16 moles of adenosine triphosphate (ATP) to reduce each mole of nitrogen (Hubbell & Kidder, 2009). These organisms obtain this energy by oxidizing organic molecules. Non-photosynthetic free-living microorganisms must obtain these molecules from other organisms, while photosynthetic microorganisms, such as cyanobacteria, use sugars produced by photosynthesis. Associative and symbiotic nitrogen-fixing microorganisms obtain these compounds from their host plants' rhizospheres (National Research Council 1994, Hubbell & Kidder 2009).

$$N_2 + 8H^+ + 8e^- + 16\ ATP \rightarrow 2NH_3 + H_2 + 16\ ADP + 16\ Pi$$

Biological nitrogen fixation (BNF), the conversion of atmospheric nitrogen (N_2) into ammonia (NH_3), is exclusively carried out by prokaryotes, such as soil bacteria or cyanobacteria. Biological processes contribute 65 percent of the nitrogen used in agriculture. Two kinds of nitrogen fixation bacteria are recognized, symbiotic nitrogen and non-symbiotic.

Symbiotic Nitrogen Fixation

The most important source of BNF is the symbiotic interaction between soil bacteria, legume and non-legume plants. The NH3 resulting from fixation can be transported into plant tissue and incorporated in to amino acids, which are then made into plant proteins.

Soil bacteria, collectively called rhizobia, symbiotically interact with legume roots to form specialized structures called nodules in which nitrogen fixation takes place. This process entails the reduction of atmospheric nitrogen to ammonia by means of the enzyme nitrogenase. Therefore, using rhizobia is a natural and environmentally-friendly way to fertilize plants as opposed to chemical fertilization that uses a non-renewable resource, such as natural gas. Through symbiotic nitrogen fixation, the plant benefits from using an endless source of nitrogen from the atmosphere. The process simultaneously contributes to soil fertility because the plant root system leaves behind some of the biologically-available nitrogen. As in any symbiosis, both organisms benefit from the interaction: the plant obtains ammonia and bacteria obtain carbon compounds generated through photosynthesis, as well as a protected niche in which to grow.

The word Rhizobium comes from the Greek words: "rhiza" which refers to root, and "bios" which refers to life. Rhizobiums are a group of Gram-negative soil bacteria that are well known for their symbiotic relationship with various leguminous (soybeans, alfalfa etc). The rhizobium species suitable for different legume crops is given in table 1.

Table: 1 Rhizobium species suitable for different legume crops:

Rhizobium spp.	Crops
R. Leguminosarum	Peas *(pisum),* lathyrus
R. Trifoli	Berseem *(Trifolium)* and clover group
R. Phaseoli	Bean group *(Phaseolus)*
R. Lupine	Lupine group
R. Japonicum	Soybean *(Glycine)*
R. Meliloti	*Melilotus* spp., Lucerne, fenugreek
Cowpea miscellany	Cowpea, clusterbean, greengram, blackgram,radgram,groundnut and sunhemp.

The quantity of nitrogen fixed by different legumes is depicted in table 2.

Table: 2. Quantity of N Fixed by Important Legumes:

S.No.	Crops	Nitrogen fixed (kg/ha)
1	Alfalfa	100-300
2	Blackgram / greengram	50-55
3	Clover	100-150
4	Clusterbean	37-196
5	Chickpea	85-100
6	Cowpea	80-85
7	Fenugreek	45-50
8	Groundnut	50-60
9	Lentil	90-100
10	Pea	52-57
11	Pigeonpea	168-200
12	Soybean	60-88

Asymbiotic Nitrogen Fixation (Nitrogen Fixation by Free-Living Heterotrophs)

Many heterotrophic bacteria live in the soil and fix significant levels of nitrogen without the direct interaction with other organisms. Examples of this type of nitrogen-fixing bacteria include species of *Azotobacter, Azospirillum*, *Bacillus, Clostridium, Klebsiella* and BGA.As previously noted, these organisms must find their own source of energy, typically by oxidizing organic molecules released by other organisms or from decomposition.

There are some free-living organisms that have chemolithotrophic capabilities and can thereby utilize inorganic compounds as a source of energy. Because nitrogenase can be inhibited by oxygen, free-living organisms behave as anaerobes or microaerophiles while fixing nitrogen.

Because of the scarcity of suitable carbon and energy sources for these organisms, their contribution to global nitrogen fixation rates is generally considered minor. Although plants perform carbon fixation in these ecosystems, many plants rely on chemoautotroph bacteria to fix nitrogen, which is necessary to make amino acids and proteins.

Conclusion

Nitrogen is an essential nutrient for plant growth and development but it is unavailable when present in atmospheric nitrogen. This atmospheric nitrogen combined with other gases, fixed by micro-organism, make available forms of nitrogen, such as ammonia (NH^{+}_3), and nitrate (NO_3^-). Biological nitrogen fixation offers a natural means of providing nitrogen for plants. It is a critical component of many aquatic, as well as terrestrial ecosystems across our biosphere.

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IoT and Cloud Computing for Agriculture

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Introduction

The Internet of Things (IoT) concept was coined by a member of the Radio Frequency Identification (RFID) development community in 1999, and it has recently become more relevant to the practical world largely because of the growth of mobile devices, embedded and ever-present communication, cloud computing and data analytics.

Imagine a world where thousands of objects can sense, communicate, and share information, all interconnected over public or private Internet Protocol (IP) networks. These interconnected objects have data regularly collected, analysed, and used to initiate action, providing a wealth of intelligence for planning, management and decision making.

Internet of Things (IoT)

Internet of things (IoT) is a network of physical objects. Now the internet is not only a network of computers, but it has evolved into a network of much different type of devices of different sizes. It may be smartphones, vehicles, home appliances, cameras, toys, medical instruments and industrial systems, animals, people, buildings and many more, all connected and communicating and sharing information based on stipulated protocols to achieve smart reorganizations, positioning, tracing, safe and control and even personal real-time online monitoring, online upgrade, process control and administration. IoT consist of things that have unique identities and all the devices or nodes are connected to the internet. IoT is not just connecting to the internet but allow terminals to communicate and exchange data. The future era will be more than 50 billion devices connected to the internet.

Figure 1: Internet of Things

A lively global network infrastructure with self-configuring capabilities based on standard and interoperable communication protocols where physical and virtual things have identities, physical attributes and virtual personalities and use intelligent interfaces, and are flawlessly integrated into the information network, often communicate data associated with users and their environments.

We define IoT into three categories i.e., Internet of things is an internet of three things:

1. People to people.
2. People to machine or things.
3. Things or a machine to things or machine.

Cloud Computing

IoT is enabled by several technologies and cloud computing is one such technology. Cloud computing is a computing paradigm, where a large pool of systems is connected in private or public networks, to provide dynamically scalable infrastructure for application, data and file storage. With the advent of this technology, the cost of computation, application hosting, content storage and delivery is reduced significantly. Cloud computing is a practical approach to experience direct cost benefits and it has the potential to transform a data centre from a capital-intensive set up to a variable priced environment. The idea of cloud computing is based on a very fundamental principle of reusability of IT capabilities.

Cloud Computing Challenges

Despite its growing influence, concerns regarding cloud computing exists and some common challenges include:
1. Data Protection: Data Security is a crucial element that demands scrutiny. Enterprises are reluctant to buy an assurance of business data security from vendors. They fear losing data to competition and the data confidentiality of consumers. In many instances, the actual storage location is not disclosed, adding to the security concerns of enterprises. In the existing models, firewalls across data centers (owned by enterprises) protect this sensitive information. In the cloud model, Service providers are responsible for maintaining data security and enterprises would have to rely on them.

2. Data Recovery and Availability: All business applications have service level agreements that are strictly followed. Operational teams play a key role in the management of service level agreements and runtime governance of applications. In production environments, operational teams support appropriate clustering and failover, data replication, system monitoring, maintenance, disaster recovery, and capacity and performance management. If any of the above-mentioned services are under-served by a cloud provider, the damage & impact could be severe.

3. Management Capabilities: Despite there being multiple cloud providers, the management of platform and infrastructure is still in its infancy. Features like auto-scaling for example, are a crucial requirement for many enterprises. There is huge potential to improve on the scalability and load balancing features provided today.

4. Cloud IoT and Agriculture: The integration of IoT and cloud computing is of great significance. Cloud computing is powerful storage, processing, and serviceability, combined with the IoT's ability of information collection, composes a real network between people and devices. IoT and cloud computing is again a technology which tends to connect various objects as devices in the world to the Internet. It involves the use of RFID, wireless and other sensors with Internet stack inbuilt into the device. Applications are developed based on IoT enabled devices to monitor and control various domains based on applications.

Benefits of Cloud IoT and Agriculture

Some of the benefits of IoT and cloud computing applications in agriculture are as mentioned below:
1. Improvement in the efficient usage of inputs like soil, water, fertilizers, pesticides, etc., to increase the crop production to meet the growing needs of increasing population in India

2. Easy rapid development including collaboration with other systems in the Cloud. IoT can be used to connect the world's objects in both a sensory and intelligent manner through combining technological developments in item identification ("tagging things"), sensors and wireless sensor networks ("feeling things"), embedded systems ("thinking things") and nanotechnology ("shrinking things").

3. Reduced cost: Cloud computing along with IoT is helpful to charge pay per usage and thus reducing the cost in agriculture. In this case, cloud computing may offer data as a service (DaaS), it costs less as compared to the

fixed services which are charging on a fixed basis irrespective of the utilization of service. Use of IoT along with Cloud Computing can help a lot to Indian farmers to increase the production by providing the correct communication between objects and charging according to the usage of service

4. Other benefits include livestock monitoring, indoor farming – greenhouses and stables, storage monitoring – water tanks, fuel tanks and allocation of resources on-demand without limit.

Challenges in Cloud IoT and Agriculture

Cloud computing has been used for storage of agriculture data by Government and private agencies. Although IoT is beneficial for the Indian agriculture sector, this technology has various challenges as far as India is concerned.

1. Internet availability and connectivity in India is one of the biggest challenges.

2. Consumer IoT adoption: this would remain another major challenge. As global vendors, often mistakenly, assume that Indian consumers are “not ready” for advanced products. This is very much evident in the IoT space, with hardly any kind of vendor activity today. This, in turn, has led to low awareness levels of IoT devices and systems among consumers. Apart from the internet the supporting infrastructure such as smart grids, traffic systems, etc., are far from being ready for IoT.

3. Farmers need a variety of data and services to improve crop production based on land, crop, climate conditions, finance availability, irrigation facilities etc.,

4. Indian farmers have already started taking the help of modern and advanced agriculture tools and machines. But as far as the usage of IoT is concerned, Indian farmers are just at an introductory level in using the IoT technology for agriculture as compared to the other countries which have reached to the advance stage in utilizing the technology for farming.

5. Cloud computing is required in agriculture as farmers can't deal with service providers on an individual basis. They need comprehensive and cost-effective service providers with multiple services.

The IoT offers tremendous potential to innovate in the agricultural field. With its wealth of experience in IP design and project management, India is in a unique position to come up with innovative products. Recent government incentives and support have given entrepreneurs the boost they need to forge ahead. If they do, India can truly realize the dream of “Make in India” for the world.

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Oyster Mushroom Production in IIAT farm

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Mushroom is a palatable food accepted by people as daily diet and alternative to meat and fish. Also it is a vegetarian diet but gives nutrition of non- veg such as some essential amino acids, vitamins and minerals. Straw, the main raw materials is available more. There is no constraint to get spawn, as so many spawn units are there in the state. Nowadays people are consuming mushroom in different ways like curry, snacks, soup, salad, mixed with rice and pickle etc.

A mushroom unit is present at our IIAT campus which falls under the division of Plant Pathology. It is being maintained regularly and production is done to meet out local demands. Students are also trained about the whole mushroom production process in their respective experiential learning courses. They are trained enough to start this as agribusiness in imminent. The unit comprises of a proper shed, it has sand floor and the insides of the walls are covered with jute bag, water is sprinkled twice every day for the maintenance of moisture inside shed.

The following steps are practiced for the proper mushroom production. Mushroom spawn variety (MDU 1) is collected from Agriculture college and research institute Madurai, followed by the substrate preparation i.e. paddy straw was soaked in cold water over night and boiling the paddy straw, shade dried and packed in polythene bags. Incubation period of 15-25 days is given for fruiting and finally the edible fungal fruiting bodies are harvested.

Cultivation Practices

Bed Preparation Procedure

The cultivation of oyster mushroom is usually carried out in transparent polythene covers.

↓

The size of the cover should be 60 x 30 cm, with a thickness of 80 gauge.

↓

Take the polythene cover and tie the bottom end with a thread and turn it inwards.

↓

Take out a well-grown bed spawn, squeeze thoroughly and divide into two halves.(Two beds are prepared from the single spawn bag).

↓

Fill the straw to a height of 3” in the bottom of polythene bag, take a handful of spawn and sprinkle over the straw layer, concentrating more on the edges.

↓

Fill the second layer of the straw to a height of 5” and spawn it as above.

↓

Repeat this process to get five straw layers with spawns.

↓

Gently press the bed and tie it tightly with a thread.

↓

Put 6 ventilation holes randomly for ventilation as well as to remove excess moisture present inside the bed.

↓

Arrange the beds inside the thatched shed, (Spawn running room) following rack system or hanging system.

↓

Maintain the temperature of 22-25 º C and relative humidity of 85-90 % inside the sheds.

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↓

Observe the beds daily for the infestation of insect pests and moulds development

↓

The fully spawn run beds should be transferred to cropping room in the thatched shed.

↓

Two to three days after opening pinheads of mushroom button develop which will be ready for harvest with in another 4 days.

↓

Harvest the entire bunch of mushrooms gently in the early hours of morning.

Yield

After harvest we weighed the mushroom.
First harvest: 120g
Second harvest: 375g
Third harvest: 750g
Totally we get the yield of 1 kg 245g from the single bed.

Conclusion

Finally, we conclude that the commercial mushroom production was very useful to the students and they acquired knowledge about the entire mushroom production practices and also, they have a sound knowledge to become a mushroom entrepreneur and marketing of mushrooms techniques in future.

		
Mushroom Unit in IIAT	**Watering of Mushroom shed**	**Soaking of Paddy straw**
		
Removal of paddy straw after soaking(overnight)	**Boiling of Paddy dtraw for 30 minutes (Heat sterilization)**	**Removal of excess water from the boiled straw**
		
Removal of excess water from the boiled straw	**Chemical Sterilization of floor**	**Shade drying of paddy straw**

		
Spawning	**Hanging of mushroom bed in mushroom shed(Hanging rope method)**	**Spawn Running stage**
		
Pinhead formation stage		**Harvesting**

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Care and Management of Growing Plants in the Nursery, During Transport and Planting in Field

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Abstract

Care and management of growing plants in the nursery, during transport and planting in field is essential as care and management of plant in nurseries and during transport are the heart of our ornamental, vegetative fruits and forest industries. Most of the seedlings planted by farmers are produced in local small-scale plant nurseries and very costlier which have an important role in the sustaining the development of local community and doubling the income of farmers. Very few plants nurseries managers have received professional training and advice on the techniques of nursery management. Thus, this paper discusses in details the setting up and caring and managing of plant in nurseries, as well as during transportation with emphasis on the points to look out for in each procedure. Also, general principles of plants nurseries growth and management are outlined in non-technical language.

Keywords: Establishment, Management, Plant Nursery.

Introduction

Nurseries are places where seedlings are raised for planting purposes. In the nursery the young seedlings are tended from sowing to develop in such a way as to be able to endure the hard field conditions. Whether local or introduced species, nursery seedlings are found to have better survival than seeds sown directly in the field or through natural regeneration. So, nursery seedlings become the planting material for plantations, whether these plantations are for production, protection or amenity.

Seedling production is a major expense of forestation and every effort should be made to produce good quality seedlings at a reasonable cost. To this end mastering the techniques of nursery operations is essential. This chapter will review the various operations involved in the Planning and managing growing trees in the nursery, during transport and planting in field.

Looking after the advanced stock in the nursery will produce healthy trees for sale. Understanding how to transport, plant out and manage trees in the field will enable you to advice farmers how to reduce losses during transplanting in the field. Maintaining optimum environmental conditions in the nursery will enable advanced trees to develop the healthy and strong growth required for field planting.

What to Consider?

1. Potting up advanced trees.
2. Training the tree canopy.
3. Training plant in the nursery.
4. Training trees in the orchard.
5. Preparing for sale and transport.
6. Hardening.
7. Transporting plants.
8. Planting grafted trees in the field.
9. Planting.

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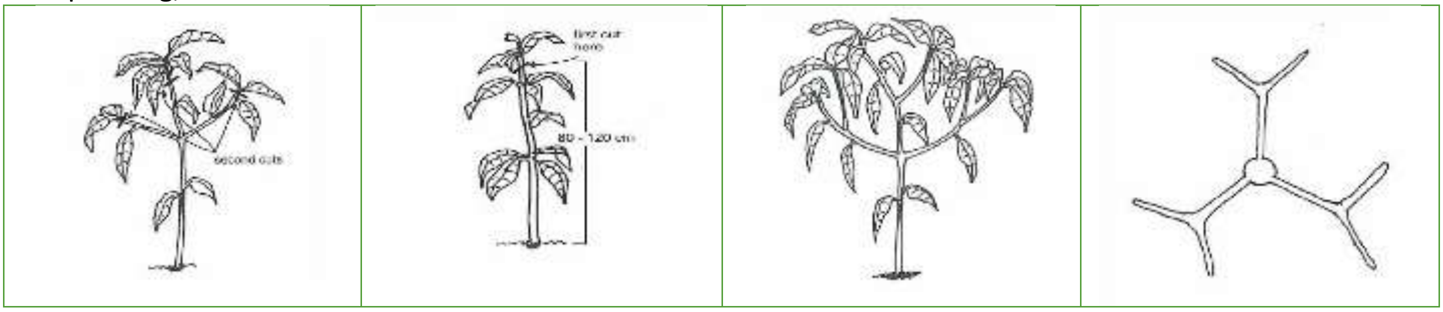
10 Watering.

Potting Up Advanced Plant

When plants are to be held in the nursery beyond the minimal field planting size, they are considered to be advanced trees (Figure 1). Generally, tree growth rate is better when the roots are not disturbed and they are germinated and grown in the pots they will be sold in. Advanced nursery trees (which are larger than the usual, field-planting size) will need to be replanted into a larger pot or poly-bags to avoid restricting root growth. Advanced trees will require potting up from their 3–5 litre pots to 10–15 litre pots if they are to continue to grow without root-restriction or stunting.

Training the Tree Canopy

Training encourages the tree to develop a strong framework of branches, increasing the potential fruit yield. Training is done in two main stages the first stage is done with advanced nursery trees that are still in the pot in the nursery. The remaining steps are carried out over the following two years, beginning 6–8 weeks after field planting, when the first flush has hardened.



Preparing for Sale and Transport

2. Hardening: The way container trees are handled between the nursery; the point of sale and the farm has a significant impact on their survival and long-term health. Before sale, trees should be fully sun-hardened in the pot at the nursery to avoid sunburn and transplant shock.

Hardening involves exposing the plant to regular sunlight, and reducing the frequency of watering. This must be done gradually, over a period of a few weeks, so that the plant can respond to the changing environmental conditions. During hardening, avoid putting plants directly on the ground outside, where they could experience extremely low temperatures.

2. Transporting plants: Moving trees over long distances must be planned carefully. For example, certain quarantine issues may restrict the movement of potting mix into different districts. In this case, prepare the plants according to quarantine guidelines. This may need certification.

Before transporting the trees to another location, consider how long they may go without water and the potential for temperature extremes during transport. Water availability alone would not be enough to overcome the extreme temperatures that may occur during transportation, particularly in enclosed containers.

a. Water the trees thoroughly just before leaving the nursery.
b. Shade the trees from excessive sunlight.
c. Transport the trees at night during the summer.
d. Do not allow trees to dry out during transport.
e. Cover the foliage in plastic to reduce water loss by transpiration.
f. Keep the trees upright.
g. Do not allow potting mix to spill out of the pot and expose the roots to dry air.
h. Cover up the foliage to protect it from wind damage.
i. Water trees thoroughly on arrival at their destination.

Planting Grafted Plant in the Field

Advanced plant that are to be planted out in orchards should be hardened before leaving the nursery by exposing them to full sun for two to three weeks and reducing the amount of water they are given .This will help them to cope with field conditions. The plant should be planted out in late winter or early spring, avoiding the risk of frosts but before daytime temperatures become too high. Trees planted outside of this season have a higher risk of failure. Maintain adequate water to the field stock to avoid root death, slow establishment and plant death.

1. Planting: The plant should be watered immediately after planting; a tractor mounted water tank is highly recommended for this task. The way the planting hole is dug can affect drainage. If the hole is dug with a round, mechanical auger, it may create a barrier to water and roots (especially in clay soils) that will restrict tree growth.

a. The planting hole should be at least 40 x 40 cm across and 50 cm deep.
b. The poly-bag or pot should be removed completely before planting.
c. Any remaining grafting tape should be removed at the time of field planting.
d. The graft union must not be covered with soil. It should remain at the same level as it was in the container.
e. Backfill and firm the soil around the tree to remove air pockets; water and allow to settle; complete the backfilling.
f. Lightly mulch (to about 10 cm), but not too close to the seedling stem, to avoid attracting insects and fungal spores.
g. Regular watering is needed for establishment.

2. Watering:

a. Watering at planting: The trees should be watered immediately after planting; a mobile water tanker is highly recommended. At planting, backfill and firm the soil around the tree to remove air pockets. Water with 5–10 litres of water. Newly-planted trees do not need a large volume of water but enough to maintain a humid environment around the roots. As little as 5 litres per tree will largely eliminate any planting stress and settle the soil around the root system.

b. Watering schedules after planting: Repeat watering as required for the first few weeks after planting. It is important that the roots from container-grown trees do not dry out before they have grown into the surrounding soil. After the initial watering-in, the weather will determine when further irrigation is necessary. In hot weather this may be after 24 hours, while in mild weather the trees may not need to be watered again for a few days. Drip irrigation is an efficient way to make sure the trees have enough water, without wasting large quantities by using a hose.

3. What to avoid: Field planting is a critical stage in which poor root and tree management can easily result in plant death, or infection with diseases that limit production.

a. Avoid root damage: During field planting utmost care must be taken not to disturb or damage the roots of the tree when removing the pot or poly-bag and placing the tree in the hole.

b. Avoid stem and graft damage: During field-planting, avoid putting stress on the stem and grafted area by rough-handling or excessive bending. This type of damage can cause grafts to fail and create entry points for diseases. If windy, support the trees by tying to a supporting stake.

c. Avoid poor irrigation practice: Soil- and water-borne disease can spread in water and enter tree roots and damaged tissue. Drip or under-tree sprinkler irrigation is best practice. Furrow irrigation (flood irrigation confined to channels called furrows) may be used to minimise the impact of flood irrigation but take care not to let water pond around the trunk.

Managing Growing Plant in the Nursery, During Transport and Field Planting

1. Avoid cultivating too close to Plants: Wounds caused by machinery are major points of entry for disease microorganisms. This is a major source of infection. Keep cultivating machinery outside the canopy.

2. Avoid planting in extreme temperatures: Avoid planting at extreme hot or cold times of the year.

3. Avoid post-planting stress: After planting, make sure trees are protected from pests, diseases, weeds, water stress, extreme temperatures, and saline water.

Conclusion

This article highlighted some practices that will bring about high degree of success in various plant nursery to the final field of gardening operation and loses will be reduced to the barest minimum for lowering the cost of input and maximize the profit. It is pertinent to mention here that proper selection of site for nursery, good propagation method, technique of grafting, care and management in nursery/during transportation up to the final field and employment of technical staff that will carry out the necessary and proper operation in the nursery. It will improve the expansion of the nursery, more revenue and availability of improved varieties of planting stocks and will reduced cost of production.

Recommendation

For a nursery to run satisfactorily and provide good returns, the following points should be kept in mind:

1. Price should be very reasonable and competitive and make aware among the farmers about care and management of growing plants in the nursery, during transport and planting in field to minimize the death of newly growing nursery plant.

2. Propagate and grow the plants keeping in views the demand and supply position in local market.

3. Impart training to your staff to acquaint with the latest technology in the field. The staff may be sent for refresher courses or long-term courses.

4. To maintain quality, to grow to rear, propagate and sell only true to the type plants to have a reputed and reliable nursery.

5. Arrange training programme, demonstrate in your nursery for the nearby farmers purchaser and garden lovers.

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Stevia – Utilization and Benefits

Article ID: 32689

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Introduction

Stevia is a sweetener and sugar substitute derived from the leaves of the plant species Stevia rebaudiana, native to Brazil and Paraguay.

The active compounds are *steviol glycosides* (mainly stevioside and rebaudioside), which have 30 to 150 times the sweetness of sugar, are heat-stable, pH-stable, and not fermentable. The body does not metabolize the glycosides in stevia, so it contains zero calories, like some artificial sweeteners. Stevia's taste has a slower onset and longer duration than that of sugar, and some of its extracts may have a bitter or licorice-like aftertaste at high concentrations.

The legal status of stevia as a food additive or dietary supplement varies from country to country. In the United States, high-purity stevia glycoside extracts have been generally recognized as safe (GRAS) since 2008, and are allowed in food products, but stevia leaf and crude extracts do not have GRAS or Food and Drug Administration (FDA) approval for use in food. The European Union approved Stevia additives in 2011 while in Japan, stevia has been widely used as a sweetener for decades.

Utilization

In the U.S., stevia sweeteners are primarily found in table sugar products and reduced calorie beverages as sugar substitutes. Extracts from the stevia leaf have been available as dietary supplements in the U.S. since the mid-1990s, and many contain a mixture of both sweet and non-sweet components of the stevia leaf. The sweet components in stevia sweeteners are naturally occurring. This may further benefit consumers who prefer foods and beverages they perceive as natural. Worldwide, more than 5,000 food and beverage products currently use stevia as an ingredient. Stevia sweeteners are used as an ingredient in products throughout Asia and South America such as:

1. Ice cream.
2. Desserts.
3. Sauces.
4. Yogurts.
5. Pickled foods.
6. Bread.
7. Soft drinks.
8. Chewing gum.
9. Candy.
10. Seafood.
11. Prepared vegetables.

Health Benefits

As an alternative to sucrose, or table sugar, using stevia as a sweetener carries the potential for considerable health benefits. Stevia is considered “no-calorie” on the Food Data Central (FDC). Stevia does not strictly contain zero calories, but it is significantly less calorific than sucrose and low enough to be classified as such. The sweet-tasting components in stevia sweeteners occur naturally. This characteristic may benefit people who prefer naturally-sourced foods and beverages. The low-calorie count qualifies Stevia to be a healthful alternative for diabetes control or weight loss.

Here are some of the possible health benefits of stevia.

1. Diabetes: Research has shown that stevia sweeteners do not contribute calories or carbohydrates to the diet. They have also demonstrated no effect on blood glucose or insulin response. This allows people with diabetes to eat a wider variety of foods and comply with a healthful meal plan. Another review of five randomized controlled trials compared the effects of stevia on metabolic outcomes with the effects of placebos. The study concluded that stevia showed minimal to no effects on blood glucose, insulin levels, blood pressure, and body weight. In one of these studies, subjects with type 2 diabetes reported that stevia triggered significant reductions in blood glucose and glucagon response after a meal. Glucagon is a hormone that regulates glucose levels in the blood, and the mechanism that secretes glucagon is often faulty in people with diabetes. Glucagon drops when blood glucose climbs. This regulates the glucose level.

2. Weight control: There are many causes of overweight and obesity, such as physical inactivity and increased intake of energy-dense foods that are high in fat and added sugars. The intake of added sugars has been shown to contribute an average of 16 percent of the total calories. This has been linked to weight gain and reduced control of blood glucose levels. Stevia contains no sugar and very few, if any, calories. It can be part of a well-balanced diet to help reduce energy intake without sacrificing taste.

3. Pancreatic cancer: Stevia contains many sterols and antioxidant compounds, including kaempferol. Studies have found that kaempferol can reduce the risk of pancreatic cancer by 23 percent.

4. Blood pressure: Certain glycosides in stevia extract have been found to dilate blood vessels. They can also increase sodium excretion and urine output. A 2003 study showed that stevia could potentially help lower blood pressure. The study suggested that the stevia plant might have cardiotonic actions. Cardiotonic actions normalize blood pressure and regulate the heartbeat. However, more recent studies have shown that stevia does not seem to impact blood pressure. Further research is required to confirm this benefit of stevia.

5. Children's diets: Foods and beverages containing stevia can play an important role in decreasing calories from unwanted sweeteners in the diets of children. There are now thousands of products on the market containing naturally-sourced stevia, ranging from salad dressings to snack bars. This availability allows children to consume sweet foods and drinks without the added calories while transitioning to a lower sugar diet. Excessive sugars and calories are linked to obesity and cardiovascular disease.

6. Allergies: In 2010, the European Food Safety Committee (EFSA) reviewed existing literature to determine if there was any cause for concern regarding the potential for allergic reactions to stevia. The reviewers concluded that "steviol glycosides are not reactive and are not metabolized to reactive compounds, therefore, it is unlikely that the steviol glycosides under evaluation should cause by themselves allergic reactions when consumed in foods." Even the highly purified forms of stevia extract are highly unlikely to cause an allergic reaction. No cases of allergic reaction to stevia have been recorded since 2008.

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Current Scenario & Future Prospects of Dairy Sector in Eastern India- Harnessing its Potential through Govt. Initiatives

Article ID: 32690

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Livestock sector is crucial in terms of its contribution to rural income and contributes substantially to agriculture GDP. In Eastern India 70% of the rural households, rear some animals or the other for their livelihood. These households earn 40% of their average income from the animal resources. But Livestock activity is mostly unorganised and is concentrated among landless households or marginal farmers. Women constitute about 71% of the labour force in livestock farming.

Dairy has been the most potent livestock sector in the country and potential in dairy sector is huge in the unexplored eastern region of the country. The Agro-climatic condition is also suitable to support cross bred and pure line animals as the availability of green fodder is in plenty. In addition, the vast majority of the rural population in the region being small and marginal farmers could obtain proper remuneration from dairy sector if it is done in a scientific organised way and ultimately could add to agriculture economy.

However, in the region rural milk trade practices are not well established and milk marketing network is not much developed. Milk is produced mostly for household consumption and local marketing. There is immense scope for cooperative development and milk route development through infrastructure development and institutional arrangements with milk processing plant. As per the 20th Livestock Census 2019, the milch cattle and buffalo population in the region has increased substantially which comes as an important indicator of the importance of this sector in this region and what potential it holds for overall economic development of eastern India.

The most basic feature of dairy sector in eastern region is that it is still predominantly unorganized characterised by small rural producer scattered all over the region. Of the total milk produced, only 18-20% is channelized via the organized sector. The unorganized sector is yet to participate into the modern processing infrastructure. A large proportion of milk continues to be marketed vendors, small processors, merchants, manufacturers, and retailers of indigenous milk products like Khoa, Paneer, Dahi, and milk-based sweets. But the main problem in the unorganised sector is quality, which creates a serious threat to the health of consumers. Unsanitary local conditions, Unhygienic containers, sub-standard processing equipment, poor handling methods, break in the cold chain etc contribute to poor quality and at times unsafe milk in the unorganised sector. However, there is gradual and steady shift in positive direction and in current times of covid-19 pandemic the consumption dynamics has changed leading to increased demand for packaged milk and value-added products. Keeping in mind the growing needs and preference of consumers, the industry is to remain demand driven for a long period of time.

Gaps in Infrastructure and Support Services in Dairy Sector

1. Breeding infrastructure and genetics: The success of Indian dairy was mostly due to rising number of animals not productivity. When the resources are limited, it is imperative to increase the productivity per animal. Productivity can be enhanced by creating breeding infrastructure to maintain pure line breeds and application of breeding methods such as artificial insemination, embryo transfer etc.

2. Animal feed and fodder: There is an acute and ever-growing shortage of green fodder and good quality feed. Growing trend of high breed animals is creating a huge demand for good quality feed and fodder to cater the dietary requirement of milking animals. Storage infrastructure and feed processing and mixing units can be set up to meet the demands.

3. Animal health: Good healthcare and animal disease diagnostic solutions are required to address the gap. As above high yielding animals demand extra care and over the years this trend is driving the animal health segment.

4. Farm mechanization: Despite being the country of 1.39 Billion population there is growing shortage and cost of labor. Farm mechanization is being welcomed by farmers to address the situation. Farm mechanization is the prime requirement for setting of dairy processing and by-product units.

5. Cold chain infrastructure: There is a lack of required infrastructure of chilling plants and bulk coolers to prevent contamination and spoilage at village level. This segment is bound to see growth opportunities as the government and private sector is investing heavily in it in order to secure sufficient procurements.

6. Power availability: Many chilling plants suffer due to shortage of electricity• and do not run optimally leading to poor quality and shelf life of milk. The opportunity within this segment could be solar powered milk chillers.

7. Quality testing infrastructure and trained work force: Adequate quality testing infrastructure is not available at milk collection centers. The problem is compounded by the lack of trained work force to undertake quality testing. At the consumer end, the demand for safe food is emerging fast and thus creating high opportunity.

8. Processing equipment and food ingredients: Growing consumer awareness and shifting lifestyle are forcing processors to move towards the product innovation and thus a growing demand of high-quality equipment and various food ingredients.

Challenges & Key Areas of Concern in the Dairy Industry

Despite the exponential growth of the dairy industry, India is still facing challenges of poor milk quality, low yield, lack of infrastructure and a fragmented production. A number of infrastructure related bottlenecks are still present in both back-end and front-end supply chain. Dairy products are a major source of cheap and nutritious food to millions of people and the only acceptable source of animal protein for a large vegetarian segment of the Indian population, particularly among the landless, small and marginal farmers and women.

1. Competitiveness, cost of production, productivity: The demand for quality dairy products is rising and production is also increasing in many developing countries. The countries which are expected to benefit most from any increase in world demand for dairy products are those which have low cost of production. Therefore, in order to increase the competitiveness of Indian dairy industry, efforts should be made to reduce cost of production. Increasing productivity of animals, by better health care and breeding infrastructure facilities and processing units along with proper management of dairy animals can reduce the cost of milk production.

2. Production, processing and marketing infrastructure: If India has to emerge as an exporting country, it is imperative that we should develop proper production, processing and marketing infrastructure, which is capable of meeting international quality requirements. A comprehensive strategy for producing quality and safe dairy products should be formulated with suitable legal backup.

3. Sourcing & Logistics: The main challenges faced by dairy industry are in sourcing and logistics. This is because procurement of the fresh milk is the most crucial element of this business. It is not feasible to procure milk beyond a 200 kms radius; because of perishability of the product. The cold storage and supply chain infrastructure bottlenecks are ubiquitous in entire farm sector in India. There is a need to develop these infrastructure facilities at least at tier-3 centres.

Impact of Covid-19 Pandemic on Milk Production

Keeping up with that demand and securing the supply chain has not been easy in the pandemic. With more travel restrictions in place because of the potential risk of spreading the diseases, export have been impacted, hurting the positive trajectory that dairy was on globally. At the same pace, the milk price, a key income source, for the dairy farmers, expected to be decreased due to transportation gaps and various restrictions locally. Owing to the closure of hotels, cafés, restaurants, and restrictions on public gatherings, the demand for milk and milk products dipped. But with this pandemic the dairy sector of India has been focusing on the ways to become self-sufficient. As a short-term measure, dairy farmers have to continue their normal management practices but with great care. At the same time, the long term prospective is to shift towards processing and create ample infrastructure for storage and marketing. Dairy producer's organisation, Dairy co-operatives and milking federations which only find places in certain pockets of the country mostly in Western India can come up in eastern part as the region has immense potential in dairy sector.

Future Prospects

On account of a growing middle class, rising prosperity, changing food habits and level of awareness, the demand of milk and milk products is certainly going to increase on a rapid pace in the Indian market. The future of Indian dairy depends highly upon its ability of improving the backward chain integration and on the growth and competitiveness of emerging dairy sectors. An increasing magnitude of milk processing capacity is going to put a lot at stake on procurement of quality milk.

In such scenario, GoI is investing hugely on processors investing in developing the backward chain as well as to create cold chain infrastructure. The approach is likely to bring more farmers in the reach of the organized sector. These developments will drive the entire chain rapidly and are already resulting in a lot of progress. In fact, India's expanding cooperative and private sector milk-processing enterprises are gradually becoming active in facilitating changes in the current small-scale structure of dairy production, improved animal feeding practices, and gains in productivity and marketing. A lot of innovation is taking place at consumer-end and thus the requirement of new technology, machinery, packaging solutions, food diagnostics and food ingredients is increasing.

Increasing Demand for Milk and Value-Added Products

With an increase in the spending power of the population, the demand for milk and other value-added dairy products is only set to increase in the coming years. Moreover, consumers nowadays not only hold greater buying power but are also health conscious regarding what they consume. There is thus a necessity to provide healthy dairy products which can be readily consumed. This creates an opportunity for boutique dairy farms to set up local operations providing fresh cow, buffalo or goats milk to consumers. Over and above with people having less time these days, the demand for premium value-added products such as probiotic yoghurt, cheese, health shakes etc. are on the rise. These products not only have a higher margin but also have a higher shelf life which makes the supply chain easier and cost effective.

Greater Technological Innovations and Increased Margins

Businessmen looking to invest in the dairy industry have noted the increased spending power of the consumers and their willingness to pay a premium in order to have fresh and healthy milk delivered to their doorsteps. As a result, it is expected that there will be investments made in this sector which will aid the introduction of technological advancements both in logistics and farm management. Big Data is one such technology which needs immediate implementation in the dairy industry. Big Data will help dairies accumulate and analyze data to accurately predict consumer behaviour, like buying patterns, leading trends, etc. With increased investments, dairies will be enabled to automate processes, reduce major costs and improve the quality of milk.

Various Govt. Initiatives & Role of NABARD in Revolutionizing Dairy Sector

In order to strengthen agriculture sector, double farmer's income by 2022 and promote self-sustenance for a new "Atma Nirbhar Bharat" GoI has taken several initiatives and has come up with several funds. The dairy sector can immensely benefit from these and there can be a paradigm shift in the sector from being unorganised to a better and strengthened organised sector. The various funds include:

1. Agriculture Infrastructure Fund (AIF): The fund envisages Medium - Long Term Debt finances facilities for all viable projects under Post Harvest or post production Management Infrastructure. The Scheme will be operational from 2020-21 to 2029-30. Disbursement in four (4) years starting with sanction of Rs. 10,000 crores in the first year and Rs. 30,000 crore each in next three financial years.

Rs. 1 Lakh Crore to be provided by banks and financial institutions as loans to Primary Agricultural Credit Societies (PACS), Milk Cooperative Societies, Farmer Producers Organizations (FPOs), Self Help Group (SHG), Farmers, Joint Liability Groups (JLG), Multipurpose Cooperative Societies, Agri-entrepreneurs, Startups and Central/State agency or Local Body sponsored Public Private Partnership Projects.

All loans will have interest subvention of 3% per annum up to a limit of Rs. 2 Crore. This subvention will be available for a maximum period of 7 years. Credit guarantee coverage will be available for eligible borrowers from this financing facility under Credit Guarantee Fund Trust for Micro and Small Enterprises (CGTMSE) scheme.

Eligible Projects under the scheme includes setting up and modernization of key elements of the value chain including:
a. Supply chain services including e-marketing platforms.
b. Warehouses.
c. Silos.
d. Pack houses.
e. Assaying units.
f. Sorting & grading units.
g. Cold chains.
h. Logistics facilities
i. Primary processing centres.

2. Food Processing Fund (FPF): Development of food processing industry in the country is accorded top priority by the Government of India as it is one of the most critical links in the Dairy value chain. A special Fund was constituted during 2014-15 with a corpus of Rs. 2000 crore available with NABARD for development/ establishment and modernization of all infrastructures in Food Parks, support individual food processing units and modernization of existing units.

The objectives of the Fund are to provide impetus to development of the food processing sector on a cluster basis in the country and to reduce wastage of agri produce. Setting up of individual food processing units or any other unit that is established for supporting the operations of the food/Dairy processing units within the Designated Food Parks (DFPs) and Modernization of existing processing units in the DFPs resulting in process technology upgradation, automation, increased efficiency, improvement in product quality, reduction in costs, etc.

The entities who are eligible to avail this fund for term loan assistance from NABARD are State Governments, Entities promoted by State Governments or Government of India, Joint Ventures, Cooperatives and Farmers' Producer Organizations.

3. Dairy Infrastructure Development Fund (DIDF): To ensure that Dairy Cooperatives remain competitive for the sustained benefit of farmers, the Government of India had announced creation of Dairy Processing and Infrastructure Development Fund under NABARD with a total corpus of Rs. 8000 crores over a period of 3 years. The End Borrowers of the scheme are Milk Unions, State Dairy Federations, Multi-state Milk Cooperatives, Milk Producer Companies and NDDB subsidiaries meeting the eligibility criteria under the project.

The main objective of the fund is to modernize the milk processing plants and machinery and to create additional infrastructure for processing milk and increased value addition by producing more dairy products. It will also help the producer owned and controlled institutions to increase their share of milk, thereby providing greater opportunities of ownership, management and market access to rural milk producers.

The components of the scheme include Modernization & creation of new milk processing facilities, Manufacturing facilities for Value added Products, Milk Chilling infrastructure, Setting up electronic milk testing equipment, Project Management and Learning.

4. Animal Husbandry Infrastructure Development Fund (AHIDF): Animal Husbandry Infrastructure Development Fund with corpus of ₹15,000 crore has been created to strengthen the animal husbandry sector. This will help strengthen the dairy sector, which has withstood the Covid challenges by ensuring uninterrupted supply of milk and milk products across the country. It is one of the major components of Atma Nirbhar Bharat Abhiyan stimulus package. This Fund will incentivise infrastructure investments in dairy, meat processing and animal feed plants.

Eligibility, funding and implementation-Farmer Producer Organizations (FPOs), MSMEs, Section 8 Companies, Private Companies and individual entrepreneur. GOI will provide 3% interest subvention to eligible beneficiaries.

A Credit Guarantee Fund of Rs. 750 crores will also be set up. It is to be managed by NABARD which would provide credit guarantee to the projects which are covered under the MSME defined ceilings. Guarantee Coverage would be up to 25% of the Credit facility of the borrower.

This ensures the availability of capital to meet upfront investment required for various projects. Such investments in processing and value addition infrastructure by eligible beneficiaries would also promote exports by adding to farmers' incomes.

Interest Subvention on Working Capital Loans for Dairy Sector

To offset the economic impact of Covid-19 on Dairy Sector, Ministry of Fisheries, Animal Husbandry and Dairying has introduced a new scheme "Interest subvention on Working Capital Loans for Dairy sector" for Supporting Dairy Cooperatives and Farmer Producer Organizations engaged in dairy activities (SDC&FPO) for implementation during 2020-21. In order to meet the working Capital needs of the Cooperatives and Farmer owned milk producer companies, Interest subvention will be given on working capital loans between 1st April 2020 and 31st March 2021 by Cooperatives/FPOs for conversion of milk into conserved commodities and other milk products. The scheme has made provisions for providing interest subvention of 2% per annum, with an additional incentive of 3% per annum interest subvention to be given in case of prompt and timely repayment/interest servicing. It will help in providing stable market access to milk producers and Enable the Producer Owned Institutions to make timely payment of milk bill to milk producers. It will also help Producer Owned Institutions in supplying quality milk and milk products to consumers at a reasonable price and will help in stabilizing the domestic market price of conserved dairy commodities and other milk products. Reduced dependency on imported commodities during the period of shortage will thereby help in stabilising the domestic prices of milk and milk products.

Conclusion

Dairy sector at present times is expected to meet multi-dimensional aspirations, which includes hygienic milk, animal welfare, minimal environmental repercussions and broadened sustainability. It faces several challenges but the good part of all challenges is nothing but opportunities in disguise and in order to meet these challenges head-on, proactive steps need to be taken to educate farmers and provide a stronger supply chain for them to rely on. The primary step to countering this would be to shift the focus to bring the numerous small farmers and dairymen of the region into the fold of aggregation and slowly shift the focus primarily from milk producers to milk processors. Along with this, if supported by successive capacity building and awareness regarding various initiatives and government interventions, the dairy sector will undergo paradigm shift, thus increasing its contribution to agriculture GDP, leading to farmer's welfare and strengthening rural economy and more prosperity to the nation.

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Importance and Identification of Beneficial Insects in Rice Ecosystem

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Introduction

Rice (*Oryza sativa* L.), is the staple food for 60% of world's population (3.5 billion people worldwide). Around 480 million metric huge amounts of processed rice are producing every year. China and India alone record for half of the rice production and consumptions. Rice gives up to half of the dietary caloric gracefully for millions living in neediness in Asia and is, consequently, basic for food security. The cultivation and production of rice is the basic source of income and employment for more than 200 million households across rice growing nations.

Various insect pests and diseases are the major importance for the rice production. So, for management of the pest is utmost importance for achieving a better yield. Besides with an Improper management practices farmer can lose up to 37- 40% of their yield each year. There are many insects found on agriculture land those are not threat to the crop production but beneficial to the farmers in different aspects, as Natural enemies, Pollinators, productive insects, Scavengers, weed killer and Soil builders. But in present situation due to the indiscriminate use of agro-chemicals threaten their growth and living which ultimately break the natural system for controlling the harmful pest in the rice ecosystem, so for managing those insects which are helpful for the production system we have to identify them clearly and take the management strategies accordingly.

Importance of Beneficial Insects in Agriculture

1. Its balance the pest population with in the ecosystem by feeding or by attacking the harmful insects that causes the ultimate damage of crop.
2. Predator insects are highly active for feeding and finding their feed in the field, during its complete life cycle its kills huge number of insects that are harmful for crop production and helping farmers by consuming such pest.
3. Parasitic insect's nature is different than the predator insects, it generally retains on the host cell and destroy it by staying with in it.
4. Some insect directly help in the nutrient recycling by dusting or splitting the material or organic compound into small pieces like the termites and the boring beetle larvae, millipede etc.
5. Some insects also play an important role by consuming the waste plant material and give it back to the soil by their enriched excreta.
6. A large percentages of pollination of the field crops and the vegetables and higher crop is done by the honey bees and the bees but due to the use of the chemical pesticides their population is lowering down which is a serious threat to the human survival which directly connected with the food security.
7. In the absence of the pollinator we have only very limited food for our survival in the world.
8. Some insects are directly help in crop production by controlling some noxious weed by feeding on them.

Some Common Beneficial Insects in Rice Field



Micraspis crocea **(Lady beetle)**	***Harmonia octomaculat*** **(Large spotted ladybird)**	***Menochilus sexmaculatus***
		
Ophionea nigrofasciata **(Ground beetles)**	***Metioche vittaticollis***	***Conocephalus longipennis***
		
Limnogonus fossarum **(Water striders)**	***Cyrtorhinus lividipennis Reuter*** **(Green miridbug)**	***Agriocnemis pygmaea*** **(Wandering wisp)**
		
Solenopsis geminate **(Fire ant)**	***Lycosa pseudoannulata*** **(Wolf spiders)**	***Oxyopes javanus*** **(Lynx spiders)**
		
Tetrastichus schoenobii	***Telenomus rowani***	***Gonatocerus triguttatus***

Conclusion

Beneficial insects, soil microorganisms and soil flora and fauna are highly effected by the application of pesticides, due to the unscientific, huge and improper application of that chemical inputs (pesticides, insecticides etc.) lead to the tremendous health hazards for both human and animals which also resulted in negative consequences for the insect those are beneficial to the farmers.

In rice ecosystem there are various beneficial insects exists which are directly or indirectly help the farmer for their crop production by controlling the harmful insects as a competitive phenomenon in the nature, as a result farmer get a better yield. For maintaining a natural balance, a superior decision has to be taken by the farmers during controlling of the pest in the field and make them aware about the beneficial insects which ultimately maintain quality ecosystem on field.

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Technology Innovations for Climate Resilient Agriculture

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Introduction

Climate resilience is the ability to predict, prepare for, and respond to climate-related dangerous events, trends or damages. In order to improve climate resilience, it is necessary to assess how climate change creates new climate-related risks or changes current risks, and measures must be taken to better respond to these risks.

National Innovations on Climate Resilient Agriculture

The National Innovations on Climate Resilient Agriculture (NICRA) is a network project launched by the Indian Council of Agricultural Research (ICAR) in 2011.

Objectives

1. The project aims to enhance resilience of Indian agriculture (including animal, crops and fish rearing) to climate change and climate vulnerability through strategic research and technology demonstration.
2. The research on adaptation and mitigation covers crops, livestock, fisheries and natural resource management.
3. To enhance the capacity of scientists, farmer's and other stakeholders in climate resilient agricultural research and awareness of impacts.

Component of NICRA Project

1. Strategic Research.
2. Technology Demonstration.
3. Capacity Building.
4. Sponsored or Competitive Grants.

Program Areas

1. Rainfed crop production system.
2. Horticulture crop production systems.
3. Irrigation crop production systems.
4. Soil, water and nutrient management.
5. Monitoring of GHGs.
6. Resource use efficiency in agriculture.
7. Improved machinery for adaptation and mitigation.
8. Livestock and dairy sector.
9. Fisheries including aquaculture.

Technology for Climate Resilient Agriculture

1. Rearing of fish seed as a livelihood opportunity in flood prone areas.
2. If planting is delayed, use community rice field nurseries as an emergency measure.
3. Community reservoirs/ponds as a means to increase and manage water resources at the village level.
4. To diversify crops for livelihood security and climate change resistance.
5. Blow rice to save water and planting speed.

6. Improve resilience by improving transportation / conveyance efficiency.
7. Flood resistant varieties enable farmers to respond to flood-prone areas.
8. Improve planting methods to increase water use efficiency and crop productivity.

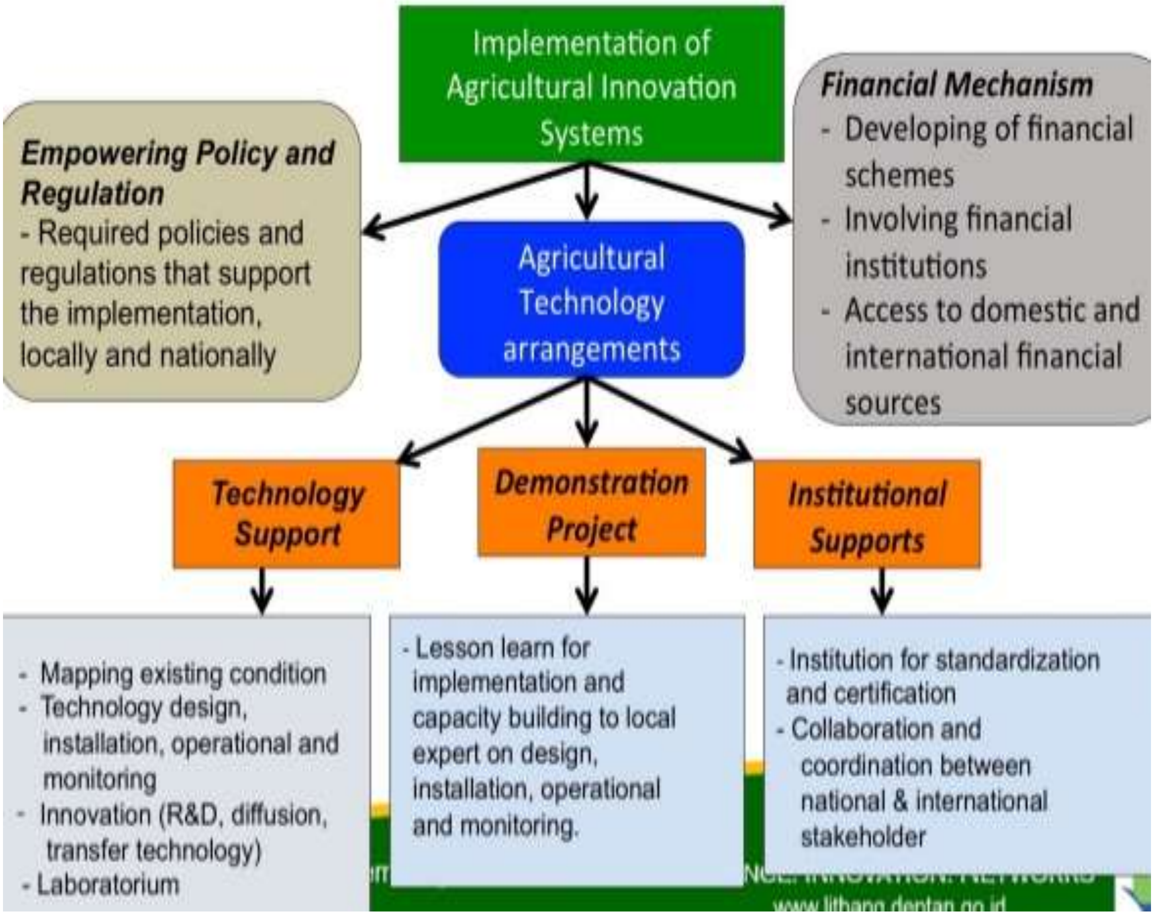

Fig. Strategy of technology transfer for sustainable and climate resilient agriculture

Advantages of Climate Resilient Agriculture

1. These services include food security, flood and drought control, recreation, and water storage.
2. Agriculture can also play an important role in reducing greenhouse gas emissions.
3. Provides specialized information on the impact and vulnerability of Indian agriculture to climate change, greenhouse gas emissions and agricultural mitigation, adaptation strategies for climate resilient agriculture and demonstration activities to develop technologies and capacities, climate research facilities and important publications.

Conclusion

Acquisition of climate resilient technologies can help in coping up with the challenge of climate change. Some climate resilient technologies like growing drought resistant crop varieties, changes in crop management practices, acquisition of water management technologies, improving nutrient use efficiency, development of farm machineries, acquisition of resource conserving technologies and pest management, access to weather forecasts, introduction of crop insurance products and harnessing of indigenous knowledge can help in agricultural adaptation to the changing climate.

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Rain Shelter: A Perk to Off-Season Cultivation in Kerala

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Vegetables are rich source of nutrients, vitamins (A and C) and dietary fibers and they play a crucial role in ensuring the nutritional security of our country. Despite of the fact of Keralites being major consumers of veggies, the state has to depend on her neighbors to satisfy the increasing demands. There are numerous reasons for such a contradicting situation and one among them is the unique climatic condition of Kerala. It experiences a tropical climate with increased temperature, high relative humidity, changes in rainfall pattern and generation of floods being the major issues.

Vegetables are highly sensitive to climatic fluctuations. It affects the flower production, pollination, fertilization and thus the final yield. There comes the importance of protected cultivation with the use of rains shelters to improve the productivity of these crops.

What is Protected Cultivation?

It is the cultivation of crops through complete or partial control of the microclimate surrounding the plant during the crop growth period. The type of protective structure used depends on the climatic condition of the region. In temperate countries, where the chilling temperature is one among the major constraints, crop production is carried out through the maintenance of proper temperature and humidity in green houses. While in tropical state like Kerala, rain shelters are used.

Rain shelters are specialized protective structures which enable us the intensive cultivation of crops even during the excessive rainfall conditions. A good structural design ensures improved growing environment for crops, especially air temperature and relative humidity. Vegetable and flower production during the south-west monsoon can help us reduce the dependence on other states during Onam to a certain extent. Unlike polyhouses, opened sides in rain shelters provide an advantage of ease in pollination and non-requirement of climate controlling devices. The production per unit area of vegetables (such as tomato, amaranth, bhindi, cucumber, capsicum, yard long beans, bitter gourd cauliflower, chilli, brinjal) and flowers (such as rose, gerbera, orchids, anthurium, chrysanthemum) can be increased through the adoption of this technology.

Use of rainshelters for vegetable cultivation in Kerala

The rain shelter should be constructed in south-north direction. It consists of vertical foundation pipes (can be galvanized iron pipe, bamboo, casuarina or palm poles) and horizontal pipes (made of PVC). The sheet or cover used is UV stabilized transparent polyethylene film of 200-micron thickness reinforced on horizontal pipes using steel clips. It has 88% light transmission, anti-fogging, anti-dust and anti-algal properties with a life span of about 3 years. The shelter can be constructed at a height of 2 m in middle and 1 m on sides. The height can reach even up to 4 m. The film should be attached from the centre to outwards to avoid wrinkling. It is advised to fix the film during sunny hours so that it may form a tight cover, due to stretching and shrinking, on heating and cooling, respectively. The temperature is increased by 2 to 3 0C from the outer environment, with the sides open. If the sides and ends are covered using net, the temperature is increased by about 6 0C and can act as a barrier to wind and insect pests. This may affect pollination too. Crops can be raised on beds or in containers, water in combination with fertilizers can be supplied using drippers. Drip or trickle irrigation has water, energy and labour-saving characteristics. Fertigation ensures better and timely availability of nutrients to plants. Fertilizers selected should be fully water soluble, non-clogging and compatible with other fertilizers. Quality of irrigation water used (salinity, boron content, fluoride content, sodium content) should be given preference.

Merits

1. Unlike polyhouse, rain shelter is a low-cost technology and thus can be adopted by small and marginal farmers.
2. Ensures year-round production of vegetables, even cool season crops that fetch high prices in market at times of peak demand.
3. Improves the fruit quality (better colour and flavour) and avoid frequent periods of canopy wetness.
4. Zero pest attack and reduced disease build up. This ensures the minimal use of pesticides.
5. The leaching loss of nutrients (N and K) from root zone by beating action of rains is diminished. So, maximum fertilizer-use efficiency.
6. Rain shelters enhance the concept of “Family Farming”. It ensures the production of safer vegetables needed for a family with a lower initial investment, efficient utilization of space in a homestead and better participation of family members.
7. Enable the adoption of modern production technologies such as aeroponics, hydroponics, nutrient film techniques.

Points to be Remembered

1. The site selected should be elevated from the nearby areas to ensure proper drainage and with reach of ample sunlight.
2. To improve the life of plastic film, remove the dust and algae by occasional washing with water, detergent and bleach.
3. Avoid pointed ends while construction, since this may cause tearing of film.
4. After harvest of each crop, allow a fallow period to avoid the build-up of pests and diseases.
5. It is better to maintain a lower planting density in rain shelters, than the usual.
6. Sides can be covered with insect proof nets of 40 mesh size as a control measure against insect pests. Install fruit traps, yellow sticky traps and pheromone traps, if necessary.
7. The planting materials selected should be healthy.
8. Timely removal of weeds should be ensured to avoid nutrient loss and pest build-up since many of them can act as alternate hosts to insect pests.
9. Soil can be drenched with Pseudomonas as a prophylactic measure against fungal infection.

It is the best time for the farmers to take up the initiative and improve their standards of living through the production and sale of off –season vegetables at a fair market price.

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Mathematical Modelling of Egg Parasitosis Against Yellow Stem Borer

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Abstract

India is leading rice producing country next to China and the annual crop losses due to insect pests and diseases are about 38 percent. Among the 100 species of insects recorded in rice field, yellow stem borer *(Scirpophaga Incertulas)* contributes 90 per cent of the damage. Among there are four conventional methods to control yellow stem borer *(Scirpophaga Incertulas)*, biological control method is the best and most effective method for using mathematical model solution.

Introduction

Food is the basic human need and producing enough to feed the growing population of developing nations is one of the biggest challenges faced by modern world. Next to wheat rice is one of the top most food grain consumed worldwide. Rice production plays a major role of the national agricultural economy of India. India holds the second position in rice production of all over the world. International Rice Research Institute (IRRI) finds that on average, Farmers lose 37 percent of their rice yield to pest and diseases. In India the annual crop losses due to insect pests and diseases are about 38 percent. Worldwide more than 100 species of insects are recorded in rice production, out of which about 20 species cause significant economic damage amongst various pests affecting the paddy crop. The yellow stem borer *(Scirpophaga Incertulas)* contributes 90 percent of damage in the paddy field, especially during the rainy season.

The four different methods are generally practiced to control yellow stem borer are cultural control, varietal resistance, chemical control and biological control. The chemical control method may contribute to decline in wildlife and create harmful impact on human health; through the biological control method the pest can be controlled by stirring up other living organisms. The biological control method helps to destroy only the harmful pests and it does not affect any beneficial insects like a human being. Hence this study was taken up and its result will be useful for scientists to work out for a biological control to support the ultimate beneficiary of the farming community.

Material and Methods

Mathematical models are intellectual tools. This model is defining and understands the system of pest and beneficial insects. The life cycle of yellow stem borer, different methods to control stem borer, advantages and disadvantages of various pest controlling methods are analyzed.

Ecological processes are usually specific to organism's age or stage. The biological events such as birth and death are usually specific to the age or stage of development of individuals. The pest reproduction takes place only during a part of life time of the female insects. The life cycle of insects is egg, larvae, pupae and adults' stages. The reproduction takes place only at the adult stage but egg and larvae are infesting the paddy crop. The age dependent life tables are constructed for the beneficial insects. Age dependent life tables are used to find out the life expectancy of beneficial insects. The stage dependent life tables are constructed for the pest to measure the mortality at different stages. This Research was undertaken with an aim to construct the life table of key mortality factors of rice stem borer and *trichogramma japanicum* using the field data.

The population growth cannot grow exponentially only on logistical model, by fitting the logistical model for the life table analysis data. Ppopulation growth in a limited environment are based on two fundamental one is the population have the potential to increase logistically and that there is density dependent feedback that progressively reduce s the actual rate increase. Density dependent relationship in single species rice stem borer its equilibrium level N_{e_1}=0 and N_{e_2}=0.05.In this equilibrium level is N_0>N_{e_2} and f(N) >0 in(N_{e_2}, ∞).N(t) increase form N_0 without any bound as t increases in the control condition.

The density dependent relationship in rice stem borer and its equilibrium level is calculated the qualitative behavior of populations of steady and equilibrium states of logistical model with harvesting stage are calculated.

By applying logistical model to develop a simple mathematical model of biological pest control problem for nonlinear systems was formulated in most popular injury levels of rice stem borer and its egg and larvae. Natural enemies are introduced in the field based on the optimal pest control strategy.

$$\frac{dN_1}{dt} = \beta\left(1 - \frac{N_1}{k}\right)N_1 - a_1N_1 - b_1N_1 - \gamma N_1 z$$

$$\frac{dN_2}{dt} = \gamma N_1 z - a_2N_2 - b_2N_2$$

$$\frac{dN_3}{dt} = b_1N_1 - a_3N_3 - b_3N_3$$

The stability conditions of nonlinear system formulated using logistical model are guaranteed by equilibrium points and its three stability conditions. Using the life table data in the three stability conditions at the egg mass stage is unstable of equilibrium point and then *Trichogramma Japonicum* to be released. The second stability condition of larval stage is satisfied stability of equilibrium point. The third stability condition of pupa and adult stage is unstability of equilibrium point. In this juncture, another parasitoid on some other should be adopted to control pupa and adult.

1. $\beta < a_1 + b_1$
2. $a_1 + b_1 < \beta < a_1 + b_1 + \frac{\beta}{\gamma b_2 k}(a_2 + b_2)$
3. $\beta > a_1 + b_1 + \frac{\beta}{\gamma b_2 k}(a_2 + b_2)$

Conclusion

Life table data values were applied in economic injury level formula by analyzing the present value of paddy calculated and it is compared with stability analysis. Both logistical model stability result and economic threshold stability conditions are considered. Using this stability condition, the time at release the *Trichogramma Japonicum* working the great amount at parasitoids which have introduced at the beginning. The both stability and economic threshold suggests that the proposed feedback control strategy can be integrated into existing biological technologies in stability condition and economic threshold method. This biological method is economically to us in constant control in agricultural practice used by periodical release of small population of natural enemies.

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Global Climate Change Impacts on Soil Conditions in Relation to Plant Growth

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Climate change is global phenomena and occurring continuously since the earth came into existence. Climate change has become a major scientific and political issue during the last decade. There are well marked cold and hot cycles in the history of earth's climate, however, these changes have been observed relatively rapid in the last 150-200 years around the world [1]. Soil seems to be more important for modern human societies than ever before to meet the global demands for food and fiber for increasing population from limited soil resources. Climate change is threatening food security globally. Countries like India are more vulnerable in view of the tropical climate and poor coping capacity of the small and marginal farmers. Climate change is projected to have significant impacts on agriculture through direct and indirect effects on crops, soils, livestock and pests. Though, climate change is a slow process involving relatively small changes in temperature and precipitation over long period of time, nevertheless these slow changes in climate influence the various soil processes particularly those related to soil fertility. The effects of climate change on soils are expected mainly through alteration in soil moisture conditions and increase in soil temperature and CO levels as a result of climate change. The global climate change is projected to have variable effects on soil processes and properties important for restoring soil fertility and productivity. The major effect of climate change is expected through elevation in CO and increase in temperature.

Soil Formation

Soil formation is controlled by numerous factors including climatic factors such as temperature and precipitation. These parameters of climate influence the soil formation directly by providing biomass and conditions for weathering. Main parameters of climate that directly influence on soil formation are sum of active temperatures and precipitation-evaporation ratio. They determine values of energy consumption for soil formation and water balances in soil, mechanism of organic-mineral interactions, transformation of organic and mineral substances and flows of soil solutions. Stable progressive climate warming lead to irreversible changes in mineral matrix of soils. Changes in external factors of soil formation (temperatures and precipitation) will lead to transformation of internal factors (energy, hydrological, biological). The climate change will increase energy of destruction of soil minerals resulting in simplification of mineral matrix due to accumulation of minerals tolerant to weathering. It will lead loss of soil function for fertility maintenance and greater dependence of on mineral fertilizers.

Soil Development

Soil development is broadly controlled by three main factors i.e. climate, parent material and vegetation type. The effects of climate change on soil development are expected mainly through alteration in soil moisture conditions and increase in soil temperature and CO levels. Climate change will influence soil moisture levels by direct climatic effects (precipitation, temperature effects on evaporation), climate induced changes in vegetation, plant growth rates, rates of soil water extraction by plants and the effect of enhanced CO levels on plant transpiration. Changes in soil water fluxes may also feed back to the climate itself and even may contribute to drought conditions by decreasing available moisture, altering circulation patterns and increasing air temperatures. Among various factors controlling the process of soil development, climate plays a major role in weathering of rocks and minerals. The variables of climate change particularly temperature and rainfall dictate various stages of weathering of rocks and minerals (parent material) resulting in chemical and mineralogical

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changes in soil forming rocks. Water is very essential for chemical weathering to take place and hence, an increase in rainfall accelerates weathering. The same types of primary minerals give rise to different secondary minerals when the conditions of weathering differ. Thus, similar rock types undergoing weathering in different climatic conditions could give rise to distinct soil profiles.

Soil Fertility and Productivity

The drivers of climate change such as moisture, temperature and CO are expected to have variable effects on various soil processes and properties having relevance in soil fertility and productivity. However, these effects of the climate change factors cannot be viewed separately, being one factor influence the other and resultant effect would be complex. Further, all these effects will be highly region specific, depending on the magnitude of the climate change, soil properties and climatic conditions. India is bestowed with 9 of the 12 soil orders that exist in world and 15 agro-climatic zones, with diverse seasons, crops and farming systems. Since climate change is a reality, it will have direct and indirect impacts on soil development processes and properties related to crop production influencing the livelihoods of millions of peoples in the country. The impact of climate change factors, specifically temperature, CO and rainfall on various soil properties is being discussed below to understand the relationship between climate change variables and various soil properties in order to evolve appropriate mitigation strategies.

Increasing Temperature	Increasing CO2 Concentration	Increasing Rainfall	Reduction in Rainfall
1.Loss of soil organic matter	1.Increase in soil organic matter	1.Increase in soil moisture or soil wetness	1.Reduction in soil organic matter
2.Reduction in labile pool of SOM	2.Increase in water use efficiency	2.Enhanced surface runoff and erosion	2.Soil salinization
3.Reduction in moisture content	3.More availability of carbon to soil microorganisms	3.Increase in soil organic matter	3.Reduction in nutrient availability
4.Increase in mineralization rate	4.Accelerated nutrient cycling	4.Nutrient leaching	
5.Loss of soil structure		5.Increased reduction of Fe and nitrates	
6.Increase in soil respiration rate		6.Increased volatilization loss of nitrogen	
		7.Increase in productivity in arid regions	

Plant Nutrient Availability and Acquisition

Plant availability of nutrients in the soil is a function of soil chemical properties as well as location of the ion relative to the root surface and the length of the pathway the nutrient must travel in the soil to reach the root surface. Increases in air temperature and changes in precipitation have significant impacts on root zone temperature and moisture regimes. It is well known that soil moisture and temperature are primary determinants of nutrient availability and root growth and development and that carbon allocation to roots governs nutrient acquisition, it is reasonable to expect that process outcomes will be reflective of the changed climate. The nature and extent of the change in these two parameters will be site- and soils specific. It has been suggested that climate change impacts on nutrient use efficiency is be primarily affected through direct impacts on root surface area and influx rate [2].

Nutrient Transformation in Soil

Plants accumulate nutrients from the soil solution pool, and nutrients must be in solution to be mobile in the soil. Biological transformation between organic and inorganic pools is strongly influenced by moisture and

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temperature, and thus, global climate change may strongly influence solution concentrations of N as well as S. Pendall et al. [3] suggests that increased CO may not exert a significant direct effect on N mineralization per se but associated warming can cause increased N mineralization, leading to increased solution-phase N. Rates of adsorption/ desorption reactions will accelerate with increased temperature, and changes in soil moisture may further modify reactions by altering the ionic strength of the soil solution.

Soil Carbon Dynamics

It is generally accepted that increases in CO concentration quantitatively and qualitatively alter the release of root derived compounds. Plants under elevated CO decrease their allocation of N-rich metabolites and increase the allocation of C rich metabolites to root exudates [4]. It results in an increase in microbial activity and consequently the CO production, which has is a potential negative effect on the accumulation of organic C in soils and thus on potential sequestration of soils. It has been observed that the priming effect as a result of the enhanced microbial activity in soil at elevated atmospheric CO concentration has a significant negative feedback on global change processes and will reduce the sequestration potential of soils. Several studies using C isotope tracers have demonstrated that the production of CO in the rhizosphere by roots and microorganisms is significantly stimulated by elevated CO plant growth conditions. The stimulation of CO respiration in the rhizosphere may be much higher than the enhancement of root biomass. Cheng & Johnson [6] demonstrated that although plants produced only 15–26% more biomass under elevated CO, rhizosphere respired C increased by 56–74% as compared to ambient CO treatments.

Response to Mycorrhizal Association

The effects of elevated atmospheric CO concentration on soil microbial community structure are often characterized by an increased mycorrhizal colonization due to the increased plant demand for nutrients, coupled with increased C assimilation rates CO enrichment should increase mycorrhizal biomass because plant demands for N and P will increase concurrently with C assimilation rates, and plants will allocate more photosynthates belowground to the roots and mycorrhizal fungi to help satisfy this increased nutrient demand. Greater fine root mass and mycorrhizal infection promote enhanced P uptake in mycorrhizal plants grown under elevated CO concentrations.

