Lecture-1 Organic farming-definition-Prospects-Principles and concepts- Genesis and History of organic farming in the world and India: Present status in world, India and Tamil Nadu

Organic agriculture has grown out of the conscious efforts by inspired people to create the best possible relationship between the earth and men. Since its beginning the sphere surrounding organic agriculture has become considerably more complex. A major challenge today is certainly its entry into the policy making arena, its entry into anonymous global market and the transformation of organic products into commodities. During the last two decades, there has also been a significant sensitization of the global community towards environmental preservation and assuring of food quality. Ardent promoters of organic farming consider that it can meet both these demands and become the mean for complete development of rural areas. After almost a century of development organic agriculture is now being embraced by the mainstream and shows great promise commercially, socially and environmentally. While there is continuum of thought from earlier days to the present, the modern organic movement is radically different from its original form. It now has environmental sustainability at its core in addition to the founders concerns for healthy soil, healthy food and healthy people.

Definition

As per the definition of the USDA study team on organic farming "organic farming is a system which avoids or largely excludes the use of synthetic inputs (such as fertilizers, pesticides, hormones, feed additives etc) and to the maximum extent feasible rely upon crop rotations, crop residues, animal manures, off-farm organic waste, mineral grade rock additives and biological system of nutrient mobilization and plant protection".

In another definition FAO suggested that “Organic agriculture is a unique production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity, and this is accomplished by using on-farm agronomic, biological and mechanical methods in exclusion of all synthetic off-farm inputs”.

The International Federation for Organic Agriculture Movement’s (IFOAM) definition of Organic agriculture is based on:

- ✓ The principle of health
- ✓ The principle of ecology
- ✓ The principle of fairness and
- ✓ The principle of care

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The principles are to be used as a whole. They are composed as ethical principles to inspire action.

1..Principle of health

Organic Agriculture should sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible.

2.Principle of ecology

Organic Agriculture should be based on living ecological systems and cycles, work with them, emulate them and help sustain them.

3.Principle of fairness

Organic Agriculture should build on relationships that ensure fairness with regard to the common environment and life opportunities. Fairness is characterized by equity, respect, justice and stewardship of the shared world, both among people and in their relations to other living beings.

4.Principle of care

Organic Agriculture should be managed in a precautionary and responsible manner to protect the health and well-being of current and future generations and the environment.

Organic agriculture is a living and dynamic system that responds to internal and external demands and conditions. Practitioners of organic agriculture can enhance efficiency and increase productivity, but this should not be at the risk of jeopardizing health and well-being. Consequently, new technologies need to be assessed and existing methods reviewed. Given the incomplete understanding of ecosystems and agriculture, care must be taken.

Concept of organic farming

Organic farming endorses the concept that the soil, plant, animals and human beings are linkedand nature is the best role model for farming. The soil in this system is a living entity .Microbes and other organisms are significant contributors to its fertility and total environment of the soil on a sustained basis and must be protected and nurtured at all cost.

Therefore,

- Its goal is to create an integrated, environmentally sound, safe and economically sustainable agricultural production system.
- Human interact with these natural components (minerals, organic matter, micro-organisms, animals and plants) to achieve harmony with nature and create a sustainable agricultural production.
- Organic farming systems do not use toxic agrochemical inputs (pesticides, fungicides, herbicides and fertilizers). Instead, they are based on development of biological diversity and the maintenance and replenishment of soil productivity.

The world of organic agriculture

As per the details released at BioFach 2010 at Nuremberg, the organic agriculture is developing rapidly, and statistical information is now available from 154 countries of the world. Its share of agricultural land and farms continues to grow in many countries. The main results of the latest global survey on certified organic farming are summarized below:

Growing area under certified organic agriculture

- ✓ 35 million hectares of agricultural land are managed organically by almost 1.4 million producers.
- ✓ The regions with the largest areas of organically managed agricultural land are Oceania (12.1 million hectares), Europe (8.2 million hectares) and Latin America (8.1 million hectares). The countries with the most organic agricultural land are Australia, Argentina and China.
- ✓ The highest shares of organically managed agricultural land are in the Falkland Islands (36.9 percent), Liechtenstein (29.8 percent) and Austria (15.9 percent).
- ✓ The countries with the highest numbers of producers are India (340’000 producers), Uganda (180’000) and Mexico (130’000). More than one third of organic producers are in Africa.
- ✓ On a global level, the organic agricultural land area increased in all regions, in total by almost three million hectares, or nine percent, compared to the data from 2007.
- ✓ Twenty-six percent (or 1.65 million hectares) more land under organic management was reported for Latin America, mainly due to strong growth in Argentina. In Europe the organic land increased by more than half a million hectares, in Asia by 0.4 million.
- ✓ About one-third of the world’s organically managed agricultural land – 12 million hectares is located in developing countries. Most of this land is in Latin America, with Asia and Africa in second and third place. The countries with the largest area under organic management are Argentina, China and Brazil.
- ✓ 31 million hectares are organic wild collection areas and land for bee keeping. The majority of this land is in developing countries – in stark contrast to agricultural land, of which two-

thirds is in developed countries. Further organic areas include aquaculture areas (0.43 million hectares), forest (0.01 million hectares) and grazed non-agricultural land (0.32 million hectares).

- ✓ Almost two-thirds of the agricultural land under organic management is grassland (22 million hectares). The cropped area (arable land and permanent crops) constitutes 8.2 million hectares, (up 10.4 percent from 2007), which represents a quarter of the organic agricultural land.

History of Organic farming

Traditional farming (of many kinds) was the original type of agriculture, and has been practiced for thousands of years. Forest gardening, a traditional food production system that dates from prehistoric times, is thought to be the world's oldest and most resilient agroecosystem.

Artificial fertilizers had been created during the 18th century, initially with superphosphates and then ammonia-based fertilizers mass-produced using the Haber-Bosch process developed during World War I. These early fertilizers were cheap, powerful, and easy to transport in bulk. Similar advances occurred in chemical pesticides in the 1940s, leading to the decade being referred to as the 'pesticide era'. But these new agricultural techniques, while beneficial in the short term, had serious longer term side effects such as soil compaction, soil erosion, and declines in overall soil fertility, along with health concerns about toxic chemicals entering the food supply.

Soil biology scientists began in the late 1800s and early 1900s to develop theories on how new advancements in biological science could be used in agriculture as a way to remedy these side effects, while still maintaining higher production.

In Central Europe **Rudolf Steine**r, whose *Lectures on Agriculture* were published in 1925 created biodynamic agriculture, an early version of what we now call organic agriculture.Steiner was motivated by spiritual rather than scientific considerations.

In the late 1930s and early 1940s **Sir Albert Howard** and his wife Gabrielle Howard, both accomplished botanists, developed organic agriculture. The Howards were influenced by their experiences with traditional farming methods in India, biodynamic, and their formal scientific education. **Sir Albert Howard** is widely considered the **"father of organic farming",** because he was the first to apply scientific knowledge and principles to these various traditional and more natural methods

In the United States another founder of organic agriculture was **J.I. Rodale**. In the 1940s he founded both a working organic farm for trials and experimentation, The Rodale Institute, and founded the Rodale Press to teach and advocate organic to the wider public.

Further work was done by **Lady Eve Balfour** in the United Kingdom, and many others across the world.

There is some controversy on where the term "organic" as it applies to agriculture first derived. One side claims term 'organic agriculture' was coined by **Lord Northbourne,** an agriculturalist influenced by Steiner's biodynamic approach, in 1940.

Increasing environmental awareness in the general population in modern times has transformed the originally supply-driven organic movement to a demand-driven one. Premium prices and some government subsidies attracted farmers. In the developing world, many producers farm according to traditional methods that are comparable to organic farming, but not certified, and that may not include the latest scientific advancements in organic agriculture. In other cases, farmers in the developing world have converted to modern organic methods for economic reasons

Organic Agriculture in India

The growth of organic agriculture in India has three dimensions and is being adopted by farmers for different reasons.

First category of organic farmers are those which are situated in no-input or low-input use zones, for them organic is a way of life and they are doing it as a tradition (may be under compulsion in the absence of resources needed for conventional high input intensive agriculture).