Soil Biological Activities

The response of soil microorganisms to changes in plant production under elevated CO is highly variable due to very different patterns of plant C allocation in different plant–soil systems. Microbial biomass, gross N mineralization, microbial immobilization, and net N mineralization under elevated CO show a high degree of variability. However, rates of soil and microbial respiration are generally more rapid under elevated CO, indicating that enhanced plant growth under elevated CO increases the amount of C entering the soil, thereby stimulating soil microbial activity. Soil microorganisms are often C-limited and therefore, increased C availability stimulates microbial growth and activity. It is generally assumed that the CO induced increases in soil C availability will increase fungal biomass more than bacterial biomass. It is because of increased concentrations of dissolved organic C in the rhizosphere and to increases in soil water dissolved organic N. Given the important roles played by fungi in organic matter degradation, nutrient cycling, plant nutrition, and soil aggregate formation, shifts in fungal communities might have a strong impact on soil functioning. Furthermore, lower N availability at elevated CO may, in part, explain these increases in fungi, as fungi tend to have a higher C/N ratio than bacteria and so have a lower demand for nitrogen than bacteria have [5] Bacteria and fungi, the initial consumers of soil organic matter, are themselves substrates for a multitude of tiny predators and grazers, including protozoa, nematodes, and arthropods, which comprise the soil food web. Therefore, an increase in bacterial growth due to an increasing C allocation at elevated atmospheric CO levels may be followed by an increase in grazing, resulting in a higher turnover of the microbial biomass. Increased grazing thus results in faster recycling of nutrients from the microbial biomass, which would increase the flux of nutrients to the plant.

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Adaptation and Mitigation Strategies

Agriculture can adapt to climate change by adopting farm management practices that minimize the adverse effects of increasing or decreasing rainfall and temperatures or other extreme weather conditions. Many management-level adaptation options are available to attenuate the effects of climate change on crop production, including zero tillage, retaining crop residues, extending fallows, increasing the diversity of production, altering amounts and timing of external inputs (fertilizers, water), as well as broader agronomic management strategies (e.g. altering planting density, row spacing, planting time; introducing new germplasm resistant to heat or drought stress). Agriculture can contribute to climate change mitigation through farm management practices that reduce greenhouse gas emissions (carbon dioxide, nitrous oxide, methane) and enhance soil carbon sequestration. Emissions of carbon dioxide can be reduced through reduced biomass burning and more efficient energy use. Emissions of methane can be reduced through improved farm management practices that include improved management of livestock waste and water in rice paddies. Nitrous oxide emissions can be reduced through improved management of N fertilizers including appropriate type, rate and method of application and soil management (avoidance of soil compaction).

Various farm management practices can enhance soil carbon stocks and encourage soil functional stability. Conservation agriculture technologies (minimum soil disturbance, cover crops and crop rotations including legumes), soil conservation measures (e.g. contour farming) and nutrient replenishment strategies can restore soil organic matter by providing a protective soil cover and an environment conducive to vigorous plant growth. In some cases, however, a change in the agricultural production system may be required. e.g. continuous cereal cropping being replaced by ley farming or by the introduction of agroforestry systems. The global soil carbon pool exceeds biomass pools by a factor of four or five, without taking into account that recent soil degradation has led to losses of between 30 percent and 75 percent of their antecedent soil organic carbon. Globally, therefore, a soil carbon increase offers great mitigation potential. Carbon sequestration refers to the storage of carbon in a stable solid form. It occurs through direct and indirect fixation of atmospheric CO. Direct soil carbon sequestration occurs by inorganic chemical reactions that convert CO into soil inorganic carbon compounds such as calcium and magnesium carbonates. Direct plant carbon sequestration occurs as plants photosynthesize atmospheric CO into plant biomass. Subsequently, some of this plant biomass is indirectly sequestered as soil organic carbon (SOC) during decomposition processes. The amount of carbon sequestered at a site reflects the long-term balance between carbon uptake and release mechanisms. Many agronomic, forestry, and conservation practices, including best management practices, leads to a beneficial net gain in carbon fixation in soil.

Agro-ecosystems can play an important role in mitigating CO emissions through biotic C sequestration in soils and vegetation. Because of historic losses of C from soils, estimated to be 41 to 55 Gt, the soils now offer an opportunity for carbon storage. The carbon sequestration potential of a soil depends on climate, the type of vegetation it supports, the nature of parent material, the depth of solum, soil drainage, the edaphic environment, soil organic matter (SOM) content and its decomposability and land management practices. Improved management of agro-ecosystems can significantly enhance C sequestration in soils. Management practices or technologies that increase carbon input to the soil and reduce C loss or both lead to net carbon sequestration in soils. Increased C input in agro-ecosystems can be achieved in a number of ways such as selection of high biomass producing crops, residue recycling or residue retention by lessened tillage intensity, application of organic materials (e.g. animal manure, compost, sludge, green manure etc.), adoption of agro forestry systems, intensification of agriculture through improved nutrient and water management practices, reducing summer or winter fallow, changing from monoculture to rotation cropping, and switching from annual crops to perennial vegetation. Soil carbon loss could be decreased by adopting conservation agriculture and minimizing soil disturbance, checking erosion through reduced tillage intensity, and using low quality organic inputs. Technological options that have been found to be efficient for soil C sequestration in Indian agro-ecosystems include integrated nutrient management and maturing, crop residue incorporation, mulch farming and/conservation agriculture, agro-forestry systems, grazing management, choice of cropping system and intensification of agriculture. Integrated nutrient management involving addition of organic manures/composts along with inorganic fertilizers results in improved soil aggregation [7].

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Digital Farming – A Reformation in Agriculture

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The use of Information and Communication Technology (ICT) to disseminate the local information and services working towards making farming socially, economically and environmentally sustainable. This also contributes to the delivery of nutritious and economical food for all which includes the Digital Agriculture. This has also led to the development of mobile apps which are helping existing government schemes and other agriculture-based information to reach farmers in rural India. With a click of a button farmers can get information about weather, market prices, agro advisories, fertilizer recommendation, IPM practices etc. The introduction of mobile apps will definitely bring out significant change in the lives of farmers and the field of agriculture. The information and utility of different apps is very much needed for the farmers to make use of the available technology to improve the farming and increase the income.

Kisan Suvidha

It is an omnibus smartphone app that helps farmers by providing information regarding weather, market prices, plant protection, agro advisories, IPM practices etc.

MKisan App

This app enables farmers and stakeholders to obtain advisories and other information being sent by experts and govt. officials through mkisan portal.

Crop Insurance

This app is used to calculate Insurance Premium for notified crops based on area, coverage amount and loan amount. It can also be used to obtain details of normal sum insured, premium details and subsidy information of any notified crop in all areas.

Shetkari App

This app helps download Shetkari Masik an Agriculture magazine & there is no requirement internet to Read it.

Agri Market

This app gives information of market price of all crops at the markets located within 50 kilometre radius of the device's location and in the nearby mandis. This app uses GPS to find the location.

Pusa Krishi

Information related to new varieties of crops developed by the Indian Council of Agricultural Research (ICAR), resource conserving cultivation practices, farm machinery and its implementation and production technologies, to the farmers is provided by this app. Feedback option enables farmers to have an immediate conversation with the stakeholders.

AgriApp

It is an online farming marketplace bringing Kisan, farming input/output, government service on an online platform. It also provides chat option for farmers. This mobile application provides diversified videos of agriculture work.

Iffco Kisan App

The farmers can easily get the help of agriculture experts using this app. It provides information about the latest agriculture advice, latest market prices, and various farming tips. It also provides weather forecast information. It also provides agriculture alerts to farmers in ten languages.

Agri Media Video App

This application comprises of various videos related to agriculture practice, new technologies, successful farmers, rural development, agriculture news, new govt. schemes related to agriculture etc. It also provides chat service for farmers to solve their query related to agriculture with the option of upload images of infected crops. Farmers can easily chat with agriculture expert and discuss their problems.

FarmBee - RML Farmer

It is available in 10 different Indian languages. It provides fertile agriculture content and information at every stage of the crop life cycle. A farmer can choose information about 450 crop varieties, 1300 markets, 3500 weather locations. It also provides mandi price and weather forecast based on a user location.

Kisan Yojana

Kisan Yojana is another popular Android agriculture apps available for free. It provides information about all Govt schemes to Kisan. It commutes the information gap between the rural people and Govt. It also provides the schemes of the different relative states Government. This mobile application also saves the time and travel expense of Kisan to reach the state Govt office is saved. Approximately 50 thousand users downloaded this app.

PM - Kisan App

Under the PM - Kisan Scheme, a direct payment of Rs. 6000 per year will be transferred in three equal installments of Rs. 2000 every four months into the bank accounts of eligible landholding families. This has been developed to broaden the reach of the scheme. Using this mobile app farmers can know the payment status, current name as per Aadhar, know registration status, scheme eligibility besides helpline nos. and self-registration features.

Kheti - Badi

Kheti-Badi is a social initiative App. It aims to promote and support Organic Farming and provide important information/issues related to farmers in India. This app is currently available in four languages viz., Hindi, English, Marathi and Gujarati.

Krishi Gyan

Works on a similar aspect as WhatsApp communication but is considered to be better as it doesn't require mobile numbers of individuals to stay connected. Apart from providing general information on farming, this application enables Indian farmers to connect with Krishi Gyan experts and ask them questions related to farming, and get answers within the application through notifications. The farmers as well as agriculture enthusiasts can also share their answer with each other.

Crop Insurance

The app helps farmers to calculate insurance premium for notified crops and provides information cut-off dates and company contacts for their crop and location. It can also be used to get details of normal sum insured, extended sum insured, premium details and subsidy information of any notified crop in any notified area.

AgriMarket

The purpose of this app is to keep farmers abreast of crop prices and discourage them to go for distress sales. Farmers can get information related to prices of crops in markets within 50km of their own device location using the AgriMarket Mobile App.

Krishi Kisan

This app helps farmers to get the benefit of field demonstration of new technologies, seed hubs and weather advisories.

CHC – Farm Machinery

Farmers across the country can hire tractor and other farm machineries using this multi lingual mobile app. So far, 40,000 custom hiring centers have been registered on the mobile app for renting over 1,20,000 agricultural machineries and equipment's.

Uzhavan (Farmer) App

This app allows farmers to have access to nine types of services, including details about their crop insurance, information on farm subsidies, book farm equipment and related infrastructure and receiving weather forecast for the next four days.

Spray Guide

The app calculates the amount of solute, the amount of solvent, the mixing time and the spraying of pesticide areas so that farmers get the best value for the investment.

Machinery Guide

This app assists the farmers for using the farm equipment for various purposes like soil cultivation (cultivator, rotator, roller, etc.), sowing, manuring, planting, fertilization, pest control, produce sorting, harvesting, irrigation, etc. p. recisely.

eNAM Mobile

The purpose of the Mobile App is to facilitate remote bidding by traders and access to arrivals and price related information to farmers and other stake holders on their smart phones.

According to a recent report, it has been revealed that mobile internet access can increase a small farmer's revenue by 50%. All these mobile apps are helping reduce transportation, corruption and transactional waste in agriculture and also offer a gateway for resource sharing for farmers. Thus, the apps are helping boost overall performance of Indian agriculture and reducing negative environmental impacts of farming. Thus, these advancements will definitely help bring significant change in the lives of farmers and the field of agriculture.

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Genetic variability in Ridge Gourd (*Luffa Acuntangula* (L.) Roxb.)

Article ID: 32697

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Abstract

An experiment was conducted on Genetic variability in the eighteen genotypes of Ridge Gourd during 2019-20 at the Research Field of Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj. The observations were recorded on various yield and yield contributing characters. The results from the present investigation revealed that on the basis of Based on mean performance for fruit yield per plant (2.720 kg) and fruit yield ((24.480t/ha-1), genotypes 2017/RIGHYB-5 were considered suitable genotypes in Prayagraj climatic condition. Coefficient of variation revealed that high magnitude of GCV and PCV were recorded for Fruit yield/ ha (ton) and Average fruit weight (g). The heritability estimates were found to be high (more than 60%). The genetic advance and genetic advance as percent of mean estimates were found to be high (more than 20%). Genotypic correlation coefficient analysis revealed that fruit yield plant-1 (kg) showed positive significant association with Fruit length (cm) (0.598**), Fruit diameter (cm) (0.741**), Rind thickness (mm) (0.514**), Flash thickness (mm) (0.523**), Number of fruit per plant (0.666**), Vine length (cm) at 90 DAS (0.275*) and Average fruit weight (g) (0.944**) at genotypic level. Whereas Phenotypic correlation coefficient analysis revealed that fruit yield plant-1 (kg) showed positive significant association with Fruit length (cm) (0.573**), Fruit diameter (cm) (0.709**), Rind thickness (mm) (0.509**), Flash thickness (mm) (0.504**), Number of fruit per plant (0.607**), Average fruit weight (g) (0.924**) and Vine length (cm) at 90 DAS (0.270*) at phenotypic level.

Keywords: Ridge Gourd, Genotypes, Genetic variability, heritability.

Introduction

Ridge gourd [*Luffa acutangula* (L.) Roxb.], popularly known as Kalitori and also called as angled gourd, angled loofah, Chinese okra, silky gourd and ribbed gourd, belongs to genus Luffa of "Cucurbitaceae" family and has chromosome number 2n = 26. The genus derives its name from the product "loofah" which is used in bathing sponges, scrubber pads, door mats, pillows, mattresses and also for cleaning utensils. It contains a gelatinous compound called "luffein'' and has pharmacological importance.

Ridge gourd *(Luffa acutangula)* is one of the most important warm season vegetables which is commercially propagated by seeds. It contains high content of water and nutrients, protein, fat, carbohydrates, minerals and vitamins (Asha et al., 2018).

This improvement in any crop is based on the extent of genetic variation and magnitude of available beneficial genetic variability. Some of the biometrical parameters include genotypic (GCV) and phenotypic (PCV) coefficients of variation. High value of these coefficients indicates wider diversity. Similarly, narrow difference between GCV and PCV reveals low sensitivity to the environmental effects. Another indicator of variability is heritability, which is the ratio of genetic variance to total variance. This is broad sense heritability and gives an idea about that portion of observed variability which is attributable to genetic differences. Genetic advance would be more in cases where the additive genetic variance is more than non-additive genetic variance (Lush, 1949). The present investigation was undertaken with 18 ridge gourd cultivars collected from IIVR with the objective of obtaining information on variability, heritability and genetic advance.

Selection based on yield alone is often misleading because it is one of the most complex characters being dependent on its components for its full expression. For rational improvement of yield and its components, association of component characters with yield and among the components themselves should be found out by estimating the correlation co-efficient. Path co-efficient analysis was carried out to know the direct and indirect effect of the traits on plant yield Harshitha et al., (2019).

Materials and Methods

The experiment was conducted in Randomized block design (RBD) with 18 treatments and 3 replications in Horticulture research field, Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during the year 2018-2019. Total number of treatments used were eighteen, collected from IIVR, Varanasi.

Conclusion

From the present study it is concluded that ridge gourd genotypes showed significant genetic variability. Based on mean performance for fruit yield per plant and fruit yield, genotypes 2017/RIGHYB-5 were considered suitable genotypes in Prayagraj climatic condition. Coefficient of variation revealed that high magnitude of GCV and PCV were recorded for Fruit yield/ ha (ton) and Average fruit weight (g). The heritability estimates were found to be high. The genetic advance and genetic advance as percent of mean estimates were found to be high. Genotypic correlation coefficient analysis revealed that fruit yield plant-1 (kg) showed positive significant association with Fruit length, Fruit diameter, Rind thickness, Flash thickness, Number of fruits per plant, Vine length and Average fruit weight at genotypic level. Whereas Phenotypic correlation coefficient analysis revealed that fruit yield plant-1 (kg) showed positive significant association with Fruit length, Fruit diameter, Rind thickness, Flash thickness, Number of fruits per plant, Average fruit weight and Vine length at 90 DAS at phenotypic level.

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Reproduction in Bitches

Article ID: 32698

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Bitches are mono-estrous with only one estrous cycle during the breeding season. The onset of estrous is gradual with a long pro-estrous period of 3 to 12 days averaging 7 to 10 days. During this period the vulva is swollen, firm, and edematous and a bloody discharge from the uterus is observed at the vulva. This is due to the effect of estradiol from the follicle on the uterus. Estrum, true heat or the period when the bitch will accept the male, lasts from 3 to 21 days, with an average of 4 to 12 days. Blood in the vaginal discharge may continue for one or two or more days into estrum. Ovulation usually occurs 1 to 3 days after the onset of true estrum, taking 12 to 72 hours for the follicles to rupture. The ova of the bitch differ from other domestic animals in not requiring prompt fertilization within 8 to 12 hours; the fertile life of the ova in the bitch may exceed 4 days.

The estrogen level increases from basal anestrous levels (2-10 pg/mL) to peak levels (50-100 pg/mL) at late proestrus, while the level of progesterone remains at basal levels (<1 ng/ml) until increase at LH surge (2-3 ng/ml). The level of estrogen decrease significantly after the LH peak, while the level of progesterone continuously increases (usually 4-10 ng/mL at the time of ovulation), marking the luteal phase of the ovarian cycle wherein the levels of progesterone continuously increase to a peak of 15-80 ng/mL before progressively declining in late diestrus.

In bitches the corpora lutea are mature by 10 days after ovulation. In pregnant bitches the CL may remain large until parturition and then regress rapidly. After 30 days of pseudopregnancy, the corpus luteum may begin to slowly atrophy or regress. This progestational or pseudo-pregnant period of 30 to 90 days in the non-pregnant bitch is characterized by proliferative change in the uterus and mammary glands. As the corpus luteum regresses at about 60 days after estrum, bitches may lactate, make a nest, and often act like bitches that are about to whelp or have recently whelped.

Vaginal cytology is highly indicative of the stage of the estrous cycle in the bitch. Exfoliative vaginal cytology (See Photo 1-4) is performed by rolling a wet sterile cotton swab over the vulva, smearing onto a clean grease free microscopic slide, drying and staining with Giemsa after fixation in methanol. The principal cell type during anestrous is parabasal cells (round or ovoid with big nucleus) with very few neutrophils. During pro-estrous there is increase in the concentration of small and large intermediate cells (polygonal cells with sharp borders and small nucleus) along with RBCs. As the pro-estrous blends into estrous the principal cell type (>80%) are superficial cells or cornified cells (anuclear cells with irregular border) with few RBCs. Ovulation is characterized by the appearance of neutrophils and as diestrous progresses the concentration of parabasal cells increase and superficial cells decrease (<20%).

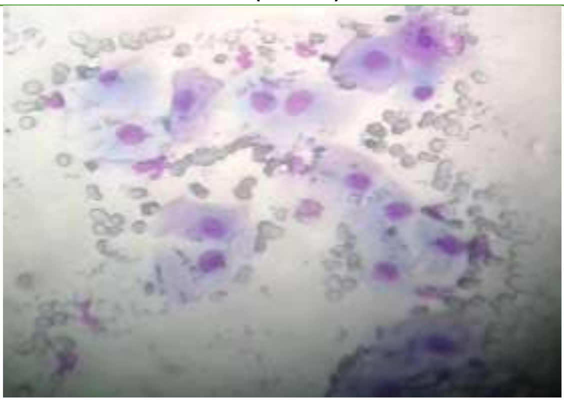	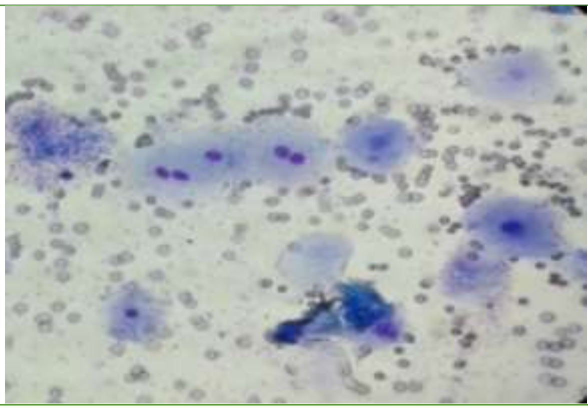
Photo 1: Early Proestrus	**Photo 2: Late Proestrus**

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	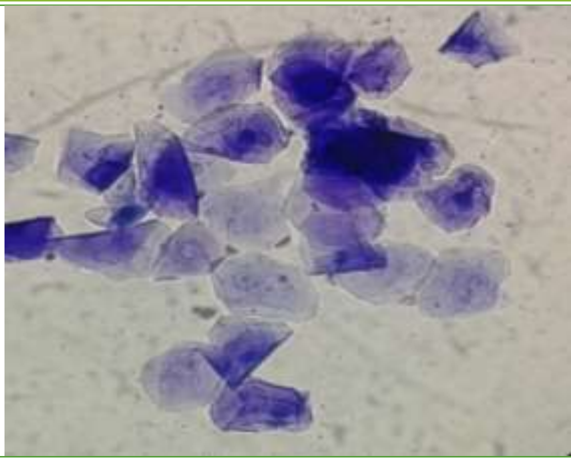
Photo 3: Early Estrus	**Photo 4: Late Estrus**

Ideally mating should be carried out on the day of ovulation. Following ovulation, it takes two days for the ova to mature and considering the prolonged fertile life of canine spermatozoa in the reproductive tract (7 to 9 days averaging 4 days) it has been found that 95% conception occurs if the bitch is mated on the day of ovulation. However, ovulation can occur at variable times during the estrous period (1-21 days). Thus, a combination of progesterone assay and exfoliative vaginal cytology should be carried out to precisely determine the timing of ovulation. It takes almost two days from the first rise in progesterone for ovulation to take place coinciding with the change of vaginal cytology by the first appearance of neutrophils. Thus, serial exfoliative cytology and progesterone assay on alternate days starting from the day of true estrous is highly beneficial in detecting the time of ovulation.

The gestational length of bitch is 63 to 65 days starting from the LH surge. In field condition, the breeders arbitrarily breed the bitches two to three times and calculate the delivery date from the day of last breeding that often turns out to be untrue.

Exfoliative vaginal cytology and progesterone assay should be used for diagnosing the time of ovulation and mating. Further pregnancy should be diagnosed after 30 days of mating by ultrasonography and reconfirmed at 50 days by X-ray or ultrasonography. It should be noted further that pregnancy should not be assumed based on external symptoms and behaviour as non-pregnant bitches also exhibit these due to pseudo-pregnancy.

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Farmer's Tips in the Field of Bovine Reproduction

Article ID: 32699

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The success of bovine reproduction and cattle rearing of the farmers also depends on their proper knowledge. By improving the current knowledge of bovine reproduction, our farmers can make the cattle rearing in profit. In this context, we are summarizing some important tips for successful bovine reproduction related to timely heat detection, conception improvement, and when to call our veterinarian to solve the problems of bovine reproduction. These important tips are given below:

1. Timely Heat Detection Instrumental in the Success of Artificial Insemination:

a. Symptoms of heat include bellowing, vulvar mucus discharge (Photo 1), swelling and redness of vulva, mounting and standing to be mounted (Photo 2), drop in milk yield and appetite as well as restlessness.

b. Heat should not be detected based on only one or few of the above-mentioned symptoms. There is great variation in the intensity of the above symptoms among cows. Therefore, cows should be checked for all the above symptoms.

c. Cows should be watched for heat for fifteen minutes daily at three times during the day i.e. 6 A.M., 6 P.M. & once before going to bed (i.e. 10 P.M.).

d. The timing of artificial insemination should be 12 hours from the onset of heat following the A.M./P.M. rule. For example, if a cow is on heat at 6 A.M. it should be inseminated at 6 P.M. and vice versa.

e. Double insemination improves the success of artificial insemination. If double insemination is to be followed the second insemination can be done 8 to 12 hours after the first.

	
Photo 1: Mounting by estrus cow	**Photo 2: Mucus discharge and insemination**

2. Management Strategies that Improve Conception Rate:

a. Cows should receive optimum nutrition during the dry period (7-9 months of pregnancy) and should not have a body score below 3 at the time of calving. This means that the rib cage of the cow should not be discernible at the time of calving. This improves the conception rate post-partum and shortens the days open.

b. Double the amount of vitamin mineral mixture three weeks before parturition. If the company label of the vitamin-mineral mixture says 50 grams to be mixed as top dressing, mix it at 100 grams daily three weeks before parturition. This minimizes the incidence of retained placenta, post-partum metritis and pyometra.

c. Do not inseminate cows at the first post-partum heat. Cows should have one 21 days cycle before the heat at which insemination has to be done.

d. Many farmers do not inseminate their cows before six to eight months of lactation with the apprehension that pregnancy depresses the milk yield. In doing so, they fail to realize that many reproductive disorders that remain un-diagnosed and un-treated during this period can cause permanent damage to the reproductive tract.

e. After insemination of the cows, watch the cows for heat on days 19, 20, 21 and 22. If the cow comes to heat at this period it is certain that the cow is not pregnant and should be inseminated. However, not returning to heat on day 21 does not guarantee pregnancy.

f. The cows that do not come to heat on day 21 should be diagnosed for pregnancy on day 65 by a veterinary doctor. Early diagnosis is also possible but carries the risk of fetal loss.

g. Never trust any organization or person claiming diagnosis of pregnancy in cows and buffaloes from urine or blood.

h. If the cow does not come to heat after day 21 of insemination but returns to heat after day 50 of insemination, call a veterinarian for the diagnosis of pregnancy before going for A.I. Many cows show symptoms of heat during pregnancy.

3. When to call the Veterinarian?

a. The cow does not come to heat by three months of parturition.
b. The cow persistently remains in heat for three or more days or has irregular estrous cycle.
c. The cow comes to heat but the discharge is not clear and watery.
d. The discharge is white mixed with blood.
e. There is persistent mucous discharge particularly when she is lying down.
f. The cow fails to conceive after three consecutive inseminations.
g. Check the cow for pregnancy
h. The cow aborts
i. Do not call a veterinarian if there is slight bleeding a day or two after the day of heat.

Thus, all farmers must consider/ remember above mentioned tips for successful bovine reproduction and production.

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Role of Biopesticides in Attaining Sustainable Agriculture

Article ID: 32700

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Introduction

The present scenario is showing an increasing trend in global hunger index and malnutrition with failure to achieve food security in many countries. According to an estimate of Food and Agriculture Organization (FAO), the world population is to cross the nine billion mark and to meet the growing food demands agriculture will need to produce nearly 60% more food globally. Most of the developed as well as developing countries are now implementing policies to attain a sustainable agriculture. So, what does the word “sustainable agriculture” mean? Sustainable agriculture is a broad term which involves those agricultural practices that are meant to meet the food and fibre needs of human beings along with enhancing the environmental quality and to make efficient use of natural resources ultimately providing better quality lives to the farmers and to the society as a whole. But many biotic and abiotic factors become barriers in attaining a sustainable agriculture. Insects are one among the major biotic constraints which cause innumerable losses to agriculture both in pre-harvest and post-harvest periods. Since time immemorial people have been using various kinds of pesticides to kill the insects attacking the crops. The pesticide era started with the use of inorganic chemicals and today we have reached at the peak of using synthetic organic insecticides. The chemical insecticides have drawn the attention of farmers mostly due to their quick action property. But nowadays the drawbacks of usage of the chemical insecticides to kill the insects have been felt very deeply by the farmers as well as the society. So, now the trend is gradually shifting from chemical pesticides to bio intensive pest control tactics. This article mainly focuses on the role and trends of biopesticides used for pest control, which will ultimately sustain the future generations without hampering the present resources.

What is Biopesticide?

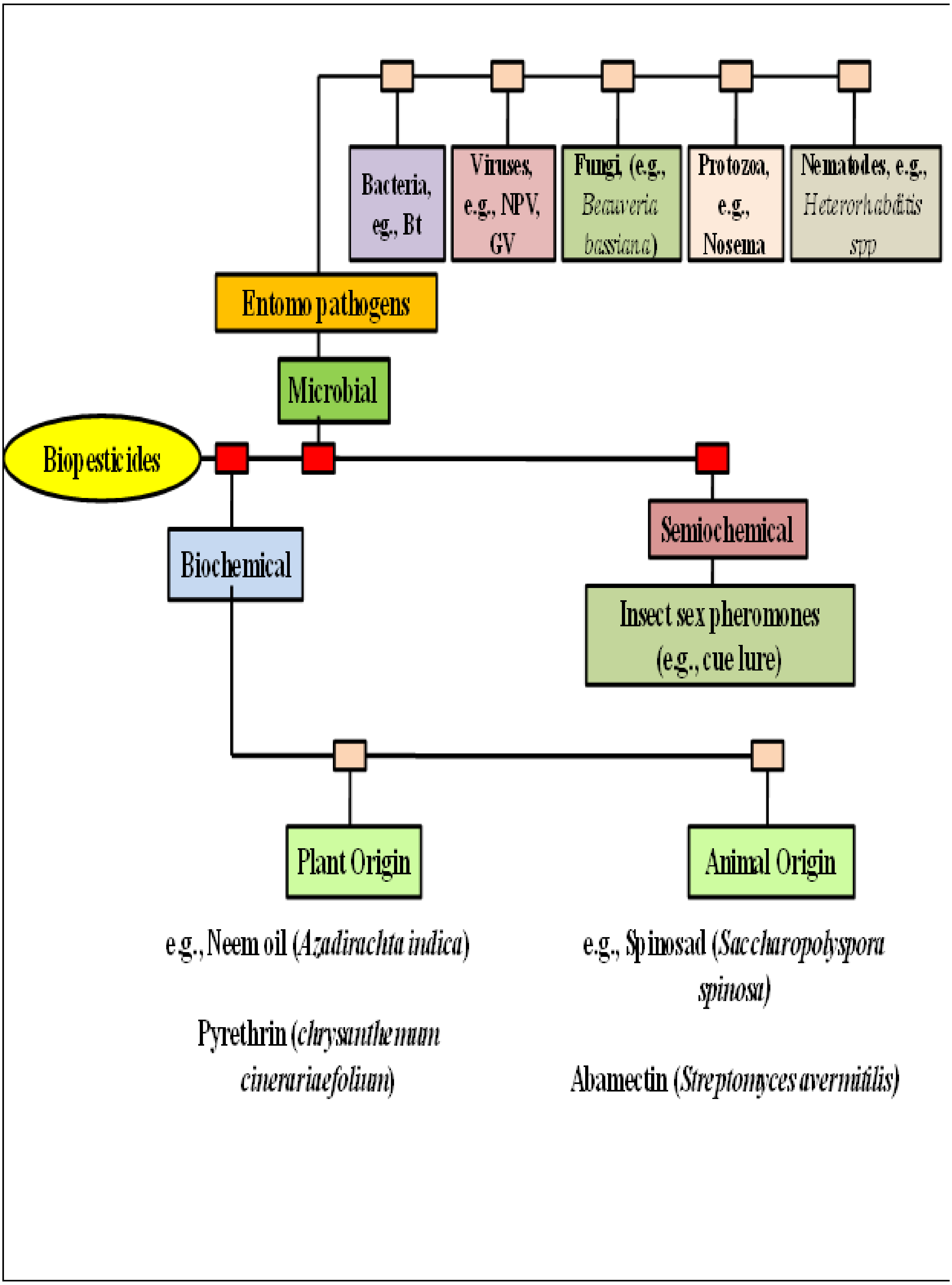
Biopesticides are the naturally occurring biological chemicals, obtained from the living organisms (both plants and animals including microorganisms) or their products (phytochemicals, microbial products) or their by-products like semiochemicals that have the capacity to control the insects by non-toxic mechanisms (Salma and Jogen, 2011).

Biopesticides are the formulations obtained from naturally occurring substances like plants, animals, microbes or living organisms or their products or by-products that control the pests by non-toxic and ecofriendly manner (Kumar and Singh, 2014).

Based on the active substance, the biopesticides are categorized into three types, viz.:
1. Microbials.
2. Biochemicals.
3. Semiochemicals (Chandler et al. 2011).

The microbial biopesticides use bacteria, viruses, fungi, protozoa and nematodes as the pesticidal agents, among these the insecticidal bacterium *Bacillus thuringiensis* (Bt) is most widely used which produces an insect gut cell lysis protein, the δ-endotoxin (Gill et al. 1992). The secondary metabolites secreted by plants, the biochemicals, possess properties like insect repellent, feeding deterrant, etc. They include the widely used plant based biochemical neem oil, extracted from seeds of *Azadirachta indica* (Schmutterer , 1990) and pyrethrins, the potential insect nerve poisons produced by *Chrysanthemum cinerariaefolium* (Silverio et al. 2009) and so many. The soil actinomycetes also secrete secondary metabolites having high insecticidal activity, e.g., Spinosad, synthesized from *Saccharopolyspora spinosa* (Mertz and Yao. 1990) and Abamectin, produced by *Streptomyces avermitilis* (Lasota and Dybas, 1991). The behavioural changing chemical signals produced by an insect species which acts either on same species or on different species are known as semiochemicals. The semiochemical that finds a wider use worldwide is insect sex pheromones which helps in insect control by mass trapping (Reddy et al. 2009), mating disruption and lure-and-kill systems (El-Sayed et al.2009).

Biopesticides Tree



(Fig. 1)

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Why Biopesticide?

The green revolution is characterized by the introduction of high yielding varieties, chemical fertilizers and pesticides which resulted in impressive crop production but consequently degraded the sustainability of the farming systems by affecting both biotic and abiotic components of the environment. The present pest management practices depend heavily on the usage of chemical pesticides which in turn have resulted in consequences like pesticide residues in food, soil and water resources, adverse effects on non-target organisms, resistance development in various pest species, environmental pollutions and serious health issues in human beings. These potential adverse effects of the synthetic chemical insecticides have raised the public concerns which have triggered the use of products based on biological processes for pest control. The use of biopesticides has considerable benefits on agriculture and human health. Biopesticides resolve the problem of residues on fruits and vegetables which is a significant public concern. The biopesticides can be prepared by using local and natural resources which reduces the cost of crop protection. The microbial pesticides have self-perpetuating capacity, so can be produced in-vitro. Biopesticides are target specific and less harmful to other animals and to the environment because of quick decomposition property. These are environmentally safe.

Biopesticides Usage Trends in India

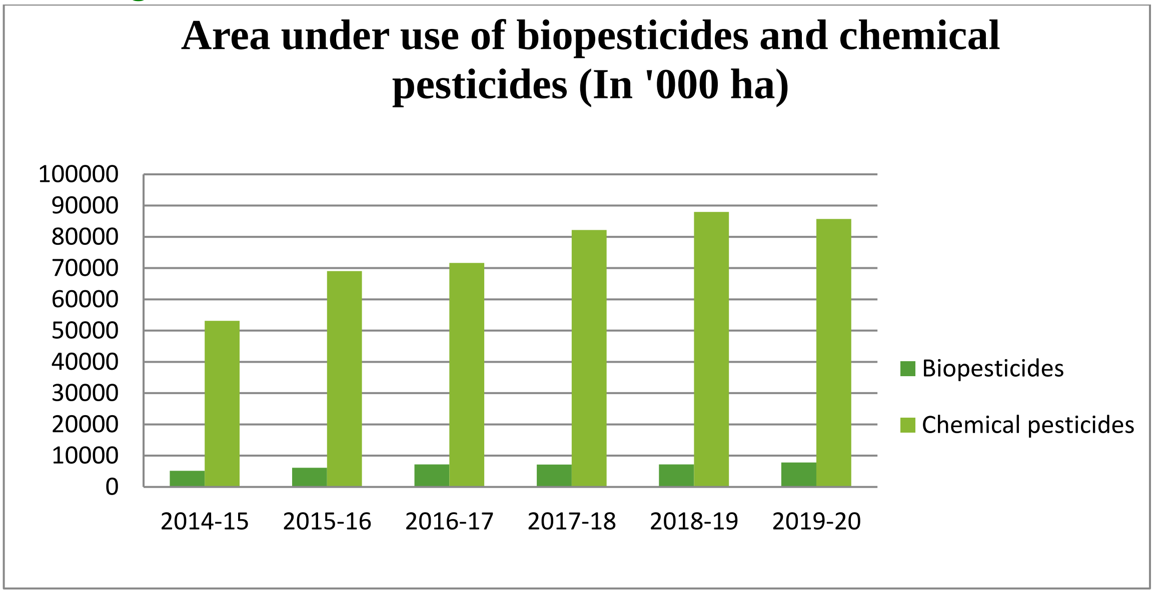

Fig.2 (Source: States/UTs Zonal Conferences on Inputs (Plant Protection) for Kharif & Rabi Seasons.)

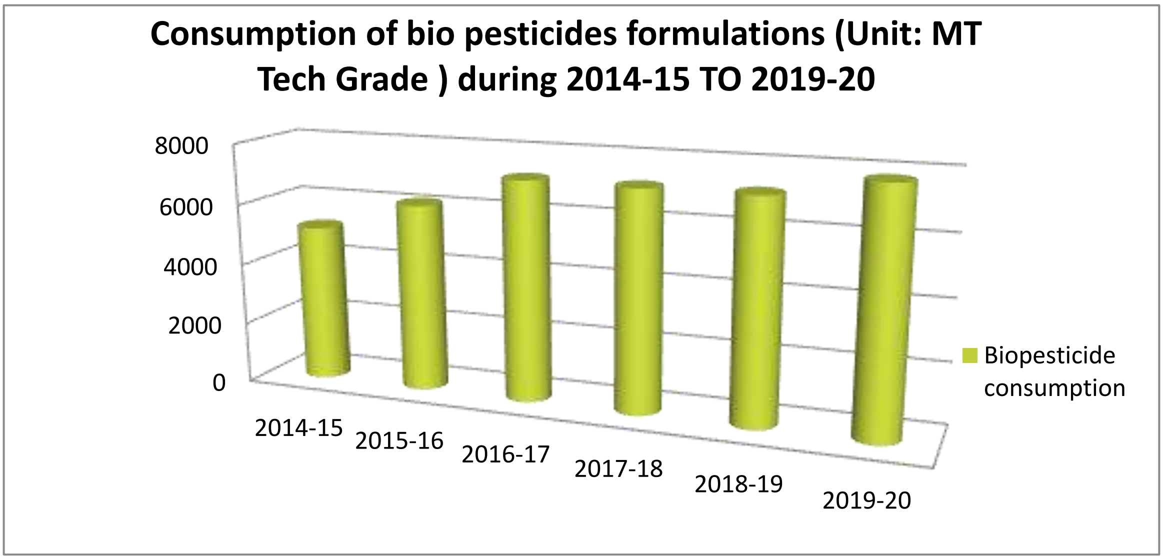

Fig.3 (Source: States/UTs Zonal Conferences on Inputs (Plant Protection) for Rabi & Kharif Seasons.)

Drawbacks of Biopesticides

There are a few downsides of biopesticides. As compared to chemical insecticides, biopesticides are slower in action. Therefore, if pest infestation is severe and needs to be controlled immediately, then biopesticides can't meet the requirement. These are quick degradable and less stable in nature. Their activities are affected by unfavourable environmental conditions. Because of their less effectiveness, these are not recommended for stand-alone treatments.

Conclusion

The growing concerns in the public as well as government on the negative consequences of use of chemical insecticides have triggered the emergence of biopesticides for the control of insect pests. The Biopesticides, being effective and eco-friendly in nature, have attracted the view of policy makers towards building a sustainable agro-ecosystem. The Biopesticides have stood upon as one of the best alternatives to the use of chemical insecticides. The demand for biopesticides is also increasing day by day globally as well as nationally.

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CRISPR: A Novel Genome Editing Tool

Article ID: 32701

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Introduction

Genome editing is also referred as genome engineering or gene editing. It is a technique used precisely and efficiently to modify DNA within a cell. It has accelerated scientific breakthroughs and discoveries in disciplines as diverse as synthetic biology, human gene therapy, disease modelling, drug discovery, neuroscience and the agricultural sciences. It can be used to add, remove base sequences or alter DNA in the genome. It involves making cuts at specific DNA sequences by the enzymes called 'engineered nucleases.' By editing the genome, the characteristics of a cell or an organism can be changed.

Genome Editing: Three Steps

1. Target the locus/ gene targeting.
2. Delete or insert a gene.
3. Repair the DNA strand.

General Principle

Genome editing can be achieved in vitro or in vivo by delivering the editing machinery in situ, which powerfully adds, deletes and "corrects" genes as well as performs other highly targeted genomic modifications. It is widely used by cells to accurately repair harmful breaks that occur on both strands of DNA, known as double-strand breaks (DSB). Targeted DNA alterations begin from the generation of nuclease-induced double-stranded breaks (DSBs), which leads to the stimulation of highly efficient recombination mechanisms of cellular DNA in mammalian cells. Nuclease-induced DNA DSBs can be repaired by one of the two major mechanisms that occur in almost all cell types and organisms: homology-directed repair (HDR) and non-homologous end-joining (NHEJ), resulting in targeted integration or gene disruptions, respectively. Genome editing mainly relies on this concept of DNA double stranded break (DSB) repair mechanics (Thomas et al., 2017).

CRISPR

CRISPR stands for 'Clustered Regularly Interspaced Short Palindromic Repeats'. Early in 1987, CRISPRs were originally discovered in E. coli and later in many other bacteria species. The CRISPR molecule is made up of short palindromic DNA sequences that are repeated along the molecule and are regularly-spaced. Between these sequences there are "spacers", foreign DNA sequences from organisms that have previously attacked the bacteria. The CRISPR molecule also includes CRISPR-associated genes or Cas genes. These encode proteins that unwind DNA, and cut DNA, called helicases and nucleases, respectively.

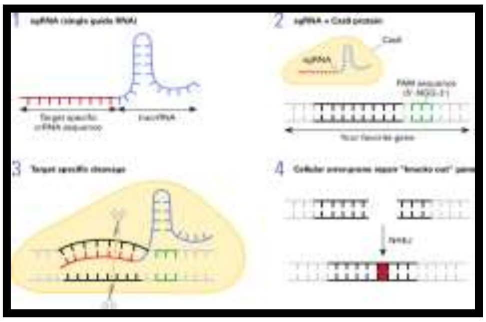
Generally, the CRISPR-Cas systems are divided into two classes based on their organization style and structural variation of the Cas genes:
Class 1: Multiprotein effector complexes
Class 2: Single effector protein

The most frequently used subtype of CRISPR systems is the type II CRISPR/ Cas9 system, which depends on a single Cas protein from Streptococcus pyogenes (SpCas9) targeting particular DNA sequences. CRISPR-Cas9 is the most common, cheap and efficient system used for genome editing. Cas9 stands for CRISPR-associated protein 9, and is the nuclease part that cuts the DNA / chops the DNA. CRISPR is the DNA-targeting part of the system which consists of an RNA molecule, or 'guide', designed to bind to specific DNA bases through complementary base-pairing (Thomas et al., 2017).

Components of CRISPR

1. Protospacer adjacent motif (PAM)
2. CRISPR – RNA (crRNA)
3. Trans – activating crRNA (tracrRNA)

crRNA + tracrRNA = sg RNA



Three Common Strategies have been Developed for Genome Editing with the CRISPR/Cas9 Platform

1. Plasmid-based CRISPR/Cas9 strategy, where a plasmid is used to encode Cas9 protein and sgRNA, assembles Cas9 gene as well as sgRNA into the same plasmid in vitro. this strategy is longer lasting in the expression of Cas9 and sgRNA, and it prevents multiple transfections. However, the encoded plasmid needs to be introduced inside the nucleus of target cells, which is a key challenge in this system.

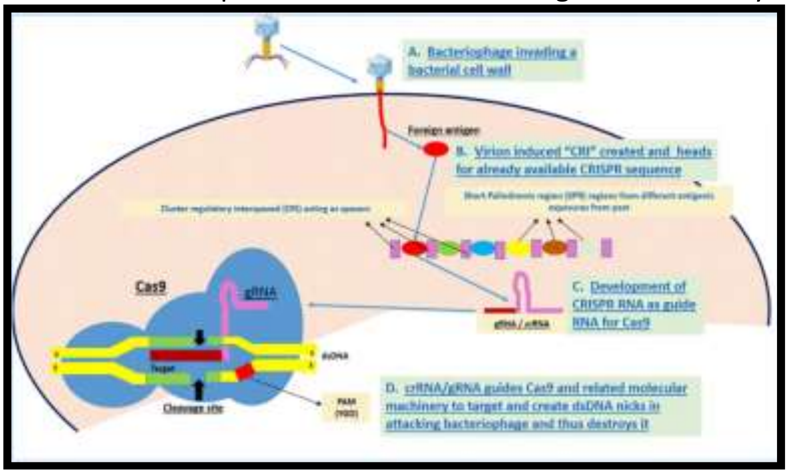
2. Direct intracellular delivery of Cas9 messenger RNA (mRNA) and sgRNA, the greatest drawback of which lies in the poor stability of mRNA, which results in transient expression of mRNA and a short duration of gene modification.

3. Direct delivery of Cas9 protein and sgRNA which has several advantages, including rapid action, great stability, and limited antigenicity.

How it Works

The CRISPR immune system protects the bacteria from repeated virus attacks through three steps:

1. Adaptation: When DNA from a virus invades the bacteria, the viral DNA is processed into short segments and is made into a new spacer between the repeats. These will serve as genetic memory of previous infections.



2. Production of CRISPR RNA: The CRISPR sequence undergoes transcription, including spacers and Cas genes, creating a single-stranded RNA. The resulting single-stranded RNA is called CRISPR RNA, which contains copies of the invading viral DNA sequence in its spacers.

3. Targeting: The CRISPR RNAs will identify viral DNA and guide the CRISPR-associated proteins to them. The protein then cleaves and destroys the targeted viral material(Cong et al., 2013).

Uses of CRISPR

1. Gene Knock-Out: Gene silencing using CRISPR starts with the use of a single guide RNA (sgRNA) to target genes and initiate a double stranded break using the Cas9 endonuclease. These breaks are then repaired by an innate DNA repair mechanism, the non-homologous end-joining (NHEJ). However, NHEJ is error-prone and results in genomic deletions or insertions, which then translates into permanent silencing of the target gene.

2. DNA-Free Gene Editing: CRISPR can be used for DNA-free gene editing without the use of DNA vectors, requiring only RNA or protein components. A DNA-free gene editing system can be a good choice to avoid the possibility of undesirable genetic alterations due to the plasmid DNA integrating at the cut site or random vector integrations.

3. Gene Insertions or "Knock-ins": The CRISPR-induced double-strand break can also be used to create a gene "knock-ins" by exploiting the cells' homology-directed repair. The precise insertion of a donor template can alter the coding region of a gene. Previous studies have demonstrated that single-stranded DNA can be used to create precise insertions using CRISPR-Cas9 system.

4. Transient Gene Silencing: By modifying the Cas9 protein so it cannot cut DNA, transient gene silencing or transcriptional repression can also be done. The modified Cas9, led by a guide RNA, targets the promoter region of a gene and reduces transcriptional activity and gene expression. Transient activation or upregulation of specific genes can be effectively done (Santiago et al., 2017).

Applications of CRISPR

1. Arguably, the most important advantages of CRISPR/Cas9 over other genome editing technologies is its simplicity and efficiency.

2. Since it can be applied directly in embryo, CRISPR/Cas9 reduces the time required to modify target genes compared to gene targeting technologies based on the use of embryonic stem (ES) cells.

3. Improved bioinformatics tools - To identify the most appropriate sequences to design guide RNAs and optimization of the experimental conditions enabled very robust procedures which guarantee successful introduction of the desired mutation (Dharmacon, 2016).

Drawbacks of CRISPR

CRISPR-mediated genome editing has drawbacks, though. The PAM requirement limits target sequences. Cas9 is large, so its gene is difficult to deliver to cells via vectors such as adeno-associated viruses commonly used in gene therapy. Scientists worry about off-target effects, although experts note that concerns about unintended mutations are often based on calculations from studies on improving editing. These studies may deliberately use low-specificity conditions to facilitate monitoring progress. An additional advantage of CRISPR/Cas9 is that it has the potential of simultaneous multiple loci editing, making this technology easier, more efficient and more scalable compared to other genome editing technologies (Sikandar, 2019).

Conclusion

CRISPR/Cas9 based genome editing is a fundamental breakthrough technique. Application of genome editing tools in crop improvement to enhance yield, nutritional value, disease resistance and other traits will be a prominent area of work in the future. CRISPR has played a huge part in the increase in genome editing studies in recent years. The system has broad applications in plant and animal improvement, as well as in the medical field. As a relatively young technique, various discoveries and innovations for its efficient use in wider applications are in the offing. CRISPR/Cas9 based genome editing will gain popularity and be an essential technique to obtain ‘suitably edited’ plants that will help achieve the zero-hunger goal and maintain feed the growing human population.

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Medicinal Values, Nutritional Benefits and Preparation: Herbal Papaya Candy

Article ID: 32702

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Introduction

The Papayas, papaw or Pawpaw is the fruit of the plant Carica Papaya L. in the genus Carica. It is native to the tropics of the America and was first cultivated in Mexico. Several centuries before the emergence of the Meso-American classic cultures (Swami Premanath, 2010). It is a common fruit in nearly all parts of tropical and sub-tropical world. It is an abundant grown in India, Srilanka, Bangladesh, south Africa, Pakistan, Mexico, Causa Rica, Hawaii, Taiwan, Kenya, Peru, USA and Philippines. It is rich in various nutrients, low in calories (32 kcal/100g ripe fruit) and good source of vitamins and minerals especially Vitamin A, C and carotenoid content. , it has very low concentration of Vitamin E (0.3mg/100g fresh weight). (Yadav and Singh, 2014).

Medicinal Values

1. Crude papain is also used to treat patients with celiac diseases as it helps in digestion of proteins. (Rajaratnam., 2010).
2. Due to the presence of benzyl isothiocynate it is used as chemoprevention against cancer.
3. Antioxidant and Diuretic properties present in cardamom used to lower the blood pressure.
4. Lemongrass is used for treating digestive tract spasms, stomachache and convulsions.
5. Tulsi is also used to treat heart diseases, respiratory problems and even it helps in skin brightening.

Nutritional Facts

Sl. No	Nutrient	Value
1	Carbohydrates	6.9 g
2	Sugars	6.9g
3	Dietary fiber	2.3g
4	Sodium	7.3mg
5	vitamin A	152µg
6	Vitamin	60mg
7	Carotenoids	1679µg

Preparation of Herbal Papaya Candy

Materials required	
Peeled Papaya	300g
Sugar	220g
Water	200ml
Flavours	Cardamom Powder, Tulsi Powder, Lemon Grass Powder, Citric Acid.

Method of Preparation

Select right quality of raw papaya and wash them properly. Make few streaks on papaya with a knife. Allow latex to flow out and peel the papaya. Cleanse them without latex. Allow them to dry. Cut the papaya and remove the seeds and chop them into small cubes (preferably 2-3 cm in dimension). Soak the cubes in common salt for one hour.

Later, cubes of papaya are blanched in water for 10-15 minutes until they become soft and transparent. Remove the water and drain it properly before transferring cubes into a container. Take another container with 220 Ml of water adding 220 grams of sugar to it. Boil the solution until the sugar is completely dissolved. Add 300 grams of papaya cubes to the sugar syrup. Boil them for 20-25 minutes and steep the pieces in the Sugar syrup for 6-8 hours. Add 1.5 grams of Citric Acid as a preservative.

Add the chosen herbal flavours Tulsi, Cardamom and Lemon grass in preferable proportion. Add organic food colour, if required. Drain the papaya cubes from sugar syrup and allow them to dry in shade until they become crisp. Pack them in Bio-degradable polythene pouches or right quality plastic containers.

Conclusion

Papaya candy can be prepared by various value additions of cardamom, tulsi, lemon grass and other spices. But this study is the preparation of Herbal papaya candy in value addition with papaya cubes is one of the best methods to improve the nutritional quality of the Candy. Candy preparation not only having the health benefits but also preserves the papaya from the post-harvest losses.

List of Photographs

		
Peeling of papaya	**Chopping them into cubes**	**Precooking**

Herbal papaya candy

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Strategies to Increases Productivity of Pulses in India

Article ID: 32703

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Introduction

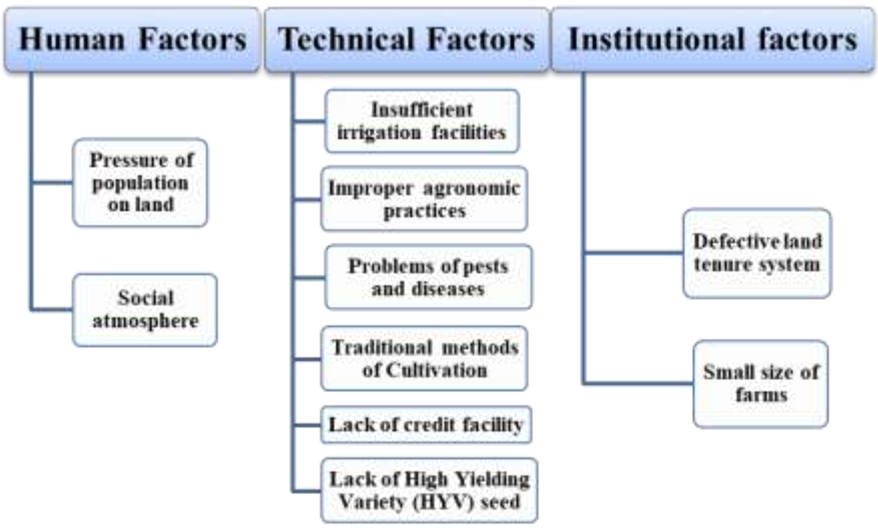
Pulses are the chief sources of proteins, vitamins and minerals and are popularly known as "Poor man's meat" and "rich man's vegetable", contribute significantly to the nutritional security of the country. For the average Indian household, dal has to be part of the daily menu. Per capita net availability of pulses in India, however, has reduced from 51.1 gm/day (1971) to 41.9 gm/day (2013) as against WHO recommendation of 80gm/day. For the majority, dal is the only source of protein.

Nutritive Value of Pulse

Constitutes	Magnitudes
Protein	>20%
Carbohydrate	55-60%
Fat	>1.0%
Fiber	3.2%
Phosphorus	300-500 mg/100gm
Iron	7-10 mg/100gm
Vitamin C	10-15 mg/100gm
Vitamin A	430-489 IU
Calorific value	69-75 mg/100gm
Calcium	343

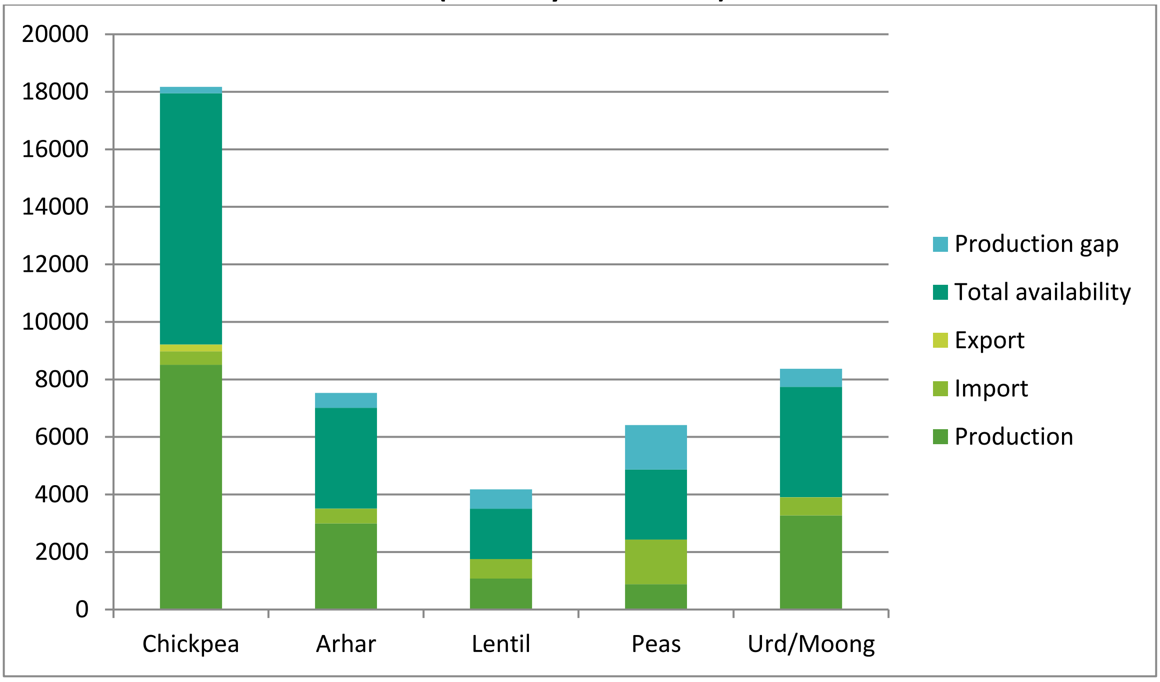
India is the largest producer and consumer of pulses in the world accounting for about 29 per cent of the world area and 19 per cent of the world's production. Among various pulse crops, chickpea dominates with over 40 percent share of total pulse production followed by pigeon pea (18-20%), moongbean (11%), urdbean (10-12%), lentil (8-9%) and other legumes (20%) (IIPR Vision 2030). The scarcity of pulses has serious problem of malnutrition. Thus, there is an urgent need to increase production of pulses to meet the requirement by manipulating production technologies appropriately.

Method of Preparation



Availability and Production Gap (Ave: 2012-13 to 2014-15):

(Quantity in 000 tons)



Source: Ministry of Commerce & DES, Ministry of Agriculture & Farmers Welfare

Strategies to Increase Productivity of Pulses in India

1. Integrated crop management technologies: These includes standardization for basal done of fertilizers/nutrients, seed rate, seed priming to ensure better germination, planting methods (raised bed, ridge and furrow, broad bed and furrow, dry sowing followed by light irrigation) for better crop establishment, pre-emergence application of weedicides, irrigation scheduling and micro-irrigation etc. Application of sulphur @ 20-25 kg/ha can enhance yield by 15-20 % irrespective of pulse crops. Similarly, soil application of 1 kg Ammonium Molybdate has helped in achieving higher productivity of chickpea in soybean belt of Madhya Pradesh (Gupta and Gangwar 2012). Supplemental irrigation with a limited amount of water, if applied to rainfed crops during critical stages can result in substantial improvement in yield and water productivity.

2. Integrated nutrient management: The low productivity of pulses is mainly due to their cultivation on poor fertile soils with inadequate and imbalanced nutrient application without the application of organic manures and micronutrients like boron, zinc and molybdenum. The use of phosphate solubilizing bacteria (strains from the genera of Pseudomonas, Bacillus and Rhizobium are among the most powerful P solubilizers) as inoculants simultaneously increases P uptake by the plant and thus crop yields (Khan et al., 2009). INM involves optimum use of indigenous nutrient components i.e. crop residues, organic manure, biological N fixation as well as chemical fertilizer and their balancing interactions to rises N and P recovery. Pulses are generally fix atmospheric nitrogen so treat seed before sowing for enhancing N-fixation.

3. Integrated pest & diseases management: In absence to access to resistant/tolerant varieties, quality bio-pesticides (Trichoderma spp., Pseudomonas fluorescen and *Bacillus subtilis*) and fungicides (carbadenzim or thiram) for seed treatment, seed as well as soil borne diseases dominated by Fusarium and collar rot alone causes 10% seedling mortality in pigeonpea, chickpea and lentil (Sharma et al., 2015). Treat seeds with bio-fertilizers and organic pesticides or fungicides. Soil application of Trichoderma harzianum @10 g/kg FYM for controlling the wilt or seed treatment @10g/kg seeds in pigeonpea for wilt in pigeonpea needs promotion. Besides, insecticides use, in situation of chickpea and pigeonpea crop, fixing of 4-5 pheromone traps per ha and erection of 20-30 bird poles per ha and neem oil spraying decreases larval population of *Helicoverpa*. Foliar spray of Dimethoate @0.03% for managing the aphids in lentil; foliar spray of Imidacloprid 17.8 SL @2.5 ml/10 litre of water or Thiamethoxam 25WG@2-3g/10 litre of water (first spray after 15 DAS and subsequent sprays at 15 days intervals as per need) to control insect of in mungbean and urdbean during kharif.

4. Integrated weed management: Integrated weed management became an accepted and frequently used term by weed scientist in the early1970's.In IWM system use two or more than two methods in combination for efficient weed management. Non-chemical methods like preventive measures, mechanical and cultural methods including stale-seed bed practice are effective for weed management. Pre-emergence and pre-plant herbicides provide effective control of weeds initial crop growth at least one month. In some pulses when the canopy is not adequately developed, 1 hand weeding or application of post-emergence herbicides is required at 20–30 days of growth. Availabilities of post-emergence herbicidal control of weeds in pulses are limited. Herbicides like imazethapyr and quizalofop-p-ethyl can be used in specific crops for controlling specific weed flora.

5. Post-harvest technology: Storage of pulses' grains is prone to loss due to storage grain pests causing huge economic losses in comparison to split ones (in form of dal). Value addition certainly ensures more money from farm produce to the farmers. IIPR, Kanpur has designed and developed a low capacity dal mill "IIPR Dal Mill", however, other Dal Mills developed by CFTRI and CIAE are also available. Still, there is need to divert sincere efforts for improvement in milling.

Conclusion

Global supply of pulses is inadequate, as India occurs to be the largest producer and consumer of pulses. Hence, India wants to produce the required quantity, but also remain competitive to protect indigenous pulses production. There is need to improve the extension activities so that the farmers can be made aware of the nutritional deficiencies in the soil hindering the production as well as to disseminate the enhanced production technologies. The much-talked schemes "Pradhan Mantri Krishi Sinchai Yojana" and "Pradhan Mantri Fasal Bima Yojana" of the Government of India have capacity to bring sea changes in pulses cultivation.

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Effect of Poor-Quality Waters on Soil and Crop Growth Management

Article ID: 32704

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Introduction

Soil and water systems are interring related through a complex web of interactions and any change in one system will cause varying degree of changes in the other. Water quality refers to the characteristics of a water supply that influences its suitability for a specific use. Water quality can be evaluated by its aesthetic, physical, chemical and biological properties which gets influenced by means of agricultural, industrial and anthropogenic uses.

The original source of salts in irrigation water is the rock that forms a part of the earth's crust - it is constantly subject to weathering which releases salts to be carried away by water. When the soil becomes truly saline, the visible surface might be a white crust or dark, moist, oily looking patch. However, salt accumulation begins to affect crop yields long before visible signs of its presence appear.

Nutritive Value of Pulse

India is the largest producer and consumer of pulses in the world accounting for about 29 per cent of the world area and 19 per cent of the world's production. Among various pulse crops, chickpea dominates with over 40 percent share of total pulse production followed by pigeon pea (18-20%), moongbean (11%), urdbean (10-12%), lentil (8-9%) and other legumes (20%) (IIPR Vision 2030). The scarcity of pulses has serious problem of malnutrition. Thus, there is an urgent need to increase production of pulses to meet the requirement by manipulating production technologies appropriately.

Hazards Associated with Water Quality

There are three principal problems that can arise from the quality of irrigation water delivered to the agricultural fields.

1. Salinity hazard: This is directly related to the quantity of salts dissolved in the irrigation water which are left in the soil after the applied water is lost by evaporation from the soil or through transpiration by the plants. Unless the salts are leached from the root zone, they accumulate in quantities which will partially or entirely prevent growth of most crops. When water with high salinity (>2.25 dSm-1) is used continuously for irrigation, it causes salinization of soil. It results in physiological drought in plants, wherein though there is sufficient moisture in the field, plants are unable to absorb water and eventually wilt. Yield of sensitive crops are affected. Use of saline water results in clogging of dripper systems and causes foliar injury when used in sprinkler irrigation systems. Salts deposited on crops can cause leaf and fruit discoloration, reducing market value.

Most surface irrigation water, whose source is rivers, has a total salinity of less than about 0.5 to 0.6 dS/m. Groundwater in the semi-arid and arid regions has generally higher salinity ranging from one dS/m to more than 12 to 15 dS/m. Sea water is highly saline with an average total soluble salts content of about 35 g/l corresponding to an electrical conductivity of about 50 dS/m.

2. Sodicity (alkali) hazard: Sodicity hazard develops when irrigation water contains relatively more sodium ions than divalent calcium and magnesium ions resulting in breakdown of the physical structure of the soil because of the deflocculation effect of sodium. When the soil dries, it becomes hard and compact leaving an impervious layer for water penetration. Fine textured soils, high in clay are most subject to this action. When the soil is high in calcium and magnesium, it may counteract the effect of sodium. Appropriate quantities of amendments, e.g. gypsum can be applied to combat the effect.

3. Toxicity hazard:

a. A high concentration of boron in the irrigation water can have a toxic effect on the growth of many plants. Sulphate salts affect sensitive crops by limiting the uptake of calcium and increasing the adsorption of sodium and potassium, resulting in a disturbance in the cationic balance within the plant.
b. The bicarbonate ions in soil solution harms the mineral nutrition of the plant through its effects on the uptake and metabolism of nutrients.
c. High concentrations of potassium may introduce a magnesium deficiency and iron chlorosis.
d. Excess nitrogen in irrigation water may result in succulence and excess vegetative growth.

Management Practices for Efficient Use of High Salinity Water

1. More frequent irrigation.
2. Selection of salt tolerant crops and varieties.
3. Use of extra water for leaching.
4. Conjunctive use of fresh and saline waters.
5. Cultural practices.

Desalinization of water to remove soluble salts through membrane filters and reverse osmosis has often been referred to as a technical possibility but at the present stage of available technologies it is doubtful if this method can have any large-scale application in the utilization of saline water for irrigation of most agricultural crops, at least in the near future.

Sodicity (Alkali) Problem

The adverse effect of irrigation water quality on soil physical properties is associated with the accumulation of sodium ion on the soil exchange complex which imparts instability to the soil aggregates and whose disruption followed by dispersion of clay particles results in clogging of soil pores. Sodium adsorption ratio (SAR) (Richards, 1954) of the irrigation water is defined by the equation below,

$$SAR = \frac{Na^{+}}{\sqrt{\frac{(Ca+Mg)^{++}}{2}}}$$

For SAR values greater than 6 to 9, the irrigation water could be expected to cause permeability problems in soils which contain swelling type clay minerals.

Eaton (1950) suggested that Residual Sodium Carbonate (RSC) is a good index of the sodality hazard of an irrigation water. The anions HCO_{3^-} and CO_{3^-} in the irrigation water tend to precipitate calcium and magnesium ions in the soil resulting in an increase in the proportion of the sodium ions. Hard water makes the land soft and soft water makes the land hard.

Magnesium Hazard

High Mg / Ca ratio results in increased dispersion of clay particles and reduced hydraulic conductivity. Mg/ Ca ratio of more than 1 is not satisfactory.

Management Practices for Efficient Use of Water with Sodality Hazard

1. Application of amendments: Gypsum needed to decrease RSC by 1 mmol (+)/L works out to 850 kg per hectare metre of water. Gypsum can be either incorporated in the soil or lumps of gypsum can be suitably placed in the water channel (Gypsum bed technology) to dissolve gradually. Sulphuric acid has also been used to amend water quality and can be applied directly to the soil or in the irrigation water. Being corrosive, handling of sulphuric acid presents problems which must be overcome through proper application techniques.

2. Mixing with an alternate source of water: If an alternate source of irrigation water is available, mixing the two sources may be helpful in obtaining water which is acceptable for irrigation considering its sodicity hazard.

3. Irrigating more frequently: Irrigating frequently with small quantities of water is an effective way to manage water with a sodicity hazard. Reduced permeability of the soils restricts water supply to the roots. Also applying large amounts at a time can result in surface stagnation which affects most crops adversely. Frequent irrigations could also reduce the precipitation of calcium by reaction with bicarbonates in water by keeping the soils wet. Using sprinkler, the ability to supply controlled amounts of water at a time should be considered where ever feasible.

4. Growing crops with low water requirements: Extra application of water with a sodicity hazard will further aggravate the sodicity problem. If feasible, growing crops and irrigating during periods of high evapotranspiration demands should be avoided.

5. Growing tolerant crops: Growing crops tolerant of excess exchangeable sodium will help to obtain better returns.

6. Organic matter application: Heavy dressings of organic manures, regular incorporation of crop residues, application of organic materials as rice hulls, sawdust, sugar factory wastes, etc., have all been found useful in maintaining and improving soil physical properties and in counteracting the adverse effect of high levels of exchangeable sodium. Organic matter can contribute to a higher cation exchange capacity (CEC) and therefore lower the exchangeable sodium percentage and improve the water holding capacity of the soil.

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Essential Role of Miraculous Millets in Food and Nutritional Security

Article ID: 32705

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Summary

Millet cultivation can be a solution in the context of food and nutritional security, as these can grow on shallow, low fertile soils with a pH of soil ranging from acidic 4.5 to basic soils with pH of 8.0. Millets can easily thrive in extreme conditions like drought, and some wild varieties can even prevail in flooded areas and swampy grounds. The grains of most of the millets can be stored for long years under normal temperature and this relative storage durability of millets serves as an effective tool in mitigating the climate related drought and famine. Long storage or shelf life period of millets provides vulnerable farmers with a certain amount of food security where income or access to other staple foods might be unstable. Dietary fibre has health benefits like good bowel movement, and reduction in blood cholesterol and sugar. Besides fibre, millets are also rich in health-promoting phytochemicals like polyphenols, lignins, phytosterols, phytooestrogens and phytocyanins. These function as antioxidants, immune modulators, detoxifying agents etc. and hence protect against age related degenerative diseases like cardiovascular diseases (CVD), diabetes, cancer etc.

Introduction

The demand of food is increasing proportionately with growth in world population. At present about 50% of world's total calorie intake is derived directly from cereals (Awika ,2011). Rice, wheat and maize have emerged as the major staple cereals with a lesser extent of sorghum and millets. Dry lands constitute 40% of the global land surface and are home for about 1/3rd of the global population. These low fertile soils are predicted to elevate up to 50–56% in 2100 AD, and 78% of dry land expansion is expected to occur in developing countries (Huang,2016). The spate of farmer's suicides in an agriculture-based country like India has reached to an average of 52 deaths/day, and reports of farmers selling their blood to earn a livelihood in drought-hit region of the country depict the severity of the agrarian crisis (Sharma , 2016).The estimated demand for millets by 2025 is 30 million tonnes. Millet cultivation can be a solution in the context of food and nutritional security, as these can grow on shallow, low fertile soils with a pH of soil ranging from acidic 4.5 to basic soils with pH of 8.0. (NAAS policy paper,2013). Millets can contribute in reducing atmospheric carbon dioxide and help to phase out climatic uncertainties. The grains of most of the millets can be stored for long years under normal temperature and this relative storage durability of millets serves as an effective tool in mitigating the climate related drought and famine. Long storage or shelf life period of millets provides vulnerable farmers with a certain amount of food security where income or access to other staple foods might be unstable.

Role of Millets for Nutritional Security

Role of millets cannot be ignored for achieving sustainable means for nutritional security. As per 2016 Global Nutrition report, 44% population of 129 countries (countries with available data) experience very serious levels of undernutrition, adult overweight and obesity (FPRI, Global Nutrition Report., 2016). A nutrient imbalanced diet is responsible for most of these diseases. According to the estimates of United Nations Food and Agriculture Organization, about 795 million people (10.9% of world population in 2015) were reported undernourished. While on the other hand more than 1.9 billion (39% of world's population) adults ≥ 18 years of age were overweight and further 13% were reported to be obese (WHO Fact sheet,2015).A substantial number of Indian children and women are underweight, anaemic and suffer from micronutrient deficiencies which are the indicators of malnutrition. In this context of global and national nutritional insecurity, millets by virtue of its nutritive value come as a saviour and it is the right time to devise and implement strategies that could enhance the production and productivity and sustain the usage of millets.

Table 1. Nutritional content (per 100 gram) of millet grains vis-à-vis major cereals:

Crop	Protein (g)	Carbohydrates (g)	Fat (g)	Crude Fibre (g)	Mineral Matter (g)	Calcium (mg)	Phosphorus (mg)	Iron (mg)
Sorghum	10.4	72.6	1.9	1.6	1.6	25	222	4.1
Pearl Millet	11.4	67.5	5.0	1.2	2.3	42	296	16.9
Finger Millet	7.3	72.0	1.3	3.6	2.7	344	283	3.9
Foxtail Millet	12.3	60.9	4.3	8.0	3.3	31	290	5.0
Kodo Millet	8.3	65.9	1.4	9.0	2.6	27	188	12.0
Little Millet	8.7	75.7	5.3	8.6	1.7	17	220	9.3
Barnyard Millet	11.6	74.3	5.8	14.7	4.7	14	121	15.2
Maize	11.5	66.2	3.6	2.7	1.5	20	348	2.3
Wheat	11.8	71.2	1.5	1.2	1.5	41	306	5.3
Rice	6.8	78.2	0.5	0.2	0.6	10	160	0.7

(Source: TNAU Agri Portal,2020)

Millets are healthy food irrespective of the age group. The average carbohydrates content of millets varies from 60.9 to 75.7 g/100 g. Least carbohydrate content has been reported in barnyard millet. The protein content of all the millets is comparable to each other with an average protein content of 8.3 to 11.6 g except finger millet, which has been reported to contain 7.3g/100 g Protein. This content is higher than the required 33.9% essential amino acids in FAO reference protein. Similarly millets are also richer in fibres 1.2 to 14.7g ,minerals 1.4 to 4.7 g and Calcium 14 to 344 mg in comparison to rice which has 0.2g,0.6g and 10 mg per 100g respectively.

Dietary fibre has health benefits like good bowel movement, and reduction in blood cholesterol and sugar. Besides fibre, millets are also rich in health-promoting phytochemicals like polyphenols, lignins, phytosterols, phyto-oestrogens, phytocyanins. These function as antioxidants, immune modulators, detoxifying agents etc. and hence protect against age-related degenerative diseases like cardiovascular diseases (CVD), diabetes, cancer etc. (Rao et al., 2011). Among minor millets, foxtail and barnyard millet have low glycaemic index (40-50). Tamilnadu Agricultural University, University of Agriculture Sciences Dharwad and other agriculture,food science and nutrition-based institutes have prepared ready to eat foods from these minor millets and demonstrated their anti-diabetic effects. However systematic studies to validate their glycemic index are needed. Dykes and Rooney (2006) reported that Millets are a great source of antioxidants and have anti carcinogenic properties. Millets are called as miracle grains or wonder grains. It is a great food for people looking for weight loss, diabetic, asthma, allergic and cardiac patients.

Conclusions

In the changing agroclimatic scenario, millets continue to play a critical role in achieving not only food security but also nutritional security as they are appropriately termed as nutritional cereals or miraculous grains. Millets can easily thrive in extreme conditions like drought, and some wild varieties can even prevail in flooded areas and swampy grounds. These have low glycaemic index, abode gluten-free protein and are rich in minerals (calcium, iron, copper, magnesium, etc.), B-vitamins and antioxidants. These extraordinary traits make them nutritious and climate change compliant crops. These can not only serve as an income crop for farmers but also improve the health of the community as a whole. Suitable measures and strategic interventions by National and International agencies can tap the unutilized potential of the water starved areas to produce and supply millets which are far more nutritious and can serve as healthy food. When implemented to a better extent, it would go a long way in removing poverty in Asian and African Countries.

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Integration of Control Measures for Brinjal Fruit and Shoot Borer, *Leucinodes orbonalis* (Guenee)

Article ID: 32706

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Brinjal fruit and shoot borer or eggplant fruit and shoot borer, *Leucinodes orbonalis* (Guenee) (Pyraloidea: Crambidae, Lepidoptera) is a very important pest on brinjal and is one of the main impediments to brinjal production. It can be found throughout India, Bangladesh, Malaysia, Thailand, Burma, Srilanka, Laos, South Africa, Congo etc. It is a major and regular pest of brinjal causing damage up to 30-50% of fruits or more.

Bionomics and Damage

Brinjal fruit and shoot borer is an internal borer which damages the tender shoots and fruits. Host ranges include Solanaceous crop viz., brinjal, potato, tomato and other crop such as mango, sweet potato and pea. About 150-350 creamy white eggs laid singly on the lower surface of the young leaves, green stems, flower buds, or calyces of the fruits. Egg period is about 3-4 days. After hatching, the caterpillar (larva) bores into the nearest tender shoot, flower, or fruit and after boring into shoots or fruits, they plug the entrance hole with excreta. Larva is stout, pink colored with sparsely distributed hairs on warts on the body and brownish head. The larval period is 15 days and there are 5 instars. Larva is the damaging stage. Symptoms of damages are drooping and drying of terminal shoots; shedding of flowers; fruits with holes plugged with excreta; presence of larva inside the shoot and fruit. Larval feeding inside shoots results in wilting of the young shoot. The damaged shoots ultimately drop off, disturbing plant growth and reducing fruit number and size.

1.

2.

3.

4.

Figure. 1 Brinjal fruit and shoot borer; (1) Eggs, (2) Larva, (3) Pupa, (4) Adult moth

Larval feeding inside the fruit results in the destruction of fruit tissue, making even slightly damaged fruit unfit for marketing. The larva takes pupation in tough greyish cocoon (boat shaped pupa) on plant itself. Pupal period is 6-8 days. The adult moths are medium sized with white wings. The forewings have black and brown patches and dots on white colour, hind wings are opalescent with black dots. The total life cycle completes in 17-50 days.

1.

2.

3.

4.

Figure. 2 Damage symptoms caused by Brinjal fruit and shoot borer; (1) Leaves damage, (2) Shoot damage, (3) Bore holes on fruit, (4) Damage inside fruit

Monitoring

Start monitoring for pest at the vegetative stage, look for drooping tender shoots and wilting. Observe crops for small exit holes below the calyx of fruits and the presence of larvae inside damaged fruit and shoots. At crop fruiting stage, look for holes filled with insect excretions. Adult moth wingspan between 18-24 mm, with white wings also can be seen in the field. Based on monitoring follow control actions if 2% of plants or 1-5% of fruit damage.

Integration of Control Measures Include

1. Use healthy, pest-free seedlings.
2. Grow seedlings under nylon netting to prevent moths from laying eggs on the plants.
3. Intercrop with coriander or fennel to reduce pest infestation.
4. Establish maize trap barriers around eggplant plots 15 days before eggplant transplanting.
5. Use tolerant varieties; round-shaped fruit bearing varieties have a higher tolerance to borer pest (e.g. Pusa purple round) or other resistance varieties like Annamalai, Arka Kusumakar, Doli - 5. Chaklasi Doli, Pusa purple Long, Pusa Purple Round, SM 67, SM 68, Pant Samrat.

6. Avoid continuous cropping of brinjal crop.
7. Remove the affected terminal shoot showing boreholes and affected fruits and destroy them. Collect and destroy the damaged tender shoots, fallen fruits and fruits with bore holes to prevent population buildup.
8. Install pheromone trap@12/ha.
9. Use light traps @ 1/ha to attract and kill the moths.
10. Release egg parasitoids *Trichogramma chilonis* @1.0 lakh/ha.
11. Larvae are commonly parasitized by *Trathala flavoorbitalis* (Cameron) (Hymenoptera: Ichneumonidae) can be encouraged.
12. Spray *Bacillus thuringiensis* var. *kurstaki* such as Dipel @ 1.5 to 2 ml /L of water.
13. Avoid using synthetic pyrethroids as they cause resurgence of sucking pests. Also avoid using insecticide at the time of fruit maturation and harvest.
14. Spray any one of the following insecticides at ETL level or starting from one month after planting at 15 days interval viz., Azadirachtin 1.0% EC (10000 ppm) @ 3.0 ml/lit or Neem seed kernel extract (NSKE) 5%, Carbaryl 50 WP 2 kg + Wettable sulphur 50 WP 2 kg, Emamectin benzoate 5% SG @ 4 g/10 lit, Quinalphos 25% EC @ 1.5 ml/lit or Triazophos 40 % EC @ 2.5 ml/lit or Thiodicarb 75 % WP @ 2.0 g/lit with 500 – 750 L of water/ha.

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Advances in Post-Harvest Management of Subtropical and Temperate Fruit Crops

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Temperate and subtropical fruits offer many diverse aromas, textures, tastes and shapes and include many different bioactive compounds. The commercial success of temperate and subtropical fruits worldwide has favoured the development of postharvest technologies and handling techniques for these fruits, especially in developed countries. Some adequate postharvest technologies have now been adopted in developing countries, where most temperate and subtropical fruits are produced and where postharvest technologies were virtually non-existent for many years in the past. There have also been improvements in methods of packaging, storage and processing. However, these can be studied under such headings.

Preharvest Treatments

1. Nutrients: Among the nutrient's calcium has the major role in:

a. Maintaining shelf life of stone fruits.

b. Stabilizes the plant cell wall and protects it from cell wall degrading enzymes.

c. Improves fruit resistance to brown rot.

d. Lower losses of phospholipids and proteins and reduced ion leakage which could be responsible for the lower weight loss.

i. Work on the biochemical aspect of calcium treatments on peach cv. Andross was done. The findings showed that the calcium pre-treatments significantly increased the calcium level in fruit peel and flesh.

ii. Effect of calcium pre-treatments were also realized on reducing post-harvest decay of sweet cherry.

iii. The effect of pre harvest spray of different sources (CaCl2 and CaNO3) and concentration of calcium on high chill peach cv. Silver King at Kullu (Himachal Pradesh) was studied .

2. PGRS and Chemicals:

a. Pre harvest sprays of PGRs and chemicals have also been tried to extend the shelf life of some by inhibiting ethylene production. Pre harvest treatment of AVG on peach cv. Red heaven reduced ethylene production and higher fruit firmness could be maintained during storage as compared to control.

b. Oxalic acid: An organic acid commonly occurring in plant can effectively enhance chilling tolerance and alleviate CI in various fruits like peach and pomegranate as it increases the antioxidant capacity.

c. Glycine betaine (GB): It accumulates plant species in response to abiotic stresses such as drought, salinity, extreme temperatures, UV radiation and heavy metals.

3. Polyamines:

a. Anti-senescence agents and their level changes with various development and ripening processes. Exogenous polyamines application inhibits ethylene production.

b. Also helps to increase fruit firmness, reduce respiration rate, reduce chilling injury, retard colour changes and reduce mechanical damage.

c. Post-harvest treatment of fruits with polyamine has been found effective on increasing fruit firmness in apple, plum, mango, apricot, lemon, etc.

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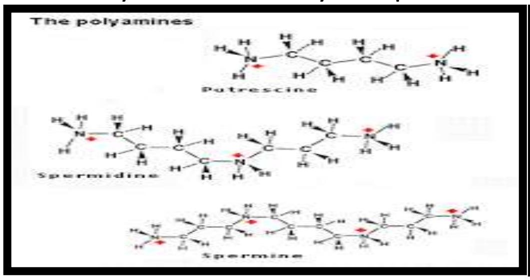
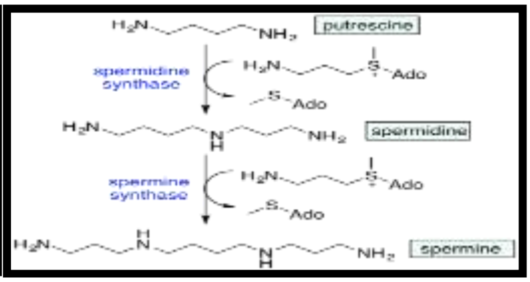
d. Example-putrescine, spermine or spermidine (1 mmol/l) in combination with fungicides were reported to delay or reduce ethylene production.





Post-Harvest Treatment

1. Precooling: Rapid removal of heat from freshly harvested fruits to slow ripening and senescence and conserve weight that reduce deterioration. They are of different types:

a. Room Cooling.
b. Forced air cooling.
c. Forced air evaporative cooling.
d. Hydro cooling.

2. Grading and sorting:

a. Mechanical sorters are available and these are the machines, usually integrated to a conveyor belt, over which agriculture products are sorted by external criteria like dimensions and weight. Such equipment is based on mechanical apparatus triggered by these criteria.
b. For example, a product, be it fruit or vegetable, is dropped into a bucket when its weight or diameter are measured at higher values than a given threshold. When values are lower, it simply travels on the conveyor belt towards the following test.

3. Ozone:

a. Most effective natural bactericide.
b. Ozone is now being used in food processing or storage of perishables as an antimicrobial agent or as a food processing aid. It is strong and ideal, germicide, sanitizer, sterilizer and vermicide, anti-microbial, fungicide and deodorizer in many fruit crops.
c. It doubles the shelf life on fresh produce. It also enhances the taste by retaining the original flavour of the products also enhances the taste of most perishables by oxidizing pesticides and by neutralizing ammonia and ethylene gases produced by ripening or decay in papaya, pomegranate, apple, pear, peach, strawberry etc.

4. Coatings:

a. Edible coatings are thin layers of edible material that provide a barrier to moisture, oxygen and solute movement.
b. Example- Semperfresh is a mixture of sucrose esters with high proportion of short chain unsaturated fatty acids esters, sodium salt of CMC and mixed mono and diglycerides.
c. Chitosan is a by-product from crustacean shell waste, is a high molecular weight polysaccharide. Carnauba wax from the underside of the leaves of a Brazilian palm tree (Copernicacerifera).

5. Nano-technology packaging:

a. Another level of packaging principle, is drawing attention recently. This approach is concerned with molecular level material manipulation that can reduce spoilage or oxidation.
b. Furthermore, there is secure hygienic production, processing and shipment Nanotechnology-based sensors and coating materials can be used for pathogen and contaminant detection and tracing.
c. Nanotechnology has a wide range of food-related applications.

6. Nano coatings:

a. Thick and uniform layers (10–100 nm coating thickness) are broadly referred to as nano-coatings.

b. In recent years, few researchers have developed an intelligent type of nano-coating film that can indicate whether any contamination has occurred during storage.

7. Aloevera coatings:

a. Now-a-days Aloevera gel based edible coating has attracted the researchers due to its film-forming properties, antimicrobial actions, biodegradability, biochemical properties and biologically safe nature.

b. Another innovation was done with the addition of rosehip oil to Aloe vera gel for treating stone fruits that reduced respiration rate in all fruits, and ethylene production in the climacteric ones (peaches, plums and nectarine).

8. Irradiation:

a. Two types of radiation sources are used for the treatments of foods like Gamma rays produced by Cobalt-60, Cesium- 137, X rays with maximum energy of 5 million electron volts (MeV) and electrons with max energy of 10 MeV.

b. The rays are directed on to the fruits, but the fruits never come into contact with source of radiation. It is also called "Cold Pasteurization" as it does not significantly increase the temp.

Application of Robots

1. Robotic system can pack meat, chocolates even fruits into the trays faster.
2. Some robotic system can handle 300 parts a minute and attain accelerations of 200 m per square second with loads of two kilograms.
3. Many food processing plants are constantly automating their final product with the palletizing robot due to the demand for increased productivity.
4. Mostly the robots are engaged in processing of labelling also.

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Impact of Herbicides on Soil Biology and Community Structure

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Introduction

Weeds are a significant constraint and cost to agricultural production worldwide. Weeds emerge fast and grow rapidly competing with the crop for growth resources viz., nutrients, moisture, sunlight and space during entire vegetative and early reproductive stages. Presence of weeds reduces the photosynthetic efficiency, dry matter production and its distribution to economical parts and there by reduces sink capacity of crop resulting in poor fruit yield. Thus, the extent of reduction in yield has been reported to be in the range of 60 to 70% depending on the intensity and persistence of weed density in standing crop. Weed management is an integral part of crop production, and herbicides continue to be the most common weed management tool in most cropping systems. Herbicides are chemicals used to kill the unwanted plants by interrupting normal plant growth.

Herbicides are usually applied when crops are absent or at early growth stages, most of the herbicides applied to the soil.

1. Over the last 2 decades, global herbicide use has increased as farmers have shifted to more sustainable conservation tillage practices and have adopted herbicide-tolerant crop cultivars.
2. The unscientific usage of herbicides significantly alter soil biology and function. These include disruptions to earthworm ecology, inhibition of soil N-cycling in alkaline or low organic matter soils; and site-specific increases in disease.

Unfortunately, little is known about the impact of increased herbicide use on soil biota and the ecosystem services they provide. This in part reflects the diversity of the chemicals being applied and also the diversity in soil ecological communities and function, which renders a full systematic assessment almost impossible. A review of the effects of herbicides on soil biology almost a decade ago (Bunemann et al., 2006) suggested that the database of knowledge is “simply too small to draw sound conclusions,” and a more recent review emphasized the lack of a suitable framework for the routine evaluation of pesticide effects on soil microbial communities and functions. From the few review papers available, the emerging picture is one of compound-specific effects on particular soil functions. With regard to herbicides, adverse effects on phosphatase activity by glyphosate inhibition of nitrification by simazine and adverse Effects on pathogen-antagonistic Pseudomonas bacteria by acetochlor and chlorimuron-ethyl are just some of the examples of the potential effects of herbicides on soil health as related to plant nutrition and disease.

Soil Biology: Community Structure and Function

Living organisms play a critical role in the distribution, transformation, availability and sequestration of carbon, nutrients and toxicants in soil, and therefore crop production. Organic matter turnover liberates nutrients for crop growth. Aside from organic matter turnover, soil organisms regulate nutrient availability through additional transformations of mineral and organic nitrogen (N), phosphorus (P), and other elements. The soil biology also influences the availability of P and other elements to crops. Symbiotic association of plants with mycorrhizal fungi. Other rhizosphere microorganisms contribute to plant nutrition through the production of organic acids that can release mineral-bound phosphates and siderophores that chelate micronutrients in the soil solution. Members of the genus *Bulkholderia*, *Enterobacter*, and Pseudomonas are particularly well represented in this group of *rhizobacteria*. The abilities of certain soil organisms to cause plant disease, and for some soils to suppress disease, are also important processes with direct relevance to sustainable crop production. One of the current challenges in soil science is defining which organisms contribute to, or influence, specific functions and how biological communities adapt to environmental changes without losing the ability to support plant growth and other agronomic goals. In the context of this review, we have taken an "agricentric" stance in that focuses on the processes relevant to sustainable crop production. Although some overlap no doubt exists with processes relevant to natural ecosystems, we should also point out that although soil biology encompasses a wide range of organisms including plant and animals, here is limited to microbial and mesofaunal communities, as well as earthworms. Mesofauna include those organisms which are less than 2 mm in size, such as nematodes, collembola, and mites. Earthworms have been included in this discussion because of their well-established role in soil fertility and common use as a bioindicator in soil toxicity studies.

Impacts of Herbicides on Soil Biology and Community Structure

1. Factors that influence the effects of herbicides on soil ecosystems:

a. Nature of the herbicides: Herbicides have a wide range of chemical structures and biological activities. It is extremely difficult to predict their effects on soil organisms from their chemical structure. Most herbicides have relatively transient effects since they are not persistent in soil. However, a few, such as atrazine, dichlobenil, diuron, fenac, monuron, neburon, picloram, propazine, propham, simazine, and TCA, can persist in relatively small quantities into a second season. Herbicides that reach the soil from foliage sprays usually remain on the surface of the soil and dissipate relatively quickly through volatility. If they are cultivated into the soil, they persist much longer and come into contact with many more organisms. The more soluble herbicides can percolate into the soil with precipitation.

b. Formulation, dose, and method of application: Different formulations influence the amount of the herbicide that reaches the soil and its persistence in soil. Moreover, it can influence the way in which it affects soil organisms. The dose is very important. A small or recommended dose usually has little effect or even stimulates some organisms, whereas large doses produce much more distinct effects. It is important to use doses close to those used in field applications when experiments aimed at predicting environmental hazards are designed. The method of application is important. Some herbicide treatments are used at the soil surface, others are incorporated into soil; this affects both the persistence of the herbicide and the effects on soil organisms.

c. Type of soil: Most herbicides become rapidly adsorbed onto organic matter and clay particles. Depending on the chemical structure of the herbicide and the nature of the bond, this may be reversible or irreversible bonding. Hence, soils with much organic matter or a high clay content tend to adsorb herbicides and lessen any effects they can have on soil organisms, the herbicide will persist longer but have fewer environmental effects.

d. Climatic conditions: Temperature and precipitation have major roles in the way herbicides affect soil organisms. These factors affect the distribution and activity of the herbicide in soil. In dry weather, the herbicide becomes tightly bound to soil fractions, such as organic matter and clay, and largely becomes inactivated. Conversely, in wet weather, it is released and mobile in soil, so it has much greater effects. Temperature and moisture also affect microbial and chemical herbicide decomposition processes and leaching through soil, with losses being much faster in the humid tropics. Moreover, temperature and moisture affect the activity and distribution of soil organisms that may potentially be affected by the herbicide.

2. Resistant mechanism of microbes to toxicities of herbicides: Resistance mechanisms by which microorganisms may avoid or overcome herbicide toxicities caused by enzyme inhibition (as represented by the conversion of substrates to products). Red hexagons indicate active herbicide, while green shapes represent inactive herbicides, herbicide metabolites or bypass systems.

3. Impact of herbicides on soil biota and community structure Microbial Communities: Herbicide-induces changes in abundance, diversity and activity of soil microbial communities may, in turn influence microorganism-mediated processes that are important to sustainable agriculture.

Conclusion

The presence of herbicide residues in soil could have direct impacts on soil microorganisms is matter of great concern. Therefore, effects of herbicides on microbial growth, either stimulating or depressive, depend on the chemicals (type and concentration), microbial species and environmental conditions. These chemicals may affect non-target soil organisms, including microorganisms. Herbicide-induced changes in abundance, diversity and activity of soil microbial communities may, in turn, influence microorganism-mediated processes that are important to sustainable agriculture, e.g., recycling of plant nutrients and maintenance of soil structure. Therefore, the study of stimulatory or depressive impact of herbicides on soil biology and functions is a need of an hour.

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Medicinal Importance of Stevia

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Introduction

Stevia plant is a nutrient rich plant which belongs to asteraceae family. The leave of stevia contains diterpene glycosides stevioside, rebaudiosides A-F, steviolbioside and dulcoside which are responsible for its sweetness. Stevia is termed as natural sweetener.

Stevia herb is a very low in calories parts by parts, its dry leaves possess roughly 40 times more sweetness than sugar rebaudioside-A, are found to be 300 times sweeter than sugar. Stevia is a semi-humid subtropical plant that can be grown easily like any other vegetable crop even in the kitchen garden. Different species of Stevia contain several potential sweetening compounds, with *S. rebaudiana* being the sweetest of all. Stevia is also known as sweet herb, sweet leaf, honey leaf, candy leaf and honey yerba.

Originates in South American wilds, grows in semi-arid habitat, from scrub to grasslands to mountain terrain. It grows up to the height of 65cm to 180 cm. The leaves of stevia are simple, opposite, rarely alternate, mostly petiolate but exstipulate, penninerved or reticulately nerved. It is a short-day plant. The flower is white is colour whit a purple throat.

Medicinal Uses of Stevia

1. Anti-diabetic properties: Stevia leaf extract can defeat plasma glucose level and significantly increase glucose tolerance because it has the ability to increase insulin effect on cell membrane, thus increases insulin production and stabilizes blood sugar level. Stevia leaf either in powder form or dried form is used as supplementary food products for diabetic patients which increases natural sweetness and it also helps in rejuvenating the pancreatic glands. Stevioside enhances glucose-stimulated insulin secretion, but does not affect fasting insulinemia (Chen et al. 2006)

2. Blood pressure regulation: Stevia is used as a heart tonic that regulates blood pressure levels, heartbeat and other cardiopulmonary actions. Hot water leaf extract of stevia lowers the systolic and diastolic blood pressure in humans. *S. rebaudiana* leaves (steviolglycosides) contain non-caloric sweeteners on regular consumption reduces cholesterol in blood, improves cell regeneration and blood coagulation, suppresses neoplastic growth and strengthens blood vessels (Barriocanal et al. 2008) which exert beneficial effects on human health. They relax arteries and lowers the blood pressure.

3. Obesity: The leaves of stevia contain zero calories natural sweetener ent-kaurene diterpene glycosides *(stevioside andrebaudiosides)* that they do not metabolize to produce energy and its sweetness is 300 times more than sucrose. Thus, stevia helps in reduction of weight loss in humans (Kaushik, 2010).

4. Renalfunction: Melis (1992) studied the effect of stevioside from the leaves of S. rebaudiana on renal function that it acts as typical systemic vasodilator which provoked hypotension, diuresis and natriuresis. Steviol and its analog is used in polycystic kidney disease.

5. Other uses: Stevia has anti-fungal and anti-bacterial properties. Mild stevia leaf tea helps in relief of stomach upset. Stevia leaf is used in sweetening foods. It also has antiproliferative/ antimutagenic/antioxidant properties.

Conclusion

Stevia *(S. rebaudiana)* is considered as a non-caloric natural sweetener which has many potential benefits to human beings especially in the field of diabetics, blood pressure, obesity etc. It is used as sugar substitutes in foods due its sweetness in many countries. Stevia provides an opportunity to develop foods rich in antioxidants which is a new functional food.

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Rose Rosette: A New Disease of Rose (Rosa × *hybrida* L.)

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Rose (*Rosa × hybrida*.; Family: Rosaceae) is one of the most economically important ornamental cut flowers and occupies the first position in International as well as domestic trade. It is also used as loose flowers, pot plants, in landscape and in preparation of many other value-added products. Roses are affected with numbers of diseases caused by fungus, bacteria, viruses, etc. Among them, Rose rosette disease is a disease that causes malformation and stunting in rose. It is caused by *Rose rosette virus*. The pathogen has been found to infect the genus *Rosa* only. *Rosa multiflora* has been reported as the most susceptible species to *Rose rosette virus.* Rose rosette disease can cause huge economic lose to rose growers as once the plant is infected, there is no definite control measure and there is high risk of transmission to other healthy plants that are in close proximity.

History of Disease

Symptoms that were undoubtedly due to rose rosette disease were described in the United States as early as 1941. Spread of the disease in the U.S. was linked to the history of the multiflora rose, an exotic plant that was introduced from Japan in 1866 as a rootstock for ornamental roses. During the 1930s through the 1960s, planting multiflora rose was recommended for erosion control, as a bird sanctuary and food source, as a living fence for cattle, for strip mine reclamation, and as a crash barrier on highways. This recommendation ultimately backfired because multiflora rose can produce a million or more seeds per plant and can propagate itself vegetatively as well. It quickly spread and was now declared a noxious weed in several states. Multiflora rose is highly susceptible to RRD. Most rose growers, however, are very cautious of this recommendation because RRD can spread quickly from multiflora rose to cultivated roses.

Symptoms

1. Rose rosette virus infected plants shows symptoms of mosaic pattern in leaf, red pigmentation, excessive thorniness, witches' broom, malformed leaves and flowers, stunting and contorted yellow leaves (Fig.1).
2. The earliest symptoms found in susceptible Rosa spp., include a vibrant magenta, almost purple colouration on the abaxial veins which extends out into leaves, reduction in flowering and increased density of thorns on the shoots.
3. Infected plant also exhibits rosette character in which leaves display a mosaic pattern with vibrant red colouration. Affected leaves are deformed, chlorotic with red pigmentation, and elongated. The leaves tend to be highly elongated, disfigured, and exhibit a ruffled pattern.
4. Lateral buds break dormancy early and grow before the plant is ready. Petioles are significantly shorter, which gives the classic rosette phenotype on symptomatic shoots. Growth rate on unaffected areas of the rose bush is often greatly reduced.
5. Flowering is extremely rare in affected RRV areas of the plant. At the later stage large reduction in leaf size, with leaves becoming almost hair-like and intensely red in hue.
6. Rosette formation is fully characterized by the formation of the described witches' broom phenotype.
7. Petioles are short, almost all lateral buds break dormancy, growth is weak, and the whole plant is characterized by a vibrant, deep red coloration.
8. For rose plants that are in Stage 3, most are unable to survive freezing conditions. As there is no cure for RRV, most rose plants that are susceptible to the disease will die.
9. Typically, a mature rose plant that becomes infected with RRV, will succumb to disease after a period of three to five years.

Disease Cycle and Transmission

Rose rosette disease is most likely caused by the newly named Rose rosette virus, an Emaravirus. The causal agent of rose rosette disease is not soilborne, so it is possible to successfully plant healthy roses in beds where diseased plants have been removed. However, because the pathogen is systemic in infected plants, the virus may persist in RRD-infected root pieces that remain in the soil. If plants regrow from these old root pieces, as multiflora rose is apt to do, they can serve as an inoculum source for healthy plants. Therefore, it is important to thoroughly remove symptomatic plants and ensure that infected plants are not allowed to regrow from old, infected root pieces.

Rose rosette virus is primarily transmitted by eriophyid mite *(Phyllocoptes fructiphilus)*. Eriophyid mites feed on infected rose tissue and carry virons within their probiscous, transferring RRV when they come into contact with another rose plant. Although mites cannot fly, they can move passively long distances via air currents to nearby roses, subsequently infecting new roses. Even though RRV can be transmitted by mites through wind, the risk of infection for roses is minimal if 150-300m distance is maintained away from another infected rose plant. Transmission of RRV can be avoided by maintaining long planting distances between rose planting.

Management

1. The best rose rosette virus disease management practice is to use virus free planting material. Most of the varieties and species are susceptible to this disease, however, *Rosa setigera* was found to be resistant to rose rosette disease.
2. RRV is effectively managed by controlling the vector of transmission i.e. eriophyid mite using miticides such as Hexygon 50DF, Sanmite 75WP, Floramite 2SC, Akari 5SC, etc.
3. RRV infected plants should be uprooted and disposed of properly or burned.
4. Although there is no compound that will directly control Rose rosette virus, effective control of mites with certain miticides can reduce the risk of spread. Pruning roses can potentially eliminate mites and eggs. The eggs and mites are predominately found within the new growth areas and petiole areas of the rose.
5. Phytocides, although unproven, may be an effective measure in managing the population of eriophyid mites.
6. Garlic oil, neem oil and neem seed kernel extract were also found to be promising against eriophyid mites.

	
Witches' broom (Clustering of small branches)	**Leaf proliferation**
	
Excessive thorniness	**Deformed flowers**

	
Leaf redness and distortion	**Stunting of leaves**

Figure: Rose rosette virus infected plants showing different symptoms

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Tillage Relation to Weed Control and Moisture Conservation

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Introduction

Tillage has long been an essential component of traditional agricultural systems. Broadly defined, tillage is the mechanical manipulation of the soil and plant residues to prepare a seedbed for crop planting. The benefits of tillage are many: it loosens soil, enhances the release of nutrients from the soil for crop growth, kills weeds, and regulates the circulation of water and air within the soil (Reicosky and Allmaras, 2003). Soil tillage plays a crucial role, as it determines both the productivity of the cropping system in terms of yield as well as its environmental impacts, such as soil erosion or carbon sequestration.

Tillage has been performed for millennia because it reduces weed density while positively affecting water and nutrient availability. At the same time, brief exposure to sunlight, due to soil inversion after tillage, can trigger the germination of deeply buried weed seeds. Tillage has been used since the beginning of agriculture to prepare the seedbed and reduce weeds that will compete with the crop. The weeds present in any given field will reflect the tillage management system used; therefore, the weed community in a conventional tillage system will be very different than those in a no-till system.

In the arid and semiarid regions, the conservation of precipitation water for crop production is very vital. In dryland crop production areas, a major challenge is to conserve precipitation water appropriately for use during crop growth (Baumhardt and Jones, 2002). It is imperative that farming practices should conserve and utilize the available rainfall efficiently. To optimize water storage under any precipitation condition, the soil should have enough infiltrability, permeability and capacity to store water.

Water is the main constraint in dryland farming. Tillage affects the WP by modifying the hydrological properties and influencing root growth and canopy development of crops and influences soil moisture conservation through reduction in water loss from the surface and subsoil because of break of continuity of capillaries (Hatfield et al., 2001). Tillage practices (such as ZT) to improve infiltration and soil water storage can boost WP by an estimated 25–40%, while nutrient management can boost WP by 15–25% (Hatfield et al., 2001).

Water conservation in the arid and semi-arid regions is an important issue that influences both the environment and crop production. Runoff which is induced by rainfall can cause soil erosion which poses a dominant threat against long-term sustainability of farming (Derpsch et al., 1986). A further problem usually associated with runoff is the loss of soil particles that may pollute water bodies. Pollutants commonly found in runoff include soil particles, phosphorous, nitrogen, pesticides, etc.

Tillage Relation to Moisture Conservation

Tillage practices play an important role in dry farming agriculture; however, the appropriate implements, their time and method of use have to be specific for different agro-climatic zones.

Importance of Tillage for Conserving Soil Moisture

When soil is saturated, all the pores are full of water, but after a day, all gravitational water drains out, leaving the soil at field capacity. Plants then draw water out of the capillary pores, readily at first and then with greater difficulty, until no more can be withdrawn and the only water left is in the micro-pores. The soil is then at wilting point and without water additions, plants will die. The amount of soil water available to plants is governed by the depth of soil that roots can explore (the root zone) and the nature of the soil material.

Because the total and available moisture storage capacities are linked to porosity, the particle sizes (texture) and the arrangement of particles (structure) are the critical factors. Organic matter, carbonate levels, and stone content also affect moisture storage. Poor structure, low organic matter, low carbonate content and presence of stones all reduce the moisture storage capacity of a given texture class. Clays store large amounts of water, but because they have high wilting points, they need significant rain to be able to supply water to plants.

Types of Tillage Systems

There are a lot tillage systems are being carried out. Some are used for conservation of soil moisture and energy for optimize use of natural resources and are described as:

1. Conventional Tillage: In conventional tillage, ploughing and several disking are used to prepare soils for planting. In addition, harrowing and dragging are sometimes performed during or after ploughing (Young, 1982; OISAT, 2005). According to IFOAM (2001), there are different cultivation practices, depending on the aim of the soil cultivation and they are implemented during different stages of the cropping cycle: Post-harvest soil cultivation is done to incorporate the residues of the previous crops into the soil before preparing the seedbed for the next crop, with the objective of accelerating its decomposition.

Crop residues, green manure crops and farmyard manure should be worked only into the top soil layer (15 to 20 cm), as decomposition in deeper soil layer is incomplete; they can produce substances which can harm the next crop.

2. Shallow soil cultivation: Shallow soil cultivation in between the crop is done to suppress weeds, to enhance the aeration of the soil, to reduce the evaporation of the soil moisture from the deeper soil layers and to stimulate the decomposition of organic matter, thus making nutrients available; Deep tillage is normally implemented to increase the soil moisture holding capacity through increased porosity, to enhance infiltration rates and to reduce the surface runoff by providing surface micro-relief or roughness. It also allows roots proliferation to exploit soil water and nutrients at deep horizons. The conventional tillage operations are expensive and require high farm labour supply (OISAT, 2005).

3. Deep tillage/ subsoiling: The insitu rainwater conservation tillage techniques tested are open and tied ridging, subsoiling, and no till. Subsoil cultivation is a technique that cuts soil deeper than achieved with conventional tillage. Subsoiling improves grain yield by enhancing root growth and infiltrating more rainfall deeper in the soil profile particularly in soils with compacted low permeability sub-layers.

4. Conservation tillage: Conservation tillage is defined as any tillage or planting system in which at least 30 % of the soil surface is covered by plant residue after planting to reduce water and wind erosion. There are five types of conservation tillage systems: no-tillage, mulch tillage, strip or zonal tillage, ridge till and reduced tillage (FAO, 1993). The amount of crop residue may vary widely, but it must be enough to reduce erosion significantly in comparison with tillage systems that bury or remove the residue. It is any method of soil cultivation that leaves the previous year's crop residue (such as corn stalks or wheat stubble) on fields before and after planting the next crop to reduce soil erosion and runoff, as well as other benefits such as carbon sequestration (MDA, 2011).

Tillage Relation to Weed Control

Tillage has been a major agricultural weed control technique for several decades, so the development of conservation tillage systems that advocate no-tillage or reduced tillage has significant implications for growers. Tillage affects weeds by uprooting, dismembering, and burying them deep enough to prevent emergence, by changing the soil environment and so promoting or inhibiting the weeds' germination and establishment, and by moving their seeds both vertically and horizontally.

Tillage Prior to Planting

Control of weeds with tillage prior to planting is a major method to reduce weed density and is often referred to as primary tillage. Annual weed control can be greatly enhanced if primary tillage is used in combination with delayed planting, which allows the annual species to germinate prior to the tillage operation.

However, if tillage is delayed to the point where weeds become larger, the effectiveness of tillage as a control tactic can be reduced. Summer annual weeds that are not killed by tillage can be more difficult to control with herbicides later in the season. Some examples of primary tillage implements are the mould board plough and chisel plough, with the mouldboard plough being more effective in burying weeds and weed seeds.

Secondary tillage is not as disruptive as primary tillage and is mainly used to prepare the seedbed. Secondary tillage will control small seedlings and germinating annual weeds by desiccation; therefore, it is best used when soil conditions are dry, and temperatures are high.

Generally, perennial and small-seeded weeds (i.e. lambs quarter) are more common in no-till systems as the roots of the perennials are undisturbed and small-seeded weed seeds are not buried below the germination depth. On the other hand, some large-seeded weeds (i.e. Pitted morning glory) left on the soil surface may not be able to successfully establish.

Tillage After Planting

There are two types of tillage used for weed control after planting: blind cultivation and inter-row cultivation. Blind cultivation is done without regard to the crop rows and is usually used to dislodge small weeds; the most common implement used is a rotary hoe.

Plant size dictates the time limit on the use of blind cultivation. While corn and soybeans are good candidates for blind cultivation, small seed crops are not as they can become easily dislodged. Timing is critical for blind cultivation to be successful; the "white thread" stage (seed has germinated but not emerged) of weed seed germination is associated with the most consistent control.

Inter-row cultivation has become more precise and can be done with more speed with the advent of guidance support systems. While they were originally designed for low residue systems, over the past 20 years the equipment has been modified to be used in higher residue systems.

Usually there is more time to utilize inter-row cultivation with row crops as compared to using blind cultivation. Tillage can be used as a single tactic to manage weeds; however, using it in conjunction with other cultural and chemical tactics will provide a more consistent and sustainable weed management program.

Conclusion

Among tillage practices ploughing up to 30cm depth across the slope give significantly higher soil moisture content. ploughing across the slope up to 30cm depth is more beneficial for conserving maximum moisture. The soil under conventional tillage had significantly higher moisture content than tested reduced till, mulch till and no-till treatments.

The flexibility to apply a wide variety of weed management tactics is an important trait of tillage systems. In current tillage systems, soil conservation and reducing herbicide reliance are often controversial. Controlled traffic combined with high-precision strip tillage may offer good opportunities to merge mechanical and thermal weeding, enhanced weed seed mortality and maintaining surface residues. Some alternative techniques to manage weeds are also available. Growers may have to adjust some aspects of a CT system to facilitate weed management; for example, hard-to-control weeds such as annual morning glory in cotton and perennial weeds may still require cultivation. Proper weed management is essential for the success of a CT system.

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Role of Women in Agriculture

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If you educate a woman, you educate society.

India has a predominantly agrarian economy. 70% of this population is rural; of those households, 60% engage in agriculture as their main source of income. It has always been India's most important economic sector. Agriculture sector as a whole has developed and emerged immensely by empowering men with technology. But this emergence is incapable of lifting the status of women labour as an integral part of the industry. Over the years, there is a gradual realization of the key role of women in agricultural development and their vital contribution in the field of agriculture, food security, horticulture, processing, nutrition, sericulture, fisheries, and other allied sectors. Women are the backbone of any developed society. The central role of women in any society ensures stability, progress and long-term development of a nation.

Swaminathan, the famous agricultural scientist describes that it was woman who first domesticated crop plants and thereby initiated the art and science of farming. While men went out hunting in search of food, women started gathering seeds from the native flora and began cultivating those of interest from the point of view of food, feed, fodder, fibre and fuel. Women have played and continue to play a key role in the conservation of basic life support systems such as land, water, flora and fauna. They have protected the health of the soil through organic recycling and promoted crop security through the maintenance of varietal diversity and genetic resistance. Overall, the labour burden of rural women exceeds that of men, and includes a higher proportion of unpaid household responsibilities related to preparing food and collecting fuel and water. The contribution of women to agricultural and food production is significant but it is impossible to verify empirically the share produced by women. Women's participation in rural labour markets varies considerably across regions, but invariably women are over represented in unpaid, seasonal and part-time work, and the available evidence suggests that women are often paid less than men, for the same work.

In a developing country like India, agriculture contributes 16% to the GDP of the economy. It provides 55% employment in the country out of which a good number of work forces is shared by women. Role of women in this sector cannot be ignored they comprise 33% of the agriculture labour force and 48% of the self-employed farmers. Women in India are major producers of food in terms of value, volume and number of hours worked. Nearly 78 percent of all economically active women are engaged in agriculture as compared to 63 per cent of men. Almost 50 percent of rural female workers are classified as agricultural labourers and 37% as cultivators. About 70 percent of farm work was performed by women. It is observed that women play a significant and crucial role in agricultural development and allied fields including, crop production, live-stock production, horticulture, post-harvesting operations, agro / social forestry, fishing etc. Rural Women form the most important productive work force in the economy of majority of the developing nations including India. Rural women often manage complex households and pursue multiple livelihood strategies. Their activities typically include producing agricultural crops, tending animals, processing and preparing food, working for wages in agricultural or other rural enterprises, collecting fuel and water, engaging in trade and marketing, caring for family members and maintaining their homes. Many of these activities are not defined as "economically active employment" in national accounts but they are essential to the wellbeing of rural households. Variations in women's participation in agricultural work depend on supply and demand factors linked to economic growth and agricultural modernization.

Women Play a Significant and Crucial Role in Agricultural Development and Allied Fields

1. Role of women in Agricultural Activities: Sowing, Nursery management, Transplanting, Weeding, Irrigation, Fertilizer Application, Plant Protection, Harvesting, Winnowing, Storing, Cattle Management, Fodder Collection, Cleaning of the Shed & Animals, Watering the Cattle, Milking, Preparing of Dung Cakes, Collection of Farm Yard Manure, Poultry Management etc.

2. Role of women in Domestic Activities: Cooking, Child Rearing, Water Collection, Fuel Wood Gathering, Household Maintenance, Keeping of Livestock and its Other Associated Activities like Milking, Milk Processing, and Preparation of Ghee etc.

3. Feminisation of Agriculture: Economic Survey says that migration of rural men to urban; there is 'feminisation' of agriculture sector, with increasing number of women in multiple roles as cultivators, entrepreneurs, and labourers. Globally, there is empirical evidence that women have a decisive role in ensuring food security and preserving local agro-biodiversity. Rural women are responsible for the integrated management and use of diverse natural resources to meet the daily household needs. This requires that women farmers should have enhanced access to resources like land, water, credit, technology and training which warrants critical analysis in the context of India. In addition, the entitlements of women farmers will be the key to improve agriculture productivity. The differential access of women to resources like land, credit, water, seeds and markets needs to be addressed.

Conclusion

With women predominant at all levels-production, pre-harvest, post-harvest processing, packaging, marketing– of the agricultural value chain, to increase productivity in agriculture, it is imperative to adopt women specific interventions. Women make essential contributions to the agricultural and rural economies in all developing countries. Their roles vary

Considerably between and within regions and are changing rapidly in many parts of the world, where economic and social forces are transforming the agricultural sector. Rural women often manage complex households and pursue multiple livelihood strategies. They represent a crucial resource in agriculture and the rural economy through their roles as farmers, labourers and entrepreneurs, almost everywhere, face more severe constraints than men, in access to productive resources. Efforts by national governments and the international community to achieve their goals for agricultural development, economic growth and food security will be strengthened and accelerated if they build on the contributions that women make and take steps to alleviate these constraints.

In this article, we collate the empirical evidence on women's roles in agriculture. The contribution of women to agricultural and food production is clearly significant. However, it is impossible to verify empirically the share produced by women. Women's participation in rural labour markets shows much heterogeneity at the regional level, but they are over represented in unpaid, seasonal and part-time work. We conclude that accurate, current, regionally specific information and analysis is necessary for good gender-aware agricultural policy making. Data collection has improved substantially over the last decades, as has our understanding of the complexity of women's roles and the need to collect data not only on primary activities but on all women's activities.

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Overcoming Challenges in Propagation of Bougainvillea

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Summary
The tremendous production, promoting and garden successes intimate by people and floriculturists cause a rise in quality of ornamentals that are vegetatively propagated. However, moderate and difficult to root plant species will forestall producers from realizing their full potential as propagators. Application of plant growth regulators and ontogenesis hormones are keys to overcoming this challenge that ultimately cause a rise in product diversity. Several decorative plants reproduce beneath natural conditions by asexual means; vegetative propagation of plants is that variety of plant propagation within which this new individual possesses precisely the same traits because of the parent plant from which it had been taken. Bougainvillea's are primarily propagated by stem cuttings, however lack of competency to create extrinsic roots by cuttings, happens habitually in nursing which is an obstacle for the vegetative propagation, root formation may be a key in vegetative propagation of woody or agriculture species, and issues related to ontogenesis of cuttings often times end in important economic losses. The secretion that aids the expansion of extrinsic roots is termed auxin; but artificial kinds of auxins are accessible commercially within the variety of indole –butyric acids (IBA) and naphthalene acetic acid (NAA).

Introduction
Bougainvillea is an ornamental shrub bearing flowers cherished for their beautiful petal like bracts, bearing different hues of colour named after famous French navigator Louis Antoine de Bougainville, enlisted under family Nyctaginaceae and finding its roots from tropical and subtropical South America. The credit of its first discovery or collection is surely given to commerson, a French botanist, from Rio-de-Janeiro, Brazil. The leaves are simple, alternate, roundish, ovate, roundish, ovate, or elliptic lanceolate. Presence of Stout spines helps the shrub to climb. A specialty is that actual flower is inconspicuous, small, tubular, ridged, open into star at apex, and remains attached at bae of the bracts. Peak blooming time is September to December and from Feb –June in north India. Exceptions are always there as here 'Snow white' flowers only once during the winter.

There are mainly three species of commercial importance namely; *B. spectabilis, B. peruviana, B. glabra*. The fourth species *B. × buttiana* is a result of hybridization between *B. peruviana* and *B. glabra*.

Bougainvillea adds to the beauty of landscape in different forms sometimes as a climber, as a well-pruned hedge e.g. 'partha', 'Thimma'; a specimen in a lawn, in pot culture, in pergolas, in arches, decorating boundary walls, screening ugly spots, bonsai culture. The Yanadi tribe of Chittoor district, Andhra Pradesh, India, once used the leaves of Bougainvillea spectabilis to heal diabetes. The plant is also widely grown as an ornamental plant.

Bougainvillea is a pollution tolerant plant and can help in the mitigation of air pollution besides its ornamental value in the landscaping. (Sharma et al., 2005)[12.]. B. "Mahara" is a dust mitigator and it adsorbs and / or absorbs the pollutants from the environment in which it grows. (Kulshreshtha et al, 2009)[4.]. On the basis of leaves physical experiment of bougainvillea, it can be reffered that this plant is a dust mitigator and it absorbs the pollutants from the environment in which it grows. Therefore, this plant was highly recommended for plantation in urban and industrial areas where particulate is a problem.

Propagation
1. Cuttings: Usually pencil - thick hardwood leafy cuttings 15-25 cm length are best. Some cultivars such as 'Mary palmer' , 'Thimma', 'Louis Wathem', 'Tomato red' , Lateritia', etc. are difficult to root from cuttings. So,

use of different rooting hormones can aid in better translocation of nutrients from soil to root to plant and thus better root formation. Time of planting cuttings is during Feb to March or July to Aug. In eastern India, cuttings are planted in nursery during the rains.

2. Ground or air layering: Cultivars where propagation by cuttings is not successful layering can be done in them. Compost used for air layering is leafmould, leafmould and FYM, FYM soil and sand. Some delicate cultivars can be raised by inarching method on a vigorous growing rootstock.

3. Shield Budding: “T” or “Shield” budding raise other cultivars in which both of the above- specified methods are unsuccessful. Some cultivars helping as rootstocks are ‘Dr.R.R. Pal’, ‘Partha’. The best budding time is from February to March.

4. Seeds: For raising new hybrids.

Objectives of Using Rooting Hormones

1. Inducing rooting of moderate too difficult to root cuttings.
2. Accelerating root initiation process.
3. Increasing number of roots per cutting.
4. Reducing rooting time.
5. Improving rooting uniformity.
6. Improving root length
7. Improving in turn plant growth characters like number of shoots, a greater number of sprouts, better sprouting percentage, a greater number of shoots, better shoot length and in turn plant height.

Main Rooting Hormones

Indole-3-acetic acid (IAA) ($C_{10}H_9NO_2$): Derivative of indole, IAA contains a carboxymethyl substituent. It is a white / colourless solid, Soluble in ethanol to 50mg/ml and insoluble in water. It is synthesized in cells of the apex and very young leaves of a plant. Precursor for its synthesis is tryptophan. It aids in cell elongation and cell division resulting in plant growth and development. IAA serves as signalling molecule necessary for development of plant organs and coordination of growth. Plants mainly produce IAA from tryptophan through indole-3-pyruvic acid. (Mashiguchi et al, 2011).

Indole-3-Butyric Acid (1H-Indole-3-Butanoic Acid, IBA) ($C_{12}H_{13}NO_2$)

It is a white to light-yellow crystalline solid. IBA is insoluble in water; it is typically dissolved in 75% or purer alcohol for use in plant rooting. IBA is also available as a salt, which is soluble in water. The is better to keep solution in a cool, dark place for best results. IBA was isolated from leaves and seeds of maize and other species. In maize IBA has been shown to be synthesized in vivo using IAA and other compounds as precursors (Ludwig-Müller et al, 2000) [5.]. This chemical may also be extracted from any of the Salix (Willow) genus (William G. Hopkins, 1999) [13.]. Genetic evidence has been found that suggests that IBA may be converted into IAA through a similar process to β-oxidation of fatty acids. The conversion of IBA to IAA then suggests that IBA works as a storage sink for IAA in plants (Zolman et al, 2008) [14.]. There is other evidence that suggests that IBA is not converted to IAA but acts as an auxin on its own (Ludwig-Müller et al, 2000)[5.]. The effect of IBA is in concurrence with other studies where IBA is the most commonly used auxin for root formation (Pooja Goyal et al, 2012).

The application of IBA initiates root formation by increasing internal free IBA, or synergistically modifying action of IAA or endogenous synthesis of IAA. The efficiency of IBA as a rooting hormone in bougainvillea is supported by findings of ; (Sahariya et al, 2013)[9.], (Ibironke OA., 2013)[3.], (Seyedi et al, 2013)[10.], (Shabha and Alshammary, 2013)[11.], Asl et al (2012) [1.] etc.

1-Naphthaleneacetic Acid (NAA) ($C_{10}H_7CH_2CO_2H$)

This colorless solid is soluble in organic solvents. It features a carboxymethyl group (CH2CO2H) linked to the”

1-position" of naphthalene. NAA is a synthetic plant hormone in the auxin family and is an ingredient in many commercial plants rooting horticultural products.

NAA has been shown to greatly increase cellulose fiber formation in plants when paired with another phytohormone called gibberellic acid. It prevents premature dropping and thinning of fruits from stems. It is applied after blossom fertilization.

In plant tissue culture, IBA and other auxins are used to initiate root formation in vitro in a procedure called micro propagation.

The efficiency of NAA as a rooting hormone in bougainvillea is supported by findings of; (Memon et al, 2013) [7.], (Babita et al, 2017)[2.] etc.

Conclusion

Use of different auxins acting as rooting hormones can help in better rooting of bougainvillea cuttings and can thereby help in overcoming the obstacle of root formation and thus its propagation by cuttings.

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Indigenous Rice of West Bengal

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Introduction

Rice (*Oryza sativa L.*) is a staple crop of our country and everyday millions of Indian comforts in it. With a high carbohydrate content, it is known to provide instant energy hence consumed by the majority of India's population. India is not only a leading consumer of rice crop but also its second largest producer in the world(116.42 MT) lagging behind only China(144 MT) according to the annual report 2018-19 by USDA. It is our pride that our state West Bengal currently tops in Rice production all over the country with 14.97 MT production annually. India's indigenous or folk rice varieties, which had passed into oblivion due to market dominance of high-yielding varieties and the prevalence of the Basmati rice in terms of aroma and taste, are nowadays gaining importance due to regional culture and food habits of the people and their rituals. Several efforts that have been made earlier to revive these folkore varieties, in this regard one initative had been taken in 2004,"The save our Rice programme", which helped to promote traditional varieties in Kerala and other south Indian states later it spread towards East Indian states like Odisha, West Bengal, Assam. After the Green revolution, farmers have been lured into growing HYVs with subsidized fertilizers, pesticides and pump-sets. They have been made to believe that planting these seeds are the only option for them to get higher yield. But if we observe more carefully, we will find that HYVs do not give a high yield everywhere, especially in the marginal lands such as flood, drought, saline prone areas, rendering the abbreviation HYV inappropriate. On the other hand, traditional crop varieties are often recorded to have out-yielded in marginal environmental conditions. There are several traditional varieties which possess unique character like disease resistance, flood and drought tolerance. Thus, it is gaining importance among small-holder farmers due to its easy adaptability, low cost of cultivation and other specific favourable characters.

Nowadays traditional rice enthusiast farmers like Kamala Pujari of Odisha(awarded Padmasree, 2019), Shivaprasad Raju of Hyderabad, Sailen Chandi of Nadia(Grown '*Radhatilak Dhan'*),West Bengal came into highlights after their recognition by Central Government of India.

Traditional Rice Diversity in West Bengal

In India we have a rich treasure of at around 82,000 indigenous rice varieties, among them only West Bengal accounts more than 5500 varieties. These region-specific varieties may be termed as indigenous or folk rice varieties.

The early rice research efforts in the beginning of the 1930's,aimed at improving the yielding capacity and quality of indigenous rice varieties. Throughout the country, indigenous rice germplasm was collected, evaluated and improved through pure line selection or to a lesser extent through hybridization and mutation. The West Bengal department of agriculture released some sixty improved varieties between 1948 and 1960.After the intervention of IRRI in the field of Rice research, they introduced IR-8 which was also evaluated at Chinsurah Rice Research Station, West Bengal and also tested in various Government adaptive trial farms. Interestingly, during the 70's when modern rice varieties were introduced, no research programme focused on risk prone rainfed areas. Thus, in the late 70's when adverse climatic conditions had arrived, it stimulates to the new direction of Rice research considering the hazardous situation. The southern district of West Bengal suffered from a major flood in 1978.Dr. Biswas, then head of the Chinsurah Rice Research Station took the opportunity to collect and make a pureline selection of rice strands that have survived the flood. Their genetic make-up was used to increase flood resistance performance of varieties grown in rainfed lowlands. Since then at Chinsurah and many other rice research centres throughout India, scientists are engaged in cross breeding works between the IRRI materials and indigenous lines. The subcentres of Bankura, Gosaba, Fulia and Purulia emphasized research on local indigenous varieties with an aim to develop flood tolerance, salinity tolerance in location specific high yielding varieties.

Crop diversity, as a distinctive characteristic of organic farming, is adequately emphasized at the Research Centre. It has issued by advisory that folk rice has less nutrient requirement as compared to the modern input responsive varieties. Soil management through sustain release of organic matter is good enough to grow folklore rice varieties. In the present situation where researchers are preferring biologically active cultivation over chemically active it is good to know that adapted traditional rice varieties can give good grain and straw yield without application of any chemical fertilizers. For example, in 2015-16 ATC Fulia grows FRVs, using only floating azolla; it gives eight kg Nitrogen and 100 kg of biomass/bight in four-and-a-half months. One to two kilograms of azolla are allowed to float for 25 days after FRVs are transplanted.

Few traditional Rice varieties grown in our states are as follows:

Varieties	Yield (t/ha)	Duration(days)
Gobindabhog (GI Tagged var of WB)	3-3.5	120-130
Tulaipanji (GI Tagged var. of WB)	2.5-3	120
Dudheswar (Scented)	3.2	142
Lalat	4.3	125-130
Ratna	4.5-5	130-135
Kalabhat (Scented) (Origin- MP)	3.5	142
Shatia	3.5	85-90
Radhatilak (Scented) (grown in Medinipur)	3.2	138
Kerala Sundari (grown in Purulia district)	5-6	132
Kesabsal	4.5	140
Chamarmani (grown in Nadia district)	4.0	142
Khara Violet colour in leaf due to anthocyanin (Origin-MP)	4.0	136
Agniban (grown in 24 parganas)	4.0	135
Adansilpa(scented) (origin- MP)	4.0	142
Kanakchur (Grown in 24 parganas, used for preparation of GI tagged dessert 'Jaynagarer Moa')	2.8-3.4	140
Komal /Maguri (Origin- Assam)	3.9	136
Bahurupi (grown in Medinipur)	4.5-5.5	138
Kabirajsal	4	140
Bangla Patnai	5.5-6	110-150
Katidhan	4	120
Radhuni pagol	2.3-2.5	125
Kalonunia	2.2-2.4	125
Khitish	4-4.5	115-120
Lalswarna	6-6.5	145-150

Conservation Initiatives taken in West Bengal

As mentioned earlier, since 70's era Chinsurah Rice Research station has been working to promote indigenous rice cultivation among farmers. This centre selected many improved rice varieties from the indigenous rice and at present, it has more than 300 folk rice varieties in its stock. Beside them, some non-Governmental organizations like VRIHI in Bankura are also working substantially. It has characterized many traditional rice varieties and distribute those varieties among the cultivators. Inspired by the works of Vrihi in Bankura, the Agriculture Training Centre, Fulia, started the conservation of indigenous rice in 2001.The Centre was declared a Bio-diversity Conservation Farm by the Directorate of Agriculture in 2006.Many universities are taking the folk varieties for various studies—morphological, DNA finger printing, in estimating vitamin B complex, proteins and minerals. Agricultural universities such as Bidhan Chandra Krishi Viswavidyala, and Viswa Bharati of Santiniketan have taken 30 and 55 varieties, respectively, from the Centre.

Cyclone Aila in May 2009, which devastated all of the southern islands of 24 parganas with saltwater overflowing from surrounding rivers to the agricultural fields, has ushered in a new realisation among island dwellers regarding their food security. They realised, after that painful experience, that preserving and practicing local salt tolerant varieties is a viable coping strategy against such threats in future. The realisation translated into, even without any outside support or counselling, renewed interest among farmers to organize themselves to create local seed banks for such rice varieties.

The Department of Agriculture of West Bengal sanctioned a new scheme in 2015 under the Production & Growth of RKVY XIIth Plancalled"Folkrice—collection, conservation, multiplication through distribution and on-farm trial for popularization among the farming community of West Bengal." This scheme is the first of its kind in India. The Centre is actively engaged in 11 earmarked districts of the state. The Directorate of Agriculture, WB, has also issued a notice to grow folk rice in organic mode in an acre of land in each government farm.

Conclusion

Under comparative studies between high yielding varieties and indigenous varieties it can be found that in an ideal condition HYVs can produce more yield than local indigenous varieties but in farmer's field not always ideal condition is available, in such situation considering drought prone areas like Bankura, Purulia, Birbhum districts or saline, flood prone areas like 24 parganas indigenous varieties are more preferrable. Farmers can use indigenous varieties years after years without using large amount of fertilizers and pesticides thus it is very much eco-friendly as well as helpful for small-holding farmers. Even farmers nowadays are coming forward to conserve old indigenous varieties, in this regard Government and Agriculture officials should be more enthusiastic by organizing seed festival to highlight the importance of the issue among the common people. In this way, we can preserve our indigenous varieties for us and the generations to come.

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Management Practices in Rabi Maize to Increase Productivity

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Introduction

Maize is called 'queen of cereal' as it is grown throughout the year due to its photo-thermo insensitive character and highest genetic yield potential among the cereals. In India, maize is cultivated throughout the year in most of the states of the country for various purposes including grain, feed, fodder, green cobs, sweet corn, baby corn, popcorn and industrial products. As a dramatic increase of maize demand in the developing world, including India, the current trend appears unable to keep pace. The option of further increasing the maize area is limited. In India, the area of maize is sticking to around 6-7 million hectares for the last three decades, and the overall increase in maize is realized largely from increasing productivity in favourable ecologies. However, the trend of genetic gain in the favourable environment seems unable to meet the fast-growing demand for maize in the country. Further, a viable option is to reduce the available yield gaps in a less favourable environment through genetic enhancement of tolerance to biotic and abiotic stress prevalent in tropics and the development of improved crop management technology for such ecologies.

Maize is predominately a Kharif season crop but in past few years, Rabi maize has gained a significant place in total maize production in India. The yield obtained during this season is invariably higher (>6 t/ha) than the Kharif season yield (2-2.5mt/ha.) due to the long duration of growth and least infestation of pests and diseases. Though the crop favourably responds to better crop management both in Kharif and Rabi season, the erratic rainfall pattern of the south-west monsoon comes in the way of timely field operations of Kharif season. In absence of any major environmental impediments in Rabi, the desired field operations can be planned and executed at the most desired time. Moreover, the various environmental factors, including the absence of any major disease and insect pest in this season, helps in realizing better profits from every additional unit of monetary inputs.

Some of the important factors favouring maize cultivation in Rabi are briefly discussed below:
1. Better water management due to the absence of erratic rainfall in the rabi season lessen the damage from pre-flowering stalk rots and leaching of fertilizers.
2. The important advantage is the possibility of undertaking various field operations at the most desired time.
3. Maize plants in Rabi season tend to be more efficient because of lower photorespiration losses due to lower night temperatures as well as larger leaf surface for effective photosynthetic activities.
4. Because of more favourable growing conditions, response to the application of nitrogen and other nutrients is better in Rabi than Kharif season.
5. Due to low temperature and humidity in Rabi season, the level of infection or infestation by various diseases and insect pests is quite low, resulting in higher yields.
6. In Rabi season, due to effective water management and low temperature, weeds can be controlled effectively.

Package of Practices for Increasing Rabi Maize Productivity

1. The success and the level of profit from Rabi crop depend to a great extent on the choice of maize hybrid/composite to be grown. Farmers should therefore be encouraged to sow only high yielding hybrids suitable for Rabi season.

2. Well, drained, aerated deep-loams and silt loams are mostly suitable for maize cultivation. Highly saline, acidic, alkaline and water-logged soils should be avoided for the cultivation of maize crop.

Sowing Time and Plant Population

1. Generally, sowing should be completed before the end of October, preferably by mid-October. The temperature during the second fortnight of October to mid-November in most of North India drops sharply, resulting in delayed germination and plant growth receives a major setback. Hence, any marked delay in sowing is likely to result in a lower yield.

2. A population of 90,000 plants/ha at harvest is desirable for realizing high grain yield in Rabi. A spacing of 60cm * 20cm is optimum. For this purpose, 20-22 kg of seed would be needed to sow one hectare of land. Before sowing, the seed should be soaked overnight in warm (45oC at the time of seed soaking). This treatment helps in obtaining better plant stand and healthy crops. Seeds should be sown 4-5 cm deep.

Method of Sowing

1. Raised bed planting: It is the best method for maize during monsoon and winter season, under both excess moisture as well as limited irrigation availability conditions. Sowing should be done on the southern side of the east/west ridges/beds, which helps in good germination. Using raised bed planting technology, 20-30% irrigation water can be saved with higher productivity.

2. Zero-till planting: Maize can be successfully grown without any preparatory tillage under a no-till situation with less cost of cultivation, higher profitability and better resource use efficiency. Under such conditions, one should ensure good soil moisture at sowing and seed and fertilizers should be placed in a band using zero-till seed-cum fertilizer planter with furrow opener as per the soil texture and field condition.

3. Transplanting: Maize can be successfully cultivated by transplanting seedlings especially in the north-west and eastern plain regions of the country. This practice is particularly suitable after the harvest of late paddy, early harvest of crops like sugarcane, or as a companion crop with autumn sugarcane. This is also suitable for the Diara and Tal areas where flood water recedes late. The seedling may be transplanted on the southern slope of east west ridges or in flat fields.

Nutrient Management

Maize is an exhaustive crop that requires all types of macro and micronutrients to get better growth and exploit yield potential. The efficiency of nitrogen utilization is better in Rabi than in Kharif season, primarily because of better water management and lower leaching losses. With better fertilizer response, it should be possible to substantially reduce the cost of production of every tonne of maize produced in Rabi season.

Weed Control

Light hoeing is to be given as and when necessary for better control of weeds. Broad-leaved weeds and most of the grasses can be conveniently controlled with the application of Atrazine or Simazine @ 0.5-1.0kg a .i./ha in 1000 lit of water as a pre-emergence spray. In zero-till maize production, pre-plant application (10-15 days before seeding) of non-selective herbicides viz., Glyphosate @ 1.0 kg a.i. ha-1 in 400-600 litre water or Paraquat @ 0.5 kg a.i. ha-1 in 600 litre water is recommended to control the weeds. Under heavy weed infestation, post-emergence application of Paraquat can also be done as a protected spray using hoods.

Water Management

The rainfall during Rabi is rather inadequate for the successful cultivation of high-yielding maize hybrids. Timely availability of assured irrigation is one of the major factors determining the success of a crop. Where soils are generally light, it is desirable to schedule the irrigation 70% soil moisture availability throughout the period of crop growth and development. In heavy soils, a moisture level of 30% during the vegetative stage and 70% during the reproductive and grain –filling period is desirable for obtaining optimum yield.

Intercropping

Maize is the most versatile crop for growing inter-crops, because of the wide row it needs, providing higher income to the farmers. Short duration variation of pulses (pea, rajmash and other beans), most vegetables, and oilseed crop (soybean, linseed) can be successfully intercropped in maize.

Plant Protection

The disease problem in Rabi is less as compared to Kharif maize. However, turcicum leaf blight and common rust occur in moderate to high intensity. During Rabi season, post flowering stalk rots, particularly charcoal-rot occur predominantly in a late sown crop, especially when the temperature at maturity is high and the crop is subjected to soil-moisture stress. The best remedy to minimize yield loss due to these diseases is to grow resistant varieties/ hybrids.

Insect Pests

Maize grown in Rabi is known to be free from the attack of major insect pests which usually attack Kharif crop. However, pink stem borer, Sesamia inferens is a major pest. To control this pest two sprays of Quinalphos 0.05% 15 days and 35 days after germination followed by a second application with Trichlorphon 5G or Cabofuran 3G @ 0.5 kg a.i/ha 20 days after germination followed by a second application 20 days after the first recommendation.

Conclusion

Rabi maize cropping can provide insights on intensive agriculture and other strategies for meeting future food production challenges and will be one of the important cereals in the food security of the country. So the development and adoption of new technologies, better management strategies are needed in rabi maize to achieve the food security of India.

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Fertilizer Management for Sustainable Agricultural Production

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Introduction

Nutrients play a key role in increasing agricultural production in the intensive cropping systems. Sustainable agriculture can be achieved by efficient utilization of this input. Nutrient use efficiency can be improved by checking the pathways of nutrient losses from soil-plant system, making integrated use of nutrients from all possible sources, optimal allocation and enhancing recovery of added nutrients by crops.

Checking the Pathways of Nutrient Losses

Nutrients present in soil and added through fertilizer are lost by gaseous, leaching, and runoff / erosion losses. Efficient nutrient management involves in understanding the pathways of nutrient losses and developing technologies to minimize these losses.

Reducing Gaseous Losses

Part of the applied nitrogen is lost from soil by volatilization of ammonia and part of the nitrogen is lost as N_2O and N_2 gas by denitrification.

1. Volatilization of ammonia can be minimized by mixing of nitrogen fertilizer in soil, deep placement of urea super granules (USG) in puddled rice field.
2. Use urease inhibitors like thiourea, methyl urea and ammonium thiosulphate (ATS).
3. Apply coated fertilizers like sulphur coated urea (SCU) mud ball urea and use of synthetic slow release urea-based fertilizers viz., Iso-butylidene diurea (IBDU) and Crotonylidene diurea (CDU).

Nitrous oxide (N_2O) is mainly produced by denitrification of NO_3 under anaerobic condition as in low land rice fields. Denitrification can be minimized by avoiding the use of NO_3 form of nitrogenous fertilizer (Example: Calcium ammonium nitrate, potassium nitrate) in rice and use of nitrification inhibitors viz., N-serve (2-chloro, 6-trichloro methyl pyridine), coated calcium carbide (CCC) and neem coated urea.

Reducing Leaching Loss

Mobile nutrients are lost from the soil-plant-system through the percolating water. Leaching loss of NO_3 can be minimized by balanced fertilization, split application of urea synchronizing with crop demand, manipulation of water application and use of slow release fertilizers.

Reducing Runoff and Erosion Losses

Water-soluble nutrients are lost through runoff. Proper land management, selection of crops, cropping systems, tillage and mulching can minimize this loss. Nutrients on the clay particles and soil organic matter are lost when the topsoil is eroded. Proper soil conservation measure should be adopted to minimize this loss.

Integrated Plant Nutrient Management System

Losses of fertilizer N leading to environmental pollution and yield decline over the years calls for a cheaper and more sustainable measure to improve productivity by substituting part of the inorganic fertilizers by organic sources of nutrients. Organic sources of nutrients alone can't sustain the crop yield to meet the demand of growing population. Hence, there is a need to combine the use of inorganic fertilizers and organic sources of nutrients viz., manures, green manures, crop residues, biofertilizers etc. in a synergistic manner which is referred as integrated plant nutrient supply (IPNS) system.

Integrated Nutrient Supply System

Sustain and improves the physical, chemical and biological health of soil and enhance the availability of both applied and native soil nutrients during growing season. This helps in retarding soil degradation and soil deterioration of water and environmental quality by promoting carbon sequestration and checking the losses of nutrients to water bodies and atmosphere.

Green manures can be incorporated in soil to improve the crop productivity. When the crops are harvested mechanically a sizable quantity of crop residues are left in the field that can be recycled for nutrient supply, out of the nutrients taken up by cereals on an average 25% of N and P, 50 % of S and 75 % of K are retained in crop residues and making them available sources of nutrients.

Biofertilizers help in improving the soil fertility through biological nutrients fixation, solubilizing P from native soil and applied sources and mobilizing the micronutrients like Zn and Cu for plant uptake. Rhizobium plays a major role in symbiotic nitrogen fixation in legumes. Blue-green algae, Azotobacter and Azospirillum help in nitrogen fixation in cereals.