Second category of farmers are those which have recently adopted the organic in the wake of ill effects of conventional agriculture, may be in the form of reduced soil fertility, food toxicity or increasing cost and diminishing returns.

The third category comprised of farmers and enterprises which have systematically adopted the commercial organic agriculture to capture emerging market opportunities and premium prices.

While majority of farmers in first category are traditional (or by default) organic they are not certified, second category farmers comprised of both certified and un-certified but majority of third category farmers are certified. These are the third category commercial farmers which are attracting most attention. The entire data available on organic agriculture today, relates to these commercial organic farmers

Growing area

Emerging from 42,000 ha under certified organic farming during 2003-04, the organic agriculture has grown almost 29 fold during the last 5 years. By March 2010 India has brought more than 4.48 million ha area under organic certification process. Out of this cultivated area accounts for 1.08 million ha while remaining 3.4 million ha is wild forest harvest collection area

Regulatory mechanism

For quality assurance the country has internationally acclaimed certification process in place for export, import and domestic markets. National Programme on Organic Production (NPOP) defines the regulatory mechanism and is regulated under two different acts for export and domestic markets. NPOP notified under Foreign Trade Development and Regulation Act (FTDR) looks after the export requirement. The NPOP notified under this act has already been granted equivalence by European Union and Sweden. USDA has also accepted the conformity assessment system of NPOP. Due to this, the product certified by any Indian accredited certification agency under NPOP can be exported to Europe, Sweden and USA without the requirement of re-certification.

To look after the requirement of import and domestic market the same NPOP has been notified under Agriculture Produce Grading, Marking and Certification Act (APGMC).

Regulatory body of NPOP under FTDR act is Agricultural and Processed Foods Export Development Authority (APEDA) under Ministry of Commerce and of NPOP under APGMC act is Agricultural Marketing Advisor (AMA) under Ministry of Agriculture.

Accreditation of Certification and Inspection Agencies is being granted by a common National Accreditation Body (NAB). 18 accredited certification agencies are looking after the requirement of certification process. Out of these 4 agencies are under public sector while remaining 14 are under private management.

Future prospects

Although, commercial organic agriculture with its rigorous quality assurance system is a new market controlled, consumer-centric agriculture system world over, but it has grown almost 25-30% per year during last 10 years. In spite of recession fears the growth of organic is going unaffected. The movement started with developed world is gradually picking up in developing countries. But demand is still concentrated in developed and most affluent countries. Local demand for organic food is growing. India is poised for faster growth with growing domestic market. Success of organic movement in India depends upon the growth of its own domestic markets.

India has traditionally been a country of organic agriculture, but the growth of modern scientific, input intensive agriculture has pushed it to wall. But with the increasing awareness about the safety and quality of foods, long term sustainability of the system and accumulating evidences of being equally productive, the organic farming has emerged as an alternative system of farming which not only address the quality and sustainability concerns, but also ensures a debt free, profitable livelihood option.

Questions

A. Choose the correct answer

A1.	Organic farming otherwise called as	
	a. Ecological farming	c. Natural farming

	b. Biological farming	**d. All the above**
A2.	Agriculture practices which aim to meet the demand of present generation without endanger the resource base for future generation referred as	
	a. Intensive agriculture b. Integrated agriculture	c. Extensive agriculture **d. Sustainable agriculture**
A3.	India has ------------ % of the area under organic farming	
	a. 0.33% b. 0.25%	c. 0.20% d. 0.40%
A4	------------ lectures in Agriculture created biodynamic agriculture	
	a.BioFach	**c. Rudolf Steiner**
	b..J.I. Rodale	d. Sir Albert Howard

B. Short question

B1.	Enumerate the concepts of organic farming
B2.	State the principles of organic farming

C. Brief question

C1.	What is organic farming? Mention the status of organic farming in Tamil Nadu.

Lecture-2 Introduction to bio-diversity, importance and measures to preserve bio-diversity

Biodiversity

The word biodiversity is a combination of two words: biological and diversity. It refers to the variety of life on the earth and encompasses all the living things that exist in a certain area, in the air, on land or in water : plants, animals, microorganisms and fungi. The area considered as small as a compost pit or as big as our whole planet. Animals and plants do not exist in isolation. All living things are connected to other living things and to their non- living environment. If one tiny species in an ecosystem becomes extinct, we may not notice or think it is important. But the biodiversity of the ecosystem will be altered and all the ecosystems the species belonged to will be affected.

Biological diversity therefore refers to the variety and variability among living organisms and the ecological complexes in which they occur. Diversity can be defined as the number of different items and their relative frequency. For biological diversity, these items are organized at many levels, ranging from complete ecosystems to the chemical structures that are the molecular basis of heredity. Thus the term encompasses different ecosystems, species, genes and their relative abundance. Biological diversity is defined as the variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and ecological complexes of which they are part; this includes diversity with in species, between species and ecosystems. There crop biodiversity, agri-horticultural biodiversity, herbal biodiversity, forest biodiversity all occurring at molecular, micro, and macro levels, a synergistic understanding alone will make us realize about the economic value of biodiversity resources.

Types of biodiversity

There are three aspects to biodiversity: species diversity, genetic diversity and ecosystem/habitat diversity. All three interact and change over time and from place to place.

Habitat diversity

Life exists in soil, air, water and other such habitats and biotic communities are controlled by the environmental variables. Ecosystems include not only the plants, animals and microbes that coexist at a place but also the ways in which they interact with each other and adopt to their physical environment. For example the river Ganges includes the fish, aquatic insects, mussels and variety of plants that have adapted.

Habitat is the aggregate of different environment types in a region. For example, a country on the coast could have a diversity of ecosystems from sandy beaches with salt water adapted biodiversity to lush rain forests and dry deserts, each with a unique set of species. Living organisms and physical environment interact with each other in an ecosystem.

Species diversity

Biodiversity is the sum of the variety of all living organisms at the species level. It includes earth's plants, animals, fungi and microbes. Around 1.5 millions species of living organisms are named. There is a hidden wealth of 10 to 100 million more living organisms which have to be estimated. Species diversity is a function of both species richness and evenness. It measures the number of species in a given community and also distribution of each species within the community.

Genetic diversity

Tremendous amount of genetic diversity exists within individual species. This genetic variability is responsible for different characteristic. Such species adopt to different environments. Genetic diversity is the raw material from which new species arise through evolution. Genetic diversity refers to the variation at the level of individual genes besides providing a mechanism. For ecological adaptation, more the variation, better the chances that at least some of the individuals will have an allelic variant that is suited for new environment.

Genetic diversity can be assessed at three levels

a) Diversity within breeding populations
b) Diversity between breeding populations
c) Diversity within species.

Value of biodiversity

The value of biodiversity in terms of its commercial utility, ecological services, social and aesthetic value is enormous. We get benefit from the organisms in innumerable ways. Sometimes we realize and appreciate the value of the organism only after it is lost from this earth. The multiple uses of biodiversity ay be classified as follows.

1.Consumptive use value

These are direct use values where the biodiversity products can be harvested and consumed directly e.g., fuel, food, drugs, fibre, etc.,

a) Food: A large number of wild plants are consumed by human beings as food. About 80000 edible plant species have been reported from the wild. About 905 of present day food crops have been domesticated fro wild tropical plants.
b) Drugs and medicines: About 75% of the world's population depends upon plants or plant extracts for medicines. The wonder drug penicillin used as an antibiotic is derived from a fungus called penicillium. Quinine, the cure for malaria is obtained from the bark of Cinchona tree. Digitalin is obtained from foxglove which is an effective cure for heart ailments.
c) Fuel: Our forests have been used since ages for fuel wood. The fossil fuels like coal, petroleum and natural gas also products of fossilized biodiversity.

2. Productive use values

These are the commercially usable values where the product is marketed and sold. These may include the animal products. Many industries are dependent upon the productive use values of biodiversity.

3. Social value

These are the values associated with the social life , customs, religion and psycho-spiritual aspects of the people. Many of he plants are considered holy and sacred in our country like Tulsi, Peepal, Mango, lotus, Bael etc., the leaves, fruits or flowers of these plants are used in worship. Many animals like cow, snake, bull, peacock, etc., also have significant place in psycho –spritual arena and thus hold special importance.