Optimum Allocation of Nutrients

Maize is the most versatile crop for growing inter-crops, because of the wide row it needs, providing higher income to the farmers. Short duration variation of pulses (pea, rajmash and other beans), most vegetables, and oilseed crop (soybean, linseed) can be successfully intercropped in maize.

Plant Protection

The available nutrient should be optimally allocated among the competing crops to get the maximum returns by following optimization of nutrients production functions which relate crop responses to applied nutrients under given soil, climate and management factors. Fertilizer application to crops based on soil test, crop correlation approach for targeted yield can help in improving the nutrient use efficiency.

Enhancing Recovery of Added Nutrients by Crops

The nutrients management practices that help in enhancing nutrient recovery by crops, maximizing yield and minimizing losses of nutrients lead to enhanced nutrients use efficiency some of these practices include balanced fertilizer application and selection of proper source, rate, time and methods of nutrients application.

Balanced Fertilizer Application

Balanced and judicious use of fertilizers is the key to efficient nutrient use for maintaining soil productivity. The crop would efficiently use an added nutrient only if other essential nutrients are present in adequate amount. Imbalanced use of nutrients causes disparity in the rate of nutrient removal and application leading to excessive mining of some nutrients, which affects the long-term productivity of soil.

Selection of Source, Rate, Time and Method of Nutrient Application

The nature of fertilizer used and the rate, time and method of application influences the recovery of the added nutrient by crop plants and it varies with the crop.

Ammonium nitrate is considered to be a better source of nitrogenous fertilizer for upland crops whereas ammoniacal and amide form of N is superior for lowland rice crop. Fertilizer rates greater than the optimum level lead to lower utilization efficiency.

Timing of fertilizer application should match with the crop demand. Split application of N is superior to basal application. The efficiency of water-soluble phosphatic fertilizers can be improved by band placement with below or to the side of the seed row. This can improve the physical fertility of soil of the plant roots and can easily take up nutrients from these sources. All these interventions slowly but surely will help to increase the fertilizer use efficiency to sustain the crop production.

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Probiotics and their Role in Agriculture

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Introduction

Probiotics can be defined as live microorganisms which when administered in adequate amounts, confer a health benefit on the host (FAO, 2006). Lilly and Stillwell are the scientists who were the first to use the term probiotics in 1965. According to them, probiotics can be defined as "substances secreted by one organism that stimulate the growth of the another". Parker defined them as organisms or substances that contribute to intestinal microbial balance.

Probiotics is not a new concept of science, it is known to be in practice from the times immemorial (Amara et al., 2012). Fermented milk was the first probiotic product (Hosono et al., 1992). From fermented milk, humans learned to produce cheese, yogurt etc., by different processes using microorganisms. These components, as they are fermented contains large amounts of bacteria which are helpful for digestion of some indigestible ruminants of digestive system. Thus, they are playing a prominent role in medical science. Ilya Ilyich Metchinik off was the person to receive Nobel Prize on probiotics in the field of medicine in 1908. He worked on presence of beneficial microorganisms for effective digestion in yogurt. Bulgarian peasants were said to have long life period. It was said that, they had such life because of yogurt intake by them which contained Lactobacillus species. However, Japan was the first country to produce a commercial product of probiotics through fermented milk by name Lactobacillus casei Shirota. This contains bacterium Lactobacillus casei. Lactobacillus species and Bifidobacterium (Kun et al., 2008) species are most common bacterial species used in probiotics.

Along with medical science, probiotics are gaining popularity for their application in agricultural sciences also. In present situations, food toxicity is the major constraint for health problems globally. It is a known fact that most of the food that we are consuming now a days is said to contain toxic residues of agro-chemicals. These agro-chemicals have completely replaced the organic farming. Probiotics plays a key role in reducing this problem through biofertilizers and biopesticides which biologically control most of the pathogens and also provides good fertility to the soil as well. Land with a greater number of microorganisms is the most fertile land, as they decompose organic matter and also converts unavailable forms of nutrients to available forms to the plants. In plants also they help in easy uptake of nutrients.

Probiotics in Agriculture

Plant probiotics has a strong market in the field of agriculture with annual growth rate of 10%. They can be used as bio pesticides, biofertilizers, plant strengthens, Phyto stimulators. They also have uses of:

1. Effective in small quantities.
2. Multiply themselves.
3. Reduce environmental pollution.
4. Specific and have targeted activity.
5. Reduce or decompose quickly than other chemicals.
6. Reduced resistant development in pathogens (since they operate in various mechanisms).
7. Strengthens plant's natural immunity.
8. Promotes faster, stronger rooting.
9. Increases resistance to environmental stress.
10. Improves soil structure.
11. Aids in nutrient breakdown, availability and absorption; reduces nutrient leaching.

12. Reduces planting/transplant shock (better establishment of plant).

Several mechanisms operate in plant-probiotics interaction like recognition, adherence, invasion, colonization, growth. Initially plant roots produce chemicals for signalling to probiotics about their presence. Probiotics identifies and colonises in the roots which later were transported to shoot system thereby acting on the whole plant by influencing hormonal activities in plants. This is similar to Rhizobium inoculation mechanism in legumes. Along with these hormonal balances, bacteria also supply macro and micro nutrients. They metabolize root exudates and releases amino acids, organic acids, carbohydrates etc. A few bacteria liberate phosphorous from organic compounds called phytates. In case of protection, bacteria act in two ways:
1. By activating plant against to pathogen to defend itself - called "induced systemic resistance".
2. By microbial antagonism - through inhibition of microbial growth, competing for nutrients and degradation of pathogenicity factors.

In Japanese composting, they use three types of bacteria Actinomycetes, Bacillus, Lactic acid bacteria, so that this compost can protect plants from different pathogenic fungi like Pythium, Plasmodiophora brassicae, powdery mildew and downy mildew.

Methylobacterium is a genus of bacteria (also called PPFM bacteria) that seems to be associated ubiquitously with plants. This bacterium helps in germination of seeds. PPFMs might be used in a kind of genetic engineering strategy. That is, engineering the bacteria to produce a desirable enzyme or other useful metabolite could allow us to alter the metabolism of a plant simply by inoculating the plant with the engineered PPFM. This is a much simpler and quicker method of changing plant metabolism than conventional plant breeding or plant genetic engineering. It has been said that sometimes poorly stored or aged seeds fail to germinate because their bacteria have died, not because they are themselves dead. There was an increase in crop yield when PPFMs are applied to the leaves of plants during the growing season. Still some strategies of these bacteria for manipulating male sterility are being carried. Intensive research on PPFMs is being carried out by Mark Holland (Salisbury educational society, USA).

Bacterial Species Used in Plant Probiotics

Rhizobium, Azospirillum, Serratai, Bacillus.

Specific Functions of Few Species of Bacteria

1. *Bacillus* spp:

a. Produce natural plant hormones.
b. Improve soil structure.
c. Solubilize minerals (including phosphorous) for plant availability.
d. Nitrogen fixation.
e. Enhance plant growth.
f. Decompose organic matter and pesticide residues--nutrient cycling.
g. Enhance seed germination and viability of emerging seedlings.

2. *Trichoderma* spp:

a. Increases resistance to environmental stresses.
b. Produces natural plant harmones for growth of plant.

3. Streptomyces / Actinomyces:

a. Increases resistance to environmental stresses.
b. Decomposes complex organic matter.

4. Biotechnology for Probiotics: There is a need of sequencing the genome of probiotic bacterial species of interest. This enables the study of gene expression of probiotic strains at specific production steps. So that enabling the better control and optimization of growth. Identification of novel genes of stress, tolerance genes enables them to survive under adverse conditions, makes their commercial production more convenient.

However, as these are genetically manipulated, before using them in dietary purposes, they should be studied seriously and thoroughly.

5. Nanotechnology for Probiotics: The word "nano" comes from the Greek for "dwarf ". A nano meter is a thousandth of a thousandth of a thousandth of a meter (10-9 m). Nano particles are usually sized below 100 nanometres. Nano technology involves in encapsulation of probiotics with nano particles for protection. Nano structured food ingredients are being developed with the claims that they offer improved taste, texture and consistency. Nano-encapsulation is defined as a technology to pack substances in miniature using techniques such as nano composite, nano emulsification, and nano structuration and provides final product functionality and control the release of the core. These nano encapsulated bacteria have capability of modulating immune responses known as de novo vaccines. Bacteria encapsulated as nano particles directly moves to the targeted sites and shows their action. This improves shelf life period of food products.

Microencapsulation is another technique which involves encapsulating bacteria which are acidic sensitive like *Bifidobacterium* and *Lactobacillus* with gelatine or vegetable gum to protect them.

Conclusion

Probiotics has revolutionised the medical field. However, it is still in budding stage in agriculture. There is a necessity to control the toxicity of agro-chemical residues in food products which is becoming a typical hazard at present situations. This problem can be defeated only by means of organic farming which in turn through a more advanced tool called "probiotics". This can be achieved through technological approach (biotechnology and nanotechnology) to traditional probiotics.

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RNA Interference (RNAi) – A Modern Approach Towards Sustainable Crop Protection

Article ID: 32718

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Introduction

RNA interference (RNAi) is a biological process which occurs in the cytoplasm of cells and affects the expression level of specific genes by degrading the mRNA of target genes through a post transcriptional gene silencing process (PTGS). Here gene characteristics were blocked through inserting short sequences of ribonucleic acid (RNA) that match part of the target genes sequence, as a result no proteins are produced. Richard Jorgensen and colleagues aimed to deepen the purple pigment of petunias by introducing the colour producing gene. Surprisingly, the experiment showed the unexpected result that many flowers were either colourless or variegated.

This phenomenon was called ‘cosuppression’, due to the suppression of both the endogenous and the homologous exogenous gene (Napoli et al., 1990). Later, Fire et al. (1998) conducted an experiment by injecting a mixture of sense and anti-sense strands as dsRNAs into *Caenorhabditis elegans* and showed that the dsRNA was ten times more effective in decreasing expression of homologous endogenous mRNA than using either the sense or the antisense strand alone. After the time of green revolution era pest population also developed the mechanisms of breaking the resistance provided by major and minor resistance genes.

With the advent of biotechnology recently transgenics for disease and pest resistance came into the scenario. But due to the complexity of regulations most of the transgenics didn’t released. In this situation RNA interference (RNAi), as an alternative to transgenics, has supplied a manner to control pests and diseases, introduce novel plant traits and increase crop yield by protecting from major insect pests and diseases.

RNAi (Interference) Technology

Cellular process by which an mRNA is targeted for degradation by a dsRNA with a strand complementary to a fragment of such mRNA. A selective gene knock-down phenomenon.

Main Component of RNAi Machinery for siRNA, miRNA and shRNA Generation

There are five components for siRNA, miRNA and shRNA generation:

1. Dicer: The dicer catalyzes the production of siRNAs from the long dsRNA and requires ATP for this function. It is a large (~220kDa) multi-domain protein and act as an anti-parallel dimer.

2. Drosha: Drosha that catalyses the nuclear processing of pri-miRNA in to pre-miRNA, the stem loop precursor of about 70 nucleotides which is further acted upon by dicer to generate miRNA.

3. RNA-Induced Silencing Complex (RISC): RISC reaches at the target site, the endonuclease activity of the protein of Argonaute family chops that sequence and thus renders the target gene unexpressed.

4. Argonaute (Ago): Argonaute proteins constitute the catalytic unit of the RISC (RNA induced silencing complex). Argonaute proteins contain four conserved domains: The N- terminal, PAZ, mid and PIWI domains.

5. RNA-Dependent RNA Polymerase (RdRP): RdRp is primarily found in RNA virus where it catalyses its genome multiplication. RNA-dependent RNA polymerases (RdRPs) catalyze the formation of phosphodiester bonds between ribonucleotides in an RNA template-dependent fashion. RdRp is involved in the regeneration of dsRNA which is the key component in the gene silencing.

Metabolic Pathway of RNA Interference (RNAi)

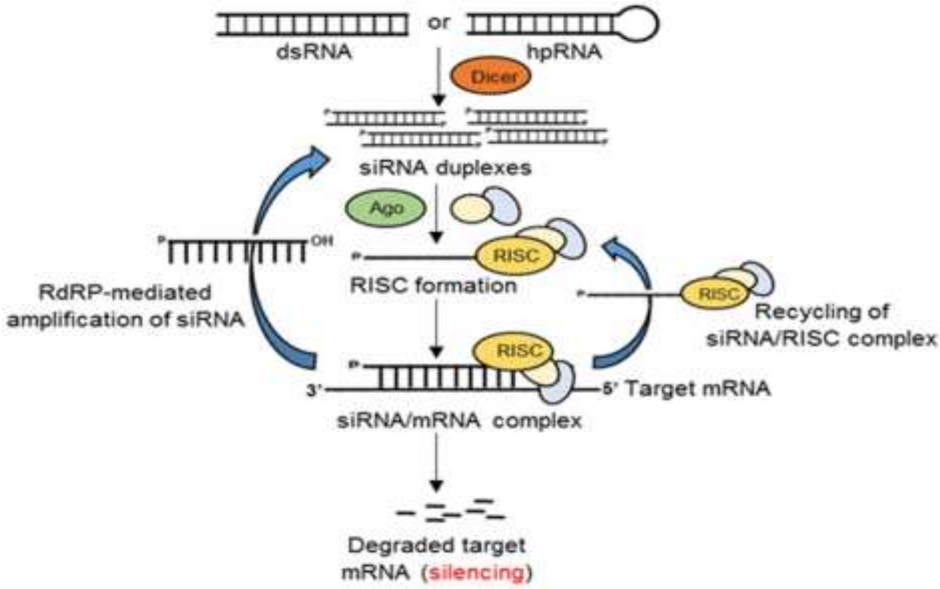


Figure 1: RNAi-mediated gene silencing in eukaryotes
(Source:https://www.frontiersin.org/files/Articles/245287/fpls-08-00200-HTML/image_m/fpls-08-00200-g001.jpg)

Figure shown here represented that there can be Double-stranded RNAs (dsRNA) or hairpin RNAs (hpRNAs) which generate small siRNA duplexes by the action of Dicer (a key enzyme initiating the RNA silencing process. The entry of long double stranded RNA triggers the RNAi pathway of cells. This results in the recruitment of the enzyme Dicer. Dicer cleaves the dsRNA into short, 20-25 base pair long, fragments, called small interfering RNA (siRNA). An RNA-induced silencing complex (RISC) then distinguishes between the two siRNA strands as either sense or antisense. The sense strands are degraded. The antisense strands on the other hand are incorporated to the RISC. These are used as guide to target messenger RNAs (mRNA) in a sequence-specific manner. Messenger RNAs (mRNA), which codes for amino acids, are cleaved by RISC. The activated RISC can repeatedly participate in mRNA degradation, inhibiting protein synthesis.

RNAi as an Insect Control Perspective

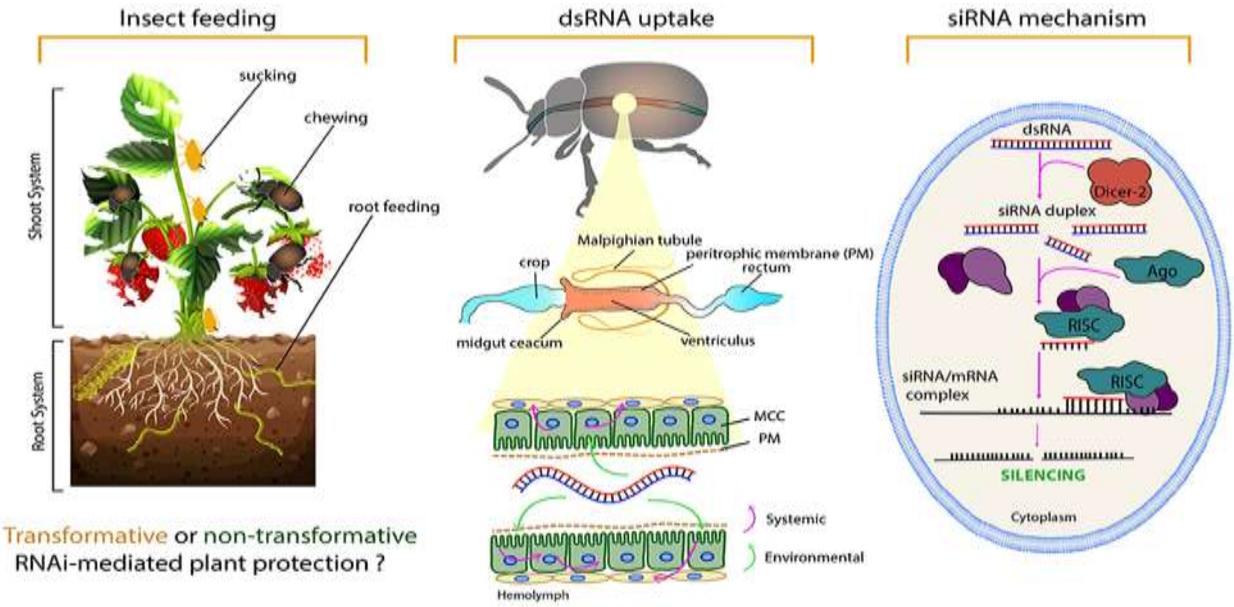


Figure 2. The basic levels of RNAi from an insect control perspective
(Source: https://www.frontiersin.org/articles/10.3389/fphys.2016.00553/full)

The application of RNAi technology for pest control is based on the introduction of dsRNA into the insect body to silence a gene of interest, thereby activating the siRNA pathway.

Fig 2. demonstrates some action that need to be taken into consideration regarding insect feeding behaviour, using a hypothetical example of a strawberry plant and some pest insects. Knowing the feeding habits of the target insect is important in planning the (delivery) strategy and whether a transformative or non-transformative RNAi-plant protection approach might be preferred.

For chewing insect, dsRNA can be taken up directly from leaves after dsRNA has been delivered through a foliar spray such as a normal plant protectant chemical. For sap-sucking insects, the dsRNA needs to be delivered through the phloem sap, which can be achieved via irrigation water, trunk injection for perennial trees, in planta dsRNA production (transgenic or transplastomic plants) or recombinant plant viruses (further details on dsRNA delivery approaches are provided latter).

The second step illustrates the dsRNA path/uptake by the microvilli of the columnar cells (MCC) in the insect midgut, as well as its environmental and systemic properties. Here the right panel shows the cellular siRNA mechanism of gene silencing.

The dsRNA Delivery Methods in Insects

To deliver of dsRNA in insects for RNAi studies, different methods have been explored viz:
1. Microinjection.
2. Oral feeding.
3. Soaking and transfection method.
4. Topical application.
5. Plant-mediated RNAi.
6. Foliar application of dsRNA.
7. Nanoparticle delivered dsRNA.

Application of RNAi in Crop Protection

1. Protection from insect pests: Baum et al. (2007) showed that silencing of a vacuolar ATPase gene (Vtype ATPase A gene) in midgut cells of western corn rootworm (WCR) led to larval mortality and stunted growth.

2. RNAi and Plant Disease Management:

a. RNAi has been successfully utilized in controlling viral disease like papaya ring spot virus, bean golden mosaic virus, mosaic in squash, potato, potato leaf roll etc. through RNAi based transgenic approach.

b. Similarly, in case of fungal disease like rust of wheat, powdery mildew of barley, Fusarium head blight RNAi approach successfully introduced using virus induced gene silencing (VIGS) or RNA spray.

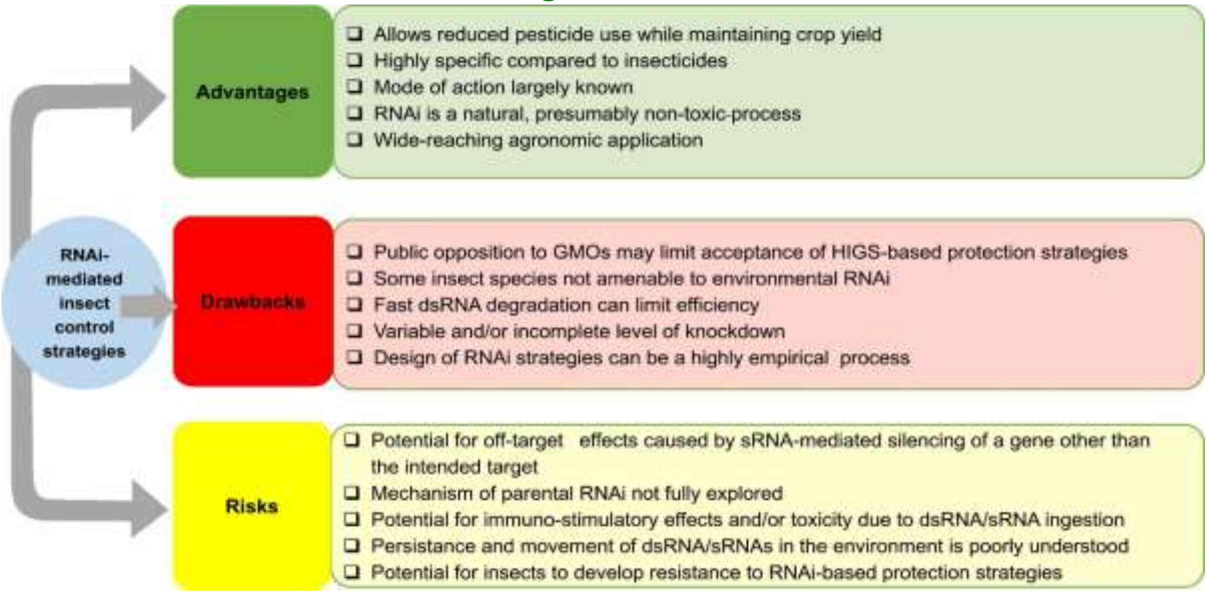
c. Bacterial disease canker, gall and nematode infestation by corn root worm was managed through silencing of gene by dsRNA following transgenic approach.

3. Nematode resistance: Huang et al. (2006) showed that Arabidopsis plants expressing dsRNA for a gene involved in plant – parasite interaction (16D10) had suppressed formation of root galls by Meloidogyne sp nematodes and reduced egg production.

Future Prospects for RNAi-Based Experiments in Insects

1. RNAi use to study: social behaviour, reproductive strategies and host-parasite interactions.
2. Systemic RNAi: genome wide screening is useful to identify genes involved at the whole animal level, e.g. in determination of life span and size, metabolic controls, ecdysis, etc.
3. Comparative studies for the function of a gene, or gene network, at species level.
4. More gene orthologs in different insects should be identified and their roles should be determined.

RNAi Mediated Insect Control, its Advantage and Drawbacks



(Source: https://www.sciencedirect.com/science/article/pii/S0734975019301636)

Conclusion

In combating the resistance mechanism developed against different pesticide, gene editing technologies like RNAi facilitate as novel next generation pest management strategies. With RNAi, it would be viable to target more than one gene for silencing using a thoroughly-designed single transformation construct. Moreover, RNAi can also offer broad-spectrum resistance against pest-pathogens with excessive degree of variability, like viruses. Recent studies have hinted feasible roles of RNAi-related approaches in plant biotic and abiotic stress adaptation and might be useful tool for pest management approach in future although the complexities of RNAi pathway, the molecular machineries, and how it pertains to plant development are still to be elucidated.

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Nonfertilizer Synthesis and their Limitations

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Introduction

Nanotechnology is an interdisciplinary promising research field, opening a vast number of opportunities in fields like medicine, pharmaceuticals, electronics, and agriculture. The term nanomaterials are generally used to describe the materials having a size between 1 and 100 nm. The small size and enormous surface area of such characteristics give unique properties for nanomaterials like optical, physical, and biological. Recently, a wide range of nanotechnology applications has been intensively studied in the agriculture research sector developing practices at both academic and industrial levels. In fact, nanotechnology has the potential to improve the entire current agricultural and food industry, by developing new tools for plant disease treatments, pathogen detection, and improving the ability of plants to absorb nutrients. Furthermore, nanotechnology started to attract more intention in the agriculture field specially to produce new nano fertilizers for increasing the efficacy and bioavailability of such new fertilizers as well as decreasing the loss of these materials to the surrounding environment. Many researchers illustrated that the agromorphological criteria, photosynthesis, and the yield of wheat plant and common bean were improved by the application of ZnO-NPs as a foliar fertilizer.

Synthesis of Nano Fertilizer

1. Synthesis of Surfactant Modified Zeolite: According to Banishwal et al. (2006) surfactant modification of the zeolite was carried out using hexadecyl trimethyl ammonium bromide (HDTMABr). A pre-weighed quantity of zeolite was mixed with HDTMABr solution (200 mg/L) in a 1:100 (solid: liquid) ratio. The mixture was agitated for 7-8 h at 150 rpm on an orbital shaker and then filtered. The solid residue was washed with double-distilled de-ionized water and oven dried for 4-6 hrs. The synthesized Surfactant Modified Zeolite (SMZ) was then mechanically ground with a mortar and pestle into fine particles. As the surfactant is the only source of carbon in the system, the surfactant loading was monitored by total organic carbon (TOC) analysis of the initial and final solutions obtained during the synthesis of SMZ.

2. Synthesis of Nano Fertilizer: To prepare nano fertilizer, required quantities (~170 g) of SMZ were stirred with 1.0 M solution of $(NH4)2SO4$, for 8 h and filtered, washed three times with de-ionized water, and oven dried. The solid: liquid ratio was 1:10 for the synthesis of nitrogen loaded zeolites. The amount of nitrogen incorporated, was calculated from the difference of the quantities of these elements in the unmodified zeolite and that in the synthesized zeolite (Banishwal et al., 2006). X-ray Diffraction (XRD) analysis of the two zeolites was done to confirm the incorporation of the fertilizer elements. For the in vitro incubation and macrocosm study, soil samples were collected from an agricultural field close the working laboratory following the procedures of USDA (1951).

3. Limitation of Nano fertilizers: In the context of sustainable agriculture, recent progress is un-doubted witnessing the successful use of some nano fertilizers for achieving enhanced crop productivity. However, the deliberate introduction of this technology in agricultural activities could result in many unintended non-reversible outcomes. In this scenario, new environmental and unintended health safety issues can limit the use of this technology in horticultural crops ‘productivity. Nanomaterial phytotoxicity is also an issue in this regard since different plants respond differently to various nanomaterials in a dose-dependent manner. Hence, it is crucial to consider the advantages of nano fertilizers, but also their limitations before market implementation. Importantly, nanomaterials are very reactive because of the minute size with enhanced surface area. Reactivity and variability of these materials are also a concern. This raises safety concerns for farm workers who may become exposed to xenobiotics during their application. These include not only those exposed to nano-fertilizer manufacturing but also nano fertilizer application in the field.

Considering the anticipated benefits, there is consequently a need to explore the feasibility and suitability of these new smart fertilizers. I need, a considerable concern about their transport, toxicity and bioavailability as well as unintended environmental impacts upon exposure to biological systems, limit their acceptance to adoption in sustainable agriculture and the horticulture sectors. Risk assessment and hazard identification of the nanomaterials including nanomaterial or fertilizer life cycle assessment are critical as well as establishing priorities for toxicological research. This is particularly true considering the accumulation of nanoparticles in plants and potential health concerns. Indeed, the use of nano fertilizers derived from nanomaterials have raised serious concerns related to food safety, human and food security. Some studies have reported phytotoxic effect of nanoparticles, and the uptake, translocation, transformation and accumulation (phytotoxicity) of NPs in plants is dependent on species, dose and ap-plication method as well as type of NPs (composition, size, shape, surface properties). Examination of the degree of toxicity of each NP in any given crop is important to study and understand the uptake and translocation of nano fertilizers, the possible transformation of nanoparticles when they interact with soil and plant compounds, and the accumulation of NPs in different plant tissues.

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Biofloc Technology

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Summary

This article is based on collective information resulting from available literature and expertise knowledge concerning about principle, advantages and disadvantages of biofloc technology.

Introduction

The problems associated to aquaculture activity like increasing the required area, water conduction carriage and building of ponds drains for remaining water must be fixed for increase in aquaculture production. Introduction of exotic species has generated a risk by inciting the transition of new microbes and diseases to local organisms (De Schryver et al. 2008; Emerenciano et al. 2011). Another way to ease the environmental damages caused by aquaculture and to enhance production is the usage of the "Biofloc" Technology (BFT), which was developed in the 70's, and based on the microbial communities that will help minimizing or avoiding water exchange and, the production of microbial protein that can be used as food as an additive advantage of biofloc (Avnimelech, 1999a).

Biofloc Technology (BFT)

The term "biofloc" applies to a compound made out of 60 to 70% of organic matter, which includes a diverse combination of microorganisms like fungus, algae, protozoans, and rotifers and of 30-40% of inorganic matter (colloids, organic polymers, and dead cells), and BFT is regarded as the new "blue revolution" in aquaculture. The technique is based on the production of microorganism under in situ conditions having 3 major roles: maintaining the quality of water by the uptake of nitrogen compounds generating in situ microbial protein; nutrition, increasing culture viability by dropping feed conversion ratio (FCR) and decrease of feed costs; and competition with pathogens. The aggregates of bioflocs are rich in protein-lipid natural source of food which are available in situ 24 hours per day because of the complex interaction among organic matter, physical substrate, and large range of microorganisms. This natural productivity plays a significant role in recycling of nutrients and retaining the quality of water.

Principle

The principle behind this system is to generate nitrogen cycle maintaining higher C:N ratio by stimulating heterotrophic microbial growth, which assimilates the nitrogenous waste that which will be broken down by the cultured spices as a feed. This technology is not only effective in treating the waste but also grants nutrition to the aquatic animal. The higher C:N is maintained through the addition of carbohydrate source (molasses) and therefore, the water quality is improved through the assembly of top-quality single cell microbial protein. In such condition, dense microorganisms develop and function both as bioreactor controlling water quality and protein food source. In bioflocs, immobilization of toxic nitrogen species occurs more rapidly because the rate of growth and production of microbial per unit substrate of heterotrophs are ten-times superior to that of the autotrophic nitrifying bacteria.

Benefits of Biofloc Technology

1. Biofloc culture system is ecofreindly
2. Lowers down the threats to environment.
3. Land and water use efficiency is enhanced.

4. Water exchange is minimized.
5. It enhances the role of productivity such as survival rate, growth performance, feed conversion within the culture systems of fish.
6. Advanced biosecurity.
7. It does not contribute to water pollution and therefore, minimizes the risk associated with the introduction and spread of pathogens
8. Economical feed production.
9. It decreases the exploitation of protein rich feed and price of ordinary feed.
10. It eases the pressure on capture fisheries.

Limitations of Biofloc Technology

1. It increases the requirement of energy for mixing and aeration.
2. It also reduces response time because of water respiration rates are elevated.
3. Set-up period required.
4. Alkalinity supplementation required.
5. Increased pollution potential from nitrate accumulation.
6. Uneven and seasonal performance for sunlight-exposed systems.

Conclusions

Establishment of the biofloc technology will allow aquaculture practices to an environmentally friendly approach and also provides aids to the production systems, like lowering the toxic components density that can affect the culture, it can also help reducing or eliminated the water exchange in the ponds, which is of great help when there is scarcity of water.

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Grow Ber Fruit for Health and Wealth

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Introduction

Ber (*Zizyphus mauritiana Lamk)* is an indispensable and indigenous fruit of India, China and Malaysia region. The fruits are treasure of nutrition and are rich in vitamin C, A & B complex. It is one of the most common fruits of India and is cultivated commercially all over the country. Ber fruits can be within the reach of the common people and hence known as poor man's fruit. It is ideal fruit for cultivation in the arid and semi-arid zones of northern India because it has least irrigation in the summer season of when it sheds its leaves and enter a period of dormancy. It is also known as King of Arid fruits.

Uses

The fruit is eaten fresh or pickled or used in beverages. It is quite nutritious fruit and rich in vitamin C next to guava and much higher than citrus fruits. Ripe fruits are preserved through sun-drying and a powder is prepared for off-season use. Fruits are also consumed in other ways, such as dried, candied, pickled, butter. Ber fruits are also used to prepare chutney, jam, jelly, murabba, and squash. The pulp of fruits is applied on cuts and ulcers are employed in pulmonary ailments and fevers. The dried ripe fruit is a mild laxative. The seeds are sedative and are taken with buttermilk, to halt nausea, vomiting, and abdominal pains in pregnancy, check diarrhoea, and poulticed on wounds. Mixed with oil, they are rubbed on rheumatic pains.

Nutritional Value (Food Value Per 100 g of Edible Portion)

Moisture	81.6-83.0 g
Protein	0.8 g
Fat	0.07 g
Fiber	0.60 g
Carbohydrates	17.0 g
Total Sugars	5.4-10.5 g
Reducing Sugars	1.4-6.2 g
Carbohydrates	2.47 g
Iron	0.76-1.8 mg
Carotene	0.021 mg
Thiamine	0.02-0.024 mg
Riboflavin	0.02-0.038 mg
Niacin	0.7-0.873 mg
Citric Acid	0.2-1.1 mg
Ascorbic Acid	65.8-76.0 mg
Protein	1.44 g

Climate

The ber is growing arid and tropical climate all over India and thrives up to the elevation of 1000 m above mean sea level. The ber is a hardy fruit tree and can grow successfully even under unfavourable climatic conditions, where most other fruit trees cannot survive. Ber relishes hot and dry climate for its successful cultivation, but the trees need adequate watering during the fruiting season. Excessive atmospheric humidity is considered a limiting factor for satisfactory fruiting. Frost during winter does not have much effect on the tree. It can very well withstand hot and dry weather during summer months of May - June, its tree enters into dormancy by shedding its leaves. It can tolerate temperatures as low -20 C if occasional and for short periods.

Soil

Ber provides a great scope for cultivation on soils which have marginal or in those soil where considered as unsuitable for most of the fruit crops. It develops a deep tap-root system growth and as such adopts itself to a wide variety of soils. The tree does best on sandy loam, neutral or slightly alkaline soils. The tree strand well on laterite, medium black soils with good drainage, or sandy, gravelly, alluvial soil of dry river-beds where it is growing vigorously spontaneous. Even moderately saline soils are tolerated. The tree is tremendous in its ability to tolerate water-logging as well as drought condition. Ber can grow on a wide range of soils having pH up to 9.2. Sandy loam soil with pH 7 is best suitable for its cultivation.

Varieties

There are several varieties of ber but only few are commercially important. They are Umran, Banarashi, Kadaka, Seb, Kaithali, Mundia and Gola. Popular varieties common in different states of india. Gola, Seb, and Mundia are suitable for extremely dry areas, whereas Banarashi, Kadaka, Umran and Meharun for dry regions.Given below the salient features of some varieties which have proved promising for commercial production.

Umran

It is cultivated in a wide area of Punjab and Haryana. The fruit is large, oval in shape with a roundish apex and has an attractive golden yellow colour which turns into chocolate brown at full maturity. The fruit is sweet, with 14-19 per cent TSS and has pleasant flavour and excellent dessert quality. It is a prolific cropping variety, yielding 150-200 kg of fruit per tree. The fruit ripens late from second fortnight of March to mid-April and have a good keeping quality. It is susceptible to powdery mildew.

Sanaur-2

It is a selection from a small town sanaur near Patiala, which is known for ber cultivation. The fruit is large and oblong with a roundish apex. On ripening, fruits attain a light-yellow colour having TSS of 18-19 Brix. like Umran, it is also a prolofic bearer-yielding about 150 kg fruit per tree. It is a mid-season variety, ripening during second fortnight of March under Punjab conditions and has been found fairly resistant to powdery mildew disease.

Kaithli

It is a selection from Kaithal in Haryana. The fruit is medium in size, oval in shape and has a tapering apex. Fruit pulp is soft and sweet with TSS of 14-16 Brix. Fruits ripen in the second fortnight of March to first week of April. The average yield is 120 kg fruit per tree. It is an excellent variety but appears to be more susceptible to powdery mildew disease.

Z.G.-2

The fruit is medium in size and roundish in shape with smooth skin. The fruit pulp is soft with an excellent sugar-acid blend. At the time of ripening the fruits attain light yellow colour and TSS of 15-16 per cent. The average yield amounts to 150 kg fruit per tree and the ripening time extends from second fortnight of March to first week of April. This variety is recommended for growing for local markets only. It is less susceptible to powdery mildew.

Gola

It is an early variety and popular grown in Haryana and Rajasthan. The fruits are round in shape, medium in size and attaining golden yellow colour at maturity. The pulp is soft and sweet taste with TSS 16-20 Brix. The quality of fruits is excellent but cannot stand long transportation . the average yield is 80 kg fruit per tree.

Banarasi Karaka

Tree tall and vigorous. This is very popular mid-season variety of Banaras and Uttar Pradesh. Fruits globose, to oblong to long in shape with tapering to pointed styler end. The average weight of fruits is 40-50 gm and develops greenish yellow to yellow colour at maturity.

Illaichi

It is seedless variety appears cardamom in shape. Fruits are small, pulp slightly hard, white and sweet in taste, average weight of fruits 6.0 gm, pulp very soft light total soluble solids 22.5 Brix, average fruit yield is about 115 kg/tree.

Planting

Beginning of monsoon, the best time of planting. Pits of 60cm × 60cm × 60cm are dug during and refilled after mixing 40-50kg of farm yard manure with neem cake 0.5 kg to prevent termite attack. Planting is done at a spacing of 3m in low rainfall areas, and 8m in the irrigated regions or in those receiving higher rainfall. In rainfed areas, shaping the interspaces between tree rows to provide 5% slope towards the plant helps accumulate run-off water during rainy season and thereby results in higher establishment success. In irrigated areas, ber plants can be transplanted during January and March also. In sandy soils, placing subsurface barriers as clay reduce infiltration of water and thus increase success.

Manure and Fertilizers

Proper nutrition of ber tree is necessary to get good crop over the years. The fruit becomes large and attractive and get decent price in the market. 20 kg farmyard manure and 100g nitrogen, 50g phosphorus and 50g potassium is recommended for one-year old ber tree. Similar amount of farmyard manure and nitrogen should be increased every year up to the age of five years. On the 5th year' application of 50-60kg FYM, 500gm nitrogen, 200-250gm each of phosphorus and potassium per tree should be applied. Farmyard manure should be supplied in whereas fertilizers are applied twice i.e. may- June and November- December.

Irrigation

Irrigation is very much beneficial during the development of fruit, i.e. October to February at intervals of 3 or 4 weeks depending upon the moisture of soil. Trees will continue to bear even if no irrigation is applied during this period but the yield is substantially reduced because of heavy fruit drops and smaller size of the remaining fruit. The quality of fruit is also very poor. It has been observed that the fruit become large and their quality is improved the fruit shedding is very much minimized if irrigation is applied during fruit development period. Irrigation should be stopped in March as fruits on the branches lying on the ground get damaged and their ripening is delayed. The harvesting of fruit is over in April and they become dormant in May-June and shed their leaves.

Intercropping

The ber tree is very much precocious which begins to bear after one year of its planting in the field. To develop the tree properly, it is advisable that no fruit should be taken at least for the first two-three years. Intercropping can be successfully practiced on the vacant land in the young orchard during the first four years. Only leguminous crops of short stature like gram, moong and mash can be grown to get extra income from the land in these initial years. These crops also enrich the soil by fixing atmospheric nitrogen. Manures and fertilizers, irrigation and plant protection measures should be given separately to the fruit trees and intercrops according to their needs. Gram, chilly, tomato and other vegetables can be grown as intercrops. Interculture operation be to suppress growth of weeds which cause nutrient losses and act as host for the pest. Cultivation of okra intercrop under rainfed condition of western india become profitable.

Mulching

In arid region of India, water losses can be minimized by using of organic mulches like kheep, wheat straw, grass and inorganic mulches i.e. polythene. Black polythene mulch on the tree basin help in conserving soil moisture and suppresses weeds growth. Tree basin covering with organic waste materials and black polythene as mulches, reduces evaporation, prevents weed growth, and maintains an optimum temperature for normal root activity.

Budding

The propagation of ber by budding is the most successful method. Both Shield or T-budding and ring-budding methods are employed but the former is preferable, because it is easier to perform. Budding operation should be done when there is proper flow of sap in the stock to be budded. Shield-budding is done during March-April or August-September, but it has been found that August-September budding gives a far better success. The budding make growth at a very fast speed. Plants budded in April usually become saleable in August-September, where as those budded in rainy season are ready for planting by February-March next. The modified ring-budding is preferable during June-July when the new growth starts. Shield-budding done during August-September has given success of 75-81 per cent, whereas budding in April has given a little success. The highest budding success is also achieved in June.

Training and Pruning

During the beginning, pruning is required to build strong architecture of branches to bear heavy load of fruits, while subsequently it needs to be done every year to obtain profitable yield. In the first year, the plants are allowed to grow until the next spring (March) when it is headed back keeping 2-3 basal buds on the scion portion just above the graft union to induce development of vigorous shoots. One upright growing healthy shoot is retained from the scion bud. The trunk is kept clean up to a height of 30 cm from ground level by removing all side shoots. From the main trunk, 3-4 properly spaced and favourably placed branches are allowed to grow. The top of the trunk is again headed back during May to encourage growth of side branches.

Top-Working

Old and unproductive ber orchard and other wild Ziziphus species can be improved by the technique of top working. The technique involves replacement of the top by budding or grafting with desired scion cultivars. The top growth of the old tree is removed by heading back at 60-100 cm height from ground level at 2 m height, if high headed trees are to be developed However, in practice, it has been observed that heading back just above the ground level is better as there is less chances of breakage after budding due to stormy winds. The heading back operation may be carried out during April-May. Several new shoots emerge from the old stumps during monsoon season.

Harvest and Yield

The ber tree grows quickly and the first crop can be harvested within 2-3 years of planting. The fruit itself requires about 22-26 weeks to mature after fruit-setting. The peak season of harvesting in north India is in mid-March to mid-April but some early varieties may ripen by end-February. This period being a slack season for other kinds of fruits, ber sells readily at remunerative prices. The fruit should always be picked at the right stage of maturity, i.e. when it is neither under-ripe nor over-ripe. It should be picked when it has acquired normal size and characteristic colour of the variety, e.g. golden yellow colour in Umran. Normally four to five pickings have to be made as all the fruits on the tree do not ripen at the same time. In no case, the fruit should be allowed to become over-ripe on the trees, as they deteriorate in taste and quality and thus fetch lower price in the market.

The average yield during the bearing period (10-20 years) ranges from 80-200 kg per tree. A ber tree provides production up to 25 years of age. In rainfed conditions 50-80 kg fruits per tree can be obtained. the average yield per plant was observed 35, 42, 28, 14, 22, kg in Gola, Umran, Kaithfal, Sanaur-5 and kaithali in arid regions of Rajasthan.

Post-Harvest Management

1. Packaging: The fruits have to be packed properly for storage and safe transport. The harvested ber fruits should be sorted to discard the damaged, over ripe, unripe and misshapen fruits. The fruits should also be graded into large, medium and small sized groups. For local markets, fruits are generally packed in cloth sheets or in gunny bags but for long distance transport, packing should be done accord mg to grade while ' A' glade fruits can be packed in perforated cardboard cartons of six kg capacity with paper cutting as cushioning material, the lower grades can be packed in baskets or gunny bags.

2. Storage: In general, ber fruits are stored at room temperature (25-35°C) after harvest. Fruits can be kept for 4-15 days at ambient condition without loss of quality depending upon the cultivars. The varieties like Sanauar-5, Ponda, Rashmi and Umran have better shelf life. The ideal temperature for cool storage is 10°C and 79% RH. During storage, enzyme activity, sugar and carotenoid content increase with corresponding decrease in acidity, pectin and tannin content. Several pre-harvest treatments can be helpful for extending the shelf life of the fruits Spraying of CaCl2 (0.17%) with 1% Teepol 10 days before harvest improves shelf life of Umran ber. Similarly spray of calcium nitrate (1 %) at colour turning stage (10 days before harvest) can also be used. Post-harvest treatment such as pre-cooling, dipping the fruits in 1-2% CaCl2 containing surfactant prolongs shelf life of fruits Storage life could be extended up to 10 days in cv. Umran and 12 days in Sanaur -2 at room temperature by treating the fruits with wax emulsion and packaging in perforated polythene bags (Jawanda et).

3. Products from fruit pulp: Ber fruits especially, the juicy varieties can be used for preparing unfermented beverages Fruits are first peeled and destoned followed by heating with water for few minutes and then strained through muslin cloth. The juice so prepared can be preserved by pasteurization or by adding chemical preservatives. The juice can be used for preparing squash, jam and nectar.

4. Preserve and candy: Preserve and candy can be made from the fruits of selected ber varieties such as Umran, Banarasi, Karaka and Kaithli. Fully mature fruits while still hard are selected for preserve or candy making. The fruits are first pricked and softened for uniform sugar impregnation. Softening can be achieved by blanching the fruits for 2-3 minutes in boiling water followed by dipping in cold water. The sugar impregnation is achieved by dipping the fruits in sugar syrup starting with 30° Brix and gradually increasing the syrup strength to about 65-70° Brix by adding more sugar. For preparing candy sugar concentration is further increased to 70-75° Brix and the fruits are submerged for 10-15 days in concentrated sugar syrup. At the end, the syrup is drained off and fruits are air dried and packed ins air tight jars or polypacks.

Disorder

Fruit cracking: Fruit cracking in ber can be caused due to high temperature rise in March, irregular irrigation interval, imbalance in endogenous level of growth regulators and varietal characters. The cultivar Umran has less cracking problem due to hard skin and texture of fruit. Gola and Kaithli are prone to splitting due to soft skin and high TSS at maturity. Spray of NAA@ 20-30 ppm at pit hardening stages once in second fortnight of October and again during second fortnight of November increase the promoter level and thus reduce the cracking of fruit skin.

Insect Pests

1. Fruit fly *(carpomyia vesuviana)*: It is a serious pest which causes damage up to 80 per cent. When fruits are small, young in September, and the female fly puncture the fruits and lay eggs singly. Hatching of eggs completes in two to three days. The larvae feed on pulp and make hole in the fruit skin and emerge out through the hole when fully grown up. The pupal stage completes in the soil which lasts for about 15 days after that the adult fly come out. The affected fruits become unfit for consumption and reduce the growth and quality of fruits.

Management: To control the pest, pick and destroy the infested fruits and spray 500 ml of Roger 30 EC (Dimethoate) in 300 litres of water during February-March, care being taken that sprayings are stopped at least 15 days before fruit harvest.

2. Bark eating caterpillar: The caterpillar makes holes in the trunk and feed on bark in night and make frassy galleries on the stem near angles of branches. The growth and productivity of the affected trees are reduced.

Management: Remove all frassy galleries and paint the bark with Monocrotophos 40 EC (0.05%).

Diseases

1. Powdery mildew: The disease is caused by *Microsphaera alphitoides* f.sp. *Zizyphi* and appears from September to December. It has become a big menace to ber orchards in north India. If not checked in time, the disease can wipe out the entire crop. Young developing leaves and fruits are covered with whitish powdery mass of the causal fungus. The disease cause premature defoliation and heavy fruit-drop. Affected fruits remain small and become cankered and disfigured. Sometimes the attack is so sereve that the entire crop is lost either through drop or rendered unmarketable, thus causing heavy economic losses to the growers. The disease can be controlled by 3-4 spray of 0.05 per cent Karathane 40 EC (50-80 ml in 100 litres of water) or 0.25 per cent wettable sulphur (250 g in 100 litres of water). First spray must be given before flowering (first fortnight of September), second spray after fruit-set in early October and the third in the end of October. Another spray can be given if need arises.

2. Leaf spots: Two leaf spots of ber are very common in ber growing regions, i.e. 'Phoma Leaf Spot' caused by *Phoma macrostoma* Mont. and 'Black Mould of Leaf' caused by *Isariopsis indica*. Both diseases are caused by different fungi, while the Phoma leaf spot appears on the upper surface, the black mould make its appearance only on the lower surface of leaves. In case of Phoma leaf spot symptoms appear when the leaves have fully expanded, in the Black mould case the symptoms can appear even on young leaves. Phoma leaf spot appears with grey centre, yellow margin and dark fungal growth on the mid-rib, main vein, petiols and the leaves. Black mould spot appears as small circular, small finger-like projections like softy tufts.

First Spray

Bordeaux mixture 2 : 2 : 250 or with 0.3% copper oxychloride 50% (300 g in 100 litres of water) must be sprayed both on upper and lower surface of leaves with the appearance of disease in August or when the leaves have expanded.

Second Spray

This spray must be done after 14 days of the first spray with 0.2 per cent Dithane M-45 WP 75% (200 g per litres of water) both on upper and lower surface of leaves. First and second spray must be repeated alternatively at 14 days interval till the fruits are fit for marketing. Thereafter sprayings are stopped a week before harvesting.

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Bio Fortification for Sustainable and Cost-Effective Nutritive Agriculture

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Introduction

Malnutrition has emerged as one of the most serious health issues worldwide. The consumption of an unbalanced diet poor in nutritional quality causes malnutrition which is more prevalent in underdeveloped and developing countries like India. Deficiency of proteins, essential amino acids, vitamins and minerals leads to poor health and increased susceptibility to various diseases, which in turn leads to a significant loss in Gross Domestic Product (GDP) and affects the socio-economic structure of the country.

Globally, around two billion people suffer from malnutrition, children are the most affected due to malnutrition. Nearly 45 per cent of deaths among children under the age of five are associated with malnutrition. In India, 21.9 per cent of the population lives in extreme poverty, and it is estimated that 15.2 per cent of people are undernourished. As per the National Family Health Survey-4 (2015-2016), 38.4 per cent of the Indian children (5 <years) are stunted, 21.0 per cent are wasted and 35.7 per cent of the children are underweight. Anemia is also a serious health issue, where 58.4 per cent of Indian children (6-59 months) and 53 per cent of the adult women (15-49 years) are affected by this deficiency. The figure is also alarming among adult males as 22.7 per cent were found to be anemic. Considering its widespread ramification, alleviation of malnutrition has been identified as one of the most important steps for a hunger-free world. Although various avenues such as dietary-diversification, food-fortification and medical-supplementation are available, biofortification of crop varieties is considered as the most sustainable and cost-effective approach where the nutrients reach the target people in natural form.

Biofortification is a process where the nutritional quality of a crop is enhanced through genetic manipulation that includes both breeding and transgenic approaches. Among various nutrients, protein, lysine, tryptophan, iron, zinc, vitamin A and vitamin C are essential for human nutrition, and their deficiency leads to various symptoms and health disorders. Erucic acid, glucosinolates and Kunitz trypsin inhibitor (KTI) are the antinutritional factors as their consumption at higher levels leads to adverse effects in humans and livestock. The newly developed biofortified crop varieties besides serving as an important source for livelihood to poor people assume great significance in nutritional security.

The National Agricultural Research System (NARS) including the Indian Council of Agricultural Research (ICAR) institutes and State Agricultural Universities (SAUs) has contributed immensely to make India self-sufficient in food production. From 50.82 mt of food production in 1950-1951, India has touched 284.8 mt during 2017-2018 (Fourth Advance Estimates). However, in the process of yield enhancement, the nutritional quality was not given due importance, and as a result, the majority of these varieties do not possess the desired level of nutritional quality. Realizing the paramount importance of nutritional quality, research efforts of NARS have now led to the development and release of a series of biofortified varieties through All Indian Coordinated Research Projects (AICRPs) for different crops. The National Agricultural Research System under the leadership of the Indian Council of Agricultural Research (ICAR) developed 53 such varieties during the last five years. There was only one biofortified variety developed before 2014.

Recently, on the occasion of the 75th Anniversary of the Food and Agriculture Organization (FAO) on 16th October 2020, Prime Minister Shri Narendra Modi dedicated the 17 recently developed biofortified varieties of 8 crops (Table 1) to the Nation intending to eradicate malnutrition and to transform the Indian thali (food plate) into Nutri-thali. These varieties have up to a 3.0-fold increase in nutritional value than existed varieties.

Table 1: Different bio-fortified crop varieties released by Prime Minister

S.No	Crop	Variety	Fortified Nutrient
1	Rice	CR Dhan 315	Zinc
2	Wheat	HI 1633	Protein, iron and zinc
		HD 3298	Protein and iron
		DBW 303	Protein
		DDW 48	Protein
3	Maize	Maize Hybrid 1	Lysine and Tryptophan
		Maize Hybrid 2	Lysine and Tryptophan
		Maize Hybrid 3	Lysine and Tryptophan
4	Finger Millet	CFMV1	Calcium, iron and zinc;
		CFMV2	Calcium, iron and zinc
5	Little Millet	CLMV1	Iron and zinc
6	Mustard	Pusa Mustard 32	Low Erucic acid
7	Groundnut	Girnar 4	Enhanced oleic acid
		Girnar 5	Enhanced oleic acid
8	Yam	Sri Neelima	Enhanced zinc, iron and anthocyanin content
		DA 340	Enhanced zinc, iron and anthocyanin content

These varieties, along with other food ingredients, will transform the normal Indian thali into Nutri-thali. These varieties have been developed by utilizing the local landraces and farmer's varieties. The high zinc rice has been developed from landraces of Assam rice collected from Garo hills and those of finger millets from Gujarat collections of Dang districts.

ICAR has started the Nutri-Sensitive Agricultural Resources and Innovations (NARI) program for promoting family farming linking agriculture to nutrition, Nutri-smart villages for enhancing nutritional security and location-specific nutrition garden models are being developed and promoted by KVKs to ensure access to locally available, healthy and diversified diet with adequate macro and micronutrients. The production of biofortified crop varieties will be upscaled and linked with government programs of mid-day meal, Anganwadi, etc. to reduce malnutrition and make India Kuposhan Mukta (malnutrition free) through naturally enriched food ingredients. This will also usher in the higher income of farmers and will open new avenues of entrepreneurship development.

Conclusion

The deployment of biofortified cultivars holds great promise for the health and wellbeing of the human population. The development and promotion of biofortified varieties thus would help address malnutrition and achieve the Sustainable Development Goals (SDGs). Lack of awareness on the health benefits of biofortified crops is one of the major factors for the slow adoption of biofortified varieties. The educational background of the household head and the extent of farmers' participation in demonstration trials and field days are the important factors for the generation of awareness about the malnutrition and importance of biofortified varieties.

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Agronomic Measures to Reduce Methane Emission in Agriculture

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Introduction

Global warming, caused by the increase in the concentration of greenhouse gases (GHGs) in the atmosphere, has emerged as one of the most prominent global environmental issues. These GHGs – carbon dioxide (CO2), methane (CH_4) and nitrous oxide (N_2O) trap the outgoing infrared radiation from the earth's surface and thus raise the temperature. The Inter-Governmental Panel on Climate Change projected a temperature increase between 1.1 and 6.4°C by the end of the 21st Century. Global warming also leads to other regional and global changes in climate-related parameters such as rainfall, soil moisture, and sea level. The mean sea level has risen by 10–20 cm in the last century. Similarly, snow cover is also believed to be gradually decreasing.

India has set targets for itself for reducing GHG emission intensity by 20–25% by the year 2020. To develop a policy aimed at achieving these targets, an insight on major contributors and processes to GHG emission is needed. Based on such insight, the mitigation options may be formulated. Agricultural activities contribute 10%–14% of global anthropogenic GHG emissions, mostly from enteric fermentation (methane), application of synthetic fertilizers (nitrous oxide), and tillage. (carbon dioxide). Keeping this in view the objectives of this article are to overview the GHG emission from Indian agriculture and their mitigation options.

Emission of GHGS from Agriculture

Agricultural soils contribute to the greenhouse effect primarily through the emission of GHGs such as methane, nitrous oxide and carbon dioxide.

1. Methane emission:

a. Methane is produced in the soil during microbial decomposition of organic matter under anaerobic conditions.

b. Rice fields submerged with water, therefore, are a potential source of methane. Continuous submergence, higher organic C content and use of organic manure in puddled soil enhance methane emission.

c. Burning of crop residues also contributes to the global methane budget.

d. Enteric fermentation in ruminants is another major source of methane.

2. Nitrous oxide emission:

a. Nitrogenous fertilizer is a source of N_2O in fertilized soils, whereas the indigenous N contributes to the release of this GHG in unfertilized soil.

b. Soil water content and the availability of carbon enhance the production of N_2O provided a suitable nitrate source is available. Generally, an increase in N_2O emission is observed following irrigation and precipitation.

c. The burning of crop residues also contributes to the global N_2O budget.

3. Carbon dioxide emission:

a. The main source of carbon dioxide from agriculture is through soil management such as tillage which triggers carbon dioxide emission through the biological decomposition of soil organic matter. Tillage breaks soil aggregates increases oxygen supply and exposes the surface area of organic material promoting the decomposition of organic matter.

b. Fuel use for various agricultural operations and the burning of crop residues are other sources of carbon dioxide emission. An off-site source is the production of carbon dioxide for manufacturing fertilizers and pesticides.

Reducing Agricultural Greenhouse Gases

1. Field management to reduce GHGs emission:

a. Methane:

i. Water management is one of the most confounding factors affecting methane emission. Methane emission pattern from a rice field illustrates that the peaks of the flux are dictated by the moisture content of the soil. Continuously saturated rice fields gave higher methane emission compared to intermittent wetting and drying soil conditions. Saturation of soil creates anaerobic conditions conducive for the formation of methane as methanogens are strict anaerobes. When such saturated soils were allowed to dry making them aerobic, the formation of methane can be prevented.

ii. Application of manure such as farmyard manure (FYM) increases methane emission by adding organic carbon and N required for microbial activities and serving as a source of electrons. Substituting 50% of inorganic N with FYM increased emission by 172% compared to the application of the entire amount of N through urea. However, application of biogas slurry reduced emission by 2.3 times compared to FYM suggesting that biogas slurry should be a preferred source over FYM in terms of mitigating methane emission

iii. The selection of suitable rice varieties plays an important role as they show pronounced variations in methane emission. For example, seasonal emission was maximum for Pusa 933 (27.2 kg ha-1) and minimum for Pusa 169 (15.6 kg ha-1), with intermediate values in the decreasing order of Pusa 1019, Pusa Basmati, Pusa 834 and Pusa 677.

iv. Nitrification inhibitors such as neem coated urea, coated Ca-carbide, neem oil and dicyandiamide (DCD), which slow down the process of nitrification in soil, could reduce the emission of methane from the soil by 10–15%.

b. Nitrous Oxide:

i. The growth of legumes increased nitrous oxide emission, the extent of which varied from crop to crop. The selection of crop and crop varieties can mitigate N2O emissions.

ii. Fertilizer type and moisture status of soil play important roles in nitrous oxide emission. At field capacity, soil fertilized with urea, ammonium sulfate, or ammonium nitrate showed higher emissions than with potassium nitrate due to nitrification of ammonium-N. At submergence, nitrate-containing fertilizers emitted a higher amount of nitrous oxide. The results showed that the selection of the right kind of fertilizer and optimizing irrigation practices could help to reduce the emission.

iii. Nitrification inhibitors reduce the emission of N2O, directly by reducing nitrification, or indirectly by reducing the availability of NO3 for denitrification. Reduction in N2O emission on the application of nitrification/urease inhibitors along with urea. Some plant-derived organics such as neem oil, neem cake and karanja seed extract (karanjin) act as nitrification inhibitors and reduced nitrous oxide emission.

iv. Tillage plays an important role in the emission of nitrous oxide from soil. No-tillage increased the cumulative emission of N2O-N by 12.2% with urea fertilization as compared to conventional tillage.

c. Carbon dioxide: Zero tillage (also known as no-till farming) is a technique where farmers minimize disturbing the soil by tillage and in doing so, they reduce emissions from a fuel that would have been consumed for tillage operations. It can be used in the cultivation of rice, maize, cotton and sugarcane.

2. Livestock & Manure Management: Livestock and manure management are significant contributors to agricultural GHG emissions. The following practices can sequester carbon and mitigate GHG emissions from livestock and manure:

a. Select regionally appropriate forages.
b. Practice rotational grazing.
c. Select high quality feed that will reduce methane released from enteric fermentation.
d. Manage manure to reduce methane and nitrous oxide.
e. Cover manure storage facilities.
f. Optimize manure application to soil.
g. Capture and combust methane from manure.

3. Soil Conservation & Carbon Sequestration: Agricultural ecosystems hold substantial carbon reserves, primarily in soil organic matter. The following farm practices promote carbon sequestration by either increasing the storage of carbon or reducing the loss of stored carbon as carbon dioxide.

a. Implement crop rotations.
b. Decrease bare fallow.
c. Manage tillage and residues.
d. Establish agroforestry systems.

4. Energy Conservation & Fuel Switching: Each farm operation has different opportunities for energy conservation and fuel switching. Some examples include:

a. Conduct an on-farm, all-fuel energy assessment to identify energy saving opportunities.
b. Ensure that all heating and cooling systems are in good working order.
c. Use timers, sensors or variable speed drives on ventilation, heating, cooling and lighting systems.
d. Replace fossil-fuel powered equipment with electrical pumps and motors.

Conclusion

Though the inventory of GHG emission from Indian agriculture is fairly robust, it still suffers from various deficiencies like non-availability of country specific emission factors, lack of adequate monitoring stations and data quality. To capture the diverse soil and climatic conditions, different management practices and socio-economic status of the farmers influencing GHG emission, an appropriate national exercise is needed. This will not only improve estimates of emission and related impact assessments but also provide a baseline from which future emission trajectories may be developed to identify and evaluate mitigation strategies. For India's agricultural production systems to be viable into the future, there is a need to identify soil management systems that are climate change compatible, where soil organic C is maintained or enhanced and GHG emission is reduced. It would require increased mitigation and adaptation research, capacity building, development activities and changes in land-use management. A win-win solution is to start with such mitigation strategies that are needed for sustainable development such as increasing soil organic C content. Policies and incentives should be evolved that would encourage farmers to adopt mitigation options thus improve soil health and use water and energy more efficiently.

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Agricultural Education: An Instrument for Growth and Development

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Abstract

The complexity in agriculture sector is increasing with the increase in globalisation, climate change, corporatisation etc. Agricultural research and education will be the instrument of growth going forward. However, even after 73 years of agricultural research and a strong education system, there is a missing linkage between research and market. Clearly, there is a need to strengthen this linkage. This requires a strong human capital. The statistics on employment of agricultural graduates is not very encouraging. It is therefore imperative that the opportunities in this sector is scaled up which can attract and mentor high-quality, motivated students by improving the quality and relevance of training and increasing investments across the agricultural value chain.

Keywords: agricultural research, education, research and market linkage.

Introduction

Agricultural sector has gone through different phases of growth, embracing a wide variety of institutional interventions, technological and policy regimes (Parapurathu, 2018). In this new era, the agricultural sector is getting more complex due to globalization, impact of climate change, entry of corporate sector in agriculture value chain, expanding demand for processed food, and need for post-harvest technology.

A nation's success in extending the agricultural revolution to all its regions depends in large part on its ability to produce a substantial number of people who command basic farming skills and are grounded in the agricultural sciences and technology (Wortman & Cummings, 1978). Many researchers emphasize on the need to improve the performance of research, extension, marketing, credit, and policy institutions. However, very little focus, however, has been given to attract students from high school and to offering effective and relevant higher education in agriculture.

The primary objective of agricultural education is to train manpower for the agricultural and rural sector—a broad range of development workers in extension, research, experimentation, formal teaching, produce marketing and input supply, credit, planning and administration, and farming itself (Hoffmann, 1985; Jayaraj, 1992).

This has to be done for two categories of people: the university-trained people to take care of policy formulation and administration at various levels and to hold key positions as subject matter specialists, researchers, and extension providers; and the trained personnel to perform field-level, non-extension jobs. (Bonte-Friedheim, Tabor, & Tollini, 1997).

India requires enhancement in agriculture education at all levels, so that Indian farmers are better equipped to handle the threats of globalization. With the entry of Foreign Direct Investment (FDI) in the agricultural sector, many multinational companies have ventured into the segment with dozens of agricultural products.

This has resulted in a threat to Indian farmers, who lack the professional expertise to deal with the issue. The agribusiness sector is made up of commercial firms dealing with fertilizers, seeds, agrochemicals, livestock and poultry, food processing, and agricultural machinery; large plantation firms; financial institutions; consultancy firms; etc., who also need agricultural education (India Education Net, 2008).

Government Initiatives

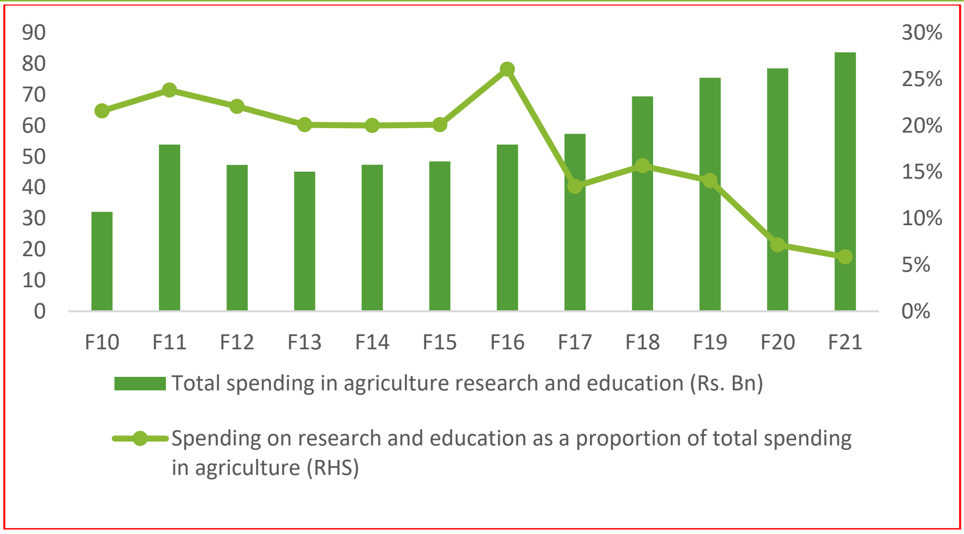
Several initiatives have been taken by the government to strengthen the agricultural education system in the country. A major development took place with the creation of the Imperial Council of Agricultural Research in 1929, an apex central body to promote and coordinate agricultural research at state and national levels. After India gained independence in 1947, the Council's name was changed to its present name, the Indian Council of Agricultural Research (Randhawa, 1979).

The first agricultural university in Uttar Pradesh was established in 1960, patterned on the land-grant university model of the United States. This was a significant turning point in the history of agricultural education in India. India currently has a strong agricultural education system consisting of one Central Agricultural University, 41 State Agricultural Universities (SAUs), and four National ICAR Institutes having the status of "Deemed University". These include, the Indian Agricultural Research Institute (IARI); the Indian Veterinary Research Institute (IVRI), Izzatnagar (Uttar Pradesh); the National Dairy Research Institute (NDRI), Karnal; and the Central Institute of Fisheries Education (CIFE), Mumbai, which cater to quality education in animal sciences and the dairy and fishery sectors, respectively. The SAUs are spread over the entire country (Department of Agricultural Education and Research, 2016)

A well-established agricultural education system is expected to lead to improved technologies that has the potential to turnaround the sector to a profitable business. However, these benefits do not necessarily materialize for the poor, for there are innumerable conditioning factors that help determine who benefits.
The entire value chain system lacks in capacity building market information, research and intelligence. The missing link of giving right signals of market through research to the producers leads to huge price distortion and wastage.

Fig 1: Link between research & value chain in agriculture system

Higher education programs in agriculture and related studies need to attract and mentor high-quality, motivated students with a genuine interest in agriculture by improving the quality and relevance of training and increasing investments across the agricultural value chain. Low investment in agriculture research has been one of the concerns for several years and particularly in the recent years when the complexity in the entire agriculture system have increased.



Source: RBI

The low investment in agricultural research and education has not only impacted research but has also failed to attract students in this sector who can contribute meaningfully. In the following section, we show low career prospects in agriculture has also hindered the growth in this sector.

Education and Employment

Despite the growing importance of agriculture education in India, proportion of students graduating with agriculture education is miniscule. As per World Development Indicators of World Bank, merely 0.9% of students enrolled in Agriculture, Forestry, Fishery and Veterinary Programs and only 0.7% of students graduated from these programmes in 2018. Moreover, there has been barely any change in the number agricultural graduates over the years.

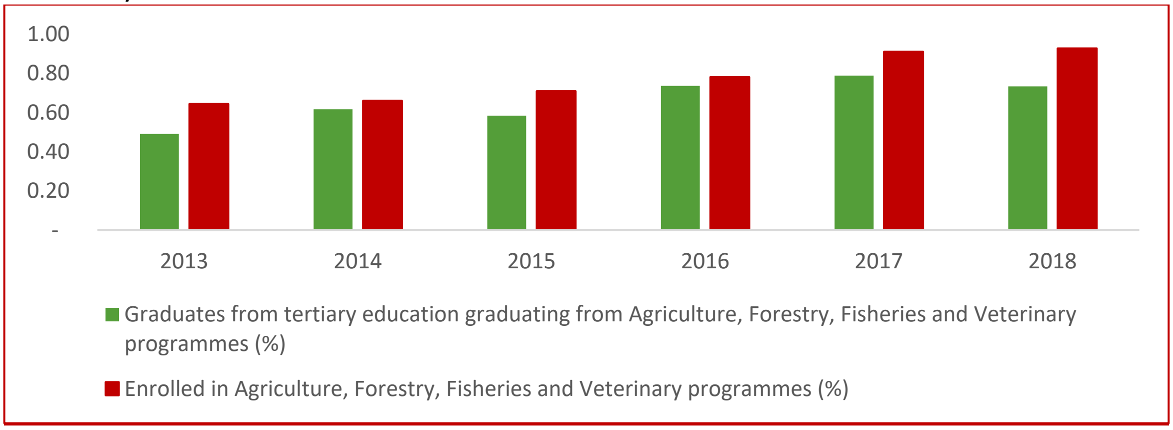


Fig 3: Enrolment and Pass-outs from Agriculture and related programs
Source: World Development Indicators, World Bank

One of the key reasons for this has been the weak career prospects as compared to any other vocational education. Agricultural graduates face a serious problem of unemployment because the public sector has not been able to absorb the entire labour force despite the low proportion of agricultural graduates in a year. As per the NSSO, sample survey of employment and unemployment, in 2011-12, about 38% of the agricultural graduates reported to be unemployed. Corresponding to this, only 10% of engineering graduates and 5% of medical graduate were without any job.

The statistics on employment of agricultural graduates is therefore barely convincing to the prospective enrollees that pursuing a career in agriculture will be rewarding. In fact, the pursuit of higher education in agriculture is considered by many as evidence of student's failure to be accepted into fields perceived to be more prestigious and lucrative, such as, medicine, engineering, information technology, law and business.