4.Ethical value

It is also sometimes known as existence value. It involves ethical issues like " all life must be preserved". It is based on the concept of "Live and Let Live"

Spatial patterns of Diversity:

Alpha diversity = number of species found in a small area.

Gamma diversity = number of species in a large region or continent.

Beta diversity = the rate of change of species composition along an environmental or geographical gradient. It links alpha and gamma diversity

Biodiversity

- The term biodiversity was coined by **WALTER G.ROSEN** in 1985.
- Defined as " the richness in variety and variability of a species of all living organism in a given habitat".
- It is the variability among living organisms from all sources including, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part..(Convention of Biological Diversity,1992)

Biodiversity Hotspots

- A **biodiversity hotspot** is a biogeographic region with a significant reservoir of biodiversity that is under threat from humans.
- A hotspot is an area which faces serious threat from human activities and supports a unique biodiversity (endemic, threatened, rare species)

- The concept of biodiversity hotspots was originated by Norman Myers(1988).
- Myers originally recognized 25 hotspots around the world.
- Recently 9 more biodiversity hotspots has been added which makes the present number to 34.
- To qualify as a biodiversity hotspot on Myers 2000 edition of the hotspot-map, a region must meet two strict criteria:

1. It must contain at least 0.5% or 1,500 species of plants of the world.
2. It has to have lost at least 70% of its primary vegetation.

India as a Mega Diversity region

- India is one of 12 mega diversity countries of world.
- It has 47,000 species of plants and 81,000 species of animals.
- Many endemic plants and animals.
- Centre of origin of many flowering and crop plants.
- Great marine diversity due to 7500 km long coastline

India has two major hotspots.

BIODIVERSITY HOTSPOTS OF INDIA

- 1. **Western Ghats -:**
  - Known as Sahyadri mountains. Floristic richness highest.
  - At least 325 globally threatened species occur. eg. purple frog, black leopard.
- 2. **Eastern Himalayas -:**
  - Numerous large birds and mammals, including vultures, tigers, elephants, rhinos and wild water buffalo.
  - Many endangered plants sps.

IUCN categories for species under threat

- Endangered species : on verge of extinction
- Vulnerable species : not endangered but is facing a very high risk of extinction in the future.
- Rare species :These are species with small total population size in the world ,their distribution are usually localized within restricted area of world.
- Threatened species: decline in number significantly in total numbers and may be on verge of extinction in certain localities.

IUCN Red list objectives

- Red data book or red list is a catalogue of taxa that are facing the risk of extinction.
- The main objectives are:
- 1. Identification and documentation of endangered species.
- 2.Providing a global index of the decline of biodiversity.
- 3.Developing awareness about the importance of threatened biodiversity.
- 4.Defining conservation priorities at the local level and guiding conservation action.

Data of endangered species

TAXANOMIC GROUP	→	NUMBER OF SPECIES.
• 1. Mammals	→	86
• 2. Birds	→	70
• 3. Reptiles	→	25
• 4. Amphibians	→	36
• 5. Plants	→	244
• 6. Fish		79

Threats to biodiversity

- Habitat Loss
- Pollution
- Over exploitation of selected species

Causes of Threat

Habitat loss - Most pervasive threat, impacting 86% of threatened mammals, 86% of threatened birds, and 88% of threatened amphibians.

Habitat loss due to :

- Rapid Industrialization
- Urbanization
- Food demand
- Deforestation and thereby land degradation.

Causes of Threat

- **Pollution** – 29% of amphibians are affected by pollution and 17% by disease.
- Air pollution
- Emissions of Toxic gases
  Acid Rain

Water Pollution

Eutrophication
Bioaccumulation followed by biomagnification
Toxicity imparted by domestic and industrial efluents

Causes of Threat

Over exploitation of selected species

Poaching :Targeting of certain selected species takes place even after legal protection , products from endangered species are traded within and between the nations.

Animals are killed for their skin, teeth, horn bones, medicinal use, research and educational purpose etc.

CONSERVATION OF BIODIVERSITY

There are two basic strategies for biodiversity conservation,these are most effective and efficient mechanism for conservation.

1-insitu(onsite) conservation

2-exsitu (off site) conservation

INSITU CONSERVATION

The term insitu conservation denotes conservation of species in its natural habitat ,that is where the species is normally found.

The insitu conservation strategies stress on protection of total ecosystems through a network of protected areas.

PROTECTED AREAS

To facilitate the growth and reproduction of plants and animals in their habitat, the area is protected by restricting human activities like hunting, firewood collection, timber harvesting etc.
Today, there are about 37,000 protected areas, parks, sanctuaries and biosphere reserves all around the world.

INDIA has over
600 protected areas, which includes over 90 national parks, over 500 animal sanctuaries and 15 biosphere reserves.
Protected areas contain maximum biological diversity.

NATIONAL PARKS

It is an protected area which is strictly reserved for the conservation/betterment of the wild life and where activities like forestry, grazing and cultivation are not permitted.

Their boundaries are well marked and circumscribed. They are usually small reserves spreading in an area of 100 sq,km. to 500 sq,km.

In national parks, the emphasis is on the preservation of a single plant or animal species.

Kaziranga national park in Assam

Gir national park in Gujarat.

Kanha national park in M.P etc.

WILDLIFE SANCTUARIES

It is an protected area which is reserved for the conservation of only animals and human activities like harvesting of timber, collection of minor forest products are allowed to a certain extent.

Boundaries of sanctuaries are not well defined and controlled biotic interference is permitted, e.g-tourist activity.

Anamalai wildlife sanctuary,Tamil nadu

Bir moti bagh wildlife sanctuary,Punjab

Chilka lake bird sanctuary,Orissa

Jaldapara sanctuary in West Bengal etc.

BIOSPHERE RESERVES

It is a special category of protected areas where human population also forms a part of the system.

They are large protected area of usually more than 5000 sq.km.

A biosphere reserves has 3 parts- core, buffer and transition zone.

1-The core zone is innermost zone, this is undisturbed and legally protected area.

2-Buffer zone lies b/w the core and transition zone. Some research and educational activities are permitted here.

3-Transition zone is the outermost part of biosphere reserves. Here cropping, forestry, recreation, fishery and other activities are allowed.

MAIN FUNCTIONS OF BIOSPHERE RESERVES:

(1)-CONSERVATION-**To ensure the conservation of ecosystem, species and genetic resources.**

(2)-DEVELOPMENT-**To promote economic development while maintaining cultural, social and ecological identity.**

(3)-SCIENTIFIC RESEARCH-**To provide support for research related to monitoring and education, local,national & global issues.**

Some biosphere reserves of India:-

Nilgiri (Kerala,Karnataka and Tamilnadu)

Nanda devi in U.P,Sunderbans in Rajasthan,Manas in M.P,Gulf of Mannar in Assam.etc.

EXSITU CONSERVATION

This is a conservation of species outside their habitat.

This includes gene, pollen,seed,tissue cultures and DNA banks and also includes various zoos & botanical gardens etc.

=>To conserve all these we have various methods of exsitu conservation:- etc.

1. Seed bank, gene bank, germplasm bank
2. Translocation area
3. Botanical parks
4. Zoological parks

(1)USE OF SEED BANK,GENE BANKS OR GERMPLASM

Some seeds show variable periods of dormancy. Most of seed plants therefore can be preserved in the form of their seeds in small packets for long durations. Places where seeds are stored are called seed banks or gene banks or sometimes germ plasm banks.

Term germplasm refers to any of plant organ or its part(living) from which new plants can be generated. They utilize the technique of cryopreservation in liquid nitrogen at a temp. of (minus)-196 degree Celsius.

(2)-ANIMAL TRANSLOCATIONS

Release of animals in a new locality:

Translocation is carried in following cases:

1-when a species on which an animal is dependent becomes rare.

2-when a species is endemic or restricted to a particular area.

3-due to habit destruction & unfavorable environment conditions.

4-increase in population in an area.

(3)-BOTANICAL GARDENS:

A botanical garden is a place where flowers, fruits and vegetables are grown.The botanical gardens provide beauty & calm environment. Most of them have started keeping exotic plants for educational & research purposes.

Many rare & endangered plants lives in botanical garden which have taken task of conservation of plants in a real sense.

In INDIA,the 1st botanical garden was established in Bombay in 1830 by agricultural society and in 1838 one more garden was established in madras.

Some Botanical gardens of INDIA:

Lloydbotanical garden at Darjeeling, Indian botanical garden at Calcutta, National Botanical garden at Lucknow etc.

(4)-ZOOLOGICAL GARDENS OR ZOOS:

In zoos wild animals are maintained in captivity .

Conservation of wild animals sp which are rare and endangered.

The oldest zoo, the Schonbrumm zoo which exist today also, was established in VIENNA in 1759.

The first indian zoo was setup by Raja Rajendra Mullick Bahadur at marble palace in calcutta(1854).

Questions

A. Choose the correct answer

A1.	Red data book contains data of	
	e. All plant species f. All animal species	g. Economically important species **h. Threatened species**
A2.	IUCN (The International Union For Conservation Of Nature And Natural Resources) headquarters is at	
	a. Morges, Switzerland b. Paris, France	a. Vienna, Austria b. Newyork, USA

A3.	Which one of the following is not an in-situ conservation method?	
	e. Zoo f. National Parks	g. Biosphere Reserves h. Sanctuaries
A4	Which of the following is not a cause for loss of biodiversity?	
	a. Destruction of habitat	**c. Keeping animals in zoological parks**
	b. Invasion by alien species	d. Over-exploitation of natural resources
A5	Which one of the following is an endangered plant species of India?	
	a. Rauwolfia serpentina	c. Cycas beddonei
	b. Santalum album (Sandal wood)	**d. All of the above**
A6	Number of species found in a small area	
	a. Alpha diversity	c. Gamma diversity
	b. Beta diversity	d. Tetra diversity
A7	The term biodiversity was coined by	
	a. **Walter Rosen**	c. Rudolf Steiner
	b. Norman Myer	d. J.I. Rodale

B. Short question

B1.	Narrate the functions of biosphere reserves
B2.	Write short notes about biosphere reserve

C. Brief question

C1.	Define biodiversity? Mention the types of biodiversity and brief about the conservation strategies

Lecture-3 Pre-requisites and basic steps for organic farming; conversion to organic farming- planning and processes in practices- IFS approach-Integration of animal components

Organic Farming Requirements

The conversion from a conventional to an organic system requires a transitory period, where the organic practices are applied progressively following an organized plan. During this period it is important to analyze carefully the actual situation of the farm and identify the actions to be taken

The analysis of the farm must include

1. Farm characteristics: size, plots and crops distribution, which kind of crops, trees, animals are integrated in the farm system.

2. Soil Analysis: an evaluation of the soil structure, nutrient levels, organic matter content, erosion level, and/or the soil have been contaminated.

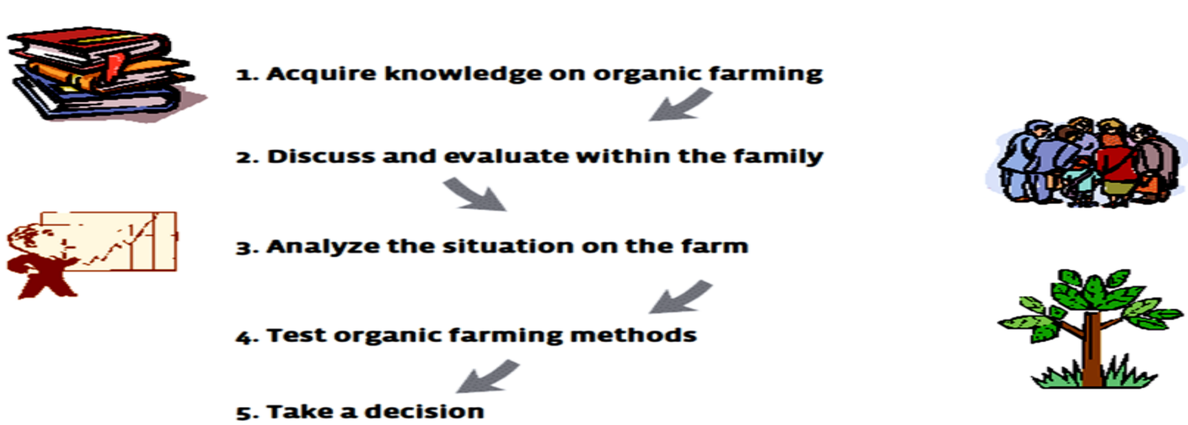
3. Climate: rainfall distribution and quantity, temperatures, frost risks, humidity.

4. Organic matter sources and management (manures).

5. Presence of animal housing systems and/or machinery.

6. Limiting factors such as capital, labour, market access, among others.

This information will help to have a clear picture of farm and to take decisions



1.Farms with high external input use

Potential challenges in conversion of such farms

- Establishing a diverse and balanced farming system with a natural ability takes several years.
- Restoring natural soil fertility by providing a considerable amount of organic matter to the soil.

- Abandoning high input external fertilizers results in yield depression in the first years of conversion,

- New approaches and practices usually involve a lot of learning and intensive observation of crop development, and dynamics of pests, diseases and natural enemies.

2.Farms with low external input use

Traditional farmers fulfil some principles of organic farming already by relying on farm-own resources, growing different crops simultaneously and raising livestock. However, there are still practices, which clearly distinguish such farms from organic farms. The following challenges need to be addressed for conversion:

- Avoiding burning of crop residues
- Establishingorganised diversification systems ,to collect the animal manure for composting.
- To prevent loss of soil through erosion and protect it from drying out.
- Special attention to requirements of the farm animals.
- Avoiding infection of seeds with diseases, gain knowledge on disease cycles and preventive measures.
- Avoiding harvest and storage losses.

Implement planned crop rotation and intercropping systems. A combination of annual and perennial crops

Mixed farms

On mixed farms, crops and farm animals may be integrated, whereby the animal manure is collected and used in the gardens after having kept it for a few weeks to rot. Some soil conservation measures may be implemented, such as mulching in perennial crops and trenches to reduce erosion.

Farmers of such mixed farms are obviously familiar with some of the organic farming practices. Such farmers will find it easy to learn new methods from other farmers or from a trainer and to implement organic practices throughout the farm.

Recommendations for organic conversion

- Implement organic practices to manage the soil and to control weeds instead of using herbicides.
- Further improve recycling of farm own nutrients from animals and crop residues
- Use seeds without pesticide-treatments
- Get familiar with approaches and methods of natural pest and disease control.

- Learn about beneficial insects and observe population dynamics of pests through regular monitoring during crop growth.
- Further diversify the farming system to increase productivity of the land and provide habitats

Climate related challenges to conversion

- Converting a farm to organic farming in an area with very little rainfall and high temperatures or strong winds will be more challenging than converting a farm located in an area with well distributed rainfall and favourable temperatures. At the same time, the improvements that follow implementation of organic practices will be more obvious under arid conditions than under ideal humid conditions. For example, compost application into topsoil or into planting holes will increase the soils water retention capacity and the crop's tolerance to water scarcity.

- In very **warm and dry climate**, the key to increasing crop productivity lies in protecting the soil from strong sun and wind and increasing the supply of organic matter and water to the soil.
- In **warm and humid climate**, high aboveground biomass production and rapid decomposition of soil organic matter imply that the nutrients are easily made available to the plants. But it also involves a high risk that the nutrients are easily washed out and lost.
- Combining different practices to protect the soil and feed it with organic matter proves to be the most effective approach to choose. These practices include creating a diverse and multi-layer cropping system ideally including trees, growing nitrogen-fixing cover crops in orchards and applying compost to enrich the soil with organic matter and in this way increase its capacity to retain water

The conversion of a farm commonly consists of three steps.

- In a first step, it is recommended to collect information on appropriate organic farming practices.
- In a second step, the most promising organic practices should be tried out on selected plots or fields to get familiar with.

- In a third step, only organic procedures should be implemented in the entire farm.

Support from an experienced extension officer or a farmer is usually very helpful to give guidance in the process.