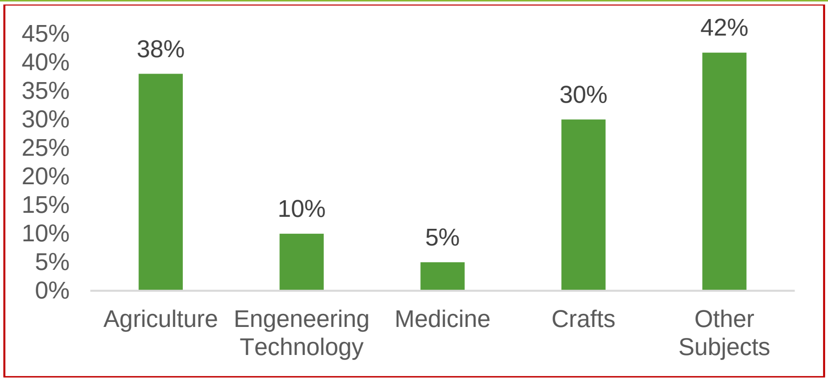


Fig 4: Proportion of Graduates by Technical Education without Job
Source: Employment and Unemployment Survey, 2011

Conclusion

Agricultural research and education is likely to be the instrument of growth. However, despite having a strong agricultural education system, the entire value chain system lacks in capacity building market information, research and intelligence. The missing link of giving right signals of market through research to the producers leads to huge price distortion and wastage. There are several factors that contributes to this, but one of the concerns, is the declining share of investment in agricultural research and education. In addition, the sector has also failed to attract students. Proportion of agricultural graduates in a year is miniscule and of these a significant proportion reported to be unemployment as compared to those with other vocational education.

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Mushroom Proven Super Food for Human Health a Review

Article ID: 32725

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Mushroom have been known since ancient time and is being used as alternate food to the vegetarian people. Mushroom have been recognized as the source of good quality of protein (20- 35%) and also contain no starch, low fat, low calories and good amount of vitamin B-complex (folic acid, thiamine, and niacin), vitamin D, minerals (potassium, phosphorus, zinc, copper and sodium) which are higher than in vegetables and fruits. In addition, many mushrooms possess naturally multi-functional medicinal properties like anti-cancerous, anti-fungal, anti-bacterial, anti-tumorous, antiviral, antioxidants activity and many other diseases. Recently Ministry of Education, Department of School Education and Literacy , Government of India advised mushroom based supplement recipe should be added in mid-day meal scheme in village, which remove the bridge of protein gap. Nutrition is the most important subject for humankind. A balanced nutrition is particularly important from the point of taking in essential elements such as minerals, vitamins and high-quality proteins. Nutritional levels in societies depend on various factors such as economic conditions, ecology, nutritional habits, traditions and education. Successful development of countries is achieved by advancing economic subjects including levels of agriculture, industry and education. Nutritional values of foods play an important role in human health. The people have to provide a balance diet containing essential food compounds; amino acids, fatty acids, minerals and vitamins. A sufficient and balanced diet should also include taking in enough carbohydrate and energy supplies. Mushrooms can provide balancing diet compounds in sufficient quantities for human nutrition, and contain medicinal compounds.

Use of Mushroom as Food and Medicine

Mushroom has a pleasant aroma, taste and flavour that differ other fruits and vegetables crops for vegetarian persons. It supplies a good amount of high-quality protein with other essential constituents fit for human consumption. Mushroom is highly nutritive, low calorie food with good quality proteins, vitamins, selenium and minerals. It is an important natural source of food and medicines. By good feature of having high fibre, low fat and low starch, cholesterol is absent and ergosterol is present which convert into vitamin D in human body. Edible mushrooms have been considered to be ideal food for overweight persons and for diabetics to prevent hyperglycaemia.

They are also known to possess promising anti oxidative, cardiovascular, hypercholesterolemia, antimicrobial; hepatoprotective and anti-cancer effects more than three thousand mushroom are mainly edible species however only hundred species are cultivated commercially and only ten species are used at industrial scale and their global and economic value is now increasing slowly due to increase in their value as a food as well as their medicinal and nutritional values in all parts of the country.

Conclusion

A number of edible and medicinal mushroom heve been known. Cultivated mushrooms have become popular, and over 200 genera of macrofungi are useful for the people in the world. Most of them are cultivated on lignocelluloses waste materials and contribute to their re-cycling. The common mushroom species produced in suitable ecological conditions are: *Agaricus* spp (button), *Lentinula edodes* (shiitake), *Calocybe* (milky mushroom) *Pleurotus* spp. (oyster), *Volvariella volvacea* (paddy straw), Lion's head or pom pom (*Hericium*), *Auricularia (ear)*, Cordyceps, *Ganoderma* (Reishi), *Grifola frondosa* (maitake), Winter (*Flammulina*), white jelly

(*Tremella*), *Pholiota* (nameko). The nutritional and chemical composition, and physical properties of edible mushrooms have been studied by different authors. It is well known that mushrooms have a rich in medicinal properties and functional activities for health.

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Doubling of Farmers Income

Article ID: 32726

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Introduction

Agriculture is the largest enterprise in the country. An enterprise can survive only if it can grow consistently. And, growth is incumbent upon savings & investment, both of which are a function of positive net returns from the enterprise. The net returns determine the level of income of an entrepreneur, farmer in this case. This explains the rationale behind adopting income enhancement approach to farmers' welfare.

It is hoped, that the answer to agrarian challenges and realization of the aim of farmers' welfare lies in higher and steady incomes. Farmers are at the epicentre of Indian economy and their livelihood upliftment is a step towards holistic development of the nation. Decline in productivity and income has a serious implication on rural household poverty, and other economic, social as well as sustainability indicators.

What is Doubling of Farmers Income?

Revenue and profit are often used interchangeably by the average person, but these term shave separate meanings, albeit profit being an outcome of revenue. Contextual clarity on terminology is important to avoid confusion of intent or action. Revenue is a synonym for income, whereas profit means net income.

1. Profits, in simple terms, means the income or revenue that remains after all expenses.
2. Income is total revenue generated from sales of goods or services. Income is therefore the immediate outcome of sales fulfilled.

Objectives of DFI by 2022

1. To increase production and productivity of crop.
2. To reduce cost of cultivation.
3. To double the farmer's income.

Concept of Doubling Farmer's Income

The goal of doubling farmer's income by the year 2022 has been dubbed as impossible and unrealistic by some experts.

Some commentators have produced calculations that agriculture will require annual growth rate of 14.86 percent per year to get farmers income doubled and pointed out that this growth level hasn't been achieved even for one year in the history of Indian agriculture.

Doubling real income of farmers till 2022-23 over the base year of 2015-16, requires annual growth rate of 10.41% in farmers income. This implies that the on-going and previously achieved rate of growth in farm income has to be sharply accelerated.

Therefore, strong measures will be needed to harness all possible sources of growth in farmers' income within as well as outside agriculture sector.

Sources of Growth Within Agriculture Sector

1. Increase in agricultural productivity.
2. Improvement in total factor productivity.
3. Diversification towards high value crops.
4. Increase in crop intensity.

Sources of Income Growth Outside Agriculture Sector

1. Improving terms of trade for farmers.
2. Shifting cultivators to non-farm and subsidiary activities.

Strategies for Improving Farmers Income

The seven strategies to help double the income of farmers, they are:

1. Big focus on irrigation with large budgets and integrated water policies, with the aim of "per drop, more crop"
2. Provision of quality seeds and nutrients based on soil health of each field.
3. Large investments in agricultural infrastructures such as warehousing and cold chains to prevent post-harvest crop losses.
4. Promotion of value addition through food processing.
5. Creation of a national farm market and removing distortions.
6. Introduction of new crop insurance schemes to mitigate risks at affordable cost like PMFBY (Pradhan Mantri Fasal Bima Yojana).
7. Promotion of ancillary activities poultry, beekeeping and fisheries.
8. Other strategies that can be adopted are:
    a. Formation of Farmer Producer Organization's to benefit small farmers, women and tribal farmers.
    b. Integrating all central and state subsidies.
    c. Promotion of Integrated Farming System.
    d. Strengthening organic food programs.

Need to be

1. Higher price realization by farmers needs to be achieved through various price realization market reforms like e-NAM and various provisions of APMC Act.
2. Concerted and well-coordinated efforts are required to be made between the Centre and the States.
3. If farmers follow the 7-point strategy given by the Prime Minister and Agriculture department the goal of DFI can be achieved.

Conclusion

DFI by 2022 is quit challenging but it is needed and is attainable by three strategy focused on:

1. Institutions.
2. technology.
3. Policy reforms in agriculture.

ICAR and SAUs develop the models of farming system for different type of socio-economic farmers and combining all their technologies in packages with focus on farm income. Research institutes should come with technological breakthrough for shifting production frontiers and raising efficiency in use of inputs. Achieving this goal will reduce disparity between farm and non-farm income, promote inclusive growth and infuse dynamism in the agriculture sector.

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Nanotechnology: An Approach for Pest Management

Article ID: 32727

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Introduction

The term "nanotechnology" simply signifies the processing, separation, consolidation and deformation of substances or materials by one atom or by one molecule. In entomology, we use the term "nanopesticides" for the formulation of fertilizers and pesticides. Nanotechnology is a modern approach that use nanoparticles in crop protection which acts as carrier of active ingredients including pesticides as well as pheromones. Nanoparticles based pesticide formulations contain the benefits like increased solubility of water insoluble active ingredients, elimination of toxic organic solvents in comparison to normally used insecticides, improved stability for the prevention of early degradation, smaller size but higher insecticidal activity, larger surface area resulting in extended longevity (Sasson et al.2007). The use and benefits of nanoparticles in agriculture is wide involving the nanocapsules for herbicide delivery and vector or pest management and the nanosensors for pest detection.

Action by Nanoparticles

Nanoparticles play an important role in the formation of pest repellents, pesticides and insecticides. A process named "nanoencapsulation" is used for the slow release of a chemical towards the particular host plant, which carries nanoparticles in form of pesticides and allows the proper absorption of the chemical into the plants. Nanoencapsulation involves the mechanisms like diffusion, dissolution, bio-degradation and osmotic pressure. This technology has also been proved beneficial for the transfer of certain chemicals and DNA into the plant tissues for the protection from particular insect pests (Torney, 2009).

These nanoparticles are also effective against the stored grain pests such as garlic essential oil loaded with nanoparticles if found to be effective against *Tribolium castaneum* Herbst (Yanget al., 2009). Combination of SiO2 and Agnanoparticles is an effective pesticide on the larvae and adults of *Callosobruchus maculates* (Rouhani et al., 2012).

It was estimated that the bulk-sized silica (individual particle greater than 1micro meter) could be replaced with surface-functionalized silica nanoparticles (SNP). When the toxicity was tested against rice weevil Sitophilus oryzae it was found that the SNP was highly effective causing more than 90% mortality.

There are several nanoparticles like CdS, Nano-Ag and Nano-TiO2 which are highly effective against Spodoptera litura. Spray of nano-silica in tomato affects the feeding preference of the pest and also affects the longevity and nymph production.

Scope of Nanoparticles in Future

1. Nanotechnology have the capacity to transform the entire food industry into much more conventional and affordable way including the production, processing, packaging, transformation and consumption of food materials.
2. Modern agricultural research is possible only due to the nanotechnology tools for disease detection and their molecular treatment, enhancement in the absorption of nutrients by the plant.
3. Nanotechnology will also prevent the environment through the use of renewable energy supplies, filters and catalysts to reduce the pollution .
4. The metal ions like zinc, magnesium and titanium are playing a very important role in the process of photosynthesis by leaching out the photosynthate in the soil through plant root.

5. The foliar application of nano particles as fertilizer has also led to the enhanced agricultural production.
6. There is a great scope of nanotechnology in precision farming that would allow the technology for satellite-positioning systems, geographic information systems and remote sensing devices.
7. In future, nanoparticles will have the power to deliver growth hormone or vaccines to livestock or DNA for the purpose of genetic engineering in plants.

Conclusion

Nanotechnology has opened the doors towards modern agriculture in whole world. It is playing a major role in plant protection department by the formation of nano pesticides. Products formed because of nanotechnology are not only easy to use but are also environmentally friendly. Nanotechnology can be more useful to improvise the rural agricultural areas. Nanotechnology innovations can help the agricultural industry to improve the production by increasing the nutrient availability and reducing disease and pest incidence in the crop. Although this technology is facing the challenges in creating a bio economy but it seems that the challenges will be overcome if the agriculture sector keeps on spreading.

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Strategies for Attracting Youth Towards Agriculture

Article ID: 32728

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Introduction

Agriculture is still the primary occupation of more than half of Indian population asserting importance of this sector in various socio-economic aspects of the country. Youth involvement is strongly realized for agricultural reform so that it can keep pace with changing global economy. India being the youngest nation in the world has massive youth resource to offer to agriculture sector but unfortunately, youth participation in agriculture is declining.

With this background, this article aims to discuss about strategies for attracting the youth in agriculture. With the help of several evidences available from different sources we aim to find out answers to some inescapable questions like whether youth participation in agriculture can decipher the crisis of unemployment and migration, whether agriculture sector has enough prospects to offer decent livelihoods to youth, how youth can be motivated to take up farming and farm related businesses and most importantly, whether leveraging youth for agriculture can be an instrument for modernization and future growth of Indian agriculture.

Who are 'Youth'?

There is no universal definition of youth. The operational definition of the term 'youth' often varies from country to country, depending on the specific socio-cultural, institutional, economic and political factors. Youth often refers to the period of transition from childhood to adulthood, encompassing processes of sexual maturation and growing social and economic autonomy from parents (Bennell et al., 2007).

Youth can also be referred to as those whose age range from 15 to 40 years old based on a number of factors deemed fit in terms of their maturity, ability to think positive and risk taking (Silva et al., 2009).

Strategies for Attracting Youth Towards Agriculture

1. Link social media to agriculture: The rise of social media and its attraction among young people with access to the appropriate technologies could be a route into agriculture if the two could be linked in some way. Mobile phone use in Africa is growing rapidly and people are now much more connected to sources of information and each other. Utilising these channels to promote agriculture and educate young people could go a long way in engaging new groups of people into the sector.

2. Improve agriculture's image: Farming is rarely portrayed in the media as a young person's game and can be seen as outdated, unprofitable and hard work. Greater awareness of the benefits of agriculture as a career needs to be built amongst young people, in particular opportunities for greater market engagement, innovation and farming as a business.

The media, ICT and social media can all be used to help better agriculture's image across a broad audience and allow for sharing of information and experiences between young people and young farmers.

3. Strengthen higher education in agriculture: Relatively few students choose to study agriculture, perhaps in part because the quality of agricultural training is mixed. Taught materials need to be linked to advances in technology, facilitate innovation and have greater relevance to a diverse and evolving agricultural sector, with a focus on agribusiness and entrepreneurship.

Beyond technical skills, building capacity for management, decision-making, communication and leadership should also be central to higher education. Reforms to agricultural tertiary education should be designed for young people and as such the process requires their direct engagement.

4. Greater use of Information and Communication Technologies (ICT): Not only can ICT be used to educate and train those unable to attend higher education institutions but it can be used as a tool to help young people spread knowledge, build networks, and find employment. Catering to a technologically savvy generation will require technological solutions. Such technologies can also reduce the costs of business transactions, increasing agriculture's profitability.

5. Empower young people to speak up: If we are to enable youth to transform agriculture then the barriers to their engagement, such as access to land and finance, need to be addressed. National policies on farming and food security need to identify and address issues facing young people.

As such youth need to become part of policy discussions at the local and national levels, whether as part of local development meetings, advisory groups or on boards or committees.

6. Facilitate access to land and credit: Land is often scarce and difficult to access for young people, and without collateral getting credit to buy land is nigh on impossible. Innovative financing for agriculture and small businesses is needed. For example, soft loans provided to youth who come up with innovative proposals in agriculture

7. Put agriculture on the school curriculum: Primary and high school education could include modules on farming, from growing to marketing crops. This could help young people see agriculture as a potential career. Farm Africa run a project aiming to help school children discover more about agriculture as a profession.

8. Greater public investment in agriculture: Young people may see agriculture as a sector much neglected by the government, giving farming the image of being old fashioned. Investment in agriculture is more effective at reducing poverty than investment in any other sector but public expenditure on agriculture remains low.

Regional and continent-wide programmes such as the Comprehensive Africa Agriculture Development Programme (CAADP) may go some way in transforming the prominence and reputation of agriculture in Africa but national efforts and public investments are also needed.

9. Make agriculture more profitable: This is an easy statement to make but a difficult one to realise. Low yields and market failures reduce the potential of agriculture to be profitable and to provide people with a chance of escaping poverty and improving their quality of life.

Making agriculture profitable requires that the costs of farming and doing business are reduced while at the same time productivity increases. Although large-scale commercial farming springs to mind, this is not necessarily the case, and small farms can be highly productive with low labour costs.

Conclusion

Agriculture has been considering as an important source of rural India since long. Above half of Indian population is below the age of 30 however few of them have interest to choose farming as profession.

To assure youth involvement in agriculture the strategies like polices required are not only in the form of incentive policies but also over-all rural industrialization policy, through agro industry development, innovation, investment infrastructure and strengthening agricultural institutions from upstream to downstream.

Social Media can be used to improve agricultural image mostly among young generations through sharing information and experiences between the farmers. Some of the effective extension strategies could be more NGO participation, counselling and guiding rural youth, creating awareness about youth programmes, entrepreneurship development, promotion of scientific farming and agribusiness.

For this urgent need is realised to develop attractive strategy and policy by Government for attracting youths towards agriculture.

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Transfer Cell in Plant

Article ID: 32729

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Introduction

The agricultural production demand is needed to be doubled by 2050 to maintain the global food security. The efficiency of nutrients transport from the site of net synthesis to the site of net acquisition is the key factor for crop productivity. Transfer cells are the highly specialized players whose cell wall ingrowths expand the surface area of plasma membranes. These cells are rich in mitochondrial amount to provide the high energy for active membrane transport. Transfer cells are crucial entities because they are optimizing the nutritional transport in plants, and thus laid the novel foundation for improving the crop performances. Several physiological and cell biological studies reveals that transfer cells are significant function in assimilate transport and nutrient uptake prominently in nutrient deficient conditions. It has been observed that numerous plants have genetic competence to fit the transfer cells to elevate the capability of amino acid, sugar and metal ions transport.

Morphology

Transfer cells are different from the other plant cells in their extensive cell wall ingrowths. The increased surface of plasma membrane allows to enhancing the number of transporters to optimize the nutrition across symplastic and apoplastic boundaries. The phloem parenchymatous transfer cells are adjacent to sieve element companion cells where the ingrowths are rich in plasmodesmatal density. The cell wall ingrowths vary from simple papillae to the more complicated branched form or labyrinth. The wall ingrowths depend upon the developmental stage and the type of species, and develop in the late maturation stages of cell and the specialized in the secondary cell walls. These are trans-differentiated cells located in the tissues and organs, ranges from the seeds to leaves to floral nectarines and ubiquitously located in the most of angiosperms (Andriunas et. al., 2013). The larger size and the higher concentration of organelles in the cytosol of these cells are located in the leaf minor veins for translocating the photosynthates from the mesophyll cells to conducting tissue. It is 10 folds higher than the normal to serves themselves as collection apparatus. The phenomenon of wall ingrowth to the polar region is largely not understood. However, it has been proposed that cytoskeleton microtubules disorganization is linked with the ingrowth deposition. The phytohormones signalling such as auxin and ethylene acts ac major regulator in the trans differentiation process.

Role of Transfer Cells

Transfer cells are playing important role in the nutrient uptake, phloem loading and phloem unloading in the roots, leaves, and developing seeds, respectively. The root system is acquired the mineral nutrients from its immediate surrounding and translocated to the shoot tissue mainly to leaves (Wang, 2004). Transfer cells are observed to be induced in roots under the nutrient's deficient conditions such as Ca, N, Mg, K, S, Fe, Zn and Mn. The sunflower plants showing that under the Fe deficiency of 24-48 hours, many peripheral cells are differentiated into transfer cells in the root apical zones. The cell wall ingrowths are found only in peripheral walls lies toward soil and increase in the Fe uptake. The ingrowths in the root xylem-parenchymetal cells efficiently which are indulges themselves in the Fe unloading to the xylem to accelerate their transport from roots to shoot (McCubbin and Braun, 2020). In the Pisum sativum, the transfer cells are beginning to develop in the minor veins once photo-assimilate begins to export. The light intensity directly correlates with the number and size of wall ingrowths. In the developing wheat seeds, the transfer cells are formed at the projection of nucellar tissue during the period of grain filling stage in the wheat. The transfer cells overcome the apoplastic barrier of pigmented strand in the wheat grains by changing the cellular pathway and potent mechanism of assimilation transport to the wheat grains. It results in the strong sink demand establishment to mediate the assimilate transport from the source leaves to the developing grain.

Conclusion

The transfer cells are undoubtedly crucial for the mineral nutrients and assimilate transport observed in most of the economically important plants. There are limitations in the transfer cell study: gene involving in molecular mechanism and the downstream regulation in the transfer cell function and development. There are valid cellular, molecular and genomic approaches can be utilized to elucidate the underlying mechanism. The approaches are microarray (gene expression profiling), targeted gene silencing, mutagenesis, gene analysis and identification based on bio-informatics to know the gene and gene families, subcellular and cellular localization of the gene products such as mRNAs and proteins at the active sites. A number of emerging evidences have been demonstrating the direct relationship between the cell wall ingrowth amplification of the surface area of plasma membrane and the transport rate. The contribution of transporter targeted at the plasma membrane must be researched out. All plant species are known to show the genetic capacity for the differentiation of transfer cells. Hence molecular analysis should be done to strategically regulate the resource flow in the desired plant species.

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Conserved Centromere Functions of RNA Interference

Article ID: 32730

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Abstract

RNA interference (RNAi) is a cellular process through which small RNAs target and regulate complementary RNA transcripts. The process has well-characterized roles in post-transcriptional gene regulation and transposon repression. However, recent studies have revealed additional conserved roles for RNAi proteins, such as Argonaute and Dicer, in chromosome function. A complete view of RNAi is obtained from studies implicating evolution of RNAi since last eukaryotic common ancestor (LECA).

Keywords: RNAi, conserved rules, argonaute; dicer, chromosome function, LECA

Small RNAs (sRNA) target complementary RNA transcripts through post transcriptional gene silencing mechanism (PTGS). Additional conserved roles of RNAi component proteins such as Aragonaute/Dicer exist in non-canonical Chromosome functions beyond micro RNA (miRNA) biogenesis. Some of these functions include guiding chromatin modification promoting chromosome segregation in Mitosis and Meiosis, regulating dosage response and DNA damage resolution. Such infamous functions are more strongly conserved across eukaryotes than just miRNA processing, the study of which provides complete view of functions of RNAi. RNA interference (RNAi) is mediated by small RNAs that play essential roles in genome defence against viruses and transposons, in development, in cellular differentiation and in tumour progression. In short, effector proteins of the Argonaute family, such as AGO and PIWI, use the sequence of bound small RNAs — microRNAs (miRNAs), small interfering RNAs (siRNAs) and PIWI- associated RNAs (piRNAs), produced from double- stranded RNA (dsRNA) generated by an RNA- dependent RNA polymerase (RdRP) or from other dsRNA substrates, to identify target RNAs with complementary base pairing. The small RNA–effector complex either cleaves the target or recruits other proteins to degrade the target RNA or inhibit its translation. In this process the passenger strand is discarded, and the guide strand is then used to recognize RNA targets.

Recently, it has become apparent that RNAi components have miRNA independent functions related to biological processes, including development, transcriptional regulation, RNA processing and maintenance of genome integrity. The strong evolutionary conservation of the proteins involved in miRNA biogenesis and RNAi, such as DROSHA–DGCR8, DICER1 and AGO, and the apparent absence of classic miRNAs in the last eukaryotic common ancestor (LECA) suggest non- miRNA precursor RNA interactions these proteins possess performing a broad range of important, conserved functions. Highly conserved functions of RNAi proteins have consequences specifically for chromosome and genome integrity and emphasize the importance of RNAi beyond the production of miRNAs. These roles of RNAi in chromosomal behaviour and genome integrity were originally described in *Schizosaccharomyces pombe* without miRNAs without clouding experimental interpretation (Provost et al., 2002; Volpe et al., 2003; Hall et al., 2003; Sugiyama et al., 2005) but found conserved in other eukaryotes.

The Role of RNAi in Centromere Function

Disruption or deletion of RNAi factors were conducted in a variety of eukaryotes. Deletion mutants of Drosha–Dgcr8, Dicer or Argonaute homologues in many model organisms were embryonically lethal including *Arabidopsis thaliana* and maize (Golden et al., 2002; Field and Thompson, 2016). Some miRNA knockout embryos progress through the early stages of development but fail to properly differentiate cell types, which is a well- defined miRNA function thus demonstrating that these factors have important roles in many eukaryotes in chromosome function unrelated to miRNA-driven gene repression.

Fission yeast contains regional centromeres with pericentromeric regions flanking inner centromeric region either side enabling accurate specification of the centromeric region for kinetochore attachment while, the pericentromeric region also demarks a boundary between the inner centromere and the rest of the chromosome. Dicer and Argonaute participate in nuclear co- transcriptional gene silencing (CTGS) at the pericentromeric regions. RNA polymerase II (Pol II) driven bidirectional transcription from the repeated elements of this region forms dsRNA that are recognized by Dcr1 cleaving into double- stranded siRNA precursors (Volpe et al., 2003). Dcr1 and Ago1 interact with the RdRP Rdp1 to further reinforce this region as a target of siRNAs generating additional dsRNA and siRNAs from the transcripts of this region. The resulting siRNAs are loaded into Ago1 and direct RNAi- induced transcriptional silencing complex (RITS) to the region. This results in complex mediated indirect recruitment of the histone 3 lysine 9 (H3K9) methyltransferase Clr4 to the region to deposit and spread the methylation mark. Methylation is in turn recognized Clr4 inducing a state of constitutively repressed heterochromatin. Swi6 is once such protein, a homologue of the conserved heterochromatin protein 1 (HP1). This factor recruits the cohesin complex to centromeric heterochromatin, for the proper cohesion of sister chromatids causing faithful segregation of chromosomes during mitosis. Furthermore, location of kinetochore attachment is facilated by Clr4, Dcr1 and Swi6 deposition in turn of the centromere- specific histone variant Cnp1 (CENP- A in mammals) in the inner core of the centromere. Loss of the cohesin subunits Rdp1 or Swi6 leads to lagging chromosomes and segregation defects during anaphase in fission yeast. This cascade of events, beginning with Dcr1 recognizing the dsRNA of pericentromeric transcripts, has an important role in the process of mitosis and chromosome segregation. Similarly, in case of regional centromeres, like in *D. melanogaster*, Dcr-2 and AGO2 deletion mutants have a lagging chromosome phenotype in wing disc cells (Pek and Kai, 2011). siRNAs produced in a Dicer- independent fashion contributes to heterochromatin formation at centromeres. In addition to this, there is evidence in other eukaryotes, such as maize and *A. thaliana*, of long non- coding centromeric transcripts associating with centromeric chromatin (Maida et al., 2014).

The role of RNAi components in *C. elegans* with holocentric centromeres is also pronounced having multiple regions throughout the chromosome specified as centromeres and serve as points of kinetochore attachment during cell division. CSR-1 (chromosome segregation and RNAi deficient), the Argonaute family member has important functions in chromosome segregation and cell division producing disrupted chromosome segregation leading to lagging chromosomes in knockdown and deletion of CSR-1 in early embryo. The molecular mechanism is based on the production of 22-nt small RNAs (22G- RNAs) and loading into CSR-1 for ensuring proper segregation of chromosomes. The 22G- RNAs target a specific subset of genes but do not lead to the repression of these genes at the RNA or protein level. Instead, these small RNAs guide CSR-1 to the chromatin associated with this subset of protein- coding genes which are widely distributed throughout all chromosomes except the X chromosome. Interestingly, frequently missegregated X chromosome is observed in meiosis and is the only chromosome whose loss is tolerated by the worm. Thus, 22G RNA-CSR1 pathway specifies kinetochore regions (Claycomb et al., 2009).

RNAi and Meiotic Chromosome Segregation

In addition to ensuring the correct transmission of genetic material during mitosis, this function of RNAi extends to the transmission of genetic material from the parental generation to progeny. In *C. elegans*, the CSR-1–22G-RNA pathway, which is required for mitotic chromosome segregation in the early embryo, is also needed for meiotic chromosome segregation, as the germ cells of pathway mutants show malformed nuclei with abnormal DNA content (Maine et al., 2005). A hermaphrodite mating population displays sex skewing to XO males as a result of the spontaneous loss of the X chromosome, which strongly implicates chromosome missegregation phenotypes in meiosis of CSR-1 mutants. Furthermore, male DCR-1 mutants have defects in sperm function and X chromosome segregation. The participation of the same pathway in both mitosis and meiosis in *C. elegans* suggests that a similar small- RNA-directed mechanism may underlie the role of RNAi in ensuring chromosome segregation in cell division. RNAi components have important roles in meiotic progression in model plants such as *A. thaliana* and maize. Genes involved in RdDM plays role in Meiosis was determined by the study on loss of function mutants of AGO4 in *A. thaliana* reduced chiasma frequency, lagging chromosomes and defective spindle organization were observed (Oliver *et al.* 2016). No variation was observed in the distribution of H3K9me histone modification between *ago4* and WT plants. However, delay in H3S10ph disappearance associated with interchromosomal bridges was observed. Serine 10 phosphorylation (H3S10Ph) specifically marks condensed chromatin. In maize, an Argonaute homologue also participates in chromosome segregation during male meiosis; mutant alleles of AGO104 showed disruption of chromosome condensation, chromosome segregation and spindle formation. Early in meiosis I, these mutants had abnormal chromosome condensation and spindle defects, whereas later in meiosis, multinucleated progeny cells and micronuclei were present. In the maize AGO104 mutant, the centromeric and pericentromeric regions are hypomethylated at the DNA level in a non- CG context, which indicates a disruption of chromatin modification in this region. This leads to an increase in transcription of the repetitive elements present at the centromere that AGO104 normally silences. The fact that chromatin disruption at the centromere in these Argonaute mutants leads to chromosomal defects again resembles the consequences of losing CTGS in *S. pombe*.

Conclusion

Formation of heterochromatin at the pericentromere regions is also decided by RNAi in chromosome segregation. Chromatin alteration can disrupt the mechanism of sister chromatid attachment and their release in mitosis. Thus, lagging chromosomes and the missegregation phenotypes are seen in RNAi mutants. Understanding important roles of RNAi in chromosome and genome integrity is possible by further study of component mutants.

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Farm Machinery for Precision Agriculture

Article ID: 32731

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Summary

Yield loss in agriculture practise is a major problem in all over world. Above conventional farming methods, over 0.25 of all farmed crops are lost before harvesting. This not only affects the farmer's pocket, but it also leaves a large carbon footprint. Resources are also getting depleted faster while the world population is increasing rapidly. This pushes the demand for food higher and under the current farming systems; it is not possible to meet the world's population food requirements. This complication has led to the invention and adoption of technologically advanced farming systems which are more effective and less strenuous on the environment. Among the most effective methods is precision farming.

Introduction

Precision farming is a universal approach that involves integrating precise farming techniques to achieve maximum output with minimum resources all while conserving the environment. It is fast gaining relevance due to its positive impact on the environment and the pockets of farmers. Under precision farming, all the activities conducted are heavily influenced by technology.

Precision Agriculture is generally defined as information and technology-based farm management system to identify, analyse and manage spatial and temporal variability within fields for optimum productivity and profitability, sustainability and protection of the land resources by minimizing the production costs. The productivity gain in global food supply have increasingly relied on expansion of irrigation schemes over recent decades, with more than a third of the world's food now requiring irrigation for production. Rapid socio-economic changes in some developing countries, including India, are creating new scopes for application of precision agriculture.

New Farm Machinery for Precision Agriculture

Precise farming will only work if the machinery being used is of high standard. This includes farm machinery, farm production equipment, wireless sensors and mobile devices. Machinery such as precision operation is required in order to effectively perform planting, plant protection, weeding and harvesting. Irrigation equipment also needs to adhere to equal spacing between the emitters in order for all crops to receive an equal share of moisture. Devices such as laptops and phones are used to record, display and process the data sent from the GPS or remote sensing equipment. Since the information is being relayed raw, the electronic device needs to have a high processing power. Such items do not come cheap, but their importance cannot be understated.

Global Positioning System (GPS)

Implementation of precision agriculture or site-specific farming becomes possible using Global Positioning System (GPS) technology. GPS technology combined with GPS-server.net tracking system enables the gathering of real-time data collection with accurate position information, leading to the efficient manipulation and analysis of collected data. GPS can be used for precision farming, field planning, yield mapping, and tractor guidance. Such information allows farmers to achieve effective soil/plant treatment strategies which can enhance production.

Geographic Information System (GIS)

Geographic Information Systems (GIS) consist of data and software designed for spatial analysis of GPS-referenced data. Various databases in an agricultural GIS system might include soil test information, soil survey data, pest infestations, yield data, remote sensing imagery and other types of observations and records that can be collected and referenced with their geographic position system. These data sets can then be converted to maps to illustrate their spatial variability within the field and become additional layers in the field database.

Remote Sensing

Remote sensing is collection of data from the farm without there being any physical contact. It has multiple uses around the farm, hence its importance as a technology essential in precision agriculture. Crop identification and crop analysis are some of the applications of remote sensing equipment such as imaging spectrometers. These are devices that can sense the light energy reflected by soils, plants and animals. They use that spectral signature to distinguish elements in the farm. The same spectral signature is also used in identifying infestation of pests and diseases in the farm. Crops which are infested with pests emit a different spectral signature from healthy crops. The applications of remote sensing in agriculture are numerous and varied. Other applications include: estimating the soil moisture, monitoring weather patterns, mapping farm resources and estimating yield production.

Drones or Unmanned Aerial Vehicles (UAV)

Drones are small and light aerial vehicles or unmanned aerial vehicles (UAV) which may fly at extremely high altitudes and carry various navigation systems or recording devices such as RGB cameras, infrared cameras, and other sensors. Due to their ability to deploy various sensors and capture high-resolution and low-cost images of crop conditions, drones are very useful in farming. Initially used for chemical spraying, today drones are a great tool for capturing aerial imagery with platform mounted cameras and sensors. Images can range from simple visible-light photographs to multi-spectral imagery that can be used to assess different aspects of plant health, weeds, and assets.

Variable Rate Application (VRA)

Variable rate application (VRA) in precision agriculture is an area of technology that focuses on the automated application of materials to a given landscape. The way in which the materials are applied is based on data that is collected by sensors, maps, and GPS. These materials include things like fertilizers, chemicals, and seeds, and they all help optimize one's crop production.

Yield Monitoring and Mapping

Yield monitoring and mapping refers to the process of collecting geo referenced data on crop yield and characteristics, such as moisture content, while the crop is being harvested. Various methods, using a range of sensors, have been developed for mapping crop yields.

The Components of a Grain Yield Monitoring and Mapping System

1. Grain flow sensor - determines grain volume harvested.
2. Grain moisture sensor - compensates for grain moisture variability.
3. Clean grain elevator speed sensor - used by some mapping systems to improve accuracy of grain flow measurements.
4. GPS antenna - receives satellite signal.
5. Yield monitor display with a GPS receiver – geo reference and record data.
6. Header position sensor - distinguishes measurements logged during turns.
7. Travel speed sensor - determines the distance the combine travels during a certain logging interval (Sometimes travel speed is measured with a GPS receiver or a radar or ultrasonic sensor.

Conclusion

Technology is changing rapidly as is the world and its population. New systems of farming which have better results need to be adopted rapidly across the world to ensure food security. With precision farming and advanced technology, major world problems like food shortage and environmental degradation can be solved. Some technology essentials are complicated and expensive to implement, but their effects are long lasting and affordable in the long run.

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Myrmecochory: An Account on Egg Dispersal of Stick Insects by Ants

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Introduction

The Phasmatidae is a family of the stick insects belong to the order Phasmatodea which contains some of the largest insects in existence. In India, there are occurrence of mainly 5 families with 146 species of stick insects. Phasmatidae family is having the highest number of species and majority of which are depending on ants for dispersal of their eggs. Dispersal is a mode of transportation of something from one place to another place. Myrmecochory is a seed dispersal mechanism used by certain plants that have evolved a mutualistic relationship with foraging ants (Giladi, 2006). It is a type of mutualism where both ant and plant get benefitted each other. The seeds of certain tree species have a fleshy appendage on the end of the seed capsule known as an elaiosome (Ciccarelli et al. 2005; Sheridan et al. 1996). It is rich in lipids and proteins, act as chemical cue for ants and aid in seed dispersal. The elaiosome acts as a food reward that induces herbivorous/omnivorous ants to pick up and carry the seed back to the nest. The fleshy elaiosome is detached and eaten by ants, while the seed itself is left undamaged. The capitulum on the eggs of stick insect is having similar structure and function to elaiosomes on seeds. Capitulum and its composition solely attract ants by producing stimulus in the form of chemical cue. In this mutualistic behaviour both get benefitted wherein ants get food while insect eggs are dispersed.

		
1.	**2.**	**3.**

The mutualistic behaviour of stick insect; (1) Stick insect, (2) egg and (3) an ant carrying their eggs.

Biology of Stick Insect

In general, the female will lay in excess of 100 eggs, some species laying more than 1,000 eggs per gestation. The insect can lay the eggs in the soil or into hollow parts of plants, attach them to the different plant parts or drop them on the ground. These eggs resemble seeds they are small, oval and hard-shelled. Eggs dropped to the ground have large capitula that contain substances ants feed on. When ants find these eggs, they normally carry them to their nest and feed on the capitula without destroying the embryo. Eggs in the ant nest are thus protected against predators, and they hatch safely. This adaptation protects eggs from winter; they hatch when the weather warms up in spring. Eggs can hatch after a period of few weeks to several months, depending on species and habitat. Nymphs look like adults but vary in colour and size. To escape from the predators, nymphs are able to shed off limbs - autotomy - and regenerate them during the moulting process. This ability lasts only until maturity. Walking stick bugs reach maturity after 3 months to a year. Female stick bugs are usually larger than males. Most male stick species have wings that enable them to fly in search of mates. In addition to camouflage, different adult stick insect species have other adaptations that enable them to escape predators.

They include playing dead for long hours, swiping predators with spines on their legs and by emitting an irritating, foul-smelling liquid. Due to the paucity of male walking stick bugs, these species reproduce through parthenogenesis; a process in which unfertilized eggs develop individually. This means that external eggs fertilization by the males is not a requirement for reproduction to continue. Unfertilized eggs hatch to resemble the females that produced them. However, some males exist and mate with the females.

Mutualism Between Ant and Stick Insect

Female stick insects are slow moving, often flightless insects and consequently have limited dispersal abilities. This is particularly the case with gravid females, which may be unable to fly even if they possess wings. Stick insect eggs are hard-shelled and often closely resemble seeds, a mimicry which may help reduce predation by insectivorous birds. They are laid singly, and are often simply dropped or flicked away by the ovipositing female. In many species the eggs have an appendage, the capitulum, which can be detached without reducing their viability.

How Ants Get Benefited in Dispersal of Eggs

1. Lack lipid synthesis pathway.
2. Mainly for lipid consumption.
3. Oleic acid 2.6 times more in elaiosomes than seeds.
4. Increase the hatching percentage.

How Capitulum Helps Stick Insect Eggs

1. Protection from predators
2. Protection from bush fires
3. Displacement of eggs to different location
4. Avoid cannibalism
5. Protection from environmental factors.

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Post-Harvest Diseases of Mango Cv. Alphonso and their Management

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Introduction

Mango (*Mangifera indica* L.) is an important fruit crop grown in India. It is grown in almost all the parts of the country. In Maharashtra, Konkan region is famous for the cultivation of Alphonso mango. Due to the humid climatic condition in the region, the crop is affected by large number of diseases. Although mango is affected by large number of diseases, some diseases are of great economic importance and are responsible for high loss in the mango production in our country. Even if we protect our crop and increase mango production, it is very essential to protect the fruits from post-harvest diseases as the post-harvest losses are huge. To reduce the post-harvest loss, it is essential to start protecting it in the field and then careful harvesting, hygienic handling, packaging and storage. For this purpose, it is desired that integrated disease management practices be adopted for their control. The important post-harvest diseases are as follows.

Anthracnose

Causal organism: *Colletotichum gloeosporides Penz*.

Symptoms:

a. The symptoms first appear in the form of irregular, small, light to dark brown colour spots generally at fruit shoulder which gradually coalesce to form bigger lesions ultimately resulting in fruit rots.
b. If the fruits are already infected in the field condition, then disease develops more rapidly after harvest because the fruit lose their natural resistance during ripening.
c. The severely infected fruit turns blackish and shrivels within three to four days under Konkan agroclimatic condition.
d. After few days of rotting, black acervuli push up on the skin, which are full of pinkish oblong spores.
e. The affected fruit becomes unfit for consumption.

Anthracnose (before harvest)

Disease management:

a. Bagging of fruits with newspaper has been found effective in controlling the disease
b. Pre-harvest sprays of any fungicide mention in table 1 in such a way that last spray falls 12-15 days prior to harvest.
c. Post-harvest dip of fruit in hot water at 520 C for 10 min reduces the disease incidence.

Table 1: Label claim fungicides for anthracnose of mango

Sr. No	Name of Fungicides	Conc.	Waiting period from last application to harvest (in days)
1.	Azoxystrobin 23% SC	0.1%	5

2.	Copper Oxychloride 50% WG	0.24%	10
3.	Carbendazim 12%+ Mancozeb 63% WP	0.15%	7
4.	Tebuconazole 50% + Trifloxystrobin 25% WG	0.1%	15

(MAJOR USES OF PESTICIDES, Registered under the Insecticides Act, 1968, up to - 30/06/2020)

Stem End Rot

Causal organism: *Diplodia natalensis*

Symptoms:

a. The fruit while ripening suddenly becomes brown to black typically from the stem end.

b. Within two-three days whole fruit becomes black, disease progresses downwards, thus involving half the area of the fruits.

c. Through the flesh of the whole fruit, often wrinkles are also observed.

d. The affected skin remains film but decay sets into the pulp below and emits unpleasant odour.

Disease management:

a. Fruit should not come in contact with the soil during harvesting.

b. Fruits should be harvested with 10 mm stalk.

c. Pre-harvest sprays of carbendazim or thiophanate methyl (0.1 %) or copper oxychloride (0.3%) reduces the incidence of stem end rot.

d. Post-harvest dip of fruit in hot water at 520 C for 10 min reduces the disease incidence.

Stem end rot

Black Rot

Causal organism: *Aspergillus niger.*

Symptoms:

a. Infection occurs during and after harvest, when fungus penetrates through wounds or the cut ends.

b. The infection usually starts at injured portion of the fruits or stem end and develops into grayish to pale brown spots mainly from stem end portion, coalescing into dark brown to black lesions and later covered with a sooty mass of brown and black spores.

c. The spots are soft and sunken, spreading rapidly.

d. In advance stages copious growth of fungal colonies develops.

Disease management:

a. Careful handling of fruits at all stages to avoid mechanical injury and sap burn damage to the fruits.

b. Pre-harvest sprays of carbendazim (0.1 %) reduces the incidence of black rot.

c. Post-harvest dip of fruit in hot water at 520 C for 10 min reduces the disease incidence.

Black rot

Conclusion

Pre- harvest spray with fungicides and post-harvest hot water treatment at 52^{O} C for 10 min. can reduce the incidence of post-harvest diseases of mango.

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Breeding Approaches for Drought Resistance

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Introduction

1. Drought accounts for 26% of the arable land among abiotic factors.
2. 85% of the cropped area of the world is under rainfed.
3. 82% of the potentially arable land is already under cultivation.
4. Prospects of increasing irrigation is troubling due to related costs.

Global Estimate of Cropped Area Share under Rainfed in Different Countries

Global Estimate of Cropped Area Share under Rainfed in Different Countries

COUNTRY	INDIA	CHINA	U.S.A.	PAKISTAN	IRAN	THAILAND	EGYPT	AUSTRALIA	ARGENTINA	S. AFRICA	WORLD
Cropped Area (m.ha)	169	91	190	21	20	03	03	47	36	13	1474
Area under Rainfed (m.ha)	127	47	1671	05	09	16	0	45	34	12	1247
% Area Share of Rainfed to Cropped	76	52	90	23	62	80	0	96	95	91	85

Drought

The inadequacy of water availability, including precipitation and soil moisture storage capacity, in quantity and distribution during the life cycle of a crop to restrict the expression of its full genetic yield potential.

Effects of Drought on Plant Growth and Development

1. Low level of stress:

a. Stomatal resistance.
b. Decrease in turgor pressure.
c. Reduction in cell enlargement.
d. Photosynthate partitioning.
e. Osmotic adjustment.

f. Root growth.

2. Moderate level of stress:

a. Rate of photosynthesis affected.
b. Senescence of older leaves occurs.

3. High level of stress:

a. Stomata close fully.
b. Turgor is lost.
c. Rolling up of leaves.
d. Gas exchange drops to zero.
e. Carbon is lost by respiration.
f. Canopy temperature increases.
g. Photosynthetic translocation affected.

Drought Resistance

The mechanism causing minimum loss of yield in a drought environment relative to the maximum yield in a constraint-free (optimal) environment for the crop.

Mechanisms of Drought Resistance

1. Drought escape.
2. Dehydration avoidance.
3. Dehydration tolerance.

Drought Escape

The situation where an otherwise drought susceptible variety performs well in a drought environment just by avoiding the period of drought. Early maturity is an important trait of drought escape.

Drought Avoidance

The ability of a plant to retain a relatively higher level of hydration under conditions of soil or atmospheric water stress. It is measured by the tissue water status expressed by water potential.

Two plant types come under this category:
1. Water savers.
2. Water spenders.

Dehydration Tolerance

The ability of cells to continue its metabolic function at low water potential is termed as dehydration tolerance.
Selection Criteria for Drought Resistance:

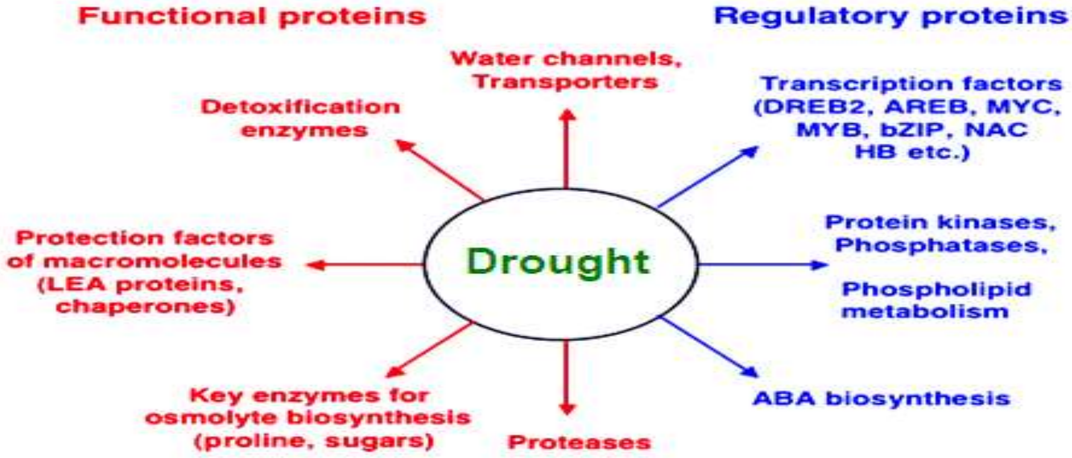
a. Yield potentials of genotypes under favourable and stress environment.
b. Leaf wilting, leaf firing and leaf rolling.
c. Seed germination, seedling emergence, survival, vigour and recovery.
d. Screening based on root studies.
e. Canopy temperature measurements.
f. Photosynthesis and other metabolic approaches.

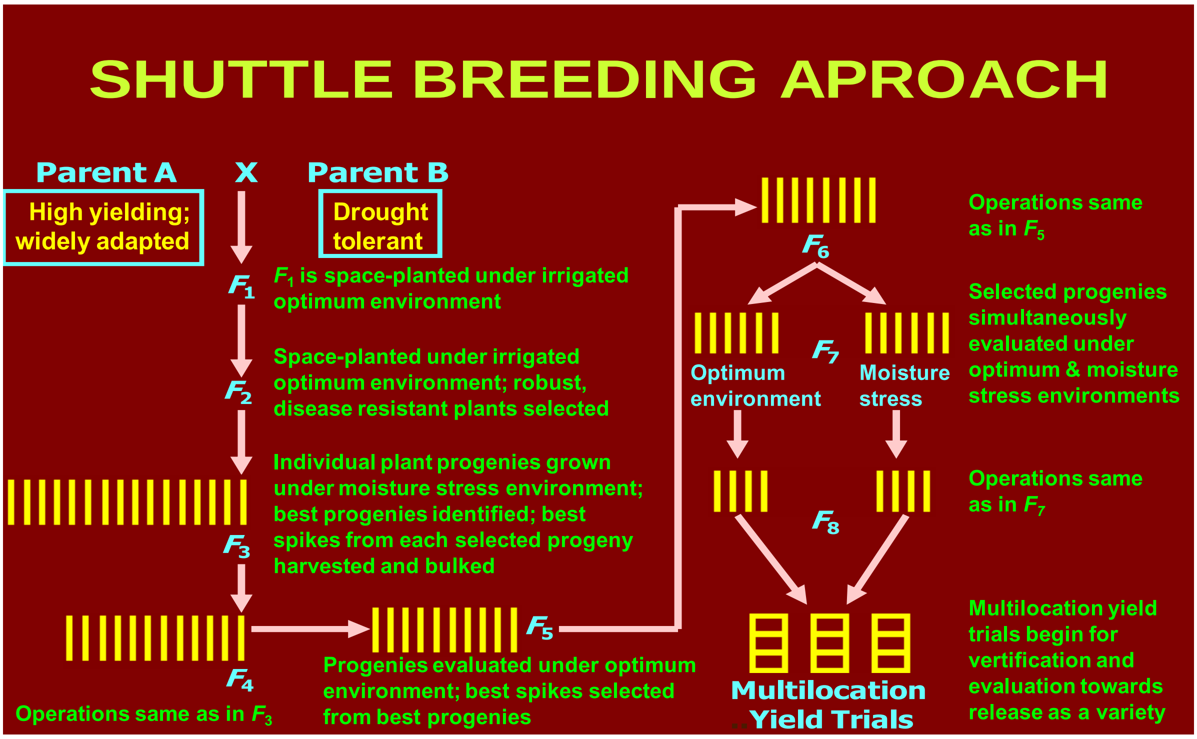
Breeding Approaches for Drought Resistance

1. Conventional breeding: To breed for high yield under optimum (water-stress-free) condition. To breed under actual drought condition. Simultaneous selection in non-stress environment for yield and in drought condition for stability.

2. Transgenic breeding:

a. Genes encoding functional proteins.
b. Genes encoding regulatory proteins.





Transgenic Approaches for Developing Drought Resistant Plants

1. Targeted approach: Metabolic pathways involving the synthesis of different metabolites such as polyamine, carbohydrate, proline, glycine betaine and trehalose have been shown to be associated with drought resistance. This approach relies on the availability of relevant information on biochemical reaction for synthesis of these metabolites and utilizes the related genes to transfer them from different sources to crop plant.

2. Shotgun approach: Genes, which are expressed under drought and for which no specific role has yet been proven, are identified. Thus, the shotgun approach appears to be better choice due to dearth of sufficient information on biochemical changes in the cell for drought resistance.

Molecular Breeding

1. Molecular markers such as restriction fragment length polymorphism (RFLP), random amplified polymorphic DNA (RAPD) and isozyme will facilitate development of drought-resistant genotypes more effectively as their expressions are independent of environmental effects.

2. After identification of the molecular markers associated with yield or other morphological traits related to drought resistance, those markers could be used as a selection criterion for drought resistance.

3. The application of marker-assisted selection in evolving drought resistant genotypes is in an experimental stage; more specifically just identification of RFLP markers associated with osmotic adjustment, stay green, root traits have been achieved.

Constraints in Breeding for Drought Resistance

1. Lack of efforts through multidisciplinary approach to understand the integrated plant responses to drought and complex genetic control of different mechanisms of drought resistance.
2. Lack of repeatable and precise screening techniques.
3. Several adaptations reducing water loss under drought seem to have a negative effect on crop productivity. For instance, both leaf rolling and stomatal closure conserve water in plant, but reduce light interception and entry of carbon dioxide into leaf and in turn, reduce the yield. These traits are not useful in breeding drought resistance.
4. Drought reduces nutrient uptake and is associated with temperature stress and at higher elevation with cold. This association makes the breeding program more complicated.
5. Limitation in application of genetic engineering on this aspect is owing to the lack of information on availability of the most appropriate gene.

Future Strategies

1. There is an urgent need for exploration of the plant genetic resources with attributes related to drought resistance in different crop plants and their characterization to facilitate transfer of desired traits through conventional plant breeding or biotechnological method.

2. A single trait cannot confer drought resistance satisfactorily. Therefore, breeding program for drought resistance should aim at pyramiding a number of relevant traits in a crop.

3. Plant genetic engineering also generated transgenic plants with only one transgene in all cases. Many different genes responsible for biosynthesis of different solutes and osmolytes conferring drought resistance should be considered for transfer in a crop plant at a time.

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How to Improve Crop Water Use Efficiency through Management Practices?

Article ID: 32735

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Abstract

The need of the hour is to develop efficient management strategies to produce "more crop per drop" in order to sustain the crop production with optimum water application. This can only be achieved through a concomitant increase in crop water use efficiency (WUE). In this article, we have discussed several agronomic, physiological and plant nutritional approaches to be followed to increase the WUE.

Introduction

Almost 70% of the earth's surface is covered with water. However, only 2.5% out of this is fresh water and only 29% is available for human and animal consumption. In this burgeoning era of population, demand for water is increasing day-by-day. Water is one of the most important inputs essential for the production of crops as it constitutes over 90% of plant body weight. Water plays important role in various plant metabolic processes like photosynthesis, respiration, transpiration, cell division and cell enlargement, absorption, translocation and utilization of mineral nutrients etc. In India, around 80% of water is consumed for agriculture. Now-a-days, demand for water in other sectors like industry, household etc. is also increasing; thereby the share of irrigation is continuously decreasing day-by-day. So, the need of the hour is to develop efficient water saving irrigation strategies to sustain the crop production with optimum water application. In case of deficit irrigation, there is a need to adopt appropriate management strategies to conserve the water in the soil profile and its subsequent utilization for plant growth. So, in future we will have to produce "more crop per drop" to feed this huge population. In other words, simply we have to increase the water use efficiency (WUE) for a sustainable development.

Water Use Efficiency (WUE) is defined as yield of marketable crop produced per unit of water used in consumptive use of water or evapotranspiration.

WUE = Y/ET

Where, WUE = Water use efficiency (kg/ha-cm)

Y = Yield (kg/ha)

ET = Evapotranspiration (cm)

Following techniques/approaches can be followed to increase the crop water use efficiency.

Agronomic Approaches

1. Selection of Crops/ Varieties: There are considerable differences between plant species to produce a unit of dry matter per unit amount of water used resulting in widely varying values of WUE. C3 plants like pulses, oilseeds, wheat, barley, oats etc. have lower WUE, whereas C4 plants like maize, sorghum, pearl-millet, finger-millet, sugarcane etc. have higher rate of WUE. Crop varieties having short duration and early vigour, deep rooting behaviour with ramified roots, short stature with erect leaves and awns and moderate tillering habit are generally efficient utilizer of water (Dahiya et al., 2018).

2. Mulching: Mulch may be of different types like plastic mulch, stubble mulch, soil mulch etc. Mulching minimizes the evaporation loss from soil surface by acting as a barrier between the soil surface and the atmosphere and thus ultimately increases the WUE.

3. Irrigation: Irrigation efficiency is highest in drip irrigation and least in flood method of irrigation. Flood irrigation methods practiced in India leads to wastage of large amounts of water through evaporation. Also, the frequency of application of irrigation water is important. The ET decreases with the decrease in number of irrigations.

4. Tillage: Tillage helps to break the continuity of the capillary pores and thus the tilled soil act as soil mulch, thereby reducing evaporation from soil surface. Moreover, it also helps to control the weed population and thereby reduces uneconomical use of soil moisture.

5. Plant population: Soil water evaporation is reduced with higher planting density. In humid regions where rainfall exceeds ET, increases in plant densities are generally accompanied with concomitant increases in yield. However, in semi-arid areas where soil moisture is deficit, the thicker plant densities are avoided (Dahiya et al., 2018).

Physiological Approaches

Use of anti-transpirants: Anti-transpirant is any material which reduces the transpiration rate from the transpiring surface of the plant. There are four types of anti-transpirant that are generally used in dryland farming to suppress the ET.

Stomata closing type anti-transpirant: These compounds reduce transpiration rate by closing the stomata by altering the permeability of the guard cell membranes. Chemicals like phenyl mercuric acetate (PMA), atrazine, abscissic acid, alachlor, chlormequat (CCC) etc. sprayed in low concentrations act as anti-transpirant.

Reflective type anti-transpirant: These materials form a refective coating after spraying on the foliage. Thus, by reflecting back a portion of the light, transpiration can be reduced without a possible decrease in photosynthesis. White materials like kaolinite, lime, hydrated lime etc. can be used as light reflecting materials.

Film forming type anti-transpirant: They form a thin film for creating resistance in the path of water vapour diffusion from leaf to atmosphere. The chemicals like silicons, polyethylenes, wax, latex and fatty alcohols etc. are the some of the important chemicals of this group.

Growth retardant type anti-transpirant: The chemicals like cycocel (CCC), uniconazole and mepiquat chloride reduce shoot growth and increase root growth. The reduced shoot growth decreases transpiration loss.

Plant Nutritional Approaches

The nutritional status of plants also plays an important role in improving the WUE and productivity in plants. During a period of water deficiency, nutrients like nitrogen (N), potassium (K), magnesium (Mg), zinc (Zn), boron (B) and silicon (Si) stimulate the production of antioxidants in plants, which in turn help to counter the toxic effects of free radicals produced during such periods of stress. Nutrients like phosphorus (P), K, Mg and Zn promote root growth which helps to explore greater amount of soil by the roots for absorption of water and other nutrients (Bacon, 2004).

Conclusion

The techniques/ approaches discussed above are relatively easier to follow. However, more research should be done about the use of anti-transpirants and their mode of action. Further field studies are also needed to develop efficient management practices suitable for a particular soil and crop condition.

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Response Farming: Boon for Semiarid Regions

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Unpremeditated dry years, variable inputs are not fully exploited by the crop and often exacerbate water deficits. In unexpected years of good water supply, opportunities for high returns are foregone. Without the ability to predict the nature of the pending season, economic benefits from yield-improving technologies in risk climates will always be less than in more reliable ones. Response farming focuses on water and its management at farm level.

The concept is that improved information about water supply (rainfall) prospects and about impacts of alternative actions which may be taken, would equip farmers to more closely meet their goals. A major factor affecting yields and production, particularly in developing countries, is the inter-seasonal weather variation. There is a clear need to assist subsistence farmers in supplying information in order to adapt the agricultural system to increased weather variability. Farmers should be able to plan their practices, given the recent past weather conditions, i.e. through contingency planning and response farming.

As a flexible system of farming in which key decisions affecting crop water utilization and crop yield are modified each season in response to pre-season and early season predictions of season rainfall parameters – Response Farming The methodology identifies and quantifies rainfall related risks (Stewart 1984), and guides strategies for addressing them at farm level.

Principles

1. The elementary version of RF, guides farmer decisions by comparing the environmental variable with reference values listed in decision tables. Typical examples include the definition of planting dates and rates of fertilizer application.
2. The decision tables have been centrally prepared taking into account historical information on local climate effect on crop yields, local soil types and local crops, crop prices.

Goals

To design sustainable cropping system for low resource farmers in marginal rainfall zones characterized by great seasonal rainfall variability, uncertainty, and recurrent drought.

Steps or Methodology Adopted

1. Response Farming analyses require localized daily rainfall records.
2. Determination of an onset date for each season of record - in terms of rainfall.
adequacy to start a crop within acceptable of risk.
3. Graphical analysis follows – illustrating season duration, water amount, average daily intensity, amounts and intensities in specified growth stages, etc, have historically related to onset dates.
4. Identifying critical date which separates early seasons from late seasons – selected arbitrarily by visual inspection of the graphs.
5. Reanalysis of the rainfall record, based on the crop selected and their growing periods - For example, early onset at some locations is often followed by relatively long dry periods before the rains gain strength again. This risk is easily mitigated or even eliminated by redefining onset to require sufficient build-up of soil water (prior to seeding) to assure both germination and seedling survival.
6. Decision on acceptable planting criteria - the next step is to decide on slopes of plant rows to balance desired rainfall runoff (if any) with capture and infiltration of rain where it falls.

7. The next decision concerns plant numbers and row spacing- affect seasonal crop water requirements and time sequences of soil water extraction.
8. Another key factor is fertilizer, especially nitrogen (N), which is costly, yet essential to markedly increase yields in good rainfall years.

Response Farming Applications

1. Farmers can improve their return by closely monitoring on-farm weather and by using.
this information in their day to day management decisions.
2. Use of quantitative current data that are then compared with historical information.
and other local reference data (information on soils etc.).
3. Using the long-term weather series, decision tools (usually in tabular or flowchart forms have been prepared in advance.
4. The knowledge of local environmental/agricultural conditions.
5. The measurement of local “decision parameters” by local extension officer or farmer; and Economic considerations where applicable.

Difficulties

Response farming, a technique that allows a farmer to adjust practices to the prevailing environmental conditions, can have limited effectiveness when data transmission facilities are weak.

Conclusion

Response farming gives predictability of rainfall behaviour based on onset dates of rain as created decision tables. It ensures sustainability of low recourse farmers to optimize yield and minimize risk instead of maximizing yield by developing coordination among agro meteorological, extension, local farmers make more success. Now, farming more viable if done in response to long-term climate info and seasonal forecast together with current weather information.

Future Thrust

1. Advisor to analyses the beginning rainfall events in each budding new season, and advise his farmer clients of their rainfall expectations in the coming season, and the steps they should be taking on response farming.
2. Required more of on farm research / project.
3. Strengthening of agro meteorological analysis and advices to farmers
4. Predicting of season rainfall, and its behaviour patterns as they affect crop water use, growth and yield.

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New Soil Testing Kit – Now Testing of Soil is Too Easy

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Abstract

In modern century, to maintain the sustainability of soil and reducing the wastage of nutrients applied for the optimization of B: C ratio of particular crop, it is necessary to apply nutrients in optimum amount. This may be possible when we know the current status of soil regarding nutrients, organic carbon content, acidity and basicity of soil. Testing will be easy for farmers by using soil testing kit, with the help of this kit farmer will test the soil of their field themselves conveniently. The kit will be cost effective and time saving tool.

Introduction

Soil testing is a definitive symptomatic tool, which can determine the nutrient needs of plants. There is deficiency of plant nutrients in some soils. But other soils are sufficient in nutrients previously, later removed by the harvesting of crops and depleted. Thus, soil testing is broadly accepted and used in most advanced crop production worldwide to determine fertilizer recommendation of crops (Mallarino, 2005). Soil testing is still uncommon in India due to cost of testing and lack of awareness of small and marginal farmers. With the view of above facts for testing of soil, a portable, friendly, rapid soil test kit was developed by the Indira Gandhi Agriculture University got patent on October, 2020 from the Government of India, which was applied through ICAR by scientists led by Vice Chancellor of IGAU in 2016.

Objectives of Soil Testing

The main objectives of soil testing are (Bhatt and Sharma, 2014)

1. To assess the inherent soil fertility status and recommended optimum dose .
2. To quantify the extent of soil degradation viz., soil sodicity, acidity, salinity and suggest effective remedial measures.
3. To maintain natural resources (By applying rational use of fertilizer).

About Soil Testing Kit

Vice Chancellor of IGAU and a team of soil scientists led by Dr. Patil had developed a low-cost mobile soil testing kit to test the soil of the fields, with the help of which farmers will be able to examine the available nutrients in the soil of their fields. The technology of this soil testing kit developed for a balanced fertilizers application to the crops by the Agriculture University has been awarded a patent certificate by the Government of India. This is a substantial attainment for Chhattisgarh state and IGAU. This tool is convenient and easy to use in field, this kit helps farmers to check the five important parameters viz., organic nutrient and pH of the soil as well as the primary nutrients required for plants like nitrogen, phosphorus and potassium available in the soil within one and half hour of their fields. According to the results farmers can determine the quantity of fertilizers required for agricultural and horticultural crops along with lime requirement in case of acidic soil can be acquired.

The weight of this soil kit is 2.5 kg. The kit will cost ₹ 4000 to ₹ 4500 and comprise chemical solutions of different concentrations, chemical powders, testing equipment's viz., filter papers, plastic stands, test tubes, funnel, distil water, colour charts and instructions guide.

A kit can test at least 25 samples. Farmers will have to purchase chemical solutions only in future instead of entire kit and the cost of these will be around ₹ 2000. This kit will available in the market very soon.

Conclusion

Soils differ in their ability to supply nutrients to plant and its assessment is must to determine the optimum dose of fertilizers for a particular crop for balancing the benefit cost ratio of farmers, especially for small and marginal farmers. This new soil testing kit will be nostrum for above purpose.

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Lemon Grass: its Potential Role in Health

Article ID: 32738

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Abstract

Lemon grass *(Cymbopogon citratus)*, is one of the most valuable plants from poaceae family. Essential oil from the lemongrass is commonly used as a fragrance in the perfumes and cosmetics, such as creams and soaps. Citral, extracted from the oil of lemon grass, is used in flavoring of soft drinks, in scenting detergents and soaps, as a fragrance in the perfumes and cosmetics, and as a mask for dis-agreeable odors in various industrial products. Citral used for production of beta carotene and Vitamin A and also used during formation of ionones which are used in perfumery. Lemon grass possess anti-depressant, anti-bacterial, anti-pyretic as well as astringent properties.

Introduction

Lemon grass is a tall plant having enormous striped leaves with an uneven edge. It is known for its smoky, sweet, herbaceous and lemony fragrance. *Cymbopogon flexuosus* is broadly utilized in preparation of soups curries and teas. This herb contains calming character. Lemon grass *(Cymbopogan flexuosus)* is smelling tall sedge belongs to the Poaceae family. It flourishes well in tropical as well as sub-tropical South East Asia and Africa. Lemon grass *(Cymbopogon citratus)*, is a grass native to Pakistan, India and Sri Lanka. In India it is present in Western Ghats of Kerala, Karnataka, Maharashtra, and Tamil Nadu. Cymbopogon citrates, is generally known as Lemongrass is a tall perennial grass. It belongs to the genus Cymbopogon of aromatic grasses and contains essential oils with the fine lemon flavour (Schaneberg and Khan, 2002).

Botany, Morphology and Ecology

Lemon grass is large, perennial sedge, which is a dense rhizome with dense leaf clusters. The cliff is erect, up to a height of 1.8 metres. Long leaves, glaucous, green, which tapered upwards linear and along the margins. The ligule (a part of leaf that is found at the junction of the blade and leaf sheath) very short; its sheaths are cylindrical, barren shoots widened at the base and tightly clasping at the bottom. Lemon grass is a short-day plant and flowering occurs plentiful in South India. The inflorescence is approximately 1 meter long. It possesses higher quality of essential oils and lower cost of production. It is a large, clumped, perennial grass that grows upto one metre height. Leaf blades are linear, conical at both ends, which are approx. 50 cm in length and 1.5 cm in width. Leaf-sheath is leaf-sheath is tubular in shape and looks like pseudo-stem. This plant generates flowers in mature growth phases (Wifek et. al., 2016).

Historical Background

Lemon grass, a perenial plant commonly grown in the sub-tropical and tropics. Various species of the lemon grass are native to the South East Asia, South Asia and Australia. That is why it is called as the tropical Asia East Indian lemon grass. *(Cymbopogon flexuosus)* also known as the Cochin or Malabar grass and is native to Sri Lanka, India, Thailand and Burma and for the associated West Indian lemon grass (Cymbopogon citratus).

In Philippines, during 17th century Lemon grass was being distilled for exporting purpose. Its first sample was displayed during world's fair in 1951 at London crystal place. In India, it is one of the favourite oil and locally called as "choomana polu". Indigenous Australians used citrus fruit to make a drink and use for washing of skin cuts and eyes.

Chemical Constituents

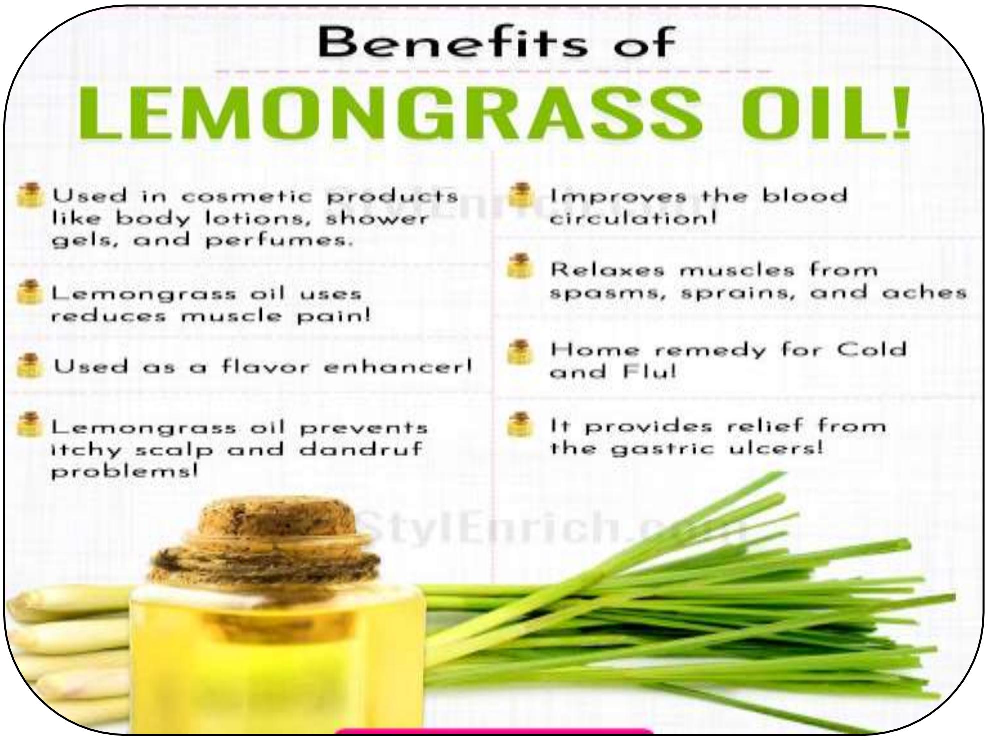
In Asia Lemongrass is widely used as essential component for health. In India it is use as sedatives for the central nervous system. The *Cymbopogon* essential oils are characterized by the monoterpene constituents like limonene, citral, elemol, citronellal, 1,8 cineole, citronellol, linalool, geraniol, methylheptenone, b-carophyllene, geranylformate and geranyl acetic acid derivation. Citral is one of the significant ingredients of the oil present in a few species of *Cymbopogon* with huge modern uses, for example, crude material for vitamin A, confectionery and perfumery. This herb brings the textural magnificence and development of a fancy grass to the nursery, alongside one extra feature: lemony leaves with a trace of ginger. Lemongrass essential oil is a source of essential vitamins such as vitamin A, B1, B2, B3, B5, B6, Folate and vitamin C. It also provides essential minerals such as Magnesium, Phosphorous, Manganese, Copper, Potassium, Calcium, Zinc and Iron.