Successful organic farming requires considerable knowledge on the functioning and the possibilities of management of natural processes. Interest in learning about the possibilities to support natural processes to sustain and improve harvests is essential for successful organic farming.

Basically, farmers who are interested in converting their farm to organic agriculture need to know:How to

- improve soil fertility.
- keep crops healthy.
- increase diversity in the farm.
- keep livestock healthy.
- give value to organic products and how to successfully sell them.

After having collected information about the requirements,

In the second step the potentials and the main practices related to conversion, farmers should start to learn from their own experience on their farms. To minimize risks of crop failure and losses of animals, and avoid frustrating overload, farmers are recommended to implement organic practices step-by-step to a limited extent, selecting specific practices at a time and testing them on selected plots or selected animals only. Examples of recommended interventions include mulching ,intercropping,composting,greenmanuring,organic pest management etc.,

Criteria for crop selection during conversion

In the first place, organic farmers should grow crops for

- Environment favourable growing conditions
- Enough food for the family and supply of fodder for animals
- Improving soil fertility,
- With low risk of failure.
- Shouldhave market andProfit
- Appropriate for the conversion period- Perennial crops such as fruit trees which take at least 3 years and Intesifying Planting - hedges other crops and/or agroforestry trees, as leguminous green leaf manures

In a third step,

Implementation of organic practices throughout the entire farm should be considered, once sufficient experience with different practices has been gained. As soon as organic practices are implemented throughout the entire farm, a farmer can claim to be an organic farmer.

Commonly, consistent application of organic practices marks the beginning of a long process of improving the production system:

1. Improving soil fertility based on the recycling of farm own organic materials and enhancement of farm own biomass production.

2. Encouraging positive interactions between all parts of the production system (the farm ecosystem) to enhance self-regulation of pests and diseases.

3. Optimizing the balance between feed production and livestock.

Farming organically also means continuously learning from personal observation, from outside experiences, sharing experiences with other organic farmers and implementing new information on the your farm, making it increasingly more sustainable.

Protecting crops from pesticide drift

To avoid pesticide drift from neighbouring fields onto the crops, organic farmers should safeguard the organic fields by using any of the following measures:

- Planting of natural hedges on the boundary to neighbouring fields
- To avoid runoff from upstream fields,
- Organic farmers, who are interested in saving nature, should share their knowledge and experiences with neighbours with the aim of helping them to either adopt organic farming practices or to minimize the risk of contaminating nature.

b) Genetically Modified Organisms (GMO):

Genetically modified seeds and planting materials are produced by transferring isolated genes from plants, animals or microorganisms into the crop genome, by using methods different from pollination and crossing natural barriers. Genetically modified products should, therefore, not be used in organic farming, and organic farmers should protect their production against any GMO contamination .

Recommendations to farmers for reducing the GMO contamination risk:

Use either personally selected seeds or get organic or untreated seeds. Verify the origin of the seeds, making sure that they do not come from neighbouring farmers where GM crops are grown, or from farms surrounded by GM crops (minimum distance of at least 1 km).

GMO free regions should be encouraged wherever possible, especially for own seed production

Conversion Requirements

General Principles

Organic agriculture means a process of developing a viable and sustainable agro-ecosystem. The time between the start of organic management and certification of crops and/or animal husbandry is known as the conversion period.The whole farm, including livestock, should be converted according to the standards over a period of three years

Recommendations

For a sustainable agro-ecosystem to function optimally, diversity in crop production and animal husbandry must be arranged in such a way that there is an interplay of all the elements of the farming management.

- Conversion may be accomplished over a period of time.
- A farm may be converted step by step.
- The totality of the crop production and all animal husbandry should be converted to organic management.
- There should be a clear plan of how to proceed with the conversion.
- This plan shall be updated if necessary and should cover all aspects relevant to these standards.
- The certification programme should set standards for different farming systems so that they can be clearly separated in production as well as in documentation, and the standards should determine norms to prevent a mix up of input factors and products.

Standards

The standards requirements shall be met during the conversion period. All the standards requirements shall be applied on the relevant aspects from the beginning of the conversion period itself.

If the whole farm is not converted, the certification programme shall ensure that the organic and conventional parts of the farm are separate and inspectable. Before products from a farm/project can be certified as organic, inspection shall have been carried out during the conversion period.

Suitability of farming system for conversion to organic farming

Drylands are the potential place where organic farming can be initiated first as it favours for easy conversions.Less effect of high input agriculture thus least residue of pesticide and less time required for conversion.Organic manure improve the fertility and water retention capacity of poor soils of dry lands.Poor economic status of the dryland farmers limits him to purchase high cost inputs. But the thedryland farmers can do the labour intensive operations, which support organic farming.

Animal Husbandry

Introduction Integrating animal husbandry into crop producing farms is one of the principles of organic farming. In temperate and arid zones, animal husbandry plays an important role in the recycling of nutrients, while it is less emphasized in the humid tropics. The caring, training, and nurturing of animals is considered an art in many farming communities.

Animal husbandry in organic farming is different from both extensive animal husbandry, which is often environmentally damaging (e.g. overgrazing of common lands), and from in-tensive animal husbandry which keeps animals under ethically unacceptable conditions.

Integrating animals into the farm

Integrating animals into a farm can help to recycle nutrients. By-products such as straw, biomass from field margins or kitchen wastes, can be used as cheap and easily available fodder. At the same time, the dung should be returned to the fields in the most efficient way in order to increase the fertility of the soil. Animal products such as milk, eggs, and meat can both be used for the family as well as for selling, thus generating income for the farmer.

Many farm animals have a multi-functional role.

They can:

- Produce dung , Yield products such as milk or eggs Recycle by-products such as straw or kitchen waste.
- Serve as draught animals
- Help in pest control (e.g. dugs) and weed management (e.g. grazing on barren fields).
- Have cultural or religious significance (prestige, ceremonies etc.).

- Produce young stock for breeding or sale.

The significance of each role will vary from animal to animal and from farm to farm. It will also depend onthe individual objectives of the farmer

IFOAM Basic Standards on animal husbandry

Organic animal husbandry means feeding organic food and avoiding synthetic food additives. It is also putting a focus on satisfying the various needs of the farm animals. Good health and welfare of the animals are among the main objectives. Suffering due to permanent tethering or isolation of herd animals must be avoided as much as possible. For various reasons, landless animal husbandry (i.e. fodder purchased from outside the farm, no grazing land) is not permitted in organic farming.

There is a range of standards regulating the management, shedding, feeding, veterinary treatment, breeding, purchase, transport, and slaughter of farm animals in detail. In order to identify the appropriate number for a specific kind of animal on a farm, the following points should be considered:

- Availability of fodder on the farm, especially in periods of scarcity (e.g. dry season).
- Carrying capacity of pastures.
- Size of existing or planned sheds.
- Maximum amount of manure the fields can bear.
- Availability of labour for looking after the animals

Questions

A. Choose the correct answer

A1.	The time between the start of organic management and certification of crops and/or animal husbandry is known as -------------------- period	
	i. Transition **j. Conversion**	k. Functional l. Clean
A2.	The process of changing an agricultural farm from conventional to organic farm	
	a. Organication b. Naturalization	**c. Transition** d. Ecologicalization
A3.	Which among the following enterprises provide constant income?	
	i. Poultry **j. Dairy**	k. Fishery l. Apiculture

B. Short question

B1.	What are the requirements for converting to organic dairy production?
B2.	How long does it take to transition land farmed conventionally to organic status?

C. Brief question

C1.	What are the pre-requisites and basic steps for conversion to organic farming?. Write in brief about the planning and processes in practices

Lecture-4 Organic carbon; status and improvement strategies- conservation tillage system

Organic matter makes up just 2-10% of the soils mass but has a critical role in the physical, chemical and biological function of soils. Carbon is a measureable component of soil organic matter. Organic matter contributes to nutrient turnover and cation exchange capacity, soil structure, moisture retention and availability, degradation of pollutants, greenhouse gas emissions and soil buffering.