Importance of Lemon Grass

Cymbopogon citratus an herb which is known throughout world as lemon grass is widely used as a source of medicines in tropical countries. Plant leaves are utilized as tea and is generally used in Brazil as analgesic, antipyretic, spasmolytic, tranquilizer, anti-inflammatory and diuretic and. This plant contains essential oil which is comprised up of citral in large amount, which is used as a source for the production of beta carotene and vitamin A etc. Due to slightly citrus flavoured, dried as well as fresh leaves of the lemongrass are commonly used among Asian cuisine in curries, teas and soups. It is also consumed for the poultry, seafood as well as for fishes. In addition, its aerial components are widely utilized in folk medicine for the treatment of digestive disorders, diabetes, nervous disorder, inflammation and fever. Functional lemongrass components have been recognized in recent years. A strong contribution to the antioxidant and anti-inflammatory characteristics of an important oil-free lemongrass infusion has been recognized as mono-and polymeric flavonoid, such as apigenin glycosides, luteolin and proantho cyanidins. Mono-and polymer flavonoids, such as luteolin and apigenin glycosides and proanthocyanidins, have been recognized which have contributed significantly to the antioxidant and anti-inflammatory characteristics of vital oil-free lemongrass infusions. The actions and the molecular mechanisms of purified phenolic compounds are responsible for the anti-inflammatory activity of lemon grass. Medicinal plants play an important role in the health societies.

It grows in the sub-tropical and tropical regions of the world due to its wide uses in the cosmetics, food, pharmaceutical, agriculture and flavour industries. Large scale cultivation of *Cymbopogon* grasses occurs in the sub-tropics and tropics. Due to the presence of higher content of aldehyde *Cymbopogon citratus* possesses lemony odor. Besides citral, the essential oils of the *Cymbopogon spp*. consists of smaller amount of geranyl acetate, geraniol and the monoterpene olefins, such as myrcene (in *Cymbopogon citratus*) and limonene (in *Cymbopogon flexuosus*). *Cymbopogon citratus* is generally used in the folk medicine for treatment of the gastrointestinal disturbances, and as analgesic, antispasmodic, antipyretic, anti-inflammatory, sedative and diuretic activity (Srivastava *et. al.,* 2013).

Consumers are increasingly aware and concerned about the use of synthetic chemicals in the food additives. Thus, food can be preserved with the natural additives have become more and more preservatives for encompassing the shelf life of various food products. Indeed, essential oils not only showed antimicrobial activity in vitro against several pathogens in the foodstuffs but also in the food systems. Lemon grass is frequently used as a flavouring agent in various food products. In addition to its attractive citric taste, lemongrass essential oils have demonstrated its powerful antimicrobial potential, thus being susceptible for incorporation into the food products. Though, food products still present some limitations. Its intense, persistent aroma greatly impacts the organic leptical characteristics and the consumer acceptance of food. This presents toxicological effect at higher dose. Thus, there is a need to lower the concentration of essential oil incorporated into the food products to avoid toxicological effects, consumer rejection, and to take into account the economic aspects.



Health Benefits of Lemon Grass

1. As a Natural Deodorizer: Lemongrass oil can be used as a natural as well as safe air freshener. It is mixed with water and used like mist.

2. Boosting Skin Health: Essential oil of lemongrass is used during skin problems. Lemon grass oil is used in cosmetical products like lotions, bathsoaps, shampoo and conditioners. Its oil is also used in face-scrubs as it is effective cleanser and natural skin toner.

3. Promoting Hair Growth: Lemongrass oil can strengthen hair follicles also. It is highly recommended during hair loss problem or any other hair problems. Only few drops of oil massage kill the bacteria and make hair shiny and odour free.

4. As a Natural Bug Repellent: Lemongrass oil is known to repel bugs such as mosquitoes and ants. This natural repellent has a mild smell. We can spray directly on the skin. We can also use lemongrass oil to kill fleas.

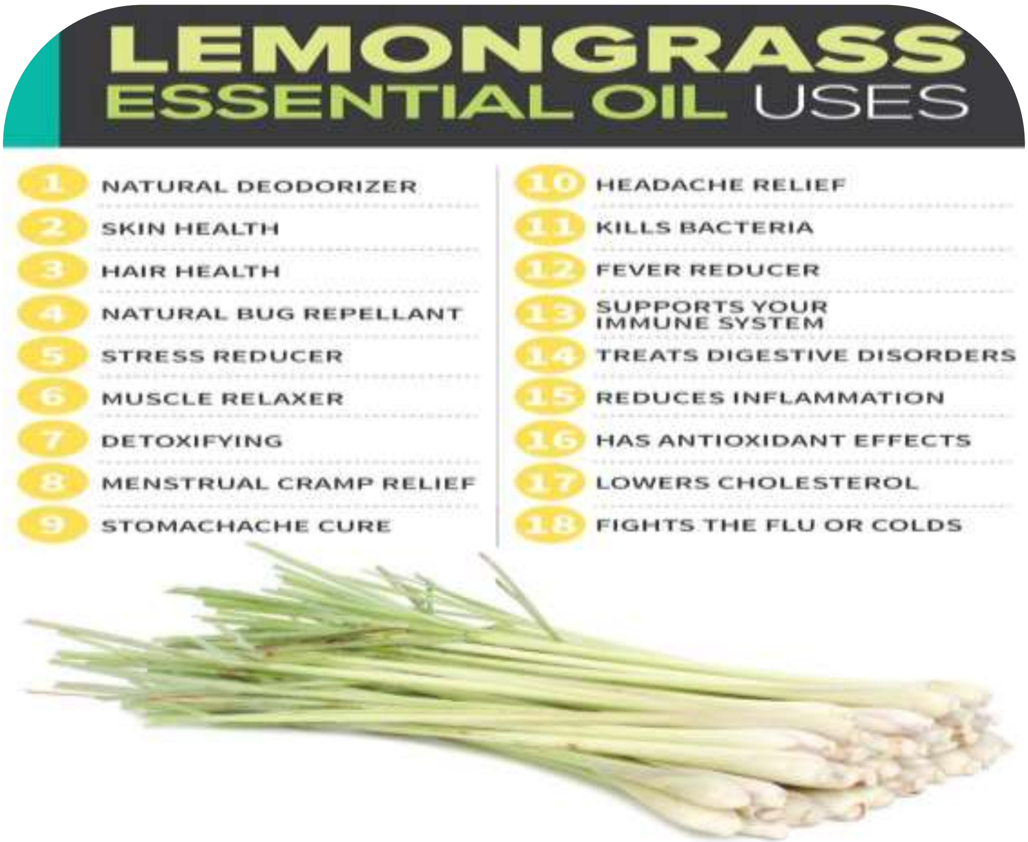
5. Stress Booster: The mild and calming smell of lemongrass oil is known to relieve anxiety, irritability, and insomnia. The lemongrass oil can help to improving the duration and quality of sleep by either use as massage oil or used in body lotion.

6. Reduce Muscle Pain: Lemongrass oil aid in improving blood circulation and also get rid from muscle spasms, backaches, sprains, and cramps.

7. As a Detoxifying Agent: The tea prepared from lemongrass is used as a detoxifier agent in several countries. It detoxes the digestive tract, liver, kidneys, bladder, and pancreas and help in cleaning the whole system of our body.

8. During Menstrual Cramp Relief: The consumption of lemongrass tea is known to help women with menstrual cramps. It can also help with nausea and irritability.

9. As a Stomach Protector and Cure Gastric Ulcer: Lemongrass oil is used during treatment of stomach problems, or gastric ulcers. Using lemongrass oil or infused lemongrass water to in tea or soup can treat the stomach pains, nausea and diarrhoea.



10. Relief Headache: The mild smell, calming and soothing effects of lemongrass oil can effectively help to relieve the pain, pressure, or tension which further results in headaches.

11. Anti-Bacterial: Due to presence of citral and limonene, lemongrass oil can effectively kill or retard bacterial and fungal growth. So, lemon grass is useful during infections such as ringworm, athlete’s foot, or other types of fungal diseases.

12. Immunity Booster: Lemongrass can improve the absorption into the body, thereby boosts immune system and the oil can be vital in restoring your system. It also helpful for the proper functioning of body organs.

13. Anti- Inflammatory: Lemongrass oil also possess the anti-inflammatory properties because of the limonene which is present in it. This plant help in getting relief from several allergic diseases like asthma, Crohn’s disease, arthritis, Alzheimer’s disease, cardiovascular disease, cancer, high blood pressure, diabetes and Parkinson’s disease.

14. Antioxidative Agent: Also, lemongrass oil has the ability to fight off free radicals. Due to main component, Citral, it has been known to inhibit the growth of cancer cells. Especially early on and these anti-cancer activities are most prevalent in the prevention of skin cancer.

Conclusion

Among medicinal plants, lemongrass also plays very important in preserving health of human beings. From this plant, there is production of commercially valuable essential oils products as well as it is widely used in food technology and in traditional medicines. The recovery of the practices and knowledge associated with medicinal plant like lemongrass resources are part of an important strategy related to conservation of the biodiversity, findings of the new medicines, and for the bettering of quality of life of the rural communities.

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Powdery Mildew Disease: Major Threats in Mango cv. Alphonso

Article ID: 32739

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Introduction

Mango (*Mangifera indica* L.) the "king of fruits" the main fruit of Asia and possessing own importance all over the world has been cultivating in the Indian sub-continent for well over 4000 years (De Candolle, 1904). Alphonso is one of the most popular variety of India. It is cultivated in large scale in Konkan region of Maharashtra. The variety is most sensitive to the pest and diseases. Among the different diseases, powdery mildew is one the most important disease caused up to 80% yield reduction if disease occurs early at the flowering stage (Johnson, 1994).

The causal organism, symptoms, epidemiology and management of disease are as follows.

Powdery Mildew

Causal organism: *Oidium mangiferae* Berth.

Symptoms:

a. In Konkan region it is observed from 2nd flowering flush onwards on Alphonso mango
b. Inflorescences are covered with a whitish powdery mass
c. flowers on the infected inflorescence remain unfertilized and drop off the plant prematurely
d. The fungus initially attacks young tissues of all parts, leaves and their stalks, flower scales, buds of tender flowers and fruits in the early stage
e. Young infected leaves fall prematurely, if covered on the underside, and mature infected leaves develop purplish brown spots.
f. Infected fruits are often malformed and off-coloured.
g. The infected fruits do not grow in size and drop at the pea stage.

Powdery mildew on inflorescence

Epidemiology: Warm humid weather and low night temperatures and high wind velocity favour disease spread and development (Singh, 2000). Powdery mildew is favoured by high humidity accompanied by cloudy weather and low night temperature between panicle development and fruit set. A minimum temperature range of 11-140C and maximum of 27-31 0C along with 64- 72% RH are the most conducive for disease development (Gupta, 1979). Warm humid weather and low night temperatures and high wind velocity favoured spread of powdery mildew (Singh, 2000).

Powdery mildew on fruit at peanut stage

Disease management: The disease is effectively controlled by timely application of fungicides as mention in table.1:

Table 1: Label claim fungicides for powdery mildew of mango:

Sr. No.	Name of Fungicides	Conc.	Waiting period from last application to harvest (in days)
1.	Azoxystrobin 23% SC	0.1%	5
2.	Carbendazim 46.27% SC	0.1 %	15
3.	Dinocap 48% EC	0.05%	-
4.	Hexaconazole 5% EC	0.1%	30
5.	Hexaconazole 5 % SC	0.2%	27
6.	Penconazole 10% EC	0.05%	30
7.	Sulphur 40%WP	0.37%	-
8.	Sulphur 55.16 % SC	0.30%	10
9.	Sulphur 80% WP	0.30%	-
10.	Sulphur 80%WG	-	-
11.	Carbendazim 12%+ Mancozeb 63% WP	0.15%	7
12.	Tebuconazole 50% + Trifloxystrobin 25% WG	0.1%	15

(MAJOR USES OF PESTICIDES, Registered under the Insecticides Act, 1968, up to - 30/06/2020)

Conclusions

Powdery mildew of mango is serious and widespread disease of mango and causes significant yield losses. The most serious losses occur when flowering and growth flushes are infected during cool and dry conditions. A minimum temperature range of 11-140C and maximum of 27-310C along with 64-72% RH are the most conducive for disease development. The disease is effectively controlled by timely application of fungicides.

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Zygogramma bicolorata: A Potential Biocontrol Agent for Parthenium

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Introduction

Parthenium does not reproduce vegetatively from plant parts, the only method of reproduction and spread is by seeds in rainy session. Plants can flower and set seeds four weeks after germination. *Parthenium* weed can produce flowers and seeds at any time of the year under favourable conditions. Flowering occurs after one month of germination. The fruit is called cypsela, each flower contains five seeds which are wedge-shaped, black, 2mm long with thin white scales. This weed may expand their population very rapidly and create mono-specific thickets and also spoils the biodiversity.

Damage

Parthenium degrades natural ecosystems and it has an allelopathic effect so there is almost no attack of insects and diseases on it and ultimately it spread rapidly. Its pollen is known to inhibit fruit set in many crops. The germination and growth of indigenous plants are inhibited by its allelopathic effect. In man, the pollen grains, airborne pieces of dried plant materials, and roots of *Parthenium* can cause allergy-type responses like hay fever, photodermatitis, asthma, skin rashes, peeling skin, puffy eyes, excessive water loss, swelling and itching of mouth and nose, constant cough, running nose.

Impact on Agricultural Viability

Parthenium weed is a serious problem in pastures and crops. It contains chemicals, like parthenin, hysterin, hymenin, and ambrosin, and due to the presence of these chemicals, the weed exerts strong allelopathic effects on different crops. Parthenin has been reported as a germination and radical growth inhibitor in a variety of dicot and monocot plants (Gunaseelan N.V 1998).

Impact on Biodiversity

It is a threat to the biodiversity of the country. It is known to exert a significant impact on the natural communities as they cause their displacement and hence exert imbalance in the natural and agricultural ecosystem.

Impact on Animal and Human health

All parts of the *Parthenium* plant at any stage of growth are toxic to humans and animals. It causes dermatitis with pronounced skin lesions on various animals including horses and cattle. If eaten, it is responsible for mouth ulcers with excessive salivation. A significant amount (10–50%) of this weed in the diet can kill cattle (Narasimhan et al., 1977). It is also responsible for various allergies like contact dermatitis, hay fever, asthma, and bronchitis in human beings. Contact of the plant with the body causes dermatitis and the spread of the problem all over the body causes great discomfort.

Biological Control of *Parthenium hysterophorus*

Biological control through insects is an environmentally sound and effective means of reducing *Parthenium* plants in the environment. The Mexican beetle, *Zygogramma bicolorata* Pallister (Coleoptera: Chrysomelidae) an effective bio-control agent of *P. hysterophorus,* was introduced in 1983 from Mexico to Bangalore. It is widely used to manage *Parthenium* plants in non-cropped areas and it was estimated that this bioagent has checked the spread of *Parthenium* in about eight million hectares of land since its release in India.

Biology of Mexican Beetle

Beetles are off-white or light reddish colour with dark brown longitudinal markings on the elytra, measuring about 6 mm. in length. Light yellow eggs are laid generally on the ventral side of the leaves ranging from 6 to 28 eggs and hatch in 4-7 days. There are four larval instars.

The grubs feed for 10-15 days on the leaves and on maturity enter into soil and pupate below up to 15 cm depth. Beetles emerge after 8-12 days. The beetle completes its life-cycle in 27-32 days. Insect completes 4-5 generations from June to October in natural conditions. The female can lay up to 2500 eggs during its lifespan. The beetle remains most active in the field during the rainy season between June to October but stages of *Z. bicolorata* may be encountered in summer and winter season depending on the moisture and temperature.

Fig 1 Zygogramma bicolorata, a leaf-eating beetle on Parthenium weed

How Beetles Kill the Parthenium?

Grubs and adult beetles feed voraciously on the foliage and inflorescence and were mostly confined to congress weed. The early stage of larvae feed on the terminal and auxiliary buds and move on to the leaf blades as they grow. An insect density of one adult per plant causes skeletonization of leaves within 4–8 weeks.
Completely defoliated plant starts to show dieback symptoms and gradually gets killed. Small and succulent plants are more vulnerable to larvae and beetle attacks and are nipped in the bud. Although the beetle is known to occur throughout the year, the insect diapauses over an extended period in nature resulting in an extensive proliferation of the weed in its absence.One adult is sufficient to bring defoliation of a single parthenium plant in 6-8 weeks. The release of about 500-1000 beetles can bring about the establishment and eventually control. Once plants are eaten up in the release spot the insect migrates to an adjacent area. taking this into consideration, several release spots can be selected in a particular place, which can act as a focal point.

Conclusions

Control of *Parthenium hysterophorus* weed by *Zygogramma bicolorata* is the most effective method as it reduces health problems in humans and animals and also increases the productivity of crops by maintaining the plant biodiversity.

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Soil Organic Matter

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Soil organic matter is the fraction of the soil that consists of plant or animal tissue in various stages of decomposition. Most of our productive agricultural soils have between 0.5 and 5% organic matter. Soil organic matter contributes to soil productivity in many different ways. Here we focus on various components of organic matter and diverse roles of organic matter in soil productivity and the field management practices that will help preserve or increase soil organic matter levels over time.

Soil Organic Matter

Organic matter is made up of three different components:
1. Plant residues and living microbial biomass.
2. Active soil organic matter also referred to as detritus.
3. Stable soil organic matter, often referred to as humus.

The living microbial biomass includes the microorganisms responsible for decomposition (breakdown) of both plant residues and active soil organic matter or detritus. Humus is the stable fraction of the soil organic matter that is formed from decomposed plant and animal tissue. It is the final product of decomposition.

The first two types of organic matter contribute to soil fertility because the breakdown of these fractions results in the release of plant nutrients such as nitrogen, phosphorus, potassium, etc.

The humus fraction has less influence on soil fertility because it is the final product of decomposition (hence the term "stable organic matter"). However, it is still important for soil fertility management because it contributes to soil structure, soil tilth, and cation exchange capacity (CEC). This is also the fraction that darkens the soil's color.

Benefits

There are numerous benefits to having a relatively high stable organic matter level in an agricultural soil. These benefits can be grouped into three categories:

1. Physical Benefits:

a. Enhances aggregate stability, improving water infiltration and soil aeration, reducing runoff.
b. Improves water holding capacity.
c. Reduces the stickiness of clay soils making them easier to till.
d. Reduces surface crusting, facilitating seedbed preparation.

2. Chemical Benefits:

a. Increases the soil's CEC or its ability to hold onto and supply over time essential nutrients such as calcium, magnesium and potassium.
b. Improves the ability of a soil to resist pH change; this is also known as buffering capacity.
c. Accelerates decomposition of soil minerals over time, making the nutrients in the minerals available for plant uptake.

3. Biological Benefits:

a. Provides food for the living organisms in the soil.
b. Enhances soil microbial biodiversity and activity which can help in the suppression of diseases and pests.
c. Enhances pore space through the actions of soil microorganisms. This helps to increase infiltration and reduce runoff.

Organic Materials

Over time, the application and incorporation of organic materials can result in an increase in stable soil organic matter levels. Sources of organic materials include:

1. Crop residues.
2. Animal manure.
3. Compost.
4. Cover crops (green manure).
5. Perennial grasses and legumes.

The quickest increases are obtained with sources that are high in carbon such as compost or semi-solid manure.

Organic Matter Management

Farm practices that help to maintain or increase soil organic matter levels:

1. Use of conservation tillage practices (for example zone tillage or no-till). Tillage exposes the organic matter to air and will result in the lowering of stable organic matter due to increased mineralization rates and erosion losses.
2. Rotation of annual row crops with perennial grass or legume sods will reduce erosion and build up organic matter as a result of the decomposition of the root mass.
3. Establishment of legume cover crops will enhance organic matter accumulation by providing the nitrogen (N) needed for decomposition of freshly added organic materials, especially those with a high C to N ratio (corn stover, cereal straw, heavily bedded manure, etc.).
4. Avoiding soil compaction which increases water logging, and maintaining proper pH to enhance microbial activity and decomposition of freshly added materials.

Actual build-up of stable organic matter will, in addition to the amount and source of organic material added, and tillage and rotation practices, also depend on:

a. Soil temperature.
b. Precipitation and soil moisture holding capacity.
c. Soil type and drainage class.
d. Existing microbial community.
e. Soil fertility status and soil pH.

Monitoring Soil Organic Matter

To get an idea of the effect of farm management practices on soil organic matter build-up or decrease, soil samples should be taken over time. Consistency in sampling time is important to build records for fields over time. Although other tests are available, most laboratories will do a loss-on-ignition (LOI) test to estimate the organic matter content of the soil.

Summary

With careful management the preservation and accumulation of soil organic matter can help to improve soil productivity resulting in greater farm profitability.

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Entomopathogens - Microbial Control of Insect Pest

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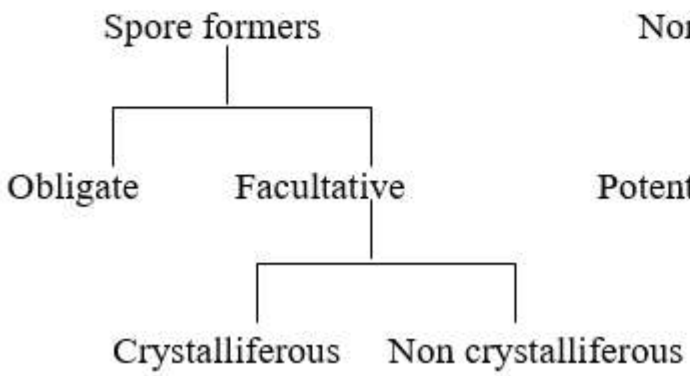
Microorganisms affect insects and cause disease in them. This fact was known to man from the earliest times (384 – 322 BC). Le Conte (1873) advocated the use microorganisms causing diseases in insects as a means of insect control. Metchinikoeff (1879) infected the scarab beetle *Anisophila austrica* with green muscaridne fungus *Metarrhizium anisopliea* and Krassiltschik (1888) mass produced spores of fungus and applied them in the field to control insects. Between 1920 and 1960 many bacteria, fungi and viruses were tried to control insect pests of crops. When microorganisms or their toxins are employed for the control of insects, it is referred as microbial control and it is an extension of biological control.

The qualities of a microbe to be used as an agent for insect control are suitable strain, virulence, toxins and shelf life. Many microorganisms have been found suitable for insect control and they are grouped as:
1. Ingested microbes which enter the insect body through food.
2. Penetrating microbes that enter the insect by penetrating the integument.

Bacteria

Entomogenous bacteria are classified as follows.



Spore formers: These bacteria produce spores to withstand adverse environmental conditions and therefore they are more promising in insect control. Again, among the spore formers the crystalliferous are better than the non-crystalliferous ones because of the toxic nature of the crystals.

One of the most studied crystalliferous spore formers is *Bacillus thuringiensis* which was first identified to be potential insect controlling agent by Steinhaus in 1956. This bacterium is effective against many lepidopteran larvae. It produces a more toxic proteinaceous crystal in its cell. The protein crystal or parasporal body is formed only when sporulation is to take place and not in the vegetative cell. So, the young vegetative cell is nontoxic to the larvae. Crystals of different species of the bacillus differ in their shape and size and the one produced by *B. thuringiensis* are diamond shaped bodies – bipyramid with prominent surface with striations. One cell give rise to one crystal only and it is stable in water and are destroyed by alkalis. They are endotoxins. When the caterpillar ingests the endospore, it germinates and produces the cells. The cells migrate into the haemocoel where they multiply rapidly and destroy the tissues. This stage of infection is called septicemia and then the caterpillar dies. Prior to death of the host, thick walled refractile. spores are formed. Then the spores are released in to the soil. The main symptoms produced in the host are stoppage of feeding, regurgitation and diorrhoea due to midgut paralysis. Some of the commercial products of *B.thuringiensis* are Bakthane, Parasprin, Thuricide, Sporine and Biospore.

Non-Spore formers: They are heterogeneous bacteria which infect insects under extraordinary circumstances. They do not multiply in the gut and do not produce any enzyme or toxins. Therefore, they are not promising in insect control. However, there are some non-spore formers regarded as insect control agents such as *Pseudomonas septica, Proteus sp,* and *Serratia marcesens.*

Viruses

Entomogenous viruses are grouped as inclusion viruses which form inclusion bodies in the host and non-inclusion viruses. The inclusion viruses are more promising as insect control than non-inclusion types. The entry of all viruses is by ingestion and less commonly subcutaneously the major viruses used in insect control are Nuclear Polyhedrosis (NPV) and Granulosis (GV).

Nuclear Polyhedrosis (NPV): They are rod shaped with dimensions of 20-50µm broad and 200 -400µm long. A polyhedron is usually hexagonal in shape and is enclosed by two protein coats. There could be one or more virus particle in a polyhedron. This virus contains only DNA and not RNA.

On ingestion the membranes of the polyhedron are dissolved by the alkaline gut juices setting the virus particles free. The virus particles then penetrate the gut epithelium and infect the blood cells. They enter the nuclei and dictate the DNA of the host to multiply the virus particles. Finally, the nuclear membrane disrupts and releases the polyhedrons to infect other cells. The symptoms of infection appear only at a later stage when the insects near death. The incubation period is 1 -3 weeks. The insect stops feeding and becomes sluggish and pale. The dead larvae usually hang on prolegs and dry down to dark brown or black cadavers. They attack primarily Lepidopteran larvae but they also attack Diptera and Hymenoptera.

Granulosis virus (GV): The virus inhabits the fat body, epidermis, blood cells and tracheal matrix. The inclusion bodies are called capsules and ellipsoidal. The capsule normally contains one virus particle and occasionally two. Except their shape and size, the properties of the capsule are the same as those of the polyhedrons. The infected tissues eventually disintegrate and the body fluid filled with inclusions.

Some names of the viruses used in insect control.
1. *Borrelinavirus*: nuclear polyhedrosis virus
2. *Smithiavirus*: cytoplasmic polyhedrisis virus
3. *Bergoldiavirus*: granulosis virus.

Fungi

The most important fungi used in insect control belong to the class fungi imperfect. These cause muscardine (forming a fungal mat over the insect body) diseases in insects. There are other fungi which can also infect insects. All these fungi are regarded as entomophagus fungi.

Phycomycetes	Ascomycetes	Basidomycetes	Deuteromycetes
Coelmomyces	*Cordyceps*	*Septobasidium*	*Beauveria*
Entomophthora			*Metarrhizium*
Massospora			*Aspergillus*
			Spicara
			Hirsutella
			Paecilomyces

The most common portal entry of fungi is through the integument though invasion via respiratory or alimentary tract is also reported. The infecting unit is mostly the spore. Under favourable conditions the spore germinates and the hyphae invade the layers of integument by enzymatic dissolution of chitin and protein. Then they ramify the cuticle and reach the internal organs where they continuously grow till the insect is virtually filled with fungus. This makes the insect to die.

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Methods of Application of Biocontrol Agents

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Fungi like *Trichoderma viride* and bacteria like *Bacillus subtilis* and P*seudomonas fluorescens* are commercially used as biocontrol agents in the management of plant diseases. They are used through the following methods.
1. Seed treatment.
2. Seedling root dip.
3. Sucker treatment.
4. Capsule application.
5. Soil application.
6. Foliar spraying.

Seed Treatment

The fungus, *Trichoderma viride* and the bacteria such as *Bacillus subtilis* and *P. fluorescens* are used to treat the seeds of various crops.

1. *T. viride :* The talc-based formulation (with 28 x 10^6 cfu/g product) of *T. viride* is used as dry seed treatment at 4 g per kilogram of seeds for the control of root rot diseases of blackgram, greengram, chickpea, gingelly groundnut, sunflower and cotton caused by *Rhizoctonia solani, Pythium spp, Macrophomina phaseolina* and *Sclerotium rolfsii*. Biofertilizers like *Rhizobium* and *Azospirillum* can be mixed with *T. viride* during seed treatment. The treated seeds are sown immediately unlike in fungicide treated seeds where the seeds are sown 24 hrs. after seed treatment.

2. *Bacillus subtilis:* Peat based culture of *B. subtilis* is used for seed treatment *B.subtilis* effectively controls root rot diseases caused by *Macrophomina phaseolina, Rhizoctonia solani* and *Sclerotium rolfsii* and wilt diseases caused by *Fusarium* spp. Besides, it also enhances growth and yield of crops.

3. *Pseudomonas fluorescens :* Seed treatment with *P. fluorescens* is usually adopted in rice for the control of blast *(Pyricularia oryzae)* and sheath blight *(Rhizoctonia solani).* It controls wilt of pigeonpea *(Fusarium udum)* and wilt of chickpea *(F. oxysporum* f. sp. c*iceri).*

Rice

In rice, wet seed treatment is followed to control blast and sheath blight diseases. Rice seeds are mixed with the talc-based product at 10 g per kilogram of seed soaked in 1 liter of for water overnight. In the next morning excess water is decanted. The treated seeds are allowed to sprout for 24 hours and then sown in the nursery. The decanted water containing antagonistic bacteria is sprinkled over germinating rice seeds.

Pigeonpea and Chickpea

Dry seed treatment is followed in pigeonpea and chickpea for the control of wilt diseases caused by *Fusarium* spp. Seeds are treated at the rate of 10 g for kilogram of seed.

1. Seedling root dip: Seedling rot dip with *Pseudomonas fluorescens* is adopted in rice to control blast disease, Irrigation water is stagnated in an area of 25 sq. m. in the rice field. A quantity of 2.5 kg of *P. fluorescens* formulation is applied and mixed with the stagnated water. Rice seedlings required to plant one hectare are pulled out from the nursery. The root portion of these pulled out seedlings is immersed in the stagnating water containing antagonistic bacteria for a minimum period of 30 min. The seedlings after treatment are transported and transplanted.

2. Sucker treatment: In banana, suckers are treated with *P. fluorescens* before planting to control of panama wilt. Ten gram of the formulation is sprinkled on clay dipped suckers before planting in the field.

3. Capsule application: Capsules filled with formulation of *P. fluorescens* are used for the control of panama wilt of banana. Each capsule is filled with 50 mg of *P. fluorescens* and applied at one capsule to each banana sucker in the field at third month of planting. Capsule application is repeated on 6 and 9 months of planting for effective control of the disease.

4. Soil application: Soil application of biocontrol agent is recommended in the use of *Trichoderma viride* and *Pseudomonas fluorescens.*

a. ***T. viride :*** Soil application of *T.viride* is recommended for the control of *Macrophomina* root rot in pulses and oilseeds and *Fusarium* wilts in pigeonpea and chickpea. Talc based formulation of *T.viride* is mixed with well decomposed farm yard manure (FYM) or sand and then applied to soil. For treating one hectare of land 2.5 kg of the formulation is mixed with 50 kg of FYM or sand and then applied to the soil. Soil application is done 30 days after sowing.

b. ***P. fluorescens*****:** Soil application is done in rice to control blast disease and panama wilt of banana. In rice, *P. fluorescens* formulation is mixed with well decomposed farm yard manure or sand and applied to rice crop 30 days after transplanting. For treating one hectare of land 2.5 kg of the formulation is mixed with 50 kg of FYM. In banana 2.5 kg of the formulation is mixed with 50 kg of FYM and applied at the time of planting and repeated once in three months.

5. Foliar spraying*:* Foliar spraying of *P. fluorescens* is recommended for the control of blast of rice at 0.2 per cent concentration i.e. 1 kg / ha of crop. The product is sprayed three times from 45 days after transplanting at 10 days interval. One to three sprays are recommended.

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Recent Advances in Secondary and Micronutrient Fertilizers

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Introduction

For many years, the main goal of applying fertilizers was to provide nutrients to the plants or to sustain optimum crop yield. Thus, improving fertilizer use efficiency in terms of crop yield and nutrient uptake is important to producers and users. However, any fertilizer in natural, inorganic and organic form can harm the environment if misused. Recently, fertilizer use has been labelled by environmentalists as one of the sources for polluting soil, air and water.

To ensure that proper use of fertilizers is beneficial to crop production and environment, researchers and fertilizer producers have tried to find the ways to achieve the newly defined goals of fertilizer use, i.e., improving fertilizer use efficiency and minimize environmental impacts (Bouwman et al., 2017; Zhang et al., 2015). Various studies such as those by Willett et al. (2019) and Conijn et al. (2018), reveal that global nutrient losses to the environment will continue to exceed the safe operating spaces with respect to the planetary boundaries with current fertilizer products. Therefore, recent developments in technology for fertilizer production and use to improve fertilizer use efficiency and reduce environmental impact have been made.

Secondary Nutrient Fertilizers

Calcium fertilizers: The primary Ca sources are liming materials such as $CaCO_3$, $CaMg(CO_3)_2$ etc that are applied to neutralize soil acidity. In situations where Ca is required without the need for correcting soil acidity, gypsum is used.

> **Sources**: Agriculture limestone (80-90%), Gypsum (40%), SSP (25-30%), Dolomite (20-45%), CAN (10-20%), Rock phosphate (39-48%).

Magnesium fertilizers: In contrast to Ca, few primary nutrient fertilizers contain Mg. Dolomite is commonly applied to low-Mg acid soils. $K_2SO_4.MgSO_4$ and $MgSO_4$ are the most widely used materials in dry fertilizer formulations.

> **Sources**: Magnesium sulphate (16%), Dolomite (5-20%), Magnesite (40%), Magnesia (55%), Chelated Mg (2-10%).

Sulphur fertilizers: Plants take Sulphur in the form of sulphate (SO_4) ion. Sulphur fertilizers predominantly contain sulphate, some of which are easily soluble and some are slightly soluble.

> **Sources**: SSP (12%), Ammonium Sulphate (24%), Potassium Sulphate (18%), Ammonium phosphate sulphate (15%), Iron pyrite (22-24%), Gypsum (13-18%).

Recent developments in Sulphur fertilizers: Currently, a lot of research efforts have been directed toward exploiting the special high-performance characteristics of polymers with sulphur in the backbone. Sulphur-containing polymers fall under various classes and cover an extremely broad property range. The impetus to their development resulted from the unique properties and success in their applications, depending upon the type of linkage introduced. Various sulphur-containing polymers especially polyamides, polyimides, poly(amide-imide)s, polybenzimidazoles, polyurethanes, polyesters, etc. came up and the outstanding performance of these polymers was attributed to their structures having sulphur-based groups such as thiophene, sulphide, sulfone, thiazol, and thiourea. Thus, these linkages endow special features to such functional polymers.

Emerging New Sulphur Fertilizers

1. Elemental S modified N/P fertilizers: Elemental S can be readily incorporated into N/P fertilizer materials to provide 5 to 20% S. Mono- ammonium and diammonium phosphates (MAP or DAP) containing from about 5 to 20% S can be made by applying a hydraulic spray of molten elemental S during drum or pan granulation.

Recently, a new sulphate and elemental S-enriched MAP fertilizer was developed in North America, containing 15 % S, 13% ammonium-N and 33 to 35% of phosphate. Sulphur enriched SSP, containing 18 to 35% S are popular in some countries, such as Australia and New Zealand.

2. Sulphur Coating: Sulphur coated urea fertilizer is formulated for increased efficiency in the use of urea consisting of an S shell around each urea particle. It contains 77 to 82 % of urea (36 to 38%N) and 14 to 20% S coating.

3. Liquid Sulphur fertilizers: Ammonium thiosulphate solution (ATS) is a popular source of S for use in liquid fertilizers because of its solubility and compatibility with various ions.

4. Micronized elemental Sulphur: Elemental Sulphur is the popular high analysis pure source of S fertilizer with 85 to 90% grade.

Micronutrient Fertilizers

Zinc Fertilizers: Zinc sulphate pentahydrate (21%), Zinc sulphate monohydrate (33%), Zinc oxysulphate (55%), Zinc oxide (55-70%), Zn EDTA (12%).
Copper Fertilizers: Copper sulphate pentahydrate (24%), copper sulphate monohydrate (35%), copper oxysulphate (13-53%), Cu EDTA (9-13%).
Manganese Fertilizer: Manganese sulphate trihydrate (25-28%), Manganese sulphate monohydrate (30-32%), Mn EDTA (5-12%), Manganese oxysulphate (40-49%), MnO_2 (55-69%).
Iron Fertilizers: Ferrous sulphate (19%), Ferric sulphate (17%), Ferric chloride (5-18%), Fe- EDTA (12%).
Boron Fertilizers: Boric acid (17.5%), Borox (10.5%), Solobar (19%).
Molybdenum Fertilizers: Sodium molybdate (37-39%), Ammonium molybdate (54%).

Recent Development in Micronutrient Fertilizers

Micro-encapsulation: Microencapsulation of micro nutrients have been developed which produce tiny capsules that have several nutritional advantages:
1. Enhancement of contact surface for absorption and hence increases its bioavailability.
2. Low cost of production.
3. Biodegradability and biocompatibility with food and environment.

The encapsulation of commercial fertilizers uses polymer film to protect the nutrient from rapid stabilization reaction in the soil and control their release into the soil solution during the plant growth.

The nutrient release mechanism is either based on direct diffusion through a polymer film or by decreasing the rate of product hydrolysis.

The property and structure of polymer together with the architecture of microcapsules influence the release of encapsulated micro nutrient fertilizer.

Nano-Fertilizers

Nano- fertilizer may be defined as the nano particles, which can supply essential nutrients precisely for maximum plant growth, have higher use efficiency and can be delivered in a timely manner to a rhizospheric target or by foliar spray. The newly developed nano-fertilizer will bring down the use of chemical fertilizers by 80-100 times.
Nano-fertilizers are more beneficial as compared to chemical fertilizers:
1. Three-times increase in Nutrient Use Efficiency (NUE).
2. 80-100 times fewer requirements as compared to chemical fertilizers.
3. 10 times more stress tolerant by the crops.
4. Completely a bio-source, so eco-friendly.
5. 30% more nutrient mobilization by the plants.
6. 17-54 % improvement in the crop yield.

Examples of recently developed nano fertilizers:
1. Nano porous Zeolite.
2. Zinc Nano Fertilizer.
3. Boron Nano fertilizer.

The Need for New Sources of Fertilizers Arises Due to the Following Reasons

1. Soil fertility varies widely for major, secondary and micronutrients.
2. Crop needs in terms of quality and ratio of nutrients vary widely and it further complicates in dealing with cropping systems.
3. When knowledge-based agriculture with precision recommendations are to be followed, the existing sources of fertilizers will be of limited value.

The application of secondary and micronutrients through blending or fortification with macronutrient fertilizers is the best option to ensure the balanced and efficient use of nutrients.

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Genetic Engineering and New Technologies in IPM

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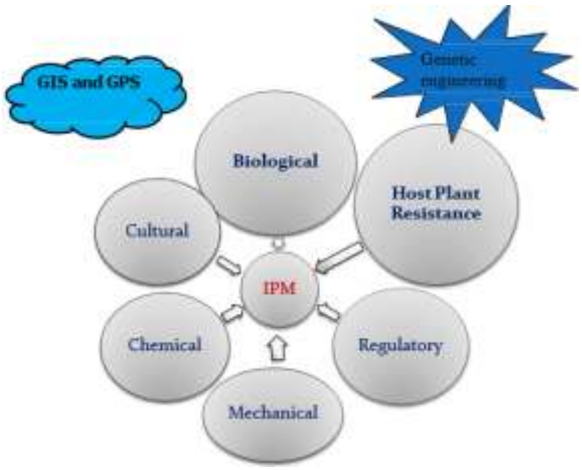
Integrated Pest Management (IPM) is a system approach that combines a wide array of crop production and protection practices to minimize the economic losses caused by the pests (insect pests, diseases, nematodes, weeds, rodents, birds etc.). It emphasizes on careful monitoring of pests and conservation of their natural enemies. Insect pathogens have demonstrated to be environmentally safe and economical alternative for the control of wide range of arthropod pests. But at present, less than 1% of the insecticides used worldwide for pest control are based on insect pathogens. Those used most widely are different subspecies of the bacterium, Bacillus thuringiensis (Bt), which constitute approximately 80% of the pathogens used as insecticides. Genetic engineering, also called genetic modification, is the direct manipulation of an organism's genome using biotechnology (Anderson et. al., 2016). It is a set of technologies used to change the genetic makeup of cells, including the transfer of genes within and across species boundaries to produce improved or novel organisms. Genetic engineering is the process of manually adding new DNA to an organism or changes in the genetic constitution of cells by introduction or elimination of specific genes using molecular biology techniques.

The goal is to add one or more new traits that are not already found in that organism. It can be used to produce:
1. Herbicide tolerant crop (Norsworthy et. al., 2012)
2. Virus resistant crop.
3. Insect resistant crop.
4. Transgenic micro-organism.



Methods of Genetic Transformation

1. Indirect gene transfer (Vector-mediated)- *Agrobacterium*-mediated gene transfer.
2. Direct gene transfer (Vectorless)– Electroporation, Microinjection, Micro projectile bombardment etc.

Categories of GM Crops

1. First generation containing only single transgene useful in transgenic plant development.
2. Second generation transgenics in addition to the selectable marker one or two transgenes encoding simple agronomic traits.
3. Third generation transgenics that contain multiple transgenes targeting multiple pests and diseases, often in a temporal or spatial manner.

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Table 1. Different biotechnological methods employed in crop improvement and the genetic improvement of Natural Enemies.

Biotechnological Techniques	Examples
Microinjection	To manipulate the reproductive system of *Trichogramma* sp. Used to produce transgenic tomato
Maternal microinjection	To enhance the survival and affectivity of *Metaseiulus occidentalis*
Electroporation	Used to produce transgenic rice, Alter sex ratio of parasitoids
Agrobacterium based plant transformation	Bt insect resistance crop plants (tobacco, corn, cotton etc.)
Protoplast fusion	Herbicide and insecticide resistant natural enemies and plants
PCR, RAPD-PCR	Identify biotypes of arthropod biocontrol agents
RAPD-PCR	Monitor establishment and dispersal of arthropod biocontrol agents
RAPD-PCR	Monitor genetic changes in arthropod colonies
Clonal propagation	Disease and insect free potatoes and strawberries

Steps Involved

1. Isolating a gene to be inserted.
2. Inserting the gene in a vector (Agent used to carry foreign gene).
3. Inserting Vector into the host.
4. Multiplication of host cells by cloning.
5. Extraction of desired product.

Potentials of Biotechnology in IPM

1. Low toxicity of protease inhibitors and Bt δ- endotoxin as compared to conventional insecticide.
2. Expression of toxins in all plant parts- No need of continuous monitoring of pest.
3. Provide protection to those plant parts which are difficult to be treated with insecticides.
4. There is no drift problem and ground water contamination.
5. Safe to non-target species and human beings.
6. Eliminate the problem of shelf life and field stability faced by pesticide formulation.
7. Inbuilt resistance to various insects.

Table 2. Transgenic crops expressing insecticidal plant genes

Transgenic crop	Transgene(s)	Origin of transgene	Target insect pest
Alfalfa	Manduca E-1	Manduca sexta	Thrips
Apple	CpTi	Cowpea	*Cydia pomonella*
Cabbage	Modified CpTi	Cowpea	*Pieris rapae*
Cotton	CpTi	Cowpea	*H.armigera*
Maize	WGA	Wheat	*Ostrinia nubilalis*
Mustard	WGA	Wheat	*Lipaphis erysimi*
Pea	Alpha-A1	Bean alpha amylase-1	*Bruchus pisorum* *Zabrotes subfasciatus*
Rice	CpTi	Cowpea	*Chilo suppressalis* *Sesamia inferens*
Transgenic crop	Transgene(s)	Origin of transgene	*Target insect pest*
Rice	Pot P1-2	Potato	*C.suppressalis, S.inferens*
	GNA	Snowdrop	*Nilaparveta lugens* *Nephotettix virescens*
Potato	CpTi	Cowpea	*Lacanobia oleracea*

	GNA	Snowdrop	L. oleracea, Myzus persicae
Wheat	GNA	Snowdrop	Sitobion avenae
Tomato	CpTi	Cowpea	L.Oleracea
	GNA	Snowdrop	L. Oleracea

GPS and GIS

GPS stands for Global Positioning System.
GIS stands for Geographic Information System.

Uses

1. Scouting monitoring pest population.
2. Predicting pest outbreak and movement.
3. Identifying and categorizing pattern of damage.
4. Assessing the success.
5. Refining the control tactics.
6. Extent of weed infestation.
7. Insect and pest population.

Limitations

1. The effects of transgenic on the natural regulation of pests and biodiversity are often negative.
2. By cross pollination herbicide resistant enter weedy relatives.
3. Widespread use of transgenic plant can render them susceptible or accelerate evolution in pest.
4. IPM favours minimized use of chemical whereas the availability of herbicide resistant crop promotes the use of more chemical.
5. Use of GIS and GPS is not economical for small area.
6. Technical support is required to use techniques.
7. Use of GIS to apply insecticide is possible but less effective as insects are much vagile.
8. Integrated farming positively affects natural control agents while yield reductions are low and economic returns are stable or even increase (Meissle, 2016).

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Genetic Engineering in Baculoviruses, Bacteria and Entomopathogenic Fungi

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The virulence and pathogenicity of pathogen is determined by the microbial genome as a result of coordinated expression of a concert of genes. The acquisition of these domains or pathogenicity islands, may be sufficient to develop a transgenic virulent pathogen. The advent of recombinant DNA techniques—in essence, genetic engineering—has provided a myriad of opportunities to enhance the efficacy and thus cost- effectiveness of the insect pathogens as their control agents.

Baculovirus

These are arthropod -specific viruses that infect species. The two genera:
1. Nucleopolyhedrovirus (NPV): Multiple virions occluded in polyhedron.
2. Granulovirus (GV): Single virions occluded in granules.

Two Strategies are Involved

1. Genetic Engineering to Optimize Speed of Kill: Ecdysteroid UDP-glucosyl transferase (EGT), renders the ecdysteroids inactive, blocks molting of the host insect, thereby prolonging the actively feeding larval stage. Deletion of EGT from the *Autographa californica* multiple nucleopolyhedrovirus (AcMNPV) genome resulted in more rapid death and an approximately 40% reduction in feeding damage caused by infected larvae of *Trichoplusia ni* and *Spodoptera frugiperda* compared to those infected with wild type AcMNPV. Insertion of a gene encoding a toxin, hormone or enzyme into the baculovirus genome. Several recombinant baculoviruses have been constructed for over expression of the host insect's own hormones or enzymes such as diuretic hormone, eclosion hormone, prothoracicotrophic hormone and juvenile hormone esterase. A wide range of genes encoding insect-specific toxins isolated from various venomous creatures such as scorpions, spiders, parasitic wasps and sea anemones have been inserted into baculovirus genomes. Insertion of Diuretic hormone gene from *Manduca sexta* resulted in 20% increase in the insecticidal activity of a recombinant *Bombyx mori* NPV. The insect selective toxin (LqhIT2) from yellow Israeli scorpion *Leiurus quinquestriatus* was inserted in HzSNPV for the control of *Helicoverpa zea*. The toxin from scorpion *Androctonus australis* was inserted in AcMNPV for the control of *Helicoverpa zea*.

2. Genetic engineering for increased virulence and modify host range: There are several examples of baculoviruses that have been genetically engineered to reduce the amount of virus required for a fatal infection of the targeted insect pest. Enhancin is a metalloprotease commonly expressed by baculoviruses that degrades insect intestinal mucin in the peritrophic membrane. Insertion of the enhancin gene derived from *Trichoplusia sp.* GV enhanced AcMNPV virulence by 2 to 14-fold in various insect species. Conversely, deletion of two enhancin genes from *Lymantria dispar* MNPV reduced viral potency 12-fold compared to wild type virus.

Genetic Improvement of Baculoviruses

To reduce the survival time of baculovirus infected larvae, several baculoviruses have been engineered for improved insecticidal performance to reduce the time taken by virus to kill the host insect. These include *Helicoverpa zea* (HzSNPV), *Bombyx mori* (BmNPV) etc. It includes the insertion of a transgene into baculovirus genome. On replication baculovirus within the host cell of the infected host, the product of transgene usually a toxin is expressed along with the baculovirus proteins. Expression of these agents results in paralysis, or in desruption of internal tissues of the host insect (Santiago et. al., 2013). Eg. HzSNPV expressing the toxin LqHIT2 was assessed for commercial variability for the control of cotton bollworm *H. zea*.

Table 1. Genetic engineering in baculoviruses:

Gene	Source	Baculovirus	Target insect-pests	Effect
BelT	Scorpion	Autographa californica nuclear polyhedrosis virus (AcMNPV)	Spodoptera frugiperda	Neurotoxin and effect feeding
HD73	Bacillus thuringiensis kurstaki	Autographa californica nuclear polyhedrosis virus (AcMNPV)	Trichoplusia ni larvae	Feeding deterrent, causes death
JHE gene	Heliothis virescence	Autographa californica nuclear polyhedrosis virus (AcMNPV)	Larvae of Trichoplusia ni	Cessation feeding
VEF gene	Trichoplusia ni	Autographa californica nuclear polyhedrosis virus (AcMNPV)	Lepidopteran larvae	10fold reduction in LD50

Bt Rice

1. Cry1Ab gene alone and a fused Cry1Ab/Cry1Ac inserted into conventional rice varieties and hybrids by various Chinese universities and research institutes in cooperation with IRRI.
2. Have high levels of resistance to Chilo suppressalis and Cnaphalocrocis medinalis

Bt Soybean

1. In 2013, the first commercial Bt soybean (MON 87701 × MON 89788), expressing Cry1Ac protein, was approved for cultivation in Brazil.
2. For the control of the main lepidopteran pests of soybean like tobacco budworm and velvetbean caterpillar.

Bt Brinjal

1. Bt brinjal created by inserting a gene (cry 1Ac) from soil bacterium Bt.
2. The insertion of the gene into the brinjal cell in young cotyledons has been done through an *Agrobacterium* mediated vector, along with promoters and markers etc.
3. Resistance against lepidopteran insects like fruit and shoot borer and fruit borer.

Fungi

Insect pathogenic fungi are key regulatory factors in insect pest populations. Most attention has focused on the ascomycetes *Metarhizium anisopliae* and *Beauveria bassiana*. The major drawbacks associated with fungal pesticides include relative instability, requirement for moist conditions for spore germination, invasion, and growth, and slow rates of mortality. A hybrid chitinase containing the chitin binding domain from the silkworm Bombyx mori chitinase fused to the *B. bassiana* chitinase showed the greatest ability to bind to chitin. Constitutive expression of this hybrid chitinase gene by *B. bassiana* reduced time to death of insects by 23% compared to the wild-type fungus (Zhao et. al., 2016).

Genetic Engineering of *Beauveria bassiana*

1. Limiting factors: solar ultraviolet (UV) radiation, temperature, humidity etc.
2. To improve resistance to these factors particularly to UV damage, Agrobacterium-mediated transformation of exogenous tyrosinase gene to engineer *B. bassiana* can be done.

3. This will give rise to the mitotically stable transformants produced larger amounts of yellowish pigments and these imparted significantly increased UV-resistance.

Eg: The virulence of the transgenic isolate can be significantly increased against the silkworm *Bombyx mori* and the mealworm *Tenebrio molitor*.

Genetic Engineering of *Metarhizium anisopliae*

1. Limiting factors: Environmental stresses, such as UV radiation, temperature extremes, and desiccation.
2. Metabolic engineering of dihydroxynaphthalene (DHN) melanin biosynthetic genes cloned from *Alternaria alternata* were transformed into entomopathogenic fungus *Metarhizium anisopliae* via Agrobacterium-mediated transformation.
3. The transformant, especially under stresses, shows enhanced antistress capacity, virulence, germination, survival rate and infectivity. Eg. effective against diamondback moth *(Plutella xylostella)*, larvae *Manduca sexta* etc.

Limitations

Although all of these products are effective when used properly, they have distinct drawbacks which limit user acceptability.
1. The bacterial and viral agents must be ingested to be active, and their killing action, especially the viruses, is slower than conventional chemical insecticides.
2. These agents are also subject to rapid inactivation by exposure to sunlight and are readily washed off the foliage by rain.
3. Viral products are expensive to produce since current methods require propagation in living insect larvae.
4. Fungi are very intolerant of low humidity conditions or high temperature, and thus are generally used only in greenhouses or in cool climates.

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Bio Control Agents of Pink Bollworm and their Mass Production

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Introduction

Indian cotton production has witnessed tremendous change in genotypes, area, production and productivity over the years. First genetically modified Bt cotton was approved in 2002 for commercial cultivation with single gene Cry1Ac (Bollgard); while two gene Bt cotton, Bollgard II (Cry1Ac + Cry2Ab) was approved during 2006. At present Bt cotton occupies 88.13% area of total cultivated area under cotton. The Bt cotton was providing protection against bollworm complex viz. American bollworm, Spotted bollworm and Pink bollworm. However, the first report of resistance development by pink bollworm (*Pectinophora gossypiella* Saunders) to Bollgard came in 2010 and subsequently to Bollgard II during 2014.

During 2015, pink bollworm severely impacted cotton production in Gujarat, but in subsequent years, Gujarat was able to manage the pink bollworm with the concerted efforts from all stakeholders. During 2017, Pink bollworm was recorded at epidemic levels in major cotton producing states like Maharashtra, Telangana, Andhra Pradesh, Karnataka and Madhya Pradesh and infestation ranged between 8-92% with corresponding yield losses at 10-30%. Historically pink bollworm was regarded as late season pest. However, in recent years, infestation is being recorded in early crop season in July- August with the onset of flowering. The pest is now of being major concern in all the cotton growing states of Central and South zone. Despite availability to several methods of pest control, farmers mostly rely on chemical pesticide due to easy access to chemicals and quick results. However, the indiscriminate use of insecticides has adverse effect on environment. Biological control agents as one of the components of integrated pest management program can offer alternative to these insecticides. In this article detailed information about three bio-control agents and their mass production techniques are given. The information on production of these bioagents may be utilized for setting up of cottage scale production of bioagents at village level.

Trichogrammatids

Trichogrammatids are an egg parasitoid killing the host at egg stage which gives control over pest at an early stage. There are three main species of Trichogramma viz. *Trichogramma bactrae* (Nagaraja), *Trichogramma brasilenssis* (Ashmead) and *Trichogramma chilonis* (Ishii) used for management of pink bollworm. Among these species *Trichogramma bactrae* is the most important. The eggs of Trichogramma hatch in about 24 hours and the larvae develop very quickly. After 3 to 4 days the host egg are parasitized which turn black. Thereafter larvae transform to pupal stage. After about 4-5 days, the adult wasps emerge from the pupae and escape the bollworm egg by leaving a circular hole in the egg shell. The life cycle from egg to adult requires about 8-9 days. Once a female finds a bollworm egg, she drills a hole through the egg shell and inserts two to three eggs into the bollworm egg.

Mass Production Protocol for *Trichogramma bactrae*

1. 2.5 kg of crushed sorghum grains treated with 0.1% formalin and 0.005 % streptomycin sulphate should be taken tin plastic tray. Later add 10 yeast powder tablets + 250 g Groundnut + 5gm wettable sulphur and mix entire content thoroughly.
2. Add 0.5 cc Corcyra eggs and leave it for 40 days. After 40 days moth emergence will start and then transfer the moths in oviposition chambers. For moth diet place cotton swab dipped in 20 % honey solution fortified with vitamin-E in oviposition chamber.
3. Collect daily eggs from oviposition chamber and UV ray's treatment have to be given for 45 min.

4. 1 cc (16000-18000) eggs of *Corcyra cephalonica*, treated with UV rays are then glued to cards of 15 cm x 10 cm.
5. 8 pieces of 4 cm x 2 cm has to be pre punched leaving uncovered space at one end to facilitate stapling.
6. Glued eggs are then exposed to adult female Trichogramma in ratio of 8:1 for 24 hours.
7. After parasitization 6-day old parasitized egg cards are prepared for field release.

Characters of Trichogramma

1. Gives control over multiple range of lepidopterian pests.
2. Kill the pest in egg stage, i.e no emergence of larvae.
3. High parasitization potential.
4. Can tolerate temperature fluctuations which make it suitable for release in many areas.

Release of Trichogramma

1. Dose- Release of 60,000 parasitized eggs/acre at two stages.
2. First release at flowering stage and second at boll formation stage in 3 weekly intervals.
3. Do not spray any chemical within 10 days after release.
4. Stapel the egg strip bellows the plant leaves.

Braconids (*Bracon lefroyi* Dudgeon and Gough)

Braconids are mainly naturally occurring endoparasitoids. These biocontrol agents are very sensitive to pesticide and thus use of pesticide is detrimental to them. By reducing the chemical use, we can conserve these potent biocontrol agents which are effective against pink bollworm. The female endoparasitoid deposits eggs through pointed ovipositor in the host body of the insect (larva). Eggs are laid singly or in groups. After hatching, endoparasitoid larva start feeding on the host, obtaining all the necessary nutrients required, completing its development up to the pupal stage, gradually host gets killed. Sometimes the host is killed by the ovipositing female through the injection of paralyzing substances and parasitoid larvae then feed only on the resulting host dead tissue.

Apanteles (*Apanteles angaleti* Muesebeck)

Apanteles angaleti female deposits one or more eggs in the pink bollworm larvae. The incubation period of eggs is 2-3 days and after hatching, endoparasitoid larva starts feeding on the host having larval period of 6-8 days, till its development up to the pupal stage (pupal period is 4-6 days), gradually host gets killed. Adult can leave up to 10-12 days.

Genetic Engineering of *Beauveria bassiana*

1. Limiting factors: solar ultraviolet (UV) radiation, temperature, humidity etc.
2. To improve resistance to these factors particularly to UV damage, Agrobacterium-mediated transformation of exogenous tyrosinase gene to engineer *B. bassiana* can be done.
3. This will give rise to the mitotically stable transformants produced larger amounts of yellowish pigments and these imparted significantly increased UV-resistance.

Eg: The virulence of the transgenic isolate can be significantly increased against the silkworm *Bombyx mori* and the mealworm *Tenebrio molitor*.

Mass Production Protocol for *Apanteles angaleti*

1. Take a clear plastic or glass container (15 x 10 cm) with water upto 2 cm height and covering it with a strong nylon or plastic mesh fixing tightly over the edges.
2. Take few 1st instar larvae of *Corcyra cephalonica* in a petridish (5 cm dia.) and add very thin layer of (2mm) wheat or sorghum flour. Place this petridish over the nylon net or plastic mesh covering the container.

3. Before exposing these larvae to the female parasitoids place a cotton swab soaked in 50% honey solution on mesh which will serve as food for adult parasitoids.
4. Another container of similar size as the bottom container squarely place over the bottom container and release adults in the space created between these two containers.
5. The column of water maintain in the lower container ensures a high humidity of 90% in the upper chamber. Expose the *Corcyra* larvae to the parasitoid for a period of 24 hours and then replace by another dish containing the first instar Corcyra larvae.
6. Parasitized larvae are then transferred to plastic basins or jars of 3 liter capacity containing 1 kg of crushed Sorghum or Bajra grains for further development.
7. An assembly line is set for getting the desired number of parasitoids. The entire assembly is replaced at 3 day/weekly interval to maintain high production quality.

Benefits of Using Biological Control Agents

1. Environment friendly tool of pest management.
2. Best suited for IPM practices.

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Onion Cry- The Price Surge in Onions

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No doubt onion is ruling not only our kitchen but also our Government. It has crashed the Governments several times since 1980 and left the farmers and common man helpless. For the second consecutive year, onion is showing a surge in the price. Such fluctuations are not seen in any other commodity.

Amidst the pandemic, a spike in onion prices is of a greater concern as many were laid off from their jobs and left unemployed. This has disturbed the budget of every household and added to the extra expenses. Onions across the country, especially the larger cities like Mumbai, Delhi, Pune, Chennai has witnessed the price rise to Rs. 100/ kg or more in the retail outlets (Usually thrice of the normal Price). During 2015, the onion has witnessed the price of Rs. 100/ Kg for the first time and this trend is continuing year after year.

Be it as a curry, salad or snacks, onions have shown its presence almost in every dish and it is irreplaceable. With the increase in population and rise in the per capita income of the people, the demand for good quality onion has grown tremendously. There is an imbalance between the demand and supply of onions in the market, thus leading to the hike in the prices.

India being the second- largest producer of onions (Production= 19,415.425 tonnes), after China (Production= 23,907.509 tonnes) grow onions in an area of 1,199.85 ha. Maharashtra is the largest producer of onions in India. The major onion producing states are Maharashtra, Madya Pradesh, Gujarat and Karnataka. Nashik in Maharashtra, known as the hub of onion in Asia, contributes to 80 % of the total onion export from India.

Onion is grown in three seasons in India as Kharif crop (sowing in June- July, harvesting in late October), Late Kharif Crop (sowing in September and harvesting in late December) and Rabi crop (Sowing in January and harvesting in Post March). Rabi crop sustains the demand by constituting 60 % of total production and is available till October- November. This produce is used for export. Majorly the price surge occurs when Rabi crop fails.

Fresh onions are available from January to May. In the later months, the onions stored by Maharashtra, Madhya Pradesh, Rajasthan and Gujarat are brought to the markets. In the mid-august, the country receives Kharif onions from northern parts of Karnataka. The Kharif crop from Maharashtra arrives from October and Onions from Gujarat are used from December.

During the onion season, sometimes the price drops drastically to Rs 7 to 10 / kg in the local mandis. This is much lower than the cost of cultivation and thus leaves the onion farmers in a distress sale. This is discouraging farmers from growing onions.

Why Onion Prices are Rising this Year?

According to agriculture economists and horticulture officers, the reasons for the rise in the prices this year are

1. Heavy Rainfall- Heavy rains in Maharashtra, Gujarat, Karnataka and Andhra Pradesh has led to the increase in price. Since the last week of August, the price of onions started moving upwards. This was due to losses caused by Kharif onions by heavy rainfall in the northern districts of Karnataka.

2. Improper storage Facilities- Farmers in Maharashtra has faced 50-60 % storage losses this year due to rainfall. Heavy rains in the onion growing belts of Nashik, Ahmednagar and Pune of Maharashtra has caused damage to the storage structures due to the seepage of water into them.

3. Shelf- life of onion has reduced due to overuse of urea this year

4. Most of the crop was affected by Anthracnose or twister bacteria due to the rains and humidity.

Government Initiatives During the Price Increase

1. Banning Export (September 14): When the Government observed the prices to be increasing in the August, it has banned the export of onions. But even after the ban, the produce continued to rise due to the lack of supply.

2. Relaxation of Import norms (October 21): Government undertook a bold step by reducing the import duties to allow easy shipping of onions from Iran, Turkey and other onion producing countries.

3. Reintroduced stock limit (October 23): The Government has imposed a stock limit on the onion. Through this limit, the wholesaler could only stock up to 25 tonnes and retailers could stock up to 2 tonnes.

These were the short-term solutions laid by the Government to control the prices. But it has not shown any positive results. The price corrections can only happen when the new crop arrives in the market. This may happen after November.

Long-term Solutions for Reducing the Prices

Onion prices can only be controlled when the policies are revised and new measures are implemented. Some of the solutions are:

1. Developing better storage structures for storing produce for the long term.
2. Increasing the processing of onions by converting them into onion paste, onion powder, onion flakes.
3. Determining MSP for onion.
4. Encouraging farmers to grow onions on a large scale by providing subsidies, strengthening the procurement process and provision of better prices to the farmers.
5. Weather forecasting beforehand so that farmers will take proper measures.
6. Determining the demand-supply scenario and taking the measure in advance like signing for the imports, banning exports.
7. Low-cost technology in onion farming should be implemented like in Israel and Brazil.

Onion is the most needed vegetable whose absence can be spotted clearly. No dish is complete without onion. Year after year, onion is showing a spike in its price and becoming a concern for the government, farmer and the common man. To curb the shortage and drop the prices, every year the Government bans the exports and increases the imports during the time of the crunch. Long term solutions must be laid to control the prices. Policy makers should work on framing better policies for improving infrastructure, encouraging farmers to grow the crop by providing subsidies and importing initially before the prices hike.

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Speed Breeding to Accelerate Crop Research

Article ID: 32749

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Introduction

To respond faster to the changing climate, evolving pathogens and to feed a global population of 9-10 billion by 2050, plant breeders are exploring more efficient crop improvement strategies. Recent advances in genomic tools and resources and the decreasing cost of sequencing have enabled plant researchers to shift their focus from model to crop plants. Despite such advances, the slow generation times of many crop plants continue to impose a high entry barrier.

Speed Breeding for Long Day Crops

This technique uses prolonged photoperiods to accelerate the developmental rate of plants, and harvesting and germination of immature seed, thereby reducing generation time. Now six generations per year can be achieved in spring wheat (*Triticum aestivum*), barley (*Hordeum vulgare*) and chickpea (*Cicer arietinum*) and 4 generations for canola (*Brassica napus*) (Fig.1). The method accelerates plant development for research purposes, including phenotyping of adult plant traits, mutant studies and transformation. High-throughput phenotypic screening for multiple traits and rapid trait introgression of important genes have been successful under speed breeding conditions as shown for grain dormancy, stripe rust (*Puccinia striiformis*) and leaf rust (*Puccinia triticina*) in bread wheat. In chickpea, it is now possible to produce up to seven generations per year. This method has a great potential for integration with other modern crop breeding technologies, including high-throughput genotyping, genome editing and genomic selection, accelerating the rate of crop improvement.

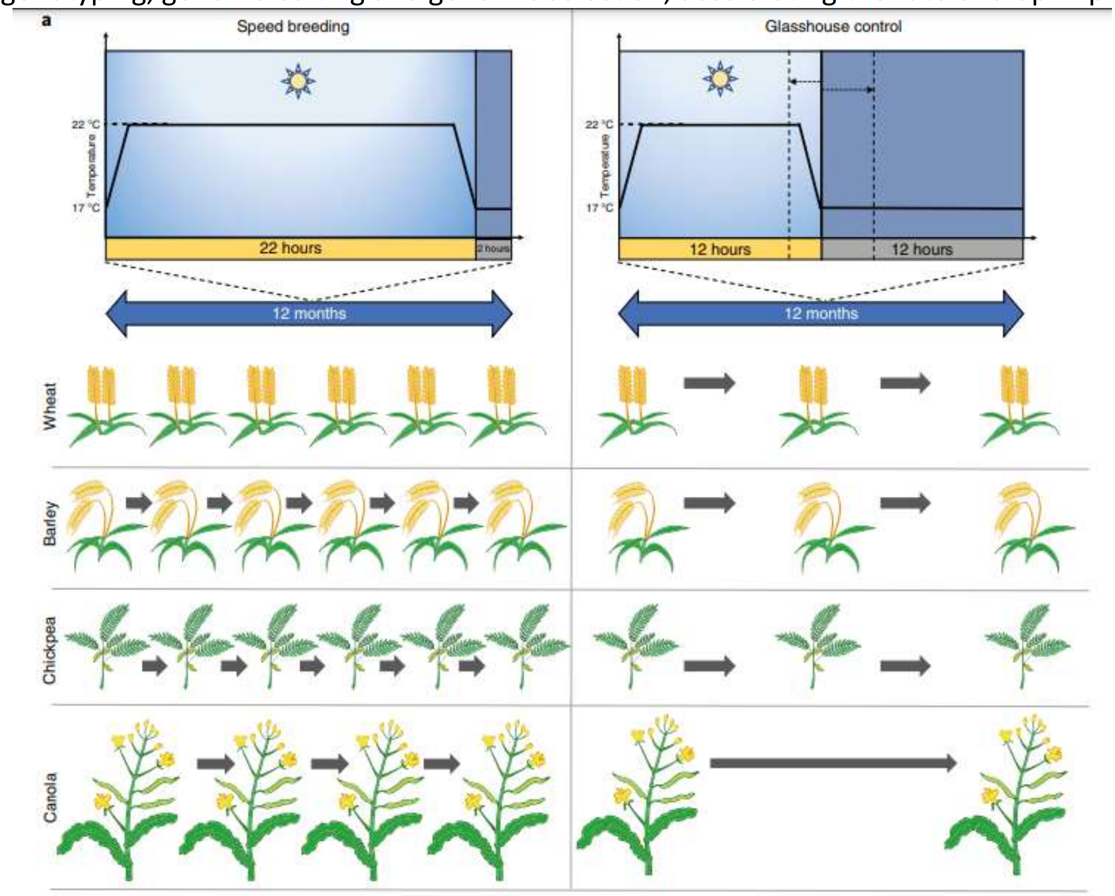

Figure 1. Speed breeding accelerates generation time of major crop plants for research and breeding

Speed Breeding for Short Day Crops

The speed breeding method was originally developed for the long day crops, however, recently it was demonstrated on best-characterised elite Japanese soybean cultivar "enrei" in a compact growth chambers with CO_2 supplement. The method utilizes commonly used fluorescent lamps (220 mmol m^{-2} s^{-1} at the canopy level), a 14 hours light (30^oC)/10 hours dark (25^oC) cycle and carbon dioxide (CO_2) supplementation at >400 p.p.m. The CO_2 supplementation improves the growth and development of plants in the growth chamber, and the reaping and sowing of immature seeds greatly shortened the generation time further. The generation time was shortened from 102– 132 days reported in the field to just 70 days, thereby allowing up to 5 generations per year instead of the 1–2 generations currently possible in the field and/or greenhouse (Fig.2). The light quality plays an important role for growth and development of plants under controlled environmental conditions which has been exemplarily demonstrated in short-day crops soybean (*Glycine max*), rice (*Oryza sativa*) and amaranth (*Amaranthus spp*.). Adjusting the photoperiod to 10 hours and using a blue-light enriched, far-red-deprived light spectrum facilitated the growth of short and sturdy soybean plants that flowered ~23 days after sowing and matured within 77 days, thus allowing up to five generations per year. Contrary to soybean, rice and amaranth flowered earlier under far-red light conditions than under far-red deprived lighting schemes. The study highlighted the need for crop-specific lighting schemes that can speed up the time to flowering and maturity and might be utilized to improve germination.

Figure 2. Schematic representation of the method for accelerating breeding in a growth chamber supplemented with CO_2.

Conclusion

Combining genetic tools and resources with speed breeding will provide a strong incentive for more plant scientists to perform research on crop plants directly, thus further accelerating crop improvement and research. Owing to the specificity of the LEDs, this system can also be used to dissect the interaction of specific wavelengths and the plant's physiological responses.

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Nutritional Benefits of Various Nuts and Dry Fruits: The Natural Energizers

Article ID: 32750

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Introduction

Nuts and dry fruits are full of nutrients that provide multiple health benefits to all. Those are underweight or in sports activities must have a minimum 50gm to 100 gm either early morning at empty stomach or day time in a mixture preferably water-soaked or dried. Some people may like to consume in the afternoon, serving within 3-4 pm (after lunch) or adding desserts. Students or sports personnel before or after practice/work out must have these to sustain their energy through a fair number of calories available in the nuts and dry fruits. Apart from nutritional benefits, nuts and dry fruits provide a satiety feeling and a great sense of taste cum flavor that smoothly accelerate the whole digestion process. The various studies show that process takes 2-3 hours on average each.