Soil organic matter

Soil organic matter (SOM) is mainly composed of carbon, hydrogen and oxygen but also has small amounts of nutrients such as nitrogen, phosphorous, sulphur, potassium, calcium and magnesium contained within organic residues. It is divided into ‘living’ and ‘dead’ components and can range from very recent inputs such as stubble to largely decayed materials that are thousands of years old. Less than 15% of below-ground soil organic matter such as roots, fauna and microorganisms is ‘living’ .

Soil organic matter also exists as four distinct fractions which vary widely in their in size, composition and turnover times in the soil .

1. Dissolved organic matter
2. Particulate organic matter
3. Humus
4. Resistant organic matter

The size, turnover rate and composition of the four soil organic matter fractions			
Fraction	**Size micrometres (µm) &millimetres (mm)**	**Turnover time**	**Composition**
Dissolved organic matter	<45 (µm) (in solution)	Minutes to days	Soluble root exudates, simple sugars and decomposition by-products. It generally makes up less than 5% of total soil organic matter.
Particulate organic matter	53µm–2mm	2-50 years	Fresh or decomposing plant and animal matter with identifiable cell structure. Makes up between 2-25% of total soil organic matter.
Humus	<53µm	Decadal (0s-00s years)	Older, decayed organic compounds that have resisted decomposition. Can make up more than 50% of total soil organic matter.
Resistant organic matter	<53µm <2mm	00s-000s years	Relatively inert material such as chemically resistant materials or organic remnants (e.g. charcoal). Can be up to 10% of soil organic matter.

Storing the carbon contained in organic matter within the soil is seen as one way to mitigate climate change by reducing greenhouse gas emissions (in this case carbon dioxide) but to do this an increase in the more stable or resistant fractions of organic matter is required.

Soil organic matter differs from soil organic carbon

Soil organic carbon (SOC) is different to organic matter because it refers only to the carbon component of organic compounds. Soil organic matter is difficult to measure directly, so laboratories tend to measure and report soil organic carbon. A conversion factor is available to report soil organic matter when required.

About 58% of the mass of organic matter exists as carbon. So if we know the organic carbon content in a soil we can estimate the amount of organic matter:

Organic matter (%) = total organic carbon (%) x 1.72

While this ratio can vary in different soils, using a conversion factor of 1.72 provides a reasonable estimate of soil organic matter and is suitable for most purposes.

The amount of soil organic carbon and soil organic matter in a soil

Soil organic carbon stock in tonnes of carbon per hectare (tCha) = total organic carbon (%) x mass of soil in a given volume (bulk density)

As an example, in a soil with a soil organic carbon of 1.3% and a bulk density of 1.2 grams per cubic centimetre (g/cm^3) the amount of soil organic carbon to a depth of 10cm would be:

1.3 x 1.2 x 10 = 15.6 tC /ha. Using the conversion factor of 1.72 the amount of soil organic matter would be: 15.6 x 1.72 = 26.8 tonnes of organic matter.

Soil organic matter cycling

Soil type, climate and management influence organic matter inputs to soil as well as its turnover or decomposition. Rainfall is a major driver of plant growth (biomass) and biological activity which results in the decomposition of organic matter that enters soil. The different fractions of soil organic matter (dissolved, particulate, humus and resistant) turn over at vastly different rates Furthermore, soil organic matter cycles continuously between living, decomposing and stable fractions in the soil .

Organic matter transforms from one form to another as it is decomposed and cycles into different soil organic fractions

1. Inputs: Plants and animals become part of the soil organic matter as they die or create by-products.
2. Transformation: Soil organisms break-up and consume organic matter, creating different forms of organic residues. For example, fresh plant residues are broken into smaller pieces (< 2mm) and become part of the particulate organic matter fraction. This material decomposes further and a smaller amount of more biologically stable material enters the humus pool.
3. Nutrient release: Nutrients and other compounds not required by microorganisms are released and are then plant available.
4. Stabilising organic matter: As the organic residues decompose, they become more resistant to further decomposition

Measurement soil organic carbon .

Accurate measurement of changes in organic carbon requires:

- a soil samplingstrategy that captures the natural variation in soil carbon
- a measure of soil organic carbon concentration
- an ,estimate of bulk densityof the soil to adjust for changes in soil mass at specified depth intervals.

Changes in soil organic carbon are most likely to be observed in the topsoil (0-10cm).

An increase in soil bulk density can occur through compaction from wheel tracks (left). As such a measurement of soil bulk density (right) is needed to measure soil organic carbon stocks on a tonnes per hectare basis and to determine changes in soil organic carbon stocks over time

Soil tests for organic carbon normally report a percentage total soil organic carbon (%). Using a measure of bulk density the amount of carbon per hectare in a given depth of soil can be calculated as shown.

Example
The amount of organic carbon to 10 cm depth in soil with a carbon value of 1.3% and bulk density of $1.2 g/cm^3$ is:
$1.3 \times 1.2 \times 10 = 15.6$ tonnes organic carbon

The depletion is exacerbated when the output exceeds the input.Severe depletion leads to

- Degrading soil quality
- Reduces biomass productivity
- Affects water quality
- May add to global warming

Estimates of pre and post industrial losses of carbon from soil and emission from fossil fuel combustion (refer Lecture 4b)

Soil carbon sequestration

It implies transferring atmospheric CO_2 into long lived pools and storing it securely so that it is not immediately reemitted.

It means increasing SOC and SIC stocks through judicious land use and recommended management practices (RMPs).

The potential soil sink capacity of managed ecosystem approximately – 55 to 78 Gt

Attainable capacity ---50-66%

Sequestration is cost effective and environment friendly

Tillage operations on C emission

Type of operation	**Loss of C in emission in Kg/ha**
Mould board ploughing	15
Chisel ploughing/heavy tanden disking	8
Light tanden disking	6
Sub-soiling	11
Cultivation	4
Rotary hoeing	2
Conversion from conventional to no till farming per season-reduction in emission by	30 to 35

Humic substances

Fulvicacid - low mol. Wt both acid & alkali soluble

1. Humic acid – Medium mol. Wt . Alkali soluble but acids insoluble
2. Humin - High mol. Wt both acid and alkali insoluble

Fulvicacid is more susceptible to microbes

Humin is most resistant to microbial action

Non-humic substances

CHO, protein, wax, resins, pigments & low mol. Wtcompoundmostly easily attacked by the microorganisms.

Humus is a complex and rather resistant mixture of brown or dark brown amorphous and colloidal substances modified from the original tissues or synthesized by various organisms.

Humus – 40-45% lignin

30-33% Protein, rests are fats, waxes and residual materials

Lignin - protein – 70-80% Hence humus is called Lignin-Protein complex

Nature and characteristics of humus

1. Humus is composed of C,H,O
2. Surface area more than silicate clays
3. Negatively charged – sources are COOH or Phenolic C6H5OH. The (-) charge is pH dependent.
4. WHC is more than 4-5 times of silicate clays.
5. At high pH, CEC ; 150-300 C mol/Kg soil
6. Low plasticity and cohesion- favours aggregate formation and stability
7. Black colour
8. Cation exchange reactions similar to silicate clays
9. Cellulose is first acted by fungi then made available to Bacteria
10. Wood is decomposed by actinomycetes.
11. Organic matter content of Indian soil is low because of high rate of decomposition under tropical and sub-tropical climate.

Factors affecting organic matter decomposition

1. Moisture
2. Temperature – 24-35• C
3. Aeration
4. C:N ratio

C:N ratio

Used for predicting rate of decomposition

Control of available N, total organic matter, organic decay rate are important for developing a sound management system.

Significance of C:N ratio

- Keen competition among micro-organisms for available N results when residues having a high C:N ratio are added to the soil.
- C:N ratio is relatively constant in the soil, the maintenance of C and hence O.M in soil depends largely on the soil N level.

Decomposition process

C is lost as CO_2, C:N ratio of the remaining material decreases , N is conserved

Older plants have wider C:N ratio

Legumes have relatively low C:N ratio

Soil organic matter can not be increased without simultaneously increasing N content and *vice-versa*

Role organic matter in nutrient supply

Organic matter is sources of plant nutrients which are liberated in available forms during mineralization

N mineralization

N mineralization is the conversion of organic N to NH_4^+

Mineralization ⟶ Aminization and ammonification by heterotrophs , Soil moisture, temperature and aeration.