Almond: Almonds are very high in protein, potassium, zinc, and other vital nutrients. They altogether contain photoprotective constituents. The fatty acids from almonds play an essential role in reducing the risk of cardiovascular disease (CVD) and control blood cholesterol. Almond also rich in fiber, i.e., 12 gm per 100 gm edible content and other micronutrients. They are rich in phytosterols and phenols. Apricot: Apricot contains phytochemicals, catechins, chlorogenic acid, and beta carotene. Apricot is a traditional dried fruit often added in the dry fruit's mixtures and highly beneficial for skin, bone, gut, and eye health. It is one of the powerful antioxidants due to PUFA, MUFA, and the right amount of potassium, magnesium, zinc, calcium, manganese, boron, amino acids, carotenoids, and xanthophylls.

Brazil nuts: These are rich in selenium, which is good for thyroid health. Further, they are beneficial in cancer, heart disease, infertility, and infections. They control cholesterol levels and reduce CVD.

Cashew nut: There are so many beneficial effects such as hypertension, inflammation, including cancer. Some studies show that cashew nut consumption has a cholesterol-lowering effect in Indian and western diet equally. There is also significant evidence of beneficial effects on oxidative stress.

Cherry: As per some studies, eating cherry fruit may decrease the markers for oxidative stress in 8 out of 10 reviews. The study showed that inflammation was reduced in 11 out of 16, and exercise-induced muscle stiffness cum loss of energy was found in 8 out of 9. Cheery fruits are also helpful in lowering blood pressure, arthritis, and improving sleep. A study showed that cherries could decrease hemoglobin A1C (HbA1C) in diabetic patients, control very-low-density lipoprotein, and the ratio of triglycerides/high-density lipoprotein among diabetic urban-based women in the tropical regions.

Chestnuts: They are good sources of manganese, molybdenum, copper, and magnesium. The nuts are gluten-free, so help in IBS and contribute brain functions, management of cholesterol, and energy.

Coconut: The item is such a wonder food may call nut, seed, and fruit, all three in one. Coconut helps in anemia, healthy brain, skin, and bone functions. Coconut provides enough energy in many recipes. Dates: Dates are potent antioxidant, anti-tumor as well as an anti-inflammatory agent. Dates fruits have medicinal values that can manage tumors, cancer, diabetes, inflammatory activities, and growth in the human body. In a country like India, Bangladesh, dates are used to worship God and Goddesses or other recipes. In SAARC countries, dates are trendy among all.

Hazelnuts: They are full of nutrients, a potent antioxidant, anti-cancerous, and control blood sugar levels. The nuts are well-protector of heart by managing LDL and TGL, and rich in all minerals. Macadamia nuts: contain just over 1 g of natural sugar, hence safe for diabetic patients. The nuts are beneficial for cardiac, obese, and other metabolic syndrome patients. They are the wealthiest sources of palmitoleic acid, monounsaturated fat, which is also called omega-7.

Peanuts: They are good sources of potassium, phosphorous, magnesium, and B vitamins apart from protein. They control healthy weight, heart, skin & hair. So, protein and fat provides dual benefits. Pecans: Pecans are very good for protecting brittle hair, hair loss, along hair growth. Anti-aging and total antioxidant benefits apart from strong immunity-boosting effects are remarkable to all.

Pistachios: They have a lower fat content (43 g/100 g), which is a combination of saturated fatty acid (SFA-5.6 gm), polyunsaturated fatty acid (MUFA-13.0 gm), and monounsaturated fatty acid (MUFA- 24.5 gm). In addition to all helpful fatty acids, oleic and linoleic acids are also present. Pistachios offer one of the best vegetable proteins (about 21.5% of total weight) and some essential amino acid. They are also a rich source of lutein and xanthophyll carotenoids as pigments and some phenolic compounds such as proanthocyanidins, anthocyanins, and flavonoids as powerful adjuvants. Raisins: These are rich with 70% sugar (fructose and glucose). It has no sodium or vitamin C, still one of the best antioxidants among dry fruits. They provide good functioning on the digestive system and the control of blood pressure, reduce the risk for cancer cell malignancies in the G.I.

Soy nuts: They are rich in protein, fiber, fatty acids, and isoflavones. Soynuts are very helpful in osteoarthritis, total bone, and cartilage health. Except for an allergic person, soy recipes are trendy.

Walnuts: Walnuts contain several potentially neuroprotective compounds like folate, vitamin E, melatonin, several antioxidative polyphenols, and adequate amounts of omega -3 fatty acids. Walnuts are highly beneficial for diabetes -II, gallstones, and weight gain for underweight people. Further, these are helpful in obesity, visceral obesity, coronary heart disease, hypertension, metabolic syndrome, various tumors, including total mortality.

Table.1. Nuts and Dry Fruits: Facts, Digestions and Health Benefits

Sl.	Names of Fruits/Nuts	Scientific Name	Kcal/ 100gm	Best time	Digestion Time	Health Benefits
1	Almond	*Prunus amygdalus*	610	Morning/afternoon/ various desserts	2.30 hr	Phytosterols and antioxidants control LDL.
2	Apricot	*Prunus armeniaca*	48	Early morning/ afternoon/ desserts	2.45 hr	Heart-protective, digestion, high energy, Potent antioxidant.
3	Brazil nuts	*Bertholletia excelsa*	656	Raw or roasted in snacks	2.45 hr	Heart disease, infertility, infections.
4	Cashew nut	*Anacardium occidentale*	583	Early morning /afternoon/ with desserts	3.15 hr	Hypertension, inflammation, including cancer, vascular reactivity.
5	Chestnuts	*Castanea dentata*	188	Any time/ in various recipes	2.45 hr	Gluten-free that help in digestive health, brain

						functions, antioxidant.
6	Cherry	*Prunus cerasus*	60	Any time/ with betel leaf/ desserts	2.00 hr	Control HDL & LDL ratio, muscle relaxant, helpful for diabetic patients.
7	Coconut	*Cocos nucifera*	660	Various culinary uses, desserts, ritual	2.30 hr	Promote healthy brain function, prevents anemia.
8	Dates	*Phoenix dactylifera*	321	Afternoon/ with desserts/rituals/ occasional/sports	2.30 hr	Anti-inflammatory, antioxidant, and anti-tumor activity.
9	Hazelnuts	*Corylus avellana*	628	Morning Water-soaked/ Milk form	3.15 hr	Antioxidant, anti-cancerous, control blood sugar.
10	Macadamia nuts	*Macadamia integrifolia*	718	Raw/roasted-any time/various recipes	3.15 hr	Helpful for cardiac, obese, and other metabolic syndrome patients.
11	Peanuts	*Arachis hypogaea*	567	Any time/ afternoon/Occasional	3.15 hr	Control healthy weight, heart, skin & hair.
12	Pecans	*Carya illinoinensis*	700	Many recipes, cheese, salad or in desserts	2.45 hr	Protecting brittle hair, hair loss rather helps hair growth.
13	Pistachios	*Pistacia vera*	540	Early morning/ afternoon/ desserts/ any time within dry fruits or nut mixtures	2.30 hr	Diabetes and other metabolic syndromes, weight control, CVD

						& cholesterol management.
14	Raisins	Vitis vinifera	297	Mixed with dry fruits/added in dessert	2.00 hr	Reduce malignancy of stomach, colon, Low G.I.
15	Soy nuts	Glycine max	471	Various recipes/Snacks	3.00 hr	Osteoarthritis, total bone and cartilage health.
16	Walnuts	Juglans regia	672	Early morning/afternoon/ with desserts	3.00 hr	Helps in gallstones, weight gain for underweight people. Useful in obesity, visceral obesity, CHD, metabolic syndrome.

Conclusion

Nuts and dry fruits are prevalent worldwide for all types of people. Students and sportspeople positively love to eat these due to high nutritional benefits. The significant number of calories also compensates for their instant energy by protein, multivitamins, and other micronutrients. Pregnant and lactating mothers often enjoy contoured structure, crunchy texture cum mind-blowing taste, and fantastic health benefits during gestation periods. Nuts and dry fruits can be consumed in the early morning or any time duly water-soaked or just instantly because of easy and quick digestion within 2-3 hours without any digestive complications. They have raw or roasted forms and versatile culinary uses, including dessert preparation, to raise better flavour and nutritional benefits. Nuts and dry fruits have uncountable health benefits in the human body on the heart, brain, skin, hair, cholesterol, muscles, and bone because of so many essential biochemical compounds. Overall, they are potent antioxidants cum anti-inflammatory agents and all-time natural energizers.

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The Second Green Revolution: An Innovative Contribution to Food Security and Sustainability

Article ID: 32751

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Introduction

The Green Revolution obtained through a sequence of scientific breakthroughs and developmental activities such as use of high yielding varieties with superior genetics, quality seeds, inorganic fertilizers, chemical based pesticides and herbicides, multiple cropping system, modern farm machineries, proper irrigation system etc., has been able to improve agricultural productivity; change the thinking of farmers; successfully fight against hunger, poverty and malnutrition; increase in trade; develop various industries; generate rural employment and provide food, livelihood and income security while endangering the natural resource base as well as environmental sustainability. The 'First Green Revolution' predominantly grounded on the cultivation of semi-dwarf high yielding cultivars of rice and wheat mainly, expansive use of irrigation, fertilizers and agro-chemicals, was witnessed during early 1970's which emanated with enormous growth and productivity enhancement in addition with a discrete deceleration in agrarian growth rate since middle of 1990s (Pingali, 2012; Shiva, 1993). Later on, the crop production level had displayed a plateau condition adversely affecting the livelihood of farming community and the availability of arable land declined due to urbanization thereby strengthening upon the only way out i.e. increased productivity route. Consequently, there was and is still space for improvement which led to the advancement of the technologies already utilized in green revolution and continued invention of modern practices by several organizations including system of rice intensification (SRI), marker assisted selection, agro-ecology and many other viable options. The modernization efforts for agricultural sector by the nation is constrained by innumerable factors such as urban-rural income gap, integration of smallholders into value chains, maintenance of competitiveness in markets, chronic poverty and hunger etc. As per the estimates or future projections, the global population will rise by one third and 70% increase in food production will be documented by the end of 2050. In this context, the 'Second Green Revolution' will favorably concentrate upon the improved tolerance of cultivated crops to dreadful insect pests and diseases along with the betterment of technological input use efficiency. Notwithstanding, a significant framework for 'Second Green Revolution' aligning itself with the sustainable development principles is precisely articulated and completely appreciated to facilitate all the stakeholders for contributing towards the passionate intentions in a collaborative association in a world that encounters unfamiliar hindrances and is more sensitive to the sustainability concerns.

What is 'Second Green Revolution'?

The 'Second Green Revolution' is referred to as an alteration in the conventional agricultural production practices which are popularly accepted as necessary means to feed and sustain the ever-increasing population throughout the globe. To encounter this revolutionary change, smallholder farming must be more productive and profitable imposing a gigantic influence on hunger, nutrition and poverty; drought, flood and pest disease resistant crops should be developed resulting into greater yield even in harsher weather; small and marginal farmers should be given more importance; productivity within limits of natural resources must be sustained along with increased production; integrated management practices taking care of all aspects of cultivation from soil properties, quality seeds, grains, conversion to food and its marketing after value addition should be well envisaged as well.

Emerging Technologies and Innovations

1. Information Technology can generate awareness among farmers by introducing them with cost effective methodologies and act as a support system which can address various information deficiencies of farmers.

2. Nanotechnology or the science of miniature is the newfangled buzzword in technological discoveries in almost every aspect of economical lives of 21st century where nano-materials of 5,000 to 50,000 times smaller than a human hair are utilized very actively and aggressively in any type of chemical reaction.
3. Bio-technology is designed to improve the genetic traits of crops, by making them drought, flood, pests, weeds, diseases as well as climate resistant.
4. Application of bio-pesticides, bio-herbicides and bio-fertilizers trigger this revolution.
5. Organic farming aims at cultivating land and raising crops in such a way so that the soil is maintained alive and in good health by using different types of organic wastes like crop, animal and aquatic wastes along with beneficial microbes to release nutrients for sustainable production in an eco-friendly environment.
6. Other vital options are micro-level land use planning and management, resource recovery and reuse, sustainable water management, multiple stress tolerant/improved crop varieties etc.
7. Adoption of integrated farming systems, bio-fortification, genetically modified food, climate resilient/smart practices, integrated nutrient management practices for dominant cropping systems, GIS based soil fertility maps for precise and balanced fertilizer use is essential.
8. Conjunctive use of chemical fertilizers, organic manures and bio-fertilizers should be done, fortified/ neem coated and customized fertilizers with micro and secondary nutrients must be promoted, on-line soil test-based fertilizer recommendation packages need to be encouraged.
9. Space technology and Information and Communication Technology (ICT) in irrigation management; dialogic tools for linking canal operation and on-farm water management; innovative ways of managing canal water through public private partnership (PPP), service providers, farmers' company or federating water users' associations (WUAs) into a private company should be prioritized.
10. A new approach termed as 'precision agriculture' needs to be brought under limelight as it can help the farmers to make the most efficient use of vital inputs such as water and fertiliser by applying them in precise amounts if harnessed appropriately. The right kind of nutrients for a specific soil area needs to be applied, at the right rate, at right time and in right place for optimal soil health which is called the '4Rs' or nutrient stewardship.
11. Some significant means for achieving the goal includes advancement of pressurized irrigation/micro-irrigation (drip and sprinkler); improvement of conveyance and distribution system of irrigation network; canal supply and demand management through automation; improved on-farm water management; laser land levelling, zero-tillage and resource conservation technologies; promotion of watershed management; location specific groundwater recharge; conjunctive use of good and poor quality groundwater/wastewater.
12. Hydrogel technology is important for areas with limited water availability which improves physical properties of plant growth media and seed germination; helps the plants to withstand prolonged moisture stress; reduces irrigation and fertigation requirements of crops, increases yield and net returns also.
13. Second Green Revolution focuses on employment generation and sustainable livelihood especially for small and marginal farmers along with increased agricultural production in unirrigated areas or degraded lands which can be profitably used for establishment of agro-forestry to withstand the vagaries of nature without sustaining heavy losses.
14. Women empowerment through drudgery reduction; undertaking community health care, nutritional and educational programmes and training in various skills is the pre-requisite to boost agricultural production.

Flagship Schemes

1. Mission for Integrated Development of Horticulture (MIDH)
2. National Horticulture Mission
3. National Bamboo Mission
4. Rashtriya Krishi Vikas Yojana
    a. Bringing Green Revolution to Eastern India (West Bengal, Bihar, Orissa, Assam, Chhattisgarh, Jharkhand and eastern Uttar Pradesh).
    b. National Saffron Mission.

c. Accelerated Fodder Development Program.
d. Promotion of nutri cereals and oil palm.
e. National Mission for protein supplements.
f. Rainfed Area Development program.
g. Crop diversification in original green revolution states.

5. National Mission for Sustainable Agriculture.
6. National Food Security Mission.
7. Integrated Scheme for Oilseed, Pulses, Oil Palm and Maize (ISOPOM).
8. Technology Mission on Cotton.
9. Pradhan Mantri Krishi Sinchayee Yojana.
10. Kisan Vikas Patra.
11. Soil Health Card.
12. e-National Agricultural Market.
13. Paramparagat Krishi Vikas Yojana.
14. Rashtriya Gokul Mission.

Conclusion

In spite of rapid industrialization and urbanization due to burgeoning population day by day, the agrarian sector holds the mainstay or most promising position of our economy which contributes almost 20% of the Gross Domestic Product and provides employment opportunities to 65-70% of country's total population as well as accounts for approximately 14% of total export earnings, besides providing raw materials to a large number of industries. To achieve the growth rate of about 8-9% of the economy, it is mandatory to sustain at least 4% agricultural growth for which a 'Second Green Revolution' is urgently required. Through ushering the 'Second Green Revolution' by Ministry of Agriculture, Indian agriculture can be transformed into sustainable and commercial farming from conventional or subsistence farming that would enable the cultivators to convey informed decisions and undertake appropriate arrangement of products in a demand-driven rather than supply-driven mode with the objective of strengthening food security in the country.

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Concept of Watershed Management and its Benefits

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Introduction

The elementary reason for poverty, hunger, malnutrition, food insecurity and marginalization in rural areas particularly in rainfed regions is inadequate crop and livestock productivity conjugated with degradation in the quality of land and several important natural resources. Consequently, any attempt designed for rural development and poverty abatement has to approach the issues interconnected with the preservation and administration of those vital resources and augmenting the land and water productivity by the means of numerous packages of practices which requires multifunctional, multi-layered, inter sectoral, embracing and extensive endeavours in an amalgamated procedure. This approach includes socio-economic, institutional and biophysical interrelationships among soil, water and land use and the connection between upland and downstream areas (Ffolliott et al., 2002). In this context, the natural resource management within the physical boundary of a watershed is the most important principle and the watershed is considered as the basic organizing unit. In essence, the conception of watershed management dates back to 2000 BC (Zheng, 2004; Chen, 2007), and it has constantly recuperated and advanced over time. Thus, watershed management implies the preservation, regeneration and sagacious/judicious utilization of all the natural resources viz. land, water, vegetation, animals and humans within the watershed depending on the topography, type of soil, available biomass and water thereby calling for an urgent adoption of an integrated management approach, which can be better emanated within a natural domain such as the watershed. Notwithstanding, a watershed is a complicated, congenital/natural and vigorous operational component established by physical relationship and social communication and activities that empowers the designer and administrators as well as implementing agencies to take into account the inputs, processes and anticipated outputs consistently which are crucial for a holistic developmental technique. In a developing country like India, where the greater number of citizenries is employed in livelihoods most probably dependent on the natural resources essential for agriculture, different aspects such as quality and accessibility to those components possess a decisive responsibility in impacting the earnings by households. Additionally, in this situation, watershed development and management practices can perform a binary role of natural resource conservation as well as livelihood enhancement along with maintenance of ameliorated soil properties, improved water availability facilitating higher crop production and fodder for livestock, which consecutively boosts income of the community engrossed in such type of occupation.

What is a Watershed?

The word ‘watershed’ was acquainted in the year 1920 which denotes the ‘water parting boundaries’ and is referred to as a geo-hydrological unit which provides runoff to a common outlet by a system of drains. It is a region of land and water confined by a drainage partition within which the overflowing of local surface water is collected and also flows out through a single discharge point into a large river or stream. All tracts of land on this planet are a portion of one or other watershed, besides each and every water body such as rivers, lakes, ponds, streams, estuaries etc. contains a watershed. The technology is mainly suitable for rainfed regions where millions and millions poor small and marginal farmers depend upon deteriorated land and water resources and try to confront with a diversified array of agro-climatic, productivity and marketing hazards.

Watershed is delineated or categorized based on the size, drainage, shape as well as land use pattern.
1. Macro watershed (> 50,000 hectare).
2. Sub-watershed (10,000 to 50,000 hectare).
3. Milli-watershed (1000 to10000 hectare).
4. Micro watershed (100 to 1000 hectare).

5. Mini watershed (1-100 hectare).

What is Watershed Management?

Watershed management is characterised by the judicious utilization of all the natural resources like land, water and vegetation in an area to furnish a solution for alleviating droughts, floods, soil erosion as well as other moderate ecological hindrances with effective engagement of several institutions, organizations and participation of common people maintaining a synchronised harmony with the ecosystem to improve water availability, conserve soil and water resources and enhance food, fibre, fuel, fodder, fruits, flowers, timber etc. on sustainable basis. The principal objective of watershed management is to obtain maximum production level with minimal disturbance to the natural resources and contribute to the wellbeing of farmers, community and society as a whole. The watershed management implies the study of various pertinent attributes of a watershed anticipated for sustainable allocation of its resources and the procedure of constituting and enforcing plans, programs and projects to endure and amplify the functions of watershed as well as implementing land use and water management practices to safeguard and augment the excellence of water and different natural resources by applying the most appropriate biological and engineering methodologies in a comprehensive fashion which influence plant, animal and human communities within the physical boundaries of a watershed in such a way that the administration must be economically viable, ecologically stable and socially justifiable. It is an adaptable, all-inclusive foundation for decision making and consolidated framework for multiple resource management which has an ability to counterbalance the vigorous environmental, financial, and cultural or social characteristics for assessing the property and condition of the watershed; diagnose watershed issues; determine and re-estimate short and long term intentions, operations and ambitions; evaluate advantages and expenditures; and employ and assess activities by taking into account both ground and surface water flow, distinguishing and designing for the interaction between water, plants, animals and human beings.

Why is Watershed Management Important?

1. Watershed management serves as an efficacious measure for controlling pollution of water and various natural resources after identification of diverse types of pollutants and their transportation mechanisms, and for recommending solutions for elimination of pollution sources.
2. It is significant as the planning procedure leads to a partnership among all the affected parties in watershed that is quite mandatory for successful administration of land and water resources and also acts as an effective means to prioritize the implementation of those activities in case of limited resources.
3. It helps to control the adverse effect of surface runoff and land degradation, conserve soil and water and also minimize the over exploitation of useful resources.
4. Watershed management can manage and utilize the runoff water for useful purposes, rehabilitate the deteriorated lands and increase infiltration and percolation of rainwater thereby improving water storage.
5. Watershed management may safeguard, preserve and ameliorate lands for effectual and sustainable productivity of food, fibre, fuel, fodder etc.
6. It has the capability to secure and intensify water resources emanating in the watershed regions and to moderate the deleterious effects of floods at downstream areas.
7. It can check soil erosion; decrease the impact of sedimentation on watersheds and enhance the ground water recharge to provide regular water supply for consumption, domestic and industrial purposes as well as irrigation, wherever applicable.
8. Watershed management improves and increases the production of timbers and quality of wild life resources or helps in wild life preservation as well.
9. It can be very much remarkable in terms of recreational facility and employment and income generation through industrial development like dairy, poultry, fishery etc.

Components of Watershed Management

The three main components are (a) Land management, (b) Water management and (c) Biomass management.

1. Vegetative measures/Agronomical measures

a. Strip cropping and pasture renovation.
b. Grassland farming and woodlands.
c. Vegetative barrier and establishment of permanent grass and vegetation.

2. Engineering measures/Structural practices

a. Contour bunding and bench terracing.
b. Construction of earthen embankment, gully controlling structures and diversion.
c. Construction of farm ponds, check dams, rock dams and percolation ponds.
d. Stone barriers and micro catchments.
e. Construction of silt tanks and broad beds and furrows.

Conclusion

The essential approach of watershed development rely upon generative planning in addition to a participatory bottom-up technique with an objective to evolve a context oriented ground-plot for accomplishment; empowerment and engagement of the nation through the formation and amplification of local level organizations; safekeeping and arrogate/appropriate management of natural resources by the means of aggregated improvement of the watershed; maintenance of sustainability because of people's contribution, voluntary assistance, invention and acceptance of a withdrawal blueprint for post endurance of this project. To forge this operation successful, it is very much momentous for the community to move forward and cooperate in designing, commencement and implementation of location specific developmental movements like soil, water and biomass conservation practices which is the key to supervise and endure the assets fabricated under the watershed management project for the purpose of community development. Nevertheless, a close connectivity is observed between human beings and environment and any alteration in the ecological situation can hamper the livelihoods of the nation directly for their subsistence. Accordingly, it is furthermost considerable to deal with the environmental deterioration efficaciously for the comprehensive outgrowth by focusing on the issues of human development in addition to the capacity building of stakeholders in the direction of origination and maintenance of assets which are vital for securing the sustainability of a watershed.

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Crop Ideotype: A Road Map to Tussle with Climate Change

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Introduction

Since the late 1960s, global production of cereal grains has doubled owing to the great success of green revolution, which created high yielding varieties throughout the world. The negative impacts of climate change resulted in certain dwindling effects in the crop production (USGCRP, 2009). Climatic and environmental changes emphasized the need of a multi-disciplinary approach including breeding strategies that deliver both substantial increase in yield potential and resilience to extreme weather events. This can be exemplified from the great success of green revolution in which tall, low yielding, traditional cultivar is made into high yielding one by modifying the plant architecture into short statured by incorporating dwarfing genes into it.

Crop Ideotype

The concept of ideotype was proposed by Collin Malcolm Donald, an agronomist in 1968 while working in wheat. An ideotype is an idea- type, i.e., the idealized envisioned appearance that it is desired. A crop ideotype is an idealized plant type with a specific combination of characteristics favorable for photosynthesis, growth and grain production based on the knowledge of plant morphology, physiology and breeding (Donald, 1968). According to Donald, an ideotype is a biological model which is expected to perform in predictable manner within a defined environment.

Classification of Ideotypes

1. Isolation ideotype: It is the model plant type that performs best when the plants are space – planted. In case of cereals, isolation ideotype is a lax, free tillering, leafy spreading plant that is able to explore the environment as fully as possible. It is unlikely to perform well at crop densities.

2. Competition ideotype: This ideotype perform well in genetically heterogeneous populations. In case of cereals, competition ideotype is a tall, leafy, free- tillering plant that is able to shade its less aggressive neighbours and thereby, gain a larger share of radiation, nutrients and water.

3. Crop ideotype: The crop ideotype performs best at commercial crop densities because it is a poor competitor. The concept of 'week competitor' is the central theme of this ideotype. It performs well when it is surrounded by plants of the same form, and also in isolation.

Steps in Ideotype Breeding

Ideotype breeding may be viewed as consisting of the following four steps:
1. Development of a conceptual theoretical model, i.e., ideotype.
2. Selection of base material.
3. Incorporation of desirable characters into single genotypes.
4. Selection of ideal or model plant type.

Ideotypes for Major Crops

Irrigated wheat (Donald, 1968)

a. Short strong stem which prevents the plants from lodging and would reduce the amount of photosynthates invested in stem production.
b. Erect leaves will provide better arrangement for proper light distribution resulting in high photosynthesis or carbon dioxide fixation.

c. Few small leaves allow deeper penetration of light and reduces the loss of water through transpiration.

d. Large and erect ear will produce more grains per ear by many florets per unit of dry matter of the whole of the plant tops. An erect ear is adopted in the belief that the best illumination of all sides of all ears will be attained in a community of erect ears.

e. Presence of awns: The additional surface provided by awns will contribute significantly to photosynthesis by the cereals and act as an assimilating organ which contributes more than 10 per cent of the total grain dry weight.

f. Single culm reduces the investment and competition to photosynthates than a multiculm species.

Non- Irrigated wheat (Asana, 1969): It should contain high percentage of fertile grains with long peduncle. Horizontal leaves will hold more amount of water long time and it can effectively collect the dew and make it available during the moisture stress period. It should also have a deep root system to absorb more water from the deeper layers of soil to support plant life. Opportune time of ear emergence indicates the time of emergence of ear should be at a time when the grains are exposed to 25oC for five weeks. So that, chilling stress and high temperature stress can be avoided.

Rice

The concept of rice plant type was first introduced by Matsushima in 1957, and later by Jennings in 1964. In 1969, Chandler proposed the ideotype for dwarf stature rice. The proposed ideotype for rice includes shorter culm length (100 cm or less), greater culm diameter, which increases culm strength, lower relative internode elongation under heavy nitrogen application, short erect leaves of medium width, high tillering capacity since this does not reduce yield potential in rice, more panicles per m2and with high harvest index (55% or more) (Jennings, 1964). Erect leaves provide better arrangement for proper light distribution resulting in high photosynthesis or carbon dioxide fixation (Tanaka et. al., 1966) than droopy leaves. In a canopy of long horizontal or drooping leaves, the upper leaves will be over lit and the lower leaves will be harmfully shaded.

Rice Ideotype for Drought

Chaudhary and Rao (1982) proposed an ideotype of rice suitable for drought conditions. They suggested an ideotype with intermediate height and having a high root- shoot ratio of short duration. They should have a synchronous flowering habit with more panicle weight type. Deep, thick and long roots are another feature of this proposed ideotype. Rapid buildup of leaf area index and slow leaf senescence with thick, erect or moderately droopy leaves are also the preferred characteristics for this ideotype.

Ideotype for Rice Under Flooded Condition

Dingkuhn et. al., (1991) suggested a new plant type for flooded conditions having larger panicles and flag leaves, improved seedling anchorage, reduced tillering ability, longer life span and higher sink capacity. For flooded condition, floating rice is best because it can elongate with the rise of water levels and can develop tillers and roots in its roots. Kneeing, the bending of terminal panicle is another feature of floating rice and thus it keeps the reproductive organs above the water surface and it can establish after the water recedes.

Maize

1. Stiff, vertically- oriented leaves above, and horizontally oriented leaves below the ears.
2. Maximum photosynthetic efficiency so that, selection for high photosynthesis rates and efficient translocation of photosynthates into grain in maize seems possible.
3. Short interval between pollen shed and silk emergence: This is important because higher planting densities lengthen this interval.

4. Ear- shoot prolificacy- more than one cob per shoot. In maize, limited sink strength of developing ear is considered as one of the greatest limitations to efficient conversion of photosynthates to grain. Prolificacy would increase sink strength.
5. Small tassel size: small tassels would show lower competition for nutrients with the developing ear as well as less shading of the upper leaves.
6. Photoperiod insensitivity: adequate genetic variation is available in maize for this trait.
7. Cold tolerance of germinating seeds and developing seedlings
8. Grain filling period should be as long as practically possible.

Cotton

Ideotype for rainfed cultivation:

a. Plant of short stature (90- 120cm) and short duration (150- 165 days).
b. Compact and sympodial plant habit making pyramidal shape.
c. Determinate fruiting habit with unimodal distribution of bolling.
d. High degree of interplant competitive ability and resistance to insect pests and diseases.

Ideotype for irrigated cultivation:

a. Short stature (75- 80cm) and compact plant habit.
b. Intermediate growth habit with at least two monopodia.
c. Few smaller and thick leaves with spares hairiness.
d. Medium to big boll size with synchronous bolling habit.
e. Responsive to nutrients and high degree of resistance to insects and diseases.

General Plant Ideotype Concept in Pulses

An ideotype of pulses in general prefers determinate and erect plant type which shows early flowering and synchronous maturity. The plant should have a greater number of seeds per pod and more pods per plant. It should be freer from anti- nutritional factors compared to that of traditional varieties.

Chickpea: Traditionally, chickpea was short stature and bushy and are not suitable for mechanical harvesting and similarly, suitable plant type with upright and more primary branches are lacking. Hence, tall plants with stiff stem and more effective fruiting branches are preferred for chickpea cultivation. Plant types for chickpea also varied according to the cultivating condition.

The ideotype for chickpea under irrigated condition was proposed by Dahiya and Lather in 1990 and includes determinate and erect plant type with tall stature, early flowering and synchronous maturity, long fruiting branches and pod bearing should be from 20cm above the ground ,so that, mechanical harvesting can be made easy.

Black Pepper: Black pepper ideotype should have acute branch angles (450) at the top and wider branch angles at the bottom (600). The fruiting branches should be well spread from top to bottom of the canopy. To harvest maximum light especially by the bottom canopy, the leaf angle should be more at the bottom (130-1400) compared to the top (100-1100). It is desirable that within a branch, the bottom leaves have lengthier petioles than the top leaves.

The vine should have a high photosynthetic rate (minimum of 3.0–3.5 µ moles), more than 90% bisexual flowers with >95% self-pollination, increased spike length (≥12 cm) and a greater number of berries spike-1 (≥70). Fruit set should be ≥80% and should yield at least 2.5–3.0 kg dry berries vine-1 (Krishnamurthy et. al., 2010).

Practical Achievements

Great progress has been achieved in China's ''super'' hybrid rice breeding project by combining an ideotype approach with the use of inter subspecific heterosis (Peng et. al., 2008). Development of New Rice for Africa (NERICA) suitable for uplands is another landmark involving the concept of ideotype.

Conclusion

Ideotypes are ideal biological models, which can perform in a particular manner within a defined environment. By modifying the plant architecture and incorporating desirable traits into a particular plant, new plant types can be developed, which better suit the environment and can will perform better in a changing climate. Thus, ideotypes serve as an effective tool for breaking the yield ceiling of crops and efficiently combating the impact of climate change on yield.

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Maturity Standards for Fruits and Vegetables Crops

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Introduction

Diverse agro-climatic regions enable cultivation of a number of fruits, and vegetables, India loses about 25 to 30% of the produce during post-harvest handling and mismatching harvest, with proper maturity of fruits plays a great role, in general, picking of immature fruits results in poor quality, lacking in flavour and taste, which shrivel during storage. Over mature fruits develop soft scald and internal breakdown with poor shelf life. Thus, harvesting of fruits at right maturity is essential to improve fruit quality and minimize post-harvest losses. Maturity may be defined as the attainment of a proper size after which ripening takes place. Ripening means the qualitative changes in fruits after maturity as a result of which it becomes edible.

Methods to Assess Maturity

Chemical analysis: Total soluble solids (TSS), solid to acid ratio, starch and oil content etc. Computation; Days after full bloom, days after pollination, heat units etc.

Physiological methods: Respiration rate, ethylene evolution etc.

Physical means: Ease in peel separation, fruit firmness and specific gravity.

Visual means: Peel colour, fruit size, fullness of fruits.

Maturity Indices for Specific Vegetables

Mango:

a. Change in peel colour on the shoulders.
b. Falling down of some ripe fruits from the tree (tapka).
c. Specific gravity of most of the fruits reaching between 1.01 and 1.02.
d. Number of days taken by the fruit to mature.

Citrus:

a. Development of proper colour, TSS:acid ratio are the best maturity indices.
b. The preferred sugar: acid ratio for sweet oranges is 8.5 to 8.9 and for mandarins between 10.5 to 13.0.
c. For Kinnow mandarin, this ratio should be between 12.1 to 14.1.
d. In Kinnow, colour break occurs much before the maturity, the TSS/acid ratio (12:1 to 14:1) should therefore, be taken as index of maturity.

Banana:

a. Bananas are harvested while fully mature but green and transported to the markets, where these are ripened artificially under controlled conditions.
b. For local markets, the banana should be harvested when the ridges on the surface change from angular to round.
c. Fall of floral remnants, pulp to peel ratio (10:1), pH of fruit (5.2-5.6) etc. are also good harvest indices in banana.

Grape:

a. Grapes ripen only on the vine, so ripening standards are practically applicable for harvesting.

b. Grapes are considered ripe when the fruits have reached the condition of accumulation of sugar and acid contents, which are the best suited for intended use.
c. At harvest, the berries should have attained attractive appearance, good eating and keeping quality and TSS/acid ratio.
d. Heat units are other useful criteria for predicting maturity in grapes.

Papaya:

a. Maturity identification to ensure adequate fruit ripening and good eating quality- major problem
b. For local markets, half-yellow fruits should be harvested.
c. Fruits can also be harvested at the appearance of yellow streaks on the dark green surface.
d. Softness to touch, seed colour, jellyness of seed and the change in latex colour (from white to watery): Other indices.

Guava:

a. Guava is consumed at different stages of fruit growth and development.
b. The recommended optimum stage for harvesting is about 2-3 weeks before attaining full growth.
c. Peel and pulp texture, peel colour, sugar and tannin contents, TSS and titratable acidity, may also be adopted as maturity indices.

Apple:

a. Apple is a climacteric fruit and thus maturity of fruit does not coincide with the ripening.
b. Picking of immature fruits results in poor quality, lacking in flavour and taste, which shrivel during storage.
c. Over mature fruits develop soft scald and internal breakdown with poor shelf life.
d. TSS, ease in separation of fruit from the spur, change in colour from green to pale or red, fruit firmness and DFFB harvest: some reliable maturity indices.

Harvest Criteria According to Edible Plant Part

Fruit vegetables:

Immature fruit: (Legumes, cucumber, squashes, eggplant, peppers, okra). Harvesting is primarily based on size and colour. Maturity is not a real problem unless the harvest is delayed too long and they become over mature.

Mature fruit: (Muskmelon, watermelon, pumpkins, tomatoes, ripe peppers). Harvest index depends on several characteristics and is dependent on the vegetable. Consumed at ripe stage, continue to increase in eating quality if allowed to fully ripen on plant, but little shelf or storage life.

Leafy vegetables: Quality and shelf life are better if harvested slightly immature. The determination of horticultural maturity varies with the commodity, but generally size is the principal criterion.

Floral vegetables: Hand harvested. Head size and development determine maturity of floral vegetables. Floral vegetables include artichoke, broccoli, and cauliflower. Maturity indices vary with commodity. Many of these products can be harvested and marketed at various stages of development.

Maturity Indices for Specific Vegetables

Cauliflower:

a. Sunlight is excluded (blanched) when the curds of the cauliflower are 1 to 2 in. in diameter by loosely tying together the outer leaves above the curd (head) with a string or rubber band.
b. The curds are harvested when they are 4 to 8 in. in diameter and compact, white, and smooth.
c. The head should be ready 10 to 15 days after tying.

Cabbage:

a. Cabbage heads are harvested when the heads feel hard and solid but before they split.
b. The outer leaves should be uniform green or purple color (depending on type).

c. The head is cut 6 to 7 in. below flower heads.

Tomatoes: Tomato fruits are harvested at the required ripeness stage for marketing or consuming, from mature green to fully red stage.

Eggplant:

a. Eggplants are harvested when the fruits are 6 to 8 in. in diameter and their colour is a glossy purplish black or white (depending on cultivar).

b. As eggplant fruits get older, they become dull coloured, soft, and seedy.

Okra:

a. Okra pods are harvested when they are 3 to 5 in. long and tender.

b. They generally harvested at least every other day during the peak growing season.

c. Over mature pods become woody and are too tough to eat.

Onions:

a. Bulb onions are harvested when the tops fall over and begin to turn red/white yellow. Ideal bulb onion diameter is 2 to 4 in.

b. Onions are dug and allowed 1 dry out in the open sun for a few days to toughen the skin.

c. The dried soil of the bulbs is removed by a gentle brushing.

d. The stems are cut, leaving 2 to 3 attached to the bulb.

Peas:

a. Edible-podded cultivars of peas are harvested when pods are fully developed (about 3 in.) but before seeds are more than one-half of their full size.

b. Regular peas are harvested when the pods are well rounded and they are fully developed but still fresh and bright green.

Potatoes:

a. Potatoes are harvested at any size greater than 2 to 3 inches in diameter.

b. For full season potatoes, the tubers are harvested when the plants begin to yellow and die down.

c. Exposure of tubers to sunlight is avoided or the tubers will turn green and become non-edible.

Pumpkins:

a. Pumpkins and winter squash are harvested when they are full size

b. The rind should be firm and glossy and the bottom of the fruit (or ground spot) is cream to orange.

c. The rind is tough and resists puncture from a thumbnail.

d. A 3- to 4-in. portion of stem is left attached to the fruit.

Watermelons:

a. Watermelon fruits are harvested when they are ripe.

b. Ripe watermelons produce a dull sound rather than a sharp, metallic sound when thumped.

c. Other indicators are a deep yellow rather than white colour where the melon touches the ground (ground spot), brown tendrils on the stem near the fruit, and a rough, slightly ridged feel to the skin surface.

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Production Technology of Costus

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Introduction

Diosgenin, widely used as starting material in commercial production of steroidal hormones, is chiefly obtained from certain species of Dioscorea of which *Dioscorea deltoidea* constitutes the most Indian staple material. It became necessary to look for an alternate botanical source which might be easily cultivated under a good range of agro-climatic conditions and supply the industry with a product at comparative low price and on sustained basis. Variety of plants were found to contain steroidal sapogenins but none could satisfy all the standards of such substitute. The report of the presence of diosgenin within the rhizomes of *Costus speciosus* (Family: Zingiberaceae) raised the hope of developing such a source because the plant was cosmopolitan in India. Diosgenin is further synthesized into sex hormones and steroidal drugs which are widely used for antifertility, antianabolic and anabolic, properties within the birth control and health programmes everywhere the planet.

Figure 1: Costus plant

Origin and Distribution

Costus (*Costus speciosus* Keon) is one of the important perennial medicinal plant originated from Indo-Malayan region.

Soil

The plant is often grown on a spread of soils starting from coastal alluvium to heavy brown forest type. Sandy and clay loam soils are best suitable and pH of 5.7-7.5.

Climate

It is often grown from water level to about 1500 m elevations. But the areas situated at elevations between 400 and 600 m above mean water level, having a subtropical climate with an annual rainfall ranging between 1000- and 1500-mm bear good quality material.

Cultivation

Propagation: Although the plant is often propagated from seeds, stem cuttings and rhizomes, commercially it's being propagated only through rhizome cuttings.

Land preparation: Land is ploughed 2-3 times and soil is delivered to a fine tilth. FYM at the speed of 15 tones is applied and mixed well with the soil. 50 cm apart furrows are opened.

Planting: The rhizome pieces are placed at a depth of 8-10 cm taking care to put the attention buds facing upwards, horizontally in rows at 50 cm apart and covered with soil. The crop is irrigated immediately after planting. Thick sized pieces show a slow rate of sprouting till 40-45 days of planting. This is often due to eye buds being dormant on these rhizome pieces which take an extended time to develop especially just in case of the crop planted during April.

Manures and Fertilizers: It's a rhizomatous crop and to compensate the biomass production, heavy manuring is required. During a trial conducted at Vallanikkara, the tentative optimum dose for obtaining the utmost yield of diosgenin was observed to be 45 kg N, 30 kg P2O5 and 30 kg K2O alongside 15 tons of FYM per hectare.

Irrigation: The plants need some amount of water for its growth. The crop planted during April and should requires to be irrigated at least two to 3 times a month till the outbreak of monsoon.

Weeding: One weeding during the sprouting period of the crop followed by two more keeps the crop fairly free from weeds.

Harvesting and Yield: It's observed that diosgenin content is maximum when the crop is in a lively stage of vegetative growth, and when it's of 16-17 months old. First harvest the aerial shoots and digging out the rhizomes. After harvesting the aerial shoots, the foremost satisfactory and economic method to dig out the rhizomes is to run the tractor drawn cultivator crosswise twice or thrice within the field and simultaneously collect the uprooted rhizomes manually. A yield of fresh rhizomes is 28 to 30 tons per hectare.

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The Socio-Economic Characteristics of Entrepreneurial Attributes of the Nursery Growers in Akola District

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Abstract

A nursery is a starting point for successful production. Nursery has emerged in this country as an important sector for diversification of agriculture with view to improve economic. The rapid growth of market economy has expedited the commercialization of agriculture sector which is gradually attaining the status of an enterprise. The study revealed that 42.00 per cent of the nursery growers belonged to middle age category with college level education (58.00 per cent). Most of them (40.00 per cent) had semi medium land holding between 2.1 to4.00 ha with annual income of above 200000.Also majority of them had medium sources of information and the majority (64.00 per cent) of the nursery growers had medium family size and majority (58.00 per cent) of the respondents having medium extension contact for seeking information. The majority (46.00 per cent) of the nursery growers had up to 0.50 ha area under nursery. Further study can be concluded that nursery owners should form strong organization, more agriculture graduates should enter in this business and become successful entrepreneurs to address the problem of unemployment.

Keywords: entrepreneurial, nursery growers, socio-economic characters.


Nursery raising is one of the highly economic enterprise and commercial venture in horticulture sector. As the demand for high quality planting material is steadily increasing there is need of setting up plant nurseries by small and marginal farmers as well as by gardeners and farmhouse owners. A nursery is a starting point for successful production.

Nursery has emerged in this country as an important sector for diversification of agriculture with view to improve economic condition of farming community. The emergence of entrepreneurs in a society depends upon closely interlinked social, religious, cultural, psychological and economic factors. Understanding the role of these factors is essential for creating an environment which can facilitate the development of entrepreneurial attributes.

Entrepreneurs have a tremendous amount of personal energy and drive. The characteristics are successful entrepreneurs have a high level of self-confidence, long term involvement, profits, capital gains and net worth are seen as measures of success, an intense level of determination and commitment to set clear goals for themselves, prefers to take moderate, calculated risk where the chances of winning are neither so small as to a gamble nor so large as to be a sure thing, not afraid of failing, uses feedback, take initiative and seeks personal responsibility, knows when and how to seek outside as well as inside, help in building their enterprise.

Materials and Methods

The present study was conducted in purposively selected Akola district. As a greater number of nurseries are located around the Akola city, so this formed the research area for present study. There are 50 respondents selected for the present study. Out of that some are private nursery growers and some are government nursery growers engaged in ornamental and floriculture nurseries from Akola district respectively were selected by using purposive sampling method. Data were collected with the help of well-structured and pretested interview schedule.

From table 1 concluded that, 42.00 per cent of the respondents were from middle age group. The finding is in the line with the findings of Thakare (2013).

The respondents might be realized the importance of formal education and motivate them to pursue higher education helps the nursery growers to gather new information required for nursery enterprise which in turn might create outlook to manage the enterprise. 58.00 per cent of respondents were educated up to college level. These findings are in the line with the findings of Palve (2003).

It was observed that, most of the nursery growers (40.00 per cent) possessed semi medium category of land holding. It is concluded that maximum per cent of the nursery growers were found in semi medium land holding category. The reason for possession of higher per cent of semi medium land holding could be due to fragmentation of land because of separation of families. Nursery business suit most and therefore they might be going for nursery as subsidiary agro-based enterprise in the study area Sadanshiv (2006) found that majority of the nursery growers were in semi medium (2.01 to 4.00 ha.) category of land holdings.

Most of the respondents (74.00 per cent) had annual income above Rs.200000/-. This finding is in line with the findings of Todmal and Kadam (2009) wherein, he found that (50.00 Per cent) of the respondents were annual income more than Rs.200000/-.

Two third (66.00 per cent) of respondents used medium sources of information. These observations are in line with the findings of Sayanolla (2002).

Majority (64.00 per cent) of the nursery growers had medium family size (5 to 8 members). These findings were supported by Chouhan, et al. (2004) and Waghmare (2010) who found that majority of size of family belonged to medium category,

Majority (58.00 per cent) of the respondents having medium extension contact for seeking information, Similar findings were observed by Angadi (1999) and Ramanna et al. (2000).

Majority (46.00 per cent) of the nursery growers had upto 0.50 ha area under nursery.While 36.00 per cent of them having 0.51 to 1.00 ha area under nursery. It may be said that higher per cent of the nursery growers (46.00 per cent) had put under 0.50 ha area of land under nursery. Similar types of finding are observed by Walke (2008).

Table.-Distribution of the respondents according to their Socio- economic characteristics(n=50)

Sr. No.	Particulars	Frequency	Percent
A	Age		
1.	Young (Up to 35 yrs.)	12	24.0
2.	Middle (36 yrs. to 50 yrs.)	21	42.00
3.	Old (Above 50 yrs.)	17	34.00
B	Education		
1.	Illiterate (No Education)	2	04.00
2.	Primary school (1st to 4th std.)	3	06.00
3.	Middle school (5th to 7th std.)	3	06.00
4.	High school (8th to 10thstd)	13	26.00
5.	College (Above 11th std.)	29	58.00

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C	Land Holding		
1.	Marginal farmer (Up to 1 ha)	2	04.00
2.	Small farmer (1.01 to 2 ha)	9	18.00
3.	Semi-medium farmer (2.01 to 4ha)	20	40.00
4.	Medium farmer (4.01 to 10 ha)	19	38.00
5.	Big farmer (10.01 ha and above)	0	00.00
D	Annual Income		
1.	Up to Rs. 50,000	0	00.00
2.	Rs.50001 to Rs.100000	3	06.00
3.	Rs.100001 to Rs.150000	4	12.00
4.	Rs.150001 to Rs.200000	6	08.00
5.	Above Rs.200000	37	74.00
E	Sources of Information		
1.	Low (Up to 7 score)	10	20.00
2.	Medium (8 to 13 score)	33	66.00
3.	Medium (8 to 13 score)	7	14.00
F	Family Size		
1.	Small (Up to 4 score)	10	20.00
2.	Medium (5 to 8 score)	32	64.00
3.	Large (Above 8 score)	8	16.00
G	Extension contact		
1.	Low (Up to 6 score)	11	22.00
2.	Medium (7 to 11 score)	29	58.00
3.	High (Above 11 score)	10	20.00
H	Area under Nursery		
1.	Up to 0.50 ha.	23	46.00
2.	0.51 to 1 ha	18	36.00
3.	Above 1 ha.	9	18.00

Conclusion

We concluded that, the entrepreneurs of medium age group are prominent in nursery business. Not only all the nursery entrepreneurs are literate but majority numbers of them are highly educated. Since, only a part of land holding was put under nursery by many of the nursery growers, it gives the scope for enlargement of their nursery units. Nursery growers with higher annual family income have higher purchasing power and as a result they have an urge to invest in specialized farm operations. Non availability of required information in time from the various medias and lack of reading habit might have influenced to lowering the situation of source of information and extension contact.

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Black Rice - The Forbidden Rice

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Introduction

Rice is the most important cereal food crop in many developing countries and is a staple food for nearly half of the world population. About 95 per cent of the rice production is concentrated in Asian countries. White rice is the most commonly consumed rice, but there are several black and red rice cultivars which contain coloured pigments. Rice varieties with black coloured pericarp are known as 'black rice' and the black colour is due to the presence of flavonoid pigments called anthocyanins which are powerful antioxidants. Abdel-Aal et al. (2006) reported that black rice had the highest content of total anthocyanins (327.60 mg 100 g-1) among all coloured grains.

History of Black Rice

The black rice is said to have originated from the Asian countries including China, Japan and India. In ancient China and Indonesia, black rice was exclusively reserved for the emperor, considered so superior, tasty and rare. Black rice was also called the "forbidden rice" because those who consumed black rice without approval from the kingdom were given capital punishment. Black rice remained popular as a tribute food in China during the Tang Dynasty which began in 618 AD and continued through the Sung Dynasty in 960 AD.

Areas Under Black Rice Cultivation

Black rice is cultivated in South East Asia, Korea, China and Japan. In India, it is indigenous to North Eastern states and is also extensively cultivated in Odisha, West Bengal and Jharkhand. In India the black rice is commonly cultivated and eaten in Manipur and is called 'Chakhao' in Manipuri language. The literal meaning of 'Chakhao' is delicious rice (Chak-rice: hao-delicious). This rice is used for the community feast as well as ceremonial purposes as a delicacy in this region. The 'Chakhao' has also been used by the traditional medical practitioners of Manipur.

Nutrient Profile of Black Rice

It is a whole grain, super nutritious type of rice, high in fibre, anthocyanin, antioxidants, vitamins B complex and E, iron, thiamine, magnesium, niacin and phosphorus. One half serving of cooked or one-fourth cup of uncooked black rice contains approximately (in daily recommended values) 160 kcal energy, 1.5 g of fat, 34 g of carbohydrate, 2 g of fibre, 7.5 g of protein, zero saturated fat and zero cholesterol (Kushwaha, 2016b).

Phytochemical Profiles and Antioxidant Activity of Black Rice

Twenty-three secondary metabolites, comprising anthocyanins, flavones, flavonoids, glycosides, carotenoids, vitamin E (tocopherols and tocotrienols) and γ-oryzanols have been qualitatively and quantitatively characterized in the dehulled seeds of Japanese black–purple rice which provides health benefits while ensuring its use as functional food (Sriseadka et al., 2012). Significant difference in nitric oxide (NO) scavenging activity was found among the different coloured genotypes of rice like black, red and brown (Ghasemzadeh et al., 2018). Black rice bran demonstrated the highest NO scavenging activity followed by red and brown rice bran extracts.

Cooking Time

The black rice is stickier than regular white rice or brown rice due to lower amylase content and higher amylopectin content. The rice is glutinous, though it contains no gluten. Due to very low amylase content it is sticky and moist after cooking. 'Chakhao' takes the longer cooking time of 40 to 43 minutes due to the presence of the fibrous bran layer and higher crude fibre content (Chanu, 2015).

Agro Techniques for Black Rice Cultivation

Cultivation practices of black rice are similar to that of normal rice even though it is mainly grown as organic to maintain its quality. The growth of black rice is influenced by cultivating systems, water management, soil and weeds.

Systems of cultivation: Low land cultivation system is mostly preferred for black rice. The growing system has a role in its growth and anthocyanin content. The grain yield of black rice was high when grown at an altitude of 1360 m than 79 m while the caryopsis colour of high-altitude rice was found darker than low altitude rice (Kushwaha, 2016a).

Field preparation: Keep the field flooded for one fortnight before transplanting. Puddling should be done 3 - 4 times in standing water.
Method of planting: Broadcasting, Drilling and Transplanting

Transplanting: For transplanting, 4 - 5 weeks old seedlings at 4 to 5 leaf stage or 15 - 20 cm height seedlings are used. Transplant 2 to 3 seedlings per hill at a spacing of 20 cm x 10 cm. Fifty hills m^{-2} should be maintained to assure adequate population in field.

Nutrient management: Black rice is found to be photo insensitive and often non-responsive and low productive towards the application of higher fertilizer doses. According to Khadka (2016), in black rice the highest yield of 2.58 mt ha^{-1} was obtained with application 120:80:40 kg NPK ha^{-1} which was on par with low dose (50:30:15) and medium dose (100:60:30) of fertilizers.

Water management: Water requirement is high during the initial seedling period covering about 10 days. Tillering to flowering is the most critical stage when rice crop should not be subjected to any moisture stress. Until the transplanted seedlings well established, water should be allowed to stand in the field at a depth of 2 - 5 cm. There after about 5 cm of water level may be maintained up to the dough stage of the crop. Water should be drained out from the field 7 - 15 days before harvest.

Harvesting and yield : The right stage for harvesting in black rice is when 80 per cent panicles have ripened spikelets. A well-managed crop yields about 4-5 m t ha^{-1}.

Health Benefits of Black Rice

1. Anti-inflammatory properties: Black rice pigment fraction can reduce some of the cardiovascular risk factors in patients with coronary heart disease. The positive effects of black rice fraction may be attributed to the antioxidant and anti-inflammatory activities of anthocyanins contained.

2. Weight management: Black rice can result in reduction of body weight when consumed regularly. Being unpolished rice rich in fibre, it makes a person feel full easily along with a reduction in the food ingestion. The anthocyanin in black rice regulates the genes involved in induction of lipid hydrolysis and thereby reduces the body fat and weight (Kim et al., 2013).

3. Anti-cancerous properties: Anthocyanins in black rice help to protect the body from free-radical damage, which can lead to cancer. These compounds can prevent carcinogenesis, and inhibit cancer progress and metastasis through cell signal transduction. Black rice anthocyanins supplemented diet can slightly reduce the breast cancer tumour growth, but can significantly inhibit cancer cells pulmonary metastasis (Luo et al., 2014).

4. Anti-diabetic effects: Black rice contains low quantities of sugar and high amounts of fibre which are known to protect the body from diabetes mellitus. The flavanoid, cyanidin-3-glucoside in the black rice has the similar ability of insulin and facilitates transport of glucose into the peripheral tissues besides protecting the pancreatic beta cells in body, which control the glucose level (Sari and Wahyuni, 2017).

5. Liver detoxification: Liver is the primary fat-metabolizing organ. Fatty liver disease is characterized by excessive fat deposit build-up in the liver. Black rice reduces the total cholesterol level, reduces the accumulation of fat cells in liver and thus moderates the fatty liver conditions (Al-Jameel and Al- Namshan, 2017).

Culinary Uses

Black rice with its unusual purple colour is commonly used in many countries as a condiment, dressing or decorating item in desserts. It is suitable for making porridge, traditional Chinese black rice cake, sushi, pudding, noodles, biscuits etc. Black rice extract is a natural food colouring dye which can be used as an alternative to artificial food colour in beverages and food.

Conclusion

Black rice is an excellent alternative to white and brown rice, due to its nutrient density, high fibre and rich antioxidant content. It is regarded as a nutraceutical and functional food and also considered as a "super food" due to its novel properties in prevention and control of cancer and life style diseases.

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Role of Entomopathogens In Present Scenario of Agriculture

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Pest problems are the main constraints of agriculture cropping system from decades. Various synthetic insecticides were developed and used in response to the insect attack since the insecticidal property of DDT was discovered. Insecticides were applied in the field by the growers as a scheduled spray without even the onset of pest. These prophylactic sprays of chemicals raise many issues like environmental hazards, and health hazards to human. Continuous chemical sprays in field resulted in killing of natural enemies, pollinators and other beneficial arthropods. Problem of secondary pest outbreak also spurred as the insecticides which were applied in field to control major pest has killed the natural enemies of minor pests. Lack of diversity in the field and continuous application of same insecticides with high doses has led the insects to develop resistance against the insecticides. In spite of all these, growers still continue to apply chemical spray in field which increases nothing but the management costs. These are the problems associated with the chemical sprayed agroecosystem. Entomopathogens has played a significant role in encountering these problems and there is more scope of entomopathogens in the near future. Seeing the negative impacts of insecticides various firms, companies has developed entomopathogenic formulations that can be applied in the field. As of 2017, at least 15 microbial control agents have been developed as biopesticides in India with 970 commercial formulations registered (Anonymous, 2017).

Entomopathogenic Bacteria

They are useful and good alternative of insecticides as they are not harmful to the grower and safe to use. It kills insect pest within 3-4 days. Most commonly used bacterial formulation is Bt which is species specific and used against several insect order including Lepidoptera, Coleoptera and Diptera. Bt variety are target specific and different variety is used for managing different insect. Cry gene (delta endotoxin) is mainly responsible for lethal nature of bacteria. Besides, *Bacillus popillae* Dutky causes milky disease in Japanese beetle larvae. The gene that code for delta endotoxins can be transfer to the desired cultivar to produce genetically modified crop through genetic engineering. In this era of organic farming they can be used in rotation or in combination with synthetic insecticides which is an environmentally friendly alternative. There are at present over 40 Bt products available for the control of insect-pests accounting for 1% of the global insecticide market. Bt cotton and Bt maize (fodder) are one such example of it. Twice the application of *B. bassiana* resulted in 72 per cent decrease in larval population of *Spodoptera litura* (Sahayaraj and Namachivayam, 2011).

Entomopathogenic Fungi

Among Entomopathogenic fungi, most of the taxonomic groups contain entomopathogenic genera, such as *Metarhizium, Beauveria, Verticillium, Entomophthora* and *Neozygites*. One advantage of using entomopathogenic fungi is that insect pest does not need necessarily to feed on the fungal spores. It may enter into the body through integument. In general, entomopathogenic fungi are compatible with most parasitoids and predators. The member of Tetranychids which are not able to be controlled by Bt, are managed successfully using EPF such as *Hirsutella* sp. EPF have comparative advantage of having a multiple site of action (Khachatourians, 1991) which further minimizes the chances of resistance development in insect pest.

Entomopathogenic Nematodes

Entomopathogenic nematodes have been applied most successfully in habitats that provide protection from environmental extremes, especially in soil, their natural habitat, and in cryptic habitat. They kill the host within

24 to 48 hours of infection. Grewal et. al., 1997 showed that *S. carpocapsae* and *S. riobrave* can be effective as chemical nematicides in suppression of root knot, sting and ring nematode. Various formulations of EPN have been prepared commercially till now and used against various soil and foliar insect pest. Novel EPN have shelf life extended up to 12 months. The product (Pusa Nemagel) has an extended shelf life and effective against, termites, white grubs, and many lepidopterans. Interestingly*, S. thermophilum* have been developed for the first time to have pathogenicity to lepidopteran eggs (Kaliya et. al., 2014).

Entomopathogenic Virus

Entomopathogenic viruses as control agents has gained more attention as they are species specific. Species in the family Baculoviridae represents DNA viruses establishing pathogenic relationships with invertebrates and showing potential in biological control, and can be taken as good alternative to synthetic insecticides. The most extensively studied baculovirus that is used for controlling lepidopteran pests is the alfalfa looper virus, *Autographa californica* (Speyer) NPV (AcMNPV) (Koul and Dhaliwal, 2002). These baculoviruses may kill the host within 4-7 days under favourable environment and may take 3 weeks in the absence of favourable conditions.

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Fruit Flies: A Major Threat to Crops

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Fruit flies are true flies, are characterized by having a single pair of true wings, which are used for flight, while the hind wings are reduced into a pair of small knob-like balancing structure called halters. Fruit flies (Diptera: Tephritidae) are one of the most fascinating and diversified group of insects often referred to as 'peacock flies' due to their habit of strutting wings, and rank among the world's most serious pests of horticultural crops. They feed primarily on ripe or unripe fruit, with many species being regarded as destructive agricultural pests, especially the Mediterranean fruit fly. Tephritids should not be confused with Drosophilids whose members are often called "small fruit flies" feed on overripe fruit. *D. melanogaster*, has been heavily used in research in genetics and is a common model organism in developmental biology. Approximately, 72 to 80 per cent of the damage caused by fruit flies to different crops. There are 4,448 species of fruit flies under the family Tephritidae. They have global distribution, covering tropical, subtropical and temperate regions and occupy habitats ranging from rainforests to open savannah except in Arctic and Antarctic regions (Kapoor *et al*., 1980). 325 species of fruit flies are known to occur in the Indian subcontinent. The tribe Dacini with genus *Bactrocera* is of great importance in India and from economic point of view, Oriental fruit fly or mango fruit fly, *Bactrocera dorsalis* (Hendel), guava fruit fly, *Bactrocera correcta* (Bezzi) and peach fruit fly, *Bactrocera zonata* (Saunders) are very important pests of fruit crops and are recognized worldwide as the most important threat to horticulture. All these species cause a loss of Rs 7000 crore per annum in India. (Sardana *et al*., 2005).

Life Cycle

Pest is active from March to November and passes winter in pupal stage. Adult fly appears in March and after mating eggs are laid which are white, cylindrical in shape laid just beneath the fruit skin in group of 2-9 eggs. Place of oviposition is marked by resinous secretion. After hatching which takes 2- 4 days, maggots feed on fruit pulp by making gallery inside. The larvae fully fed in 4-16 days and full fed larvae crawl of fruits by jumping movements and pupate in the soil. Further, Pupation takes 7 days. In this way, many generations are to be completed in a year (Verghese et. al., 2004).

Nature of Attack

Adults prefer semi-ripe fruit for egg laying. Oviposition punctures can be seen on fruits. Damage is mainly caused by maggots converting pulp into bad smelling semi liquid mass. Oozing of fluid and brownish rotten patches appears on fruits. Affected fruit become soft, fermented and decayed.

Management

Cultural control of fruit flies: Ploughing and raking the area under and between trees during winter to kill pupae.
Early harvesting of fruits: Early harvesting which can be effective for certain fruits such as mango, guava, papaya and banana.

Use of traps

Male Annihilation Technique (MAT): MAT attracts and kills male flies through the use of parapheromones. Parapheromones are alternative material in IPM when natural pheromones are expensive to produce.

Bagging of fruits: This is a kind of exclusion of fruits from egg laying. In Thailand, this method is used in mango orchards

Use of floating row covers: Floating row covers involve simply draping netting over plants and securing the edges with shovelfuls of soil.

Use of kaolin clay: Plants sprayed with kaolin look white which is repellent to fruit flies. The fine clay particles are believed to irritate flies that land on the material, discouraging them for settling.

Predators of fruit flies: Spiders, Ants, chickens and fowls, rove beetles, crickets.

Genetic control: Sterile Insect Technique is available in some countries like in Thailand. Sterile males are released in the air over infested areas, where they mate with wild females, thereby reducing the number of viable eggs. Chemosterilants and radiations are used to produce sterilized male flies.

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Size matters: Xylem and Phloem Feeders

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Introduction

The diversity of insect herbivores is just incredibly abundant and the diet of these insects is quite fascinating, many of these insects can be restricted to feed on a diet which consists of a single species, a family of species, or within a group of families. They can also possess a variety of diet varying from different plant species which can also be unrelated at times, and giving us the liberty to frame them as "Food generalists". The story of these insect herbivores takes us to 400 million years ago when the plants were evolving into terrestrial forms. This evolution of plants resulted in the growth of quite dense vegetation on the surface. Along with these also evolved arthropods, also the primitive insects. After the passing of another 100 million years, the herbivorous insects had evolved different means to feed on this rich source of vegetation. They had evolved into such high specialized creatures that, we could classify them into, spore feeders, sap suckers, and gall makers (Labandeira and Phillips, 1996). However, our focus in this article is on "sap suckers", insects known to feed on xylem and phloem contents in the vascular plants. Both the vascular tissues viz., The Xylem and Phloem are responsible for the allocation of resources from the sources to the sink and also distribute the phytohormones to assist in the regulation of physiological processes.

Characteristics

These xylem and phloem feeders (sap suckers) belong to the order Hemiptera, which includes many insects like whiteflies, psyllids, mealybugs, aphids, etc. (Phloem feeders) and spittlebugs, cicadas, leafhoppers (xylem feeders). The mouthparts of these sap suckers consist of a "stylet-like" structure which restricts them to a liquid diet but enables them to penetrate through certain tissues in the host plant extract the nutrients from i.e. xylem and phloem. But, the sole diet of either xylem or phloem are nutrient-sufficient for these insects, and they also vary a lot in their nutrient content, which in-turn also has an effect on their genomic evolution (Bennett, 2013). Both xylem and phloem exhibit different physiological properties, due to which these insect herbivores are seen specialized to feed on either xylem or phloem (Chuche. et al, 2017). These xylem feeders can be seen feeding on the root and shoot xylems of their host plants. The xylem sap is lower in nutrients compared to phloem and it is deficient in carbon and nitrogen (Mattson, 1980). Whereas, the phloem is comparatively richer in carbon and nutrients. This results in the honeydew produced by phloem feeders to be richer in sugar compared to xylem feeders which are more diluted (Raven, 1983) but the honeydew produced by the xylem feeders tend to be more compared to phloem feeders (Alves et al., 2020).

Honeydew

Honeydew is a mixture of carbohydrates, proteins, amino acids, minerals, and vitamin B. It is released from the anus of sap-sucking insects due to their sugary rich phloem diet. The release of honeydew maintains the osmotic pressure within the insect. Interestingly, this honeydew production serves as a source of food for various secondary phloem feeders like wasps, flies, beetles, bees, butterflies, moths, animals like flying foxes, and nectar-feeding birds. The ants, however, consume the honeydew droplets directly from the anus of these phloem feeders, and this behaviour is known as "tending" (Folling et al., 2001). Many researchers consider this a mutualistic relationship, the ants gain food from these phloem feeders and in return, the ants protect these feeders from predators Eg; in the case of aphids and ants, the microbes from the gut of the aphid produce many volatiles which attracts predators but also attract ants, creating a mutualistic relationship. More importantly, such physiological differences in the content of xylem and phloem largely affect the sizes of these insects.

Xylem feeders

	
Figure 1: Rhododendron leaf-hopper (Retrieved from https://commons.wikimedia.org/wiki/File:Rhododendron_leaf-hopper_(FG)_(38281677546).jpg	**Figure 2: Spittle Bug (Retrieved from https://commons.wikimedia.org/wiki/File:Rhododendron_leaf-hopper_(FG)_(38281677546).jpg**

Honeydew

	
Figure 3: White fly infestation on casava (Retrieved October 22, 2020, from https://www.flickr.com/photos/ciat/6892933289/	**Figure 4: Aphid feeding on sap Retrieved October 22, 2020 from https://www.wikipedia.org/**

Body Size

The body size of an insect is a striking feature of any organism and it often varies due to varied effects under natural selection. This can be induced by various factors like nutrition, temperature, and diet which plays a significant role in the growth rate (Chown and Gaston, 2010). The body size can also determine various factors of an organism from ecological roles to species traits that can determine the dynamics and structure of the food web (Woodward et al., 2005). The decrease in body size can limit certain functioning within the organism like feeding and locomotion (Hanken and Wake, 1993). Factors which often restrict the body size are, the irregularity with the energetic needs or the metabolic rate with respect to collecting and processing food (Brown and maurer, 1989). In the case of the sap suckers as mentioned above, the xylem is lesser in nutrients compared to phloem. To compensate for this deficit in nutrients the xylem feeders have higher ingestion rates compared to the phloem feeders. Through this process of higher ingestion rates, they are able to able to obtain nutrients which is equivalent to the phloem (Brodbeck et al.,1993). The pressure also differs among these saps, and xylem sap is constantly under negative pressure due to which the xylem feeders also require to spend additional energy while ingestion compared to the phloem sap which exhibits positive pressure. The turgor pressure in the phloem assists in driving the sap into the insect's gut with ease (Raven, 1983). As a result of the high expense of energy required to extract the xylem sap, these feeders are larger in body size compared to the phloem feeders (Novotny and Wilson, 1997). The larger body sizes of these xylem feeders can fall into the following general patterns, where larger herbivores are seen to feed on a nutrient-poor diet (Mattson, 1980) because the larger body size can make up for easier locomotion and also means better foraging for the insect on a wide-scale source of food (which here is nutritional poor). Thus, denoting that even a trait like body size cannot be neglected in the animal kingdom.

Pathogen

These sapsuckers are known to cause significant damage to plant species, studies on these plant suckers are however limited compared to other herbivores. From causing a decrease in yield, chlorosis, leaf-rolling to a loss in foliage. These neglected insects can be equally damaging as the foliage feeding insects and can weaken or even kill the plant species. These insects feed directly from the phloem and xylem and they can evade any form of secondary chemical defence mechanism (Zvereva et al., 2010). However, the phloem feeders can be more detrimental compared to the xylem feeders, due to their both direct and indirect effects in the formation of a richer sugary honeydew which affects the rate of photosynthesis by covering a large surface area on the leaves. Which in turn promotes senescence and growth of saprophytic fungus. However, studies on such indirect effects are limited and require further research.

Impact of Climate Change on the Sap Suckers

Concerns on climate change have been at an all-time high in the recent years, from melting of glaciers in the artic, extinction of species, to various zoonotic outbreaks in recent times. Their effects can also be observed within the sapsuckers. At optimal temperatures, the insect herbivores can increase their rate of feeding, development, body mass, and lay more eggs these optimal temperatures vary for each insect and is usually around 25-30 degrees. Temperatures above 25 degrees can increase the population density of these insects but temperatures above 30 degrees tends to weaken population growth, development time, and reproductive capacity. Also, elevated levels of carbon can affect the host-plant interaction withing the sapsuckers (Bezemer and Jones, 1998). It was observed that higher levels of carbon dioxide can decrease Nitrogen content within the plants, increase carbohydrates content, and secondary phenolics. This was observed to favour the phloem feeders by increasing their growth rate but higher levels of carbon dioxide reduce the rate of transpiration which in turn reduces the flow of xylem. The sap is already nutrient and nitrogen deficit, a reduced flow of nutrients occurs which results in higher mortality rates within the xylem.

Discussion

In a world of diverse herbivores, these sap suckers can be often neglected in many ecological studies. Their miniature sizes can make us overlook their existence, but yet their presence can be linked to many other organisms. From forming mutualistic relationship and providing food to smaller life-forms like ants (E.g. black garden ants) to larger forms like birds (E.g. rednaped sapsucker) these insects play a noteworthy role in an ecosystem. Yet, their pathogenic nature can also make them equally deadly like any other herbivore and demand their presence to be acknowledged. Especially in Agri-horticulture ecosystems as they can act as serious pests, vectors and causative agents of secondary infection.

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Role of Millipedes (Diplopoda) in Agroforestry Ecosystems: With Special Reference to Millipedes as Pest, Leaf Litter Decomposers and Nutrient Cyclers

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Introduction

Agroforestry ecosystems in India are home to a diverse array of millipedes. Agroforestry primarily includes agri-silviculture and agri-horticulture. This article focusses on the role of millipedes in agroforestry ecosystems (both as helpers and pests) and explores their role in carbon sequestration, provision of plant nutrients and litter decomposition. Other facets include their role in various cultures and traditional medicine which are of ethno-medicinal value.

Millipedes and Other Litter Fauna

Millipedes (class Diplopoda) associate themselves with many other organisms that also inhabit soil surface and subterranean environments. They include, but aren't limited to bacteria, nematodes, nematomorphs, fungi, annelids, mites and insects (Ramanathan et.al. 2014).

Humus Type, Land-Use and Millipede Diversity

Millipedes are dominant arthropods in soils with a mull-type humus and numerous in deciduous forests with a mor-type humus formation, but rare in mor-type humus of coniferous forest. They are more abundant and diverse in calcareous soils, in fairly moist habitats, and found typically in the O-Horizon (Culliney, 2013). A wide range of land-use: agricultural, forestry and wildlife conservation practices influence the richness and diversity of soil and litter fauna (Curry, 1994; Didham et.al. 1996). Millipedes are more abundant in closed canopy woodlands (ex. rainforest) compared to agri-silviculture, agri-horticulture systems and open forest areas. They are also found to be more abundant in mixed-tree ecosystems as compared to eucalyptus plantations (Dangerfield, 1990).

Millipedes and Soil Element / Nutrient Concentration

Significant amounts of $PO4^{3-}$, N, Na^+ and Ca^{2+} and K^+ are stored in soil arthropod (Diplopoda, Collembola, Oribatida and Isopoda) biomass. These faunae constitute an important nutrient pool in the soil, which temporarily immobilizes the ions and stops them from being leached (Culliney, 2013). The millipedes need to accumulate calcium (for their calcareous exoskeleton) which means that, they are an important component in the cycling of calcium in some terrestrial ecosystems. Not just calcium but many macro and micro nutrients are recycled by the process of litter breakdown. Nitrogen enters the soil and is picked up by plants when litter is devoured by millipedes. In addition, millipedes can increase the content of available phosphorus in soil. A study conducted by Smit *et.al*. (2001) in Richards Bay (coastal sand dune forests), South Africa reveals that concentrations of Magnesium and Potassium were higher in the microcosms subjected to millipede activity than in controls (rate of change of Mg and K measured at 5–15 g of millipedes per microcosm) which suggests that millipede activity may accelerate the release of elements in areas undergoing vegetation development. Magnesium and Potassium are crucial for the growth and development of fruit trees and crops in agroforestry ecosystems across India. The increased production of both these elements in areas abundant in millipede diversity might increase the yield and quality of fruits. Potassium boosts fruit size and colour. Magnesium is important for photosynthesis. The importance of Magnesium and Potassium for plant growth is elucidated in the table given below (Table 1).

Table 1: Functions of Magnesium and Potassium:

Elements	Element Status	Functions in plant/tree
Potassium(K)	Primary macro-nutrient	Used to make important enzymes required for respiration and photosynthesis. Boosts fruit size and colour, increases water usage efficiency, making plants less drought prone, helps in transport of nutrients.
Magnesium(Mg)	Secondary macro-nutrient	Central part of chlorophyll moiety. Chlorophyll is the integral component required for photosynthesis; deficiency causes chlorosis in leaf lamina, small fruit production, premature fruit fall and early ripening.

Role of Millipede Excreta in Agroforestry

Millipede excreta generally decomposes much faster than pre-ingested litter, causing a transformation which accelerates carbon cycling. Other studies on some species have revealed low decomposition rate of millipede excreta when compared with un-ingested litter, which could contribute to soil carbon sequestration (nutrient sink/pool) which prevents leaching of nutrients and helps in stabilization and prevent surface runoff (Wang et.al. 2018). Trees and crops in agroforestry systems benefit from this service provided by millipedes (Fig 1).

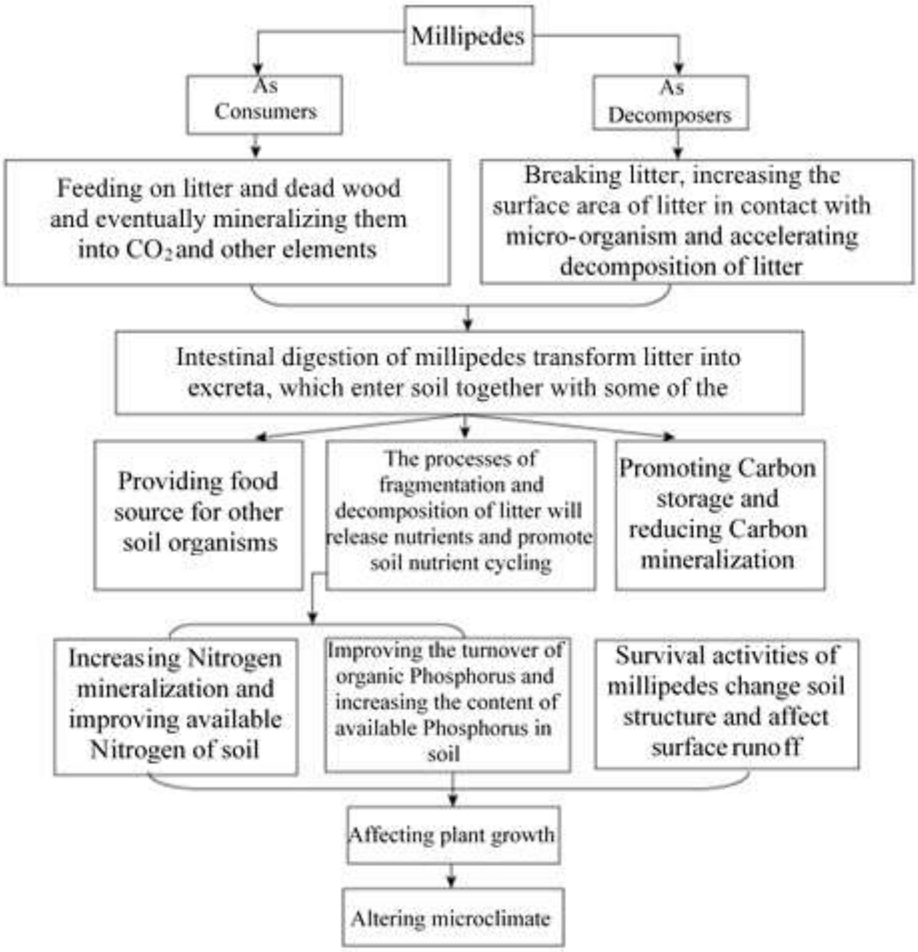

Fig 1: Ecological functions of millipedes (After Wang et.al. 2018

Role of Millipedes in Soil Aggregate Formation

The survival activity of millipedes greatly influences soil structure. Millipedes improve soil structure and decrease surface runoff by forming soil aggregates and also contributes to enzymatic and nutrient dynamics in soils. Through aggregates formed with their excrement and subterranean galleries, such organisms substantially transform soil attributes and processes (Fageria *et.al.* 2004). Da Silva *et.al.* (2007) has shown that the activity of the millipede *G. granulatus* enhanced the formation of aggregates ranging between 2.00-4.76 mm and reduced the aggregates ranging between 1.00-2.00 mm. The soil aggregation results in increased surface area of contact between soil surface and microorganisms and thereby accelerates their proliferation. It also makes the soil more arable for other soil fauna by increasing surface area of contact with the immediate atmosphere. Soil structure in agroforestry can be greatly influenced by the action of millipedes.

Leaf Litter Dynamics in Agroforestry Ecosystems

After abscission, litter fall and decomposition are the main processes which account for soil enrichment in agroforestry system. Studies conducted on N-labelled litter material by Seeber *et.al.* (2008) has revealed that litter quality is essential for the cycling of nutrients in alpine pastureland. The decomposition of Nitrogen and Carbon mainly depends on the C:N ratio of the litter species, so the rate of decomposition of litter must depend on the species type governed by its composition (Ronisha *et.al* 2015). A study conducted by Yadav *et.al.* , (2008) reveals that significantly larger amounts of organic carbon, available as N, P and K were found below the canopy of Multiple Tree Species (MTS) compared to the tree-less control. Addition of leaf litter increased the soil reaction significantly. It is confirmed by Ronisha *et.al.* (2015), that initially basic cations were responsible for increase in pH (facilitates microbial proliferation) and its subsequent decomposition by millipedes and other litter fauna causes the release of organic acids, which plays an important role in influencing soil reaction by decreasing the soil pH.

Millipedes in Agri-Silviculture

The Western Ghats in India comprises of closed canopy woodlands interspersed with regions posing anthropogenic pressures to ecosystem services such as agricultural fields, tea/coffee plantations lined with silver oak (Agroforestry) and fruit orchards of traditional, medicinal and horticultural importance such as Kokum (*Garcinia indica*). Agri-silviculture (tea/coffee plantations) is rich in millipede diversity. This is due to the fact that both the trees (often grown at regular intervals) and the shrubs (coffee/tea) contribute to leaf litter formation. This provides the necessary habitat for litter fauna such as millipedes. However, some species have faced a threat of extinction due to habitat loss and fragmentation and have a high degree of endemism. *Harpaphe haydeniana* and Rusty millipedes are abundant in Northern Western Ghats (Choudhary *et.al.* 2014). Kadamannaya *et.al.* (2012) has given detailed morphological descriptions of three species of pill-millipedes endemic to India and Sri Lanka in Western Ghats. Mixed agri-horticulture systems (ex: orchards, home-garden agroforestry systems) are richer in millipede diversity as compared to conventional agri-silviculture systems.

Millipedes in Agri-Horticulture

Woody component of the food-cum-fruit system is fruit trees. Short-term arable crops are raised in the inter-spaces of fruit trees like *Psidium guajava*, *Punica granatum*, *Annona reticulata*, *Manilkara zapota* and *Magnifera indica*. Pulses are the integral short-term crops for this system. However, depending on the requirements, crops like sorghum and millets can be grown in the inter-spaces of fruit trees (Sarvade, 2015). Wood and fruit in the litter and humus layers were correlated by Christina *et.al.* (2008) with an increase in the richness, biomass and density of millipedes. Wood and fruit are used by millipedes for both food and shelter. Christina *et.al.* (2008) has found greater diversity of millipedes in acidic soils (slopes) of sub-tropical wet forests in Puerto Rico. The same can be attributed to agri-horticulture and agri-silviculture (where coffee and other horticulture is grown in slopes) in India.

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Importance of Millipedes in Agri-Horticulture

Millipedes are important components of soil ecosystems, nutrient cycling and help in leaf litter decomposition both indirectly and directly, but the degree of decomposition depends greatly on their population density and the quality of the substrate i.e. leaf lignin content.They tend to prefer semi-decomposed litter. Ramanathan *et.al.* (2014), has found the presence of microbial assemblage belonging to the genus *Klebsiella*, *Sarcina*, *Bacillus* and *Corynebacterium* in the gut of the millipede *Schizophyllum sabulosum* in Alagarmalai Hills, Tamil Nadu, India which suggests that they help in the digestion of complex plant material by converting it into simple assimilable nutrient form. Efficiency of millipedes in assimilating leaf litter varies with litter source and composition, microbial biomass, pH and temperature in the litter. Highest lignin-content leaf species was observed to have significantly less leaf mass with millipedes (González *et.al.* 2012). Previous studies have shown that in some cases microbial biomass increases with the presence of millipedes. However, a study conducted by González *et.al.* (2012) has shown a decrease of soil microbial biomass over time, yet microbial biomass was unaffected by the presence of millipedes which might suggest some other factors might have influenced the trend. Millipedes consume decaying plant and animal matter including decaying wood. This effect reduces the risk of fungal diseases and pathogenic insects that damage trees and crops. Most millipedes are detritivores, some also feed on fungal mycelia. Fungi can decay living hardwood and sapwood and cause irreparable damage and economic loses. This suggests that millipedes have a significant role in the fabric of nature and indirectly protects the farmers by providing resistance to fruit trees and crops.

Millipede	Consumption (mg/animal/day)	Reference
Alloporus uncinatus	7	Dangerfield (1990)
	75	Blower (1974)
Amblyiulus continentalis	9.6	Striganova & Rachmanov (1972)
Calostreptus sp.	17	Blower (1974)
Chromatoiulus projectus	2.1	Gere (1956)
	5	Pobozsny (1985)
	8	Pobozsny (1986)
Cylindroiulus luridus	7	Pobozsny (1986)
	9.4	Pobozsny (1997)
Glomeris balcanica	11	Iatrou & Stamou (1989)
Glomeris hexasticha	4	Gere (1956)
Glomeris marginata	23-30	Dangerfield (1993b)
Leptoiulus proximus	6	Pobozsny (1986)
Odontopyge sp. 2	34	Blower (1974)
Odontopyge sp. 3	30	Blower (1974)
Orthomorpha gracilis	12	Kheirallah (1979)
Orthoporus ornatus	65	Wooten & Crawford (1975)
Paratophilus sp.	32	Dangerfield & Milner (1996)
Protracheoniscus politus	1.02	Gere (1956)
Rossiulus kessleri	23.3-78.4	Dangerfield & Milner (1993)
Sarmatiulus kessleri	63	Striganova (1972)
Schizophyllum caspium	25	Striganova & Rachmanov (1972)
Seychelleptus seychellarum	157	Lawrence & Samways (2003)
Unciger foetidus	3.3	Gere (1956)

Fig 2(left): Rate of litter consumption by millipedes (Sridhar et.al. 2011).

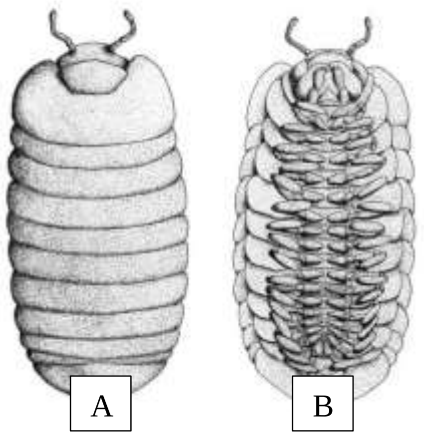

Fig 3(down): Illustration of female Glomeris marginata (European pill millipede) A) Dorsal view, B) Ventral view. Source-https://en.wikipedia.org

Millipede Pest Species, Traditional Folklore and Misconceptions

When millipedes act as pests, they ingest soft parts of the plants which includes young seedlings and roots. Studies conducted by Ebregt *et.al.* (2005) in Uganda reveals that *Omopyge sudanica* are serious pest of sweet potato (also linked to damage in groundnut) especially during crop development. Thereafter not much damage is done by them provided harvesting is done on a timely manner. The secretions of some tropical millipedes can cause edema, erythema, eczema and blisters. They may infest basements and other damp, dark areas in the house but cause no harm apart from emitting foul odour. However, most of them are occasional invaders and not serious pests. Unlike other millipedes, pill-millipedes are not pests and are devoid of offensive secretions or odour (Ambarish *et.al.* 2013). *Blaniulus guttulatus* (spotted snake millipede) is a noted pest of the salt-tolerant sugar beet. Some millipedes like *Xenobolus carnifex* in India are known to cause structural damage to thatched roofs causing them to weaken over time resulting in economic loses to farmers practicing Agroforestry. Due to their striking appearance and aposematic signal, millipedes have become etched in folklore and mysticism. They are also consumed (entomophagy) for their high protein content by some cultures in Africa. But they contain many toxins including cyanide. The Bobo people in Burkina Faso and Mali sub-boil the millipedes, as part of the preparation for meals. This treatment may help in degrading the cyanogenic compounds by liberating hydrogen cyanide gas, thus detoxifying the gomphodesmids (Enghoff *et.al.* 2014). In India, some confuse millipedes with centipedes and view them as a bad omen, often killing them at first sight. Other cultures in Brazil associate millipede activity with coming rains (Neto *et.al.* 2007). Dry millipede smoke is used for the treatment of piles by Bhotiya tribesmen in Uttaranchal, India (Chandra *et.al.* 2007).

Conclusion

Many millipedes serve as indicators for environmental conditions and they influence the content of organic matter and nutrient elements present in the soil. Millipedes and other litter fauna devour leaf litter and return the nutrients back to the soil. Agroforestry is dependent on millipedes for the formation of soil aggregates, thereby facilitating microbial proliferation. The decomposition of leaf litter releases nutrients into the soil which can be easily assimilated by plants. Apart from being farmers' friend, some species in the world are pests that eat newly emerging fresh shoot and root of sweet potato and groundnut. Some species in India infest thatched roofs of houses and cause damage to its structural integrity. They secrete liquid which causes foul odour and when in contact causes blisters and eczema. They are harmless but are feared due to striking and fearsome appearance. Many are killed due to lack of knowledge and superstition. Therefore, awareness must be created at grassroots level about their role in the ecosystem. The positive aspects and ecological service rendered by them far outweigh the negatives, which are few. India is blessed to have a great diversity of millipedes but there is no proper information available about the diversity, distribution, identification and the role of millipede in the ecosystem. Therefore, a proper system must be maintained to preserve these enigmatic creatures. Due to a lack of information, many endemic species might be pushed to extinction. It is therefore necessary to strengthen the database regarding these creatures. If the gap in knowledge can be bridged, it will become easy to protect and conserve them.

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In Canopy and Over Canopy Irrigation System: New Approach of Irrigation

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Fresh water is limited and it is much more limiting in climate change as well as burgeoning population situations. Moreover, the irrigation sector, which is the major user of water resources needs special attention in terms of its judicious use leading to enhanced water productivity and irrigation efficiency, even small changes in irrigation efficiency can make big impact on sustainable development of water resource in climate change scenario. So, Substantial annual water savings could be realized by switching from less efficient to more efficient irrigation systems with use of highly efficient irrigation system, effectively developed system leads to reduce the water losses as well as help in crop yield improvement (Howell et al., 1991, and Schneider and Howell, 1993). Mechanical move (Central pivot and linear move) irrigation systems are adversely affected by the wind and evaporation while irrigating the crop, these are limiting factor for achieving the irrigation uniformity in irrigation filed. As a result, many producers have adopted mechanical move sprinkler systems and methods that apply water at a lower height within or near the crop canopy height, thus avoiding some of the application non-uniformity caused by wind and water losses through different process.

Water losses through centre pivot or lateral move irrigation systems includes:

1. Droplet evaporation.
2. Drift of droplet from the field.
3. Canopy evaporation.
4. Evaporation directly from the soil.
5. Transpiration from the leaves.
6. Runoff from the irrigated field and deep percolation.

These types of water loss through the mechanical move system can be minimized by use of in-canopy and over canopy irrigation system.

In-Canopy and Over Canopy Sprinklers (Nozzles) and its Operation

Millipedes (class Diplopoda) associate themselves with many other organisms that also inhabit soil surface and subterranean environments. They include, but aren't limited to bacteria, nematodes, nematomorphs, fungi, annelids, mites and insects (Ramanathan et.al. 2014).

Humus Type, Land-Use and Millipede Diversity

In canopy sprinklers(LESA, LEPA, LPIC) are hang in crop biomass increasing the potential of entanglement and detachment from the center pivot and Over canopy sprinklers(MESA, Impact sprinklers) are hang just above the crop biomass to efficiently irrigate the water to the field. Based on the arrangement of the hardware on mechanical move systems they are classified as:

1. Mid- Elevation, Spray Application (MESA): Water distribution is greatly affected by the height of the nozzles and wind conditions. This type of system is over canopy system, here nozzle height varies from 1.2 to 2.5 meter above the crop canopy (Figure.1), spacing between the nozzles should be 3 meters apart and operating pressure is 1-1.5 kg/cm2. The components required for the operation of MESA are flexible drop hose, any rigid pipe on the drop, pressure regulator, gate valve, nozzle bodies, and spray pads. Field slope for its operation should be 3% or less to eliminate the runoff and deep percolation and translocation (Rajan et al., 2015). Additional measures such as conservation tillage, basin tillage with ridge till or reservoir tillage, any tillage with row orientation is compatible to use MESA system for irrigation. Maximum irrigation efficiency can be achieved through this system is 85%. The nozzles may be stationary, oscillating or rotating plates.

2. Low elevation Spray Application (LESA): It is a simple modification of sprinkler configuration fitted on centre pivot or linear move irrigation system that place water to very close to soil surface with the use of suspended water tubes or sprinkler nozzles (Figure.2). In this developed system, height of the nozzles range between 0.15 -0.6 meter within crop canopy, spacing between nozzles are 0.75 to 1 meter or not more than 2 times of crop row spacing of the crop and most of the operating pressure ranges 0.7 to 1 kg/cm2. It reduces the water loss by wind drift and evaporation and use less energy for its operation as compared to impact sprinkler fitted on conventional center pivot irrigation system. For optimum efficiency, circular crop row with center pivot and straight crop row with linear move irrigation system should be used. For better uniformity slope of the land should not be more than 3%.

3. Low Energy, Precision Application (LEPA): In LEPA system, irrigation water will be discharged through drag sack or hose or nozzles equipped with bubble shield or pad directly on the soil surface. Result of this technique, evaporation, and wind drift are minimized by running water directly onto the soil surface at very low pressure and automatically save the pumping power. However, because of water is directly applying on soil surface within a short span of time, chance of runoff, deep percolation and ponding will be more unless the irrigation system is operated in such a way to reduce the surface runoff or field should be tilted. While designing of LEPA system, nozzle spacing should not be greater than two times of row crop spacing and nozzle height should be uniform from the soil surface. This system is applicable for crop planted with furrow or bed system (Lamm et al., 2019). Row arrangement for supply irrigation water in the center pivot system is circular and for linear move system is straight. LEPA system is more efficient in reducing the crop evaporation as compared to LESA system.

Two configurations of LEPA system as follows:

a. LEPA with Bubbler nozzle: Here bubblers are used to irrigate the crop, the height of the bubblers ranges 0.15 - 0.6 meter within crop canopy (Figure3a).

b. LEPA with Drag sack: Height of drag sack is just contact (0 meter) with the soil surface (Figure. 3b). Alternative furrow irrigation method is recommended for best irrigation practice and the location of the applicator device in such a way that, each plant has equal opportunity to the water with the only acceptable deviation.

4. Low Pressure in canopy (LPIC): Height of the nozzle should be within the planned crop canopy or 0.3 to 0.6 meter within crop canopy. Lower nozzle heights will require a closer nozzle spacing to insure high distribution uniformity. Any tillage system and row orientation can be used for its operation. More over LPIC system is designed for tighter soil types, steep topography and tall crop system, where preventing runoff from LEPA and LESA systems is difficult (Figure. 4). Over a period of time LPIC system was replaced by LEPA.

Table 1: Typical water loss component associated with different irrigation system (Referred: Schneider, 2000, and Howell, 2006)

Water loss components	Impact sprinkler	MESA	LESA	LEPA
Droplet drift	Yes	Yes	No	No
Droplet Evaporation (DE)	Yes	Yes	Yes	In chemigation mode small amount of DE otherwise No evaporation
Impounded water evaporation	No	Yes	Yes	Yes (major)
Canopy evaporation	Yes	Yes	Yes	No
Wetted soil evaporation	Yes	Yes	Yes	Yes
Runoff	No	Yes	Yes	Yes (if not use of furrows/dikes)

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Percolation	No (with proper management)	No (possibility of runoff will be more with excessive redistribution of surface runoff)	No (possibility of runoff will be more with excessive redistribution of surface runoff)	No (possibility of runoff will be more with excessive redistribution of surface runoff)

Conclusion

Irrigation water discharged closer to the surface and doesn't spray as far, which minimize the spray losses and water wasted by the wetting the crop canopy. It is also saved energy for its operation. From the many research it was found that the on an average application efficiency were in the range of 60-70% for MESA system, for LESA system was very between 70-80% and for LEPA system it was found that greater than 90%. In India, Due to small land holding such type of irrigation systems are not popular.

Figure 1:- MESA system

Figure 2:- LESA system

Figure 3a: LEPA With nozzle

Figure 3b: LEPA with Drag sack

Figure 4: LPIC

Source: USDA (NRSC), Utilizing Center Pivot Sprinkler Irrigation Systems to Maximize Water Savings (http://cotton.tamu.edu/Irrigation/NRCS%20Center%20Pivot%20Irrigation.pdf)

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Farmers Centric Technologies on ICM for Commercial Tomato Production

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Introduction

Tomato, *Lycopersicumesculentum* L. (Solanaceae), is an economically important vegetable crop and grown extensively round the year in our country. In India, the tomato is grown in 0.809 million ha while the total production is 19.697 million tones and the average productivity is 24.34 MT/ha. Tomato is also very remunerative crop in mountain region of Uttarakhand. It occupied an area of 8626.81 ha with the total production of 94005.13 MT in the state of Uttarakhand and the average productivity is 10.89 MT/ ha. The productivity in the State of Uttarakhand can be doubled or even increases threefold by intervention of various high yielding varieties and hybrids, pest, disease and nutrient management practices.

From the last one and half decades, its area, production, productivity and availability have been increased significantly particularly in Himalayan States of India. The tomato is grown between March to October and its production start from May onwards which is the off season because during this period it is hardly grown in plains due to high temperature. Because of the off season, farmers get premium price of their tomato as compared to other vegetables grown in the Himalayan States. In hills of Uttarakhand cultivation of tomato has become lifeline of the farmers due to remunerative return. It is true that average productivity of tomato in hills of Uttarakhand is low because of the many factors. Amongst which poor awareness about the management of pests and diseases, nutrient management and adoption of high yielding hybrids and varieties recommended for the region. The incidence of pests and diseases is increasing year after year especially from the last 5-6 years. The major factors identified for high incidence of pests and diseases in tomato is change in agro climatic conditions.

The major pests and diseases recorded in the hills of Uttarakhand is late blight disease, bacterial wilt, damping off, whiteflies, fruit borer, cut worm etc. The late blight disease has been emerged as major problem in cultivation of tomato due to which average loss is 18-70 per cent. Farmers apply fungicides like mancozeb, metalaxyl + mancozeb etc. but these fungicides do not provide any major relief to the farmers from menace of late blight disease.

The major reason of increasing incidence of this disease is high humidity in the rainy season, close planting which affect proper aeration in the field etc. In areas where farmers applied recommended fungicides such asAzoxystrobin + Difenoconazole@ 1 ml /liter of water or Famoxadone + Cymoxanil@ 2 g/liter of waterfor management of early and late blight disease, they got outstanding result. Hence, these fungicides need to be used by the farmers on large scale for effective management of late blight disease in tomato. It is observed, if farmers managed the incidence of late blight disease, the productivity and quality of tomato can be doubled or even increased threefold.

Hence, in the changing agro climatic conditions, farmers need to be exposed on the technological advancement taking place in the field of varietal development, pest and disease management and nutrient management etc. Farmers can be sensitized on commercial tomato cultivation by imparting practical training, conducting demonstrations on their fields by involving them, distribution of farmers oriented literature in simple language, farmers-scientist interaction at frequent interval during the season, mobilization of farmers through print and electronic media, proper exposure of the extension personnel of the Developmental Departments working in the fields and are in close contact with the farmers.

Commercially Important Varieties and Hybrids of Tomato

S. No.	Variety/ Hybrid	Production (Q/ha)	Institute from where variety has been developed	Remarks
1.	ArkaRakshak	400-500	ICAR-Indian Institute of Horticultural Research, Bengaluru	Resistant against bacterial wilt, early blight and leaf curl complex
2.	ArkaSamrat	400-500	ICAR-Indian Institute of Horticultural Research, Bengaluru	Resistant against bacterial wilt
3.	Manilima	630-650	ICAR Research Complex for North Eastern Region, Umiam, Meghalay	Ideal for processing and for sale in the distant markets
4.	SolanShagun	490-500	Y.S. Parmar University of Horticulture and Forestry, Solan, Himachal Pradesh	Tolerant against early blight and buck eye rot
5.	Indam-13407	500-600	Indo-American Hybrid Seeds India Pvt. Ltd. Bengaluru	Indeterminate, high yielding, fruits are round in shape and tolerant against tomato leaf curl virus and having great demand in the markets
6.	Indam-13201	500-600	Indo-American Hybrid Seeds India Pvt. Ltd., Bengaluru	Indeterminate, high yielding, fruits are oblong in shape and resistant against tomato leaf curl virus, rain tolerant
7.	Rakshita Gold	500-600	Indo-American Hybrid Seeds India Pvt. Ltd., Bengaluru	Indeterminate, high yielding, fruits are flat round, resistant against tomato leaf curl virus and bacterial wilt, ideal for distant marketing
8.	Heamsohna	450-550	Syngenta India Pvt. Ltd., New Delhi	Indeterminate, high yielding, fruits are square round and having great demand in the markets
9.	Abhinav	500-600	Syngenta India Pvt. Ltd., New Delhi	Semi determinate, high yielding, fruits are flat round and having great demand in the markets

Factors Responsible for High Incidence of Pests and Diseases in Tomato

The diagnostic survey was conducted in various parts of tomato growing areas of Dehradun district. During survey we held discussion with tomato growers to find out their practical difficulties in obtaining maximum yield from their crops. It has been emerged out from the survey that poor availability of high yielding hybrids and varieties was one of the major constraints in production of tomato crops. Besides, most of the farmers were not aware about quality and effective chemical pesticides in the area which resulted in high incidence of pests and diseases. During base line survey, group discussion with farmers was held. The observations on varieties, hybrids, incidence of pests and diseases, judicious use of chemical pesticides, their time of application, pest monitoring, nursery raising etc were recorded during group discussion with farmers. It was found that majority of the tomato farmers were not aware about the high yielding varieties, hybrids and incidence of pests and diseases. Hence, to mobilize the farmers towards technological advancement in tomato production, trainings were imparted. During training of the farmers, sites were also selected for conducting demonstrations. During baseline survey and discussion held with the farmers, following points have been emerged out.

1. The prevailing agro climatic conditions in the district of Dehradun was very conducive for commercial tomato cultivation particularly off-season tomato farming in the mountain and tribal areas of Dehradun.

2. Majority of the farmers involved in tomato cultivation but most of them were not getting remunerative price and good productivity from their crops due to lack of knowledge.

3. Keeping in view the enormous potential and increasing demand of tomato particularly off-season tomato in the market project was formulated to mobilize and sensitize the farmers.

4. Accordingly, diagnostic survey was undertaken in which meeting and survey were organized in the potential areas of the farmers to find out their views on commercial tomato production. It was observed that almost all the farmers were convinced for tomato production. Most of the farmers told that they were willing for tomato farming but due to lack of knowledge and poor productivity obtained by some farmers they were helpless.

5. After conducting diagnostic survey, encouraging attitude of the farmers and seeing the potential, training and demonstrations had been started organizing from 2015-16 to 2018-19 (four years) which gave tremendous impact on the farming community within very short span of time.

Major Diseases and Pests of Tomato

Late blight disease:

a. It appears on the leaves, stems and fruits. On the leaves, symptoms appear as pale green and water-soaked spots.
b. Under favourable conditions, lesions enlarge rapidly, turn dark brown to purplish-black.
High humidity and leaf wetness, favours the growth of a cottony, white mould on the lower side at the edges of lesions.
c. On stem, brown to black lesions develop which enlarge rapidly under moist conditions.
d. On fruits, the fungus produces grey-green water-soaked spots, which enlarge, coalesce, and darken, resulting in large, firm, brown, leathery-appearing lesions.

Incidence of late blight disease

Damping off disease:

a. Damping off of tomato occurs in two stages, i.e. the pre-emergence Incidence of late blight in fruits and the post-emergence phase.
b. In the pre-emergence phase the seedlings are killed just before they reach the soil surface.
c. The young radical and the plumule are killed and there is complete rotting of the seedlings.
d. The post-emergence phase is characterized by the infection of the young, juvenile tissues of the collar at the ground level.
e. The infected tissues become soft and water soaked. The seedlings topple over or collapse.

f. High humidity, high soil moisture, cloudiness and low temperatures below 24° C for few days are ideal for infection and development of disease.

g. Crowded seedlings, dampness due to high rainfall, poor drainage and excess of soil solutes hamper plant growth and increase the pathogenic damping-off.

Incidence of late blight in fruits

Bacterial wilt:

a. Characteristic symptoms of bacterial wilt are the rapid and complete wilting of normal grown up plants.

b. Lower leaves may drop before wilting. Pathogen is mostly confined to vascular region; in advanced cases, it may invade the cortex and pith and cause yellow brown discolouration of tissues.

c. Infected plant parts when cut and immersed in clear water, a white streak of bacterial ooze is seen coming out from cut ends.

d. Relatively high soil moisture favours the incidence of bacterial wilt.

Incidence of bacterial wilt

Whiteflies:

a. Whitefly is a well-known vector, which transmits tomato leaf curl virus.

b. It has piercing and sucking mouthpart and both nymphs and adults feed on lower surface of the leaves causing deformation of young leaves.

c. Infected plants exhibit any one or a combination of the symptoms like vein yellowing, inter-vein yellowing, leaf yellowing, yellow blotching of leaves, yellow mosaic of leaves, leaf curling, vein thickening, leaf enations, leaf cupping and plant stunting.

d. Under protected conditions whiteflies become more persistent.

Incidence of whiteflies

Fruit borer:

a. The pest is widely distributed and is polyphagous in nature. It is one of the major pests of tomato.

b. The larvae scrap and feed on tender foliage while advanced stage larvae bore circular holes and thrust part of their body inside the fruit and eat the contents.
c. The larvae move from one fruit to another and single caterpillar may eat and destroy 2 to 8 fruits.
d. The infested fruits become unfit for human consumption.
e. The incidence of fruit borer is more common in valleys and mid hills while in high hills its infestation is almost nil due to low temperature.

Infestation of fruit borer

Integrated Pest Management

1. Nursery stage:

a. Prepare raised nursery beds about 10 cm above ground level for good drainage to avoid damping off disease.
b. Mix 50 gm of effective strain of Trichoderma+ Pseudomonas from reliable source in 3 kg FYM and leave for 10-15 days for enrichment then apply Trichoderma+ Pseudomonas enriched FYM in the soil nursery in 3 m2 bed.
c. Protection of seedlings in nursery covered with nylon net (200 mesh) for 25-30 days. Rakshita gold in demonstrated field
d. Seed treatment with effective strain of Trichoderma+ Pseudomonas @ 10 g / kg or captan 75 % WP @ 0.25 %.

Rakshita gold in demonstrated field

2. Transplanting stage:

a. Fields need to be kept free of weeds and thoroughly ploughed at least two weeks before planting.
b. Transplanting can be delayed in order to plant bigger seedlings which will tolerate cutworm damage.
c. Detecting the cutworms early helps to control them and avoid serious damage.
d. Ploughing helps in exposing the cutworm to natural predators and sunlight which eventually kills them.
e. Small infestations might be controlled by digging out the damaged seedling to find and kill the cutworm.
f. Ashes deter cutworms when spread on seed beds, around plants or mixed with soil in planting holes.
g. Removal of weed hosts to reduce the incidence of whiteflies and associated viral diseases.
h. Adopt wide spacing of 60 x 45 cm (for varieties) and 90 x 60 cm (for hybrids) to reduce the chance of spread of diseases.

i. Apply neem cake @ 250 kg / ha at 20 days after transplanting (DAP) to reduce fruit borer, leaf miner and nematode incidence.

j. Providing support to plants by staking to facilitate ventilation and sunlight in the interiors of plants for alleviating micro-climate and discourage pest and disease severity and enhanced plant and fruit growth.

Indum-13407 in demonstrated field

k. Install pheromone traps @ 2 / acre for monitoring fruit borer activity. Replace the lures with fresh lures at every 20-25 days interval.

l. Monitor top three leaves for fruit borer eggs.

m. Planting one row of 40 days old seedlings of marigold as trap crop after every 16 rows of 25 days old seedlings of tomato for attraction of adults to trap crop for egg laying and colonization.

Demonstration of Rakshita gold

3. Flowering and fruit developmental stage:

a. Two releases of Trichogrammabrasiliense @ 2, 50, 000 parasitoid eggs per ha (Tricho-cards) during peak flowering stage at 10 days interval on need basis.

b. Foliar spray of HaNPV@ 250 LE with jiggery (10 gm per liter), soap powder (5 gm per liter) and tinopal (1 ml per liter) during evening hours on need basis.

c. Application of neem oil (2-3 ml per liter water) coinciding with appearance of the whiteflies.

Demonstration of Heamsohna hybrid

d. Collection and destruction of leaf curl affected plants in the initial stages and tomato fruits infested at regular intervals on monitoring the crop.

e. If high incidence of fruit borer is noticed, spray chlorantraniliprole0.3 ml per liter water or novaluron1ml per liter water or indoxacarb0.5 ml per liter water.

f. Weekly hand picking and destruction of leaves, shoots and fruits infected with late blight disease

g. Application of Azoxystrobin + Difenoconazole@ 1 ml /liter of water or Famoxadone + Cymoxanil@ 2 g/liter of water can be done, if incidence of early and late blight disease occurs.

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Demonstration of Heamsohna hybrid

Integrated Plant Nutrient Management

Tomato requires a very fertile and less water holding soil like silty clay loam, sandy clay loam or loam soil. The fertility levels of tomato growing soils should be high and the most important aspect of this is the high organic matter content of the soil. In the hills, fertility level of the soils is generally poor as the soils are deficient in nitrogen, phosphorus and potassium. The high rainfall has ensured that the element calcium has leached away and the soil tends to be acidic in nature.

Demonstration of Indum-13407

The farmers also do not use soil amendments to balance the soil pH and thus create a soil atmosphere that is acidic. In an acidic soil there will always be high fungal population as compared to bacterial population and this also may be one of the reasons that high incidence of fungal diseases is prevalent in the hills like late blight disease. Another problem with like with soil fertility is addition of poor-quality organic matter into the soil. The farmers tend to add farm yard manure too many months before the transplanting time. This added farm yard manure suffers the vagaries of nature and is prone to high rainfall and sunshine. The high rainfall leaches down elements like phosphorus, potassium, calcium from the farm yard manure and the get washed away from the soil to the deeper soil and are rendered unavailable. The high temperature of the sunshine volatilizes the ammonia present in the farm yard manure and it also gets lost to the atmosphere. The tomato crop is generally grown in rainfed and water deficient areas and this addition of farmyard manure will trap the soil moisture and will offset the vagaries of climate change particularly related to soil moisture levels.

Farmers scientist interaction

The addition of adequate amounts of organic matter (@ 20 tons per hectare) will help the soil to conserve more moisture in it and also help in mitigating the climate change that is so visible now a days. Therefore, the added farm yard manure brings more problems to the soil than giving any advantage. Its high time that farmers start using vermicompost as a standard manure so as to get maximum yield from their tomato crop.

Farmers scientist interaction

The farmers use DAP as fertilizer which contains adequate amount of nitrogen and phosphorus but is totally devoid of potassium. The hill soils due to constant cultivation have gone gradually poor in their potassium reserves and these potassium deficient soils are not able to supply the plants with adequate nutrition. The element potassium imparts disease resistance to crops and this element has shown to prevent fungal diseases in tomato crop. The long duration of indeterminate varieties of tomato requires that the soil fertility level coupled with the soil organic matter should be high. A balanced dose of nutrients (macro nutrients and micronutrients) and compost is one of the most essential requirements for tomato cultivation.

Farmers scientist interaction

Organic amendments in the form of neem, Pungamia, groundnut, castor increase the population of Actinomycidies and reduce the population of nematodes, soil borne pests and other harmful pathogens like Fusarium and Rhizoctonia etc. In vegetable production, micronutrients play a catalytic role in nutrient absorption and balancing other nutrients. Micronutrients also play important role in enzymatic activities and their synthesis in plant system. The deficiencies of micronutrients especially during vegetative growth result in huge reduction in yield and quality.

The micronutrient such as Boron (Bo), Moly-bdenum (Mo) Zinc (Zn), Copper (Cu), Iron (Fe) and Manganese (Mn) can be applied as foiler spray to overcome the deficiencies, improve the production, quality of vegetables and make the plants harder against pests and diseases. Most of the micronutrients are required in a trace amount though their deficiencies cause poor plant growth, reduce yield and in excess toxic to the plant. Hence, micronutrients application should be done carefully for desirable result after ascertaining their deficiency symptom/ plant tissue analysis. If organic manures are applied in proper fashion in combination with micronutrients, the dosage of chemical fertilizers can be reduced to a great extent. Foliar application of NPK 19:19:19, NPK 0:52:34 and NPK 0:0:50 @ 3-5gm per liter water+ sagarika @ of 2-3 ml per liter water in different vegetative and fruit developmental stage/ productive stage of the vegetable have been found very promising as they are water soluble and available in IFFCO Cooperative Society at very low price. Hence, the use of these liquid fertilizers will help in improving the productivity and quality of vegetables and will also reduce the basal application and top dressing of chemical fertilizers like NPK, DAP, MOP, Urea etc.

1. Add good quality vermicompost(@ 1cm layer) on the soil surface to provide adequate nutrition to the seedling.
2. This addition of vermicompost on the soil surface provides soft rooting medium to the seedlings and there is less transplantation shock to the roots upon uprooting the seedlings.

3. Band placement of FYM/vermicompost is necessary so as to fulfill organic matter requirement of each tomato plant.
4. Per plant band placement vermicompost requirement is @ 1.0 kg/plant and 2.0 kg for farm yard manure. This placement of organic matter is to be done at the time of sowing only and this vermicompost/FYM is filled in the soil.
5. In one hectare of land 180 kg of NPK 12:32:16 is to be provided basally in rows just when the soil is being opened for transplanting. This much NPK is not to be spread over the whole but is to be given only in rows where the tomato seedlings will be transplanted and mixed well in soil or into vermicompost/FYM.
6. Top dressing the NPK fertilizer and vermicpmost/FYM should never be done. They should always be placed below the roots.
7. Foliar application of NPK 19:19:19 should be done after 30days of transplanting @ 3 gram per litre of water. This spray should be done preferably in the evening and in one hectare of land 500-600 litres of water will be required. The second spray should be done after 10 days of the first spray.
8. After 60 days of transplanting, foliar application of NPK 0:52:34 should be done @ 5g/litre of water and repeated three times at an interval of 10 days. Another foliar fertilizer NPK 00:00:50@ 5g/litre of water is to be sprayed at 10 days interval during fruit developmental period and continued till end of the crop.
9. After second picking of tomato fruit, it has been generally observed that the size of tomato fruit gets very small. For this, three foliar application of potassium nitrate are to be done @ 5g/liter of water at 7 days interval.
10. Another problem in tomato occurs due to calcium deficiency and is called as blossom end rot in which the lower part of tomato fruit gets soft and ultimately decays from there. For this it is advised to apply calcium nitrate to the plants.

Conclusion

1. The consumption of chemical pesticides in tomato crop can be minimized by mobilizing the farmers for adopting monitoring techniques, nature and extent of damage by pests and disease, need based use of pesticides, their time of application, selection of appropriate pesticide, right dosage of pesticides, proper spray equipment etc.
2. The productivity and quality of tomato cab be enhanced by application of liquid fertilizers which are more effective as compared to conventional chemical fertilizers.
3. The adoption of potential hybrids and varieties mentioned in the table can improve the quantitative and qualitative value of tomato and they can also reduce the number of applications of chemical pesticides as they are resistant and tolerant against various pests and diseases.
4. The application of bio pesticides and neem-based formulations will enable to the farmers for eco-friendly production of tomato which is need of the hour to meet out the emerging demand of tomato in domestic and international markets.

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Developing a Small-Scale Unit for Biodiesel Production from Non-Edible Oil Seeds – A Village Enterprise

Article ID: 32764

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Introduction

Biodiesel obtained from energy crops produces favourable effects on the environment, such as a d crease in acid rain and in the greenhouse, effect caused by combustion. Due to these factors and to its biodegradability, the production of biodiesel is considered an advantage to that of fossil fuels. In addition to this, it also shows a decrease in the emission of CO2, SOx and unburned hydrocarbons during the combustion process. It does not contain any sulphur, aromatic hydrocarbons, Metal crude oil residues. The lack of toxic and carcinogenic aromatics (Benzene, Toluene and Xylene) in biodiesel means the fuel mixture combustion gases have reduced impact on human health, and environment. The net CO2 and SO2 emissions can be reduced by 100% by using biodiesel.

Biodiesel is mainly produced using edible, non – edible oils and animal fats. In India edible oil is mainly consumed for human consumption, focus is given for production of biodiesel from non-edible oil seeds. It has estimated that even 5% replacement of fossil fuel by biodiesel would help to save Rs 4000 crores annually in foreign exchange.

Biodiesel System

A rural biodiesel system (non-conventional) involves growing of oil crop in waste land, pressing the seeds into oil, processing the oil into biodiesel by trans-esterification process as shown in Fig. 1. The following subsection detail each stage in this process for the case of non-edible oil plant. Cost model for each stage is developed. In end critical cost comparison is between diesel and biodiesel price were estimated.

Grow Crop in Wasteland → Oil expelling → Transesterification process → Biodiesel

Fig. 1: General Flow diagram of for rural biodiesel production

Oil for jatropa carcus and pongamia pinnata mostly used for production of bio diesel. Transesterification of these oils is most commonly used process for bio diesel that can get rid of problems arising out of high viscosity of these oils.

Oil Expelling from Non-Edible Oil Seeds

There are various processes, which were suitable for edible oil extraction can be utilized for extracting oil from non-edible oil seeds. The processes are classified mainly solvent extraction or mechanically by using hydraulic press or simple screw press.

Trans-Esterification Process

The most common derivatives of edible and non-edible oil for fuels are methyl esters. The purpose of the process is to lower the viscosity of the oil. Although blending of oils and other solvents and micro emulsions of vegetable oils lowers the viscosity, engine performance problems, such as carbon deposit and lubricating oil contamination, still exists. Hence transesterification process can modify the oil to almost to diesel grade. Hence, trans-esterification has proven to be the alternative with the best results (Loopez et al., 1995). These are formed by transesterification of the oil with methanol in the presence of catalyst (usually basic) to give methyl ester and glycerol. Sodium hydroxide is the most commonly used catalyst, though others such as potassium hydroxide (KOH) can also be used. Equation 1 represent the mass balance for trans esterification, and figure 4 represents the underlying chemistry.

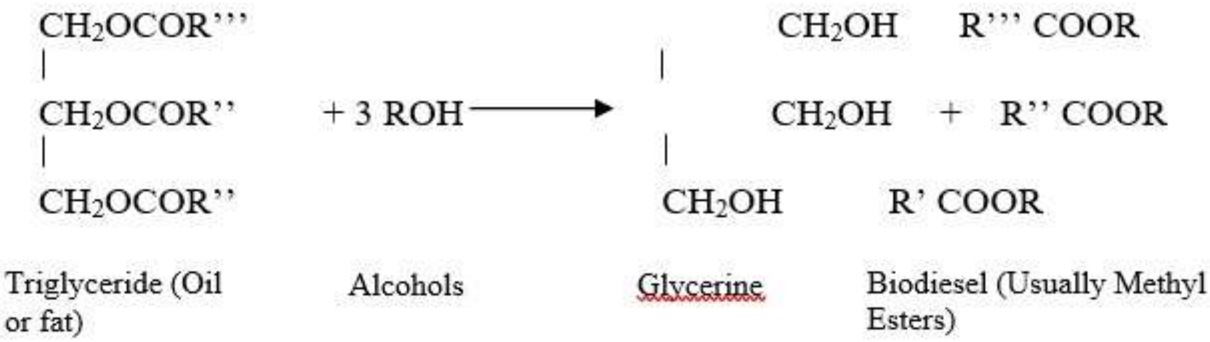

Fig. 2: Trans-esterification Chemistry

Results

Experiments were carried out for Jatropha, Karanaja and Neem and yield obtained from small-scale unit varies from 50% to 60 %. Properties observed are Viscosity, Calorific Value and specific gravity. The properties of trans-esterified biodiesel v/s diesel are tabulated as Table-3.

Table 1: Properties of biodiesel of various oils v/s diesel:

Trans-esterified oils	Viscosity (mm2/sec)	Specific gravity	Calorific value MJ/kg
Karanja	5.4	0.915	39.143
Jatropha	5.7	0.91	37.25
Diesel	3.6	0.879	40

Overall Economics for Village Enterprise

Over all economics has been worked out for small-scale biodiesel production unit, a typical non-conventional model. It has been envisaged as per following; growing the non-edible oil seeds (jatropha, karanja depending on the climatic suitability) in wastelands. Here wasteland availability has been assumed at free of cost. The yield of Jatropha is varying between 2 to 4 tons/ per ha. The assumed yield for the wasteland requirement is 3 Tons/Ha. Harvesting and storage of seeds. Utilization of Jatropha seed in a tiny oil expeller driven by animal drawn prime mover. The capacity of oil expeller is 50 kg / day of two units were assumed. It is an alternative to the electric driven oil expeller. This utilizes a pair of bullocks for driving the animal driven prime mover. The oil obtained is fed into the biodiesel production unit of 50-lit capacity (two batch productions per day).

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Impact of Covid-19 Pandemic on Food and Vegetables

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Introduction

However, it is not so for other commodities such as fruits and vegetables, eggs, meat, milk, and sugar that constitutes 78 percent of the total food consumption. Disruption in supply chains and a decline in demand had caused a huge loss of production and income to the farmers, traders, and consumers. As against other sectors of the economy, agriculture has surely shown more resilience. The country's farmers have successfully harvested winter crops. Access to food was not fully assured as a result of the decline in incomes and loss of livelihood after the Pandemic COVID-19. It was further impaired by socio-economic inequities. The food supply chain (FSC) was stressed. There were widespread disruptions owing to restricted movements, the ban on transportation, and border sealing. FSCs were exempt from lockdown, but only 6 percent of the total supply chain was organized. The utilization of food is impacted by the absorptive capacity of people, which is constrained by incomes and health standards that are adversely affected by the COVID-19 pandemic. The stability of food availability and access will depend on how soon the contagion is controlled to allow free movement of goods and persons to restore food supply chains. It has made wholesale supplies of food cheaper whereas retail consumers faced a rise in prices because of the disruptions of food supply chains.

Covid -19 Impact on Sustainable Food and Vegetables

He underscored that the right to safe and nutritious food and the role of fruit and vegetable consumption in ensuring food security and reducing malnutrition have been affirmed on several occasions. The regular consumption of diverse fruits and vegetables is essential for a well-balanced diet and to prevent micro-nutrient deficiency and non-communicable diseases such as cancer and cardiovascular diseases. However, despite this recognition, worldwide per capita consumption of fruit and vegetables. Technology continues to have an impact on reshaping contemporary food supply chain systems to improve productivity, affordability, accessibility and diversity of choice and to reduce losses and waste. The dominance of the large retailers, who can afford to invest in technological innovation, has led to raised quality and welfare standards across the food industry. This and other production line processes, air freight, moulded plastic packaging and numerous other initiatives have had major impacts on food safety and shelf life. Short food supply chains are one example of the potential for food to act as a driver of change. Supply chains of the future need to produce healthy and nutritious food that has been grown in an environmentally friendly and ethical way, while also dealing with the significant challenges of a growing population, climate change and declining natural resources.

Moderation Measures of Food and Vegetables

1. Child malnutrition is a major global health problem, leading to morbidity and mortality, impaired intellectual development and working capacity, and increased risk of adult disease.
2. There are no specific recommendations on the optimal treatment of children with severe stunting, but it is assumed that children with severe stunting would benefit from a diet adapted for moderately stunted children, as pointed out in the proceedings of this meeting on the treatment of moderate malnutrition.
3. Throughout this review, we have therefore not distinguished between children with moderate stunting and those with severe stunting.
4. Infants and young children are especially vulnerable to malnutrition because they have a high growth velocity and also high energy and nutrient needs.
5. The typical diet in populations with a high prevalence of malnutrition consists predominantly of a starch-rich staple, such as a cereal (maize, rice) or tuber (cassava), with limited amounts of fruits, vegetables, legumes, and pulses, and little or no animal-source food. Such a diet is bulky, has a low density of energy and nutrients and a low bioavailability of minerals, and will result in impaired growth, development, and host defence to infections.

Conclusion

The diet used for the treatment of severe malnutrition with a high content of animal food (milk powder) and a low content of fibers and antinutrients will also be effective in the treatment of moderate malnutrition. . This is particularly crucial for malnourished children, who often have a compromised and thereby more vulnerable gastrointestinal tract. The most used animal-source foods are milk, meat, and eggs. However, the ingredients in such a diet are expensive, are not available in most settings, and are not appropriate for a low-cost, sustainable, home-based treatment. This balance is especially important if the plantbased foods are unrefined cereals and legumes with a high content of fibers and antinutrients. Infants and young children are more susceptible to the negative effects of antinutrients such as phytate and fibers, especially insoluble fibers, than older children.

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Impact of Covid-19 on Indian Agriculture Sector

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Abstract

Farming is the foundation of any economy. It is the essential area which creates work so the whole hover of financial course goes on. At the point when we talk about the Indian economy, most of the populace is confined to this area. With the progressing pandemic, occupations of the apparent multitude of ranchers and the individuals who are enjoying this area are at high danger. In certain countries, COVID-19 has vanished while in some it is returning. Simply a limited capacity to focus the pandemic will leave a never-ending impact on the agrarian area. The pandemic will disappear definitely, yet we don't have the foggiest idea when and we don't have a clue about the quantum of the negative effect it will leave on the economy. The beginning of the Covid pandemic has corresponded with the pinnacle gathering season. As the business sectors are secured, there is a danger to the yield in more than 100 lakh hectares in the nation. Indeed, even among the various fragments, the effect changes broadly among various areas and among makers and horticultural compensation workers. This effect will resound over the bigger economy and will wait longer than a couple of months. During these difficult occasions, how does Indian Agriculture react to the emergency and how do government estimates influence 140 million homestead families the nation over and from that point sway the economy of a significant nation in the creating scene? We survey the quick difficulties that COVID19 has presented to the ranch area and recommend moderation measures to guarantee a practical food framework in the post-emergency period. So that reason there is have to contemplate the effect of Coronavirus on India Agriculture.

Key Note: Challenges, Global Agriculture, Indian Agriculture.

Introduction

Farming stays a focal mainstay of the Indian economy. The area serves the food utilization needs of the entire nation, while additionally putting among the top exporters of farming produce on the planet. The area has been confronting a lot of difficulties as of late, however few have been as extreme as the homegrown and worldwide travel limitations during Covid-19. Award Thornton separates the difficulties into two particular classes: Labor shortage and fares. Northern Indian conditions of Punjab and Haryana are among India's agrarian forces to be reckoned with, albeit cultivating work in these states is generally completed by transient work from East India.

At the point when India's cross-country lockdown was reported in March, the automatic response was a mass departure of traveller work back to rustic main residences, as laborers moved to stand by out the lockdown while at home. The reaping cycle, which ordinarily begins in mid-April, was startled totally, bringing about significant liquidity issues. The June crop is among those that have been especially hard hit, as indicated by Grant Thornton.

At that point there is the transportation area. Development across state outskirts has been intensely limited, which has obstructed the development of yields and subsequently their deal. Add to this an absence of machine fixes mechanics and other such care staff, and one gets the image of an area in a tough situation.

Objectives

1. To Study the Impact of Covid-19 on Indian Agriculture Sector
2. To Analyze the Impact on Global and India Agriculture Sector

Methodology

The methodology is incredibly needed to construct the analysis work equally qualitative and quantitative ways in which were used within the study. This text has required secondary data, secondary data has been collected from written offer, like varies periodicals, articles, reports, books, journals, and literatures, on the subject. For the aim of gathering the most recent updated information's on the topic e-sources to boot sharp-eyed.

Challenges Surfaced after COVID Pandemic

Notwithstanding all the measures and taking into account proceeding with limitations on developments of individuals and vehicular traffic, concerns have been raised with respect to negative ramifications of COVID19 pandemic on the homestead economy. The quick issues in farming right now are basically ordered under two heads.

Effect on Global Agriculture Sector

1. Yield creation and accessibility of seeds:

a. For crop creation, the biggest aspect of the cultivating cycle will be practically unaffected among now and the mid-year.

b. So there would be no effect as such on seeds accessibility for the present.

c. In any case, on the off chance that a similar situation proceeds till year end, at that point without a doubt seed accessibility can be an issue.

2. On food creation and dissemination:

a. The vast majority of the nations have taken estimates, for example, home repression, travel boycotts and business conclusion to control the pace of disease.

b. Horticulture produce is generally short-lived in nature, so ranchers are constrained to hold their unsold produce for a more drawn out timeframe.

c. This has prompted a decrease in food quality just as an expansion in the expense of creation.

3. Composts deficiency:

a. Because of worldwide exchange unsettling influence, ranchers are confronting the deficiency of agrarian information sources like manure and pesticides.

b. In a more limited range, there is little lack not out of the ordinary.

c. In the more drawn out term, the conveyance of compost through global business sectors may turn into an issue since a portion of the creation plants in China have been closed down.

4. On animals:

a. Diverse agrarian area, for example, domesticated animals and fishery have been hit hard by the pandemic.

b. In India, COVID-19 has caused a higher effect on domesticated animals cultivating because of restricted admittance to creature feed and a deficiency of work.

c. For instance, the movement boycott has influenced the conveyance of rearing load of poultry.

5. On laborers:

a. Rural laborers in low and centre pay nations need appropriate wellbeing administrations and social insurance and because of small sparing or no sparing.

b. Numerous casual specialists in agribusiness are commit to work for their food in spite of the self-separation convention during COVID-19 pandemic.

6. Effect on food interest and food security:

a. The interest for food has influenced because of decrease in pay and buying limit.

b. Froze Consumers are storing the nourishments which thusly has influenced the food accessibility and cost.

c. Because of the decrease in global exchange, aggravation in food flexibly chain and food creation, food weakness may emerge.

Effects on India

Farming contributes around 17 percent to Indian GDP. Horticulture, with its unified areas, is the biggest wellspring of vocations in India. 70% of provincial families actually rely basically upon agribusiness for their job.

1. Pinnacle collect with no acquirement:

a. This is the pinnacle of Rabi season in India and yields like wheat, gram, lentil, mustard, and so on (remembering paddy for inundated parcels) were at a harvestable stage or nearly arriving at development.

b. This is likewise when the homestead harvests come to the mandis for guaranteed acquirement tasks by assigned government offices.

2. Work inaccessibility because of opposite movement:

a. The non-accessibility of work has harmed tasks in numerous parts.

b. Thusly, the lack of transient work has brought about a sharp increment in day by day compensation for reaping crops.

c. A few pieces of farming that have the advantage of conveying innovation for harvestings, similar to Paddy and Wheat, are generally more protected since they frequently don't need to rely upon huge quantities of difficult work.

3. Fall in costs:

a. Rural costs have imploded because of absence of market access including the stoppage of transportation and conclusion of fringes.

b. The ascent in labor expenses and absence of access implies that ranchers are gazing at enormous misfortunes and consequently permitting harvests to spoil in the fields, a superior 'stop-misfortune's system.

4. Shortage of public products:

a. Making the food grains, products of the soil and other basic things accessible to shoppers, both in provincial and metropolitan regions, is the most basic test.

b. Transportation of public dissemination framework (PDS) things to last-mile conveyance specialists, by both rail and street, has been seriously affected in the first place.

5. Limitations on Sale: There were deliberate limitations on the between and intra-State developments of ranchers/workers, just as reaping and related homestead machines.

6. Interruptions in gracefully chain:

a. The nonattendance of transport offices clubbed with watchful hindering streets limitingly affects the development of transitory collect work and agri-apparatus.

b. Likewise, trucks and work vehicles are not comprehensive of 'ranch hardware' by definition.

7. Lockdown instigated obligation and Cash Flow Constraints:

a. The most significant issue that ranchers need to overcome is the issue of reimbursing their yield advances, gold credits and other casual obligations.

b. Yield credits are reimbursed among April and May and a new advance is allowed at the beginning of another season.

Suggestion

1. With a prospering populace, there is a comparing ascend in food interest in India.
2. A post-COVID circumstance offers that remarkable occasion to repurpose the current food and agribusiness strategies for a more advantageous populace.

3. India, being exchange surplus on items like rice, meat, milk items, tea, nectar, green items, and so forth may take advantage of the lucky breaks by trading such items with a stable agri-sends out strategy.
4. This is in fact uplifting news in the COVID situation, expecting horticulture can rehearse generally solid.
5. Planning agrarian arrangements, post-COVID situation, must incorporate these goals for a food framework change in India.

Conclusion

Basic changes, for example, land renting, contract cultivating and private rural business sectors, and soon have for quite some time been upheld to carry upgraded interests into the agribusiness area and to push its development. Be that as it may, there has not been the uniform execution of these enactments by State Governments thus the maximum capacity of the area is hidden. These changes need critical political will.

The finish of the lockdown won't end the issues. Unexpectedly, they are probably going to be intensified at the beginning of the new horticultural planting season. There is a more prominent requirement for government uphold as help for other farming sources of info. Absence of any help will just aggravate the rural emergency. The need of great importance is to amplify conceivable outcomes of farming, which has exhibited its utility and versatility in attempting times.

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Impact of Covid-19 on Farming Community

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Abstract

The present study aims to analyse the impact of Covid-19 on the economy and farming community of India. First, we focused on current global economic scenario along with Indian economy and how Covid-19 lockdown affects both global and national economy, after focusing in the economic condition; we tried to showcase the impact of Covid-19 on farming community of India. Several parameters were chosen for this study such as primary agriculture, supply chain, food retail, food processing, food export. The paper also focused on the problems, which were appeared due to this global pandemic, and suitable suggestions were provided to recover these problems.

Introduction

The outbreak of the Covid-19 pandemic is an unprecedented shock to the Indian economy. With the prolonged country-wide lockdown, global economic down-turn and associated disruption of demand and supply chains, the economy, which was already in a parlous state before COVID-19 struck, is likely to face a protracted period of slowdown. The magnitude of the economic impact will depend upon the duration and severity of the health crisis, the duration of the lockdown and the manner in which the situation unfolds once the lockdown is lifted.

Impact of Pandemic on Global Economy

First, markets are more integrated and interlinked, with a Chinese economy that contributes 16 percent to the global gross domestic product. Thus, any shock that affects China now has far greater consequences for the world economy.

The supply shocks due to morbidity and mortality, but also the containment efforts that restrict mobility and higher costs of doing business due to restricted supply chains and a tightening of credit will affect economies leading to a reduction of economic growth or an economic recession. In March, the OECD cut its forecast for global economic growth in 2020 from 2.9 percent to 2.4 percent, which would be the lowest level since the financial crisis a decade ago, warning that a prolonged and more intensive coronavirus epidemic could even halve this figure to a mere 1.5 percent.

The demand has also fall due to higher uncertainty, increased precautionary behaviour, containment efforts, and rising financial costs that reduce the ability to spend.

Finally, there is a significant devaluation of the exchange rate with respect to the US dollar, which will also affect the import dependent countries.

Global food markets are not immune to these developments. However, they are likely to be less affected than other sectors that are more exposed to logistical disruptions and weakened demand, such as travel, manufacturing and energy markets (Source: Market Monitor, AMIS, March 2020). But given the complexity of the food value chains and the importance of trade and transportation, these could make them extremely vulnerable. While COVID-19 likely represents a deflationary shock for the global economy, reflected in early moves by the FAO Food Price Index, in the short term the real cost of a healthy diet may rise because of the increase in the cost of perishable commodities, which would have a particularly adverse impact on lower-income households and raise the price of progress towards the Sustainable Development Goals. This effect, as shown in 2019 The State of Food Security and Nutrition in the World, will be most importantly in countries with high commodity-import dependence. Here, the negative effect is stronger, as a one percent increase in commodity-import dependence causes an average increase in undernourishment of 3.8 percent per year. When the country is food-import dependent, there is an average increase in undernourishment of 8% per year. Furthermore, the demand shock will contribute to prolonging and worsening the effect.

Impact on Indian Economy

The economic shock will likely be much more severe for India, mainly for two reasons. First, pre- COVID-19, the economy was already slowing down, compounding existing problems of unemployment, low incomes, rural distress, malnutrition and widespread inequality. Second, India's large informal sector is particularly vulnerable. Out of the national total 465 million workers, around 91 percent (422 million) were informal workers in 2017-18. Lacking regular salaries for incomes, these agriculture, migrant and other informal workers are the hardest-hit during the lockdown period.

Table 1. Impact of Covid-19 on Farming Community

Farming sector at a glance:	
Contribution to GDP and employment	16.5 percent of GVA and 43 percent of employment (2019-2020)
Global presence	1st in Dairy, Spices and Cashew; 2nd in Food grains, Fruits and Vegetables
FDI equity inflows in food processing sector (percent of total FDI)	2.14 percent (April 2000- December 2019)
Major processed food segments (value)	Dairy (29 percent), Edible Oil (32 percent) and Cereals (10 percent)

At the onset of the COVID-19 outbreak, there has been a significant increase in demand. Food demand is generally inelastic and its effect on overall consumption will be likely limited, although dietary patterns may alter. There is a possibility of a disproportionately larger decline in animal protein consumption (as a result of fears- not science based- that animals might be hosts of the virus), and other higher-value products like fish, fruits and vegetables (which are likely to cause price slumps). These fears can be particularly true for raw fish products supplied to restaurants and hotels, including small and medium enterprises.

Current and Potential Impact on the Farming Sector

Primary agriculture: Agriculture being the backbone of the country, part of government has announced it as an essential category. So, the impact is likely to be low on both primary agricultural production and use of agri-inputs like seeds, fertilizers, pesticides, etc. Lakhs of migrant workers streaming to their home villages due to COVID-19 pandemic and the subsequent lockdown have left many farmers across the country bereft of agricultural labour just before the crucial harvesting season of the rabi crop. While mechanical harvesters can be used, but there is shortage of drivers/ operators. Farmers also worry about government procurement and their ability to sell their crops, given that many mandis or agricultural markets are still closed, despite fresh Home Ministry orders to exempt all such farming activities from the shutdown. Telangana government has announced that it will procure all non-perishable crops at the village level itself, freeing the farmer of the responsibility of finding storage or transport to the mandis. Wheat, mustard, rabi paddy, maize, chickpea and soybean are amongst the major crops harvested during this season.

Supply chains remain disrupted across India. Agricultural goods have been notified as essential goods. But about 5,00,000 trucks are reportedly stranded in the highways and State borders. Milk trucks are able to unload at the destination but unable to return empty, which has upset supply schedules. Trucks are in shortage as drivers have gone home. Import of vegetable oils are not being lifted from ports due to shortage of trucks. Most APMC mandis are functioning only twice or thrice a week. Livestock feeds ae in short supply. And this is breaking the back of livestock growers. In a bid to shield farmers from logistics hurdles, both Andhra Pradesh and Telangana have launched initiatives to buy winter paddy directly from farmers at the village level, rather than expecting them to come to the mandi. In Andhra Pradesh, the responsibility of procuring the State's expected harvest of 57 lakh tonnes has been given to agriculture assistants at the village secretariats to ensure MSP to farmers who are battered by restricted transport untimely rains and damaged crops. The Telangana government has also promised procurement of "every grain of paddy" at MSP rates.

Food retail: Several state governments have allowed free movement of fruits, vegetables, milk etc. However, poultry sector is heavily impacted due to fake propaganda. Prolonged lockdown will result in increase in demand for food supplies. Online food grocery platforms are heavily impacted due to unclear police restrictions and stoppage of vehicles.

Food processing: Although all food-based industries are allowed to function normally, there are few issues on inter-state movement of skilled and semi-skilled labour. Factories should adjust to working with less labour force and overtime to meet the demands.

Food exports: Indian export will be impacted due to low consumer demand and port hurdles as the major destinations like U.S., Europe, China will tackle with COVID-19 for the next few months. Partial diversion of export inventories to domestic market will help the players in the interim. Farm gate prices for export-oriented companies like seafood, mango, grapes, etc. are crashing, which may impact future crop availability. Indian rice traders have stopped signing new export contracts amidst the nation-wide lockdown to curb the spread of COVID-19, as labour shortages and logistics disruptions have hampered the delivery of even existing constraints. The halt in exports from the world's biggest exporter is allowing rival countries like Thailand, the only key exporter to offer rice currently, to raise shipments in the short term and lift global prices.

Conclusion

Social distancing and living under a lockdown appear to be the only effective ways of dealing with the pandemic. As India lacks the resources to significantly ramp up testing, imposing a lockdown was the government's preferred option. Although there is limited evidence to suggest that this strategy may be working in containing the spread of the virus, its after-effects on thousands of migrant workers is already out in the open. Distrustful of govt.'s promise of providing support, most migrant workers decided to walk back to their home States despite efforts by the state machinery to prevent them from moving out.

Migrants are not the only ones facing the after-effects of the lockdown. With the economy coming to a complete halt in most of the formal and informal enterprises in urban areas, the lockdown is also likely to affect the rural areas, two-thirds of whom are dependent on agriculture. At a time when the rural economy was witnessing declining incomes, even before the pandemic broke out, this lockdown is only going to hurt the agricultural economy further. Even before the lockdown, rural wages were declining in real terms but there were hopes for agricultural incomes rising with food prices rising until January 2020. However, recent data on prices suggest that the trend is reversing with the decline in agricultural prices in most markets. In the short run, we will likely witness a breakdown of supply chains of agricultural produce with no facilities for transportation of produce, which is likely to have an impact on those engaged in the production of perishable fruits and vegetables. With horticultural production exceeding food grain production in the last decade, many farmers are already facing uncertainty or no markets for their produce. Media reports have already confirmed that farmers are finding it difficult to dispose horticultural produce.

There is also short-term impact on food grains and other rabi crops that were ready for harvest at the beginning of April. While the government has exempted operation of agricultural markets and mandis from lockdown, it will be difficult for farmers to harvest the agricultural produce in the surplus states of Punjab, Haryana and Uttar Pradesh in the absence of migrant labourers, which is likely to affect the prospect of higher incomes of agriculture. Some of the short-term impacts may affect price realisation by farmers but the real worry for farmers is going to be the decline in the prices of majority of agricultural produce. The food price index of the Food and Agricultural Organization, which was showing a rising trend in food prices until January 2020, reported a 1 per cent decline in prices month-on-month in February 2020.The slowdown in the economy domestically and the expected recession worldwide will contribute to lower demand for agricultural commodities. At a time when the agricultural sector was already battling declining demand and lower prices, the faint hope of better prices appears unlikely to materialise. It is the decline in the prices which is likely to hurt the income of farmers in the long run more than the short-run supply disruptions and labour shortages.

The state governments are closely working at the Tehsil levels to ensure that the farmers get the agri-inputs and logistic support to send the produce to the market. However, each state is working with their own rules at Tehsil level and a uniform country-wide policy on this, which is well defined, is the need of the hour. Secondly, there are no community meetings or BTL activities, hence there must be an alternative plan to aware farmers of such decisions and policies. In this scenario, e-commerce players operating in the agricultural sector can be a big game changer. They have a targeted base of farmers that can be directly leveraged by the government, thereby reducing the time gap and increasing effectiveness in reaching out to them. E-commerce can help in ensuring that the agri-input needs of the farmers are met effectively. Given the adequate support, these e-commerce players can deliver the goods to the farmers at their doorsteps, sanitized at the warehouse level, thereby reducing the woes and helping in a better yield

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[1]. Dutta R.N., (1984). Comparative ecological study of makhana in Darbangha region. Ph.D. thesis. Ranchi University, Ranchi Bihar.

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