Soil moisture ⟶ 50 – 705 water filled pore space

Soil temperature ⟶ 25 -35•C

Mineralization rate of OM

SOM ⟶ 5% N

Single growing season – 1to 4 % of organic N is mineralized to inorganic N

Concept

As total soil N content increases, the quantity of N mineralized from soil organic n increases.

Therefore , soil and crop management strategies that conserve or increase soil OM will result in a greater contribution of mineralizable N to N availability to crops.

The quantity of N mineralized during the growing season can be estimated.

Example

- If a soil contained 4% Om and 2% mineralization occurred, then
- 4%OMx(2x10^6 Kg soil/ha-15cm)x(2% N mineralized)=80 Kg/ha N as NH_4

Aminization

Protein

Ammonification: Amines, amino acids and urea produced by aminization of organic N are decomposed by heterotrophs and release NH_4^+. This step is termed as ammonification.

$$R\text{-}NH_2 + H_2O \longrightarrow NH_3 + R\text{-}OH + \text{energy}$$

$$NH_3 \xrightarrow[H_2O]{} NH_4 + OH$$

Diverse population of aerobic , anaerobic bacteria, fungi and actinomycetes is capable of liberating NH_4 which is subject to several fats.

N- Immobilization

It is the conversion of inorganic N (NH_4^+ or $NO3^-$) to organic N and is basically reverse of N mineralization. If decomposing organic matter contains low N relative to C, the micro organisms will immobilize NH4 or NO3 in the soil solution.

The microbes need N in a C:N ratio of about 8:1; therefore, inorganic N in the soil is utilized by the rapidly growing population.

Soil organisms compete very effectively with plants for NH4+ or NO3 during immobilization and plants can readily become N deficient.

C/N ratio effects on N mineralization and immobilization

The ratio of %C to %N (C/N ratio) defines the relative quantity of these two elements in crop residues and other fresh organic materials, soil OM and soil micro organisms.

The n content of humus or stable soil OM ranges from 5.0 to 5.5% whereas C ranges from 50 to 58%, giving a C/N ratio ranging between 9 and 12.

N mineralization/ immobiloization depends on the C/N ratio of OM

Dividing line between N mineralization and immobilization

C/N ratio of approximately 20:1 is the dividing line between immobilization and mineralization.

- OM with C/N ratio > 30:1 $\longrightarrow$ N Immobilization
- OM with C/N ratio 20- 30:1 $\longrightarrow$ Neither Immobilization or minerlization
- OM with C/N ratio <20:1 $\longrightarrow$ release of mineral N in the decomposition process

In aerobic soil

Concentration of 2.0% N are usually sufficient to minimize immobilization of soil N

In anaerobic soil

N requirement for decomposition is only about 0.5%

Estimation of immobilized inorganic N

Example

- Incorporating 2000 Kg/ha residue containing 45% C and 0.75% N (C/N ratio of 60:1) in to the soil represents 900Kg.
- 2000 Kg residue x 45%C = 900KgC in the residue
- Microbial activity will utilize 35% of residue C $\longrightarrow$ 35%
- Respiration as CO_2 $\longrightarrow$ 65%
- Thus microbes will use 315 Kg C in the residue
- 900 Kg x 35% = 315 Kg C used by microbes
- The increasing microbial population will require N governed by the microbe C/N ratio of 8:1
- 315 Kg C / X Kg N = 8/1
- X = 39 Kg/ha N needed by microbes.
- The microbes will readily use the 15Kg/ha N in the residual during decomposition
- 900 Kg C/X Kg N =60/1
- X + 15 Kg/ha in residue
- The residue N content can also be calculated as follows : 2000 Kg residue x 0.75% N = 15 lb N, thus the quantity of N immobilized is
- 39 Kg N needed – 15 Kg N in residue = 24 kg/ha N immobilized.
- Therefore, atleast 24 Kg/ha will be needed to compensate for immobilization of inorganic N. Routine fertilizer recommendations usually account for N immobilization requirements.

N mineralization and immobilization effects on soil OM

OM more in

- Cooler climate
- Effective precipitation
- Fine textured soil
- Grass land vegetation
- Drainage impeded soil

Nitrification

$2NH_4^+ + 3O_2^- \longrightarrow 2\ NO_2 + 2\ H_2O + 4H^+$

$(-3) \longrightarrow (+3)$

Increasing oxidation state of N

$2NO_2^- + O_2 \longrightarrow 2NO_3^-$

$(+3) \longrightarrow$ (+5) increasing oxidation state of N

Factors affecting the nitrification

Supply of NH_4^+

Population of organisms

Soil pH

Soil aeration

Soil moisture

Temperature

Nitrate leaching

NH_4^+ fixing

Gaseous losses of N

Questions

A. Choose the correct answer

A1.	The role of bacteria in carbon cycle is	
	a. **Breakdown of organic compounds** b.Chemosynthesis	c. Photosynthesis d. Assimilation of nitrogen compounds
A2.	Year round tillage is type of	
	a. Primary tillage b. Secondary tillage	a. Zero tillage b. All of the above
A3.	Breaks up the soil and buries crop residue	
	m. Primary tillage n. Conventional tillage	o. Pre-plant tillage p. Secondary tillage
A4	The C/N ratio of organic materials tends to ______ during the composting process	
	a. Decline	c. remain constant
	b. Increase	d. fluctuate in cycles
A5	Increasing carbon stocks through	
	a. Protecting existing forest	c. Reforesting degraded lands
	b. Trees in crop lands	**d. All the above**
A6	The amount of organic carbon to 10 cm depth in soil with a carbon value of 1.3% and bulk density of 1.2g/cm³. Find out the amount of soil organic matter	
	a. 15.6 tonnes	**c. 26.8 tonnes**
	b. 18.2 tonnes	d. 24.3 tonnes
A7	Changes in soil organic carbon are most likely	
	a. 0-10 cm	c. 20-30 cm
	b. 10-20 cm	d. 30-40 cm

B. Short question

B1.	Brief about Soil carbon sequestration
B2.	Describe the role of soil organic matter in soil fertility

B3.	Define conservation tillage. Write its advantages

C. Brief question

C1.	What is meant for soil organic carbon? Describe the status and improvement strategies of organic carbon in soil
C2.	Explain conservation tillage and list its various advantages over conventional tillage

Lecture-5 Sources of organic manures-plant, animal and microbial origin- On-farm resources; FYM, green manures, crop residues, Poultry manure, Sheep and goat manures, bio-gas slurry and vermi-compost

Sources of Plant nutrients

Plant nutrients are essentially supplied through manures and fertilizers. Manures are organic in nature and applied in large quantities. They are also called as organics or organic manures. They are of animal and plant origin and contain more than one nutrient element. Nutrient content in organic manure is low. Fertilizers are inorganic or synthetic and the nutrient content is higher than in manures. Fertilizers are available for a particular nutrient or combination of nutrients.

EFFECT OF INORGANIC FERTILIZERS AND OTHER AGRO-CHEMICALS ON SOILAND PLANTS

Excessiveuseofchemicalfertilizersandotheragrochemicals,whicharetheimportantinputsinmodernf armingcreatesdepletioninsoilfertilityandpollutioninsurfacewaterbodies.

1. Watersolublefertilizerswhenappliedtosoil,itresultsinrapidrateofnutrientslossindifferentformsan dincreases thesoilaciditywithnitrification.
2. Emissionof ammonia,methane, nitrous oxideandelementalnitrogenfromthesoilsystemas aresult ofdenitrification.
3. Depletionof secondary andmicronutrientsespeciallySulphurandZinc.
4. Deficiency of thesenutrients (S&Zn)alongwiththat of Mg,Mn, Fe, Mo, BandCulimitsproductivityof many fieldcropsespeciallyinrice.
5. Humusdepletionandfallincropproduction,whichcanbeavoidedonlybyaddingadditionalamounts

oforganicresiduesandmanures.

6. Whenhighlevels of N-fertilizersespeciallynitrateforms areappliedtosoil,nitratepollutionofdrinkingwateris aserious healthhazard
7. Alarmingissuetohumanhealthisregularuseofphosphaticfertilizerinlargequantitiesoftencausesth ebuildupoftracemetalcontaminationsuchasarsenic,fluoride,cadmiumetc.insoilandplants.
8. Thewatersolublenutrientswhencarriedtolakesandstreamthroughleachingandsurfacerunoffcause eutrophicationasmanifestedbytheluxuriantgrowthofalgaeandotherwaterweedsonthewatersurfac eleadingtooxygendeficientcondition.Thissituationisnotconducivetohealthyaquaticlife.

Farm Yard Manure (FYM)

FYM ispartiallyd e composeddung,urine,beddingandstraw.Dungcomesmostlyasundigestedmaterialandtheurinefro mthedigestedmaterial.Morethan50percentoftheorganicmatterthatispresentindungisintheformofcomplexprod uctsconsistsofligninandproteinwhicharereresistanttofurtherdecompositionandthereforethenutrientspresentindu ngarereleasedveryslowly.

Thenutrientsfromurine,becomesreadilyavailable.Dungcontainsabout50percentofthenitrogen,15percento fpotashandalmostallofthephosphorusthatisexcretedbyanimals.Straw,sawdustorotherbeddingmaterialsareuse dincattleshedstoreducethelossofurineandtoincreasethebulkofmanure.

Onanaverage,about3-5kgbeddingmaterialperanimalisusedbyfarmers.FYMcontainsapproximately5-6kgnitrogen,1.2-2.0kgphosphorusand5-6kgpotashpertonne.ThequantityandqualityofFYMdependuponthetype(draught,mulch)andageoftheanimals,th ewaytheyarefedandthecaretakentocollectandstorethematerial.

ForpreparingbetterqualityFYM,theuseofpitmethodforareaswithlessthan1000mmprecipitationandheapme thodforotherplacesisrecommended.

Inthepitmethod,thecattleshedwastesareconservedinpitsof2mwide,1mdeepandofconvenientlengthwithasl opingbottomtowardsoneend.Inthepitanabsorbent layer iscreatedat thebottomby spreadingstrawat therateof 3-5kgperanimalkept.Thesubstratecontainingwellmixeddung,urineandstrawisspreadovertheabsorbentlayerdaily toformalayerof30cmthickandtheprocesscontinueduntilthepitisfilled.Eachday'slayershouldbepressed,moisten edifdryandcoveredwitha3-

5cmlayerofwellgroundfertilesoiltohastenthedecompositionandtoabsorbtheammonia.Thepitshouldbeprepared onhighlyingareatoavoidtheentry ofrainwater.

Intheheapmethod,thedailycollectionsfromcattleshedarespreadinuniformlayersuntiltheheapattainsamaximumheightofonemeteraboveground.Thetopoftheheapisroundedandplasteredwithdungandmudmixture.Themanureisreadyforuseafter5-6months.Thesemethodsshouldbeinitiatedpriortorainyseasonandcontinuedthroughouttheyear.Ifproperlypreserved,thequantityofmanurethatcanbeproducedperanimalperyearwouldbeas muchasfourtofivetonnescontainingpercentnitrogen.Thisisincontrasttooneortwotonnesperanimalperyearcontaining0.5percentnitrogen,thatisobtainedbyindigenousmethod.Thematerials shouldnotcontainany heavymetal.

Inboththepitandheapmethodsaerationisallowedinthebeginningandlateronanaerobicconditionssetinandcontinueforalongperiod.

Sheep and Goat Manure

The dropping of sheep and goats contain higher nutrients than farm yard manure and compost. On an average, the manure contains 3% N, 1% P2O5 and 2% K2O. It is applied to the field in two ways. The sweeping of sheep or goat sheds are placed in pits for decomposition and it is applied later to the field. The nutrients present in the urine are wasted in this method. The second method is sheep penning, wherein sheep and goats are allowed to stay overnight in the field and urine and faecal matter is added to the soil which is incorporated to a shallow depth by running blade harrow or cultivator.

Poultry Manure

The excreta of birds ferments very quickly. If left exposed, 50 % of its nitrogen is lost within 30 days. Poultry manure contains higher nitrogen and phosphorus compared to other bulky organic manures. The average nutrient content is 3.03 % N, 2.63 % P2O5 and 1.4 % K2O.

Poultry Waste Compost

Poultrywastecompriseswastefeed,solidandliquiddropping,litter,eggshell,diseasedanddeadbirds,culledbirds,feathersandthewastesfrompoultrysheds.Poultrywastemanagementishighlyc omplexandchallengingbecauseofassociatedproblemslikenitrateandheavymetalcontaminationinsoil,crops,surfaceandgroundwater,airqualityandodor;disposalofdeadanddiseasedpoultryandfood safety.Poultrymanureisgoodsourceofnutrients,particularlymanureisgoodsourceofnutrients,especiallyforvegetable.Thedecompositionofthewastemustbedonewiththeuseoffungus/bacteria.Oncethedecompositioniscompleted,KMB,PSMandPaceli-T.V.inliquid100ml/tonnesuppressesthediseasecausingpathogens.

Plantnutrientstatusinpoultrywaste of different category

Source	Percent			
	Nitrogen	Ammonia	Phosphorus	Potassium
Freshchicken manure	3.7-8.8	0.4-1.1	1.2-2.0	1.2-2.7
Poultrylitter Manure	1.4-6.8	0.5-1.1	0.5-3.5	1.0-2.7
Broilerlitter	2.3-6.0	-	0.6-3.9	0.7-5.2

CROP RESIDUES

The contribution from crop residues is generally ignored. However, crop residues add considerable amount of nutrients and the amount depends on the crop. Finger millet crop residues add about 43 kg N/ha, while rice crop residues add 17 kg N/ha. The addition of phosphorus is 3.7 and 2.9 kg P2O5/ha by finger millet and rice residues respectively. By estimating the appropriate amount of nutrients added to the soil by crop residues, chemical fertilizer application can be reduced. Agricultural residues offer a potential scope to meet our growing needs through their recycling. Crop residues are important energy source.

About 2000 million tonnes (Mt) of straw is produced annually in India.

Only rice, wheat, sorghum, maize and pearl millet leave 173 Mt of crop residues.

16 Mt of sugarcane trash is not utilized properly.

Such surplus farm wastes have an estimated potential of 100 Mt/year for recycling of nutrients in agriculture ,which would be equivalent to 2.6 Mt of NPK after proper decomposition, and maintenance of proper C:N ratio through the use of celluloitic fungal culture inoculation.

Crop residues of different crops and their nutrient value					
Crop	Total yield (Grain + straw) (kg/ha)	Stubble weight (kg/ha)	Nutrient content (%)		
			N	P_2O_5	K_2O
Rice	15,536	4,200	0.42	0.066	0.66
Sorghum	5,150	2,889	0.21	0.086	0.33
Maize	14,950	667	0.21	0.060	0.83
Finger millet	18,800	3,111	1.40	0.120	0.66
Foxtail millet	6,500	1,200	0.98	0.070	0.17
Gingelly	500	338	0.70	0.098	0.17

Water hyacinth, an aquatic weed of 2.92 lakh ha is a nuisance and creates serious problem in normal flow of water, fish transport and human health. Water hyacinth can be used as compost, green manuring, soil mulch, etc. It can contribute about 0.17 million tonnes equivalent of NPK Water hyacinth on dry weight basis can yield 370 l of biogas with average methane content of 69%

Vermicompost

Soil fauna including protozoa to mammals though not considered major is the important source of nutrients. Among the soil fauna earthworms have attracted more attention than others because of their importance in agriculture. Earthworm gut is the site of production of genuine humic acids which are distinct from the polysaccharide-gum humic acids. About half of the gums secreted by earthworm are in form of muco proteins that help stabilizing pore space distribution. The earthworm soil casts are richer in available plant nutrients (nitrate nitrogen, exchangeable Ca, Mg, K and P) and organic matter. The earthworms through their casts and dead tissues supply about 60-90 kg N to the soil. Earthworm eats on fungal mycelia. Earthworms convert farm waste and organic residues into high quality compost.

Nutrient composition of vermicompost

SN Nutrient Content

1. Organic carbon 9.15 to 17.98 %
2. Total nitrogen 1.5 to 2.10 %
3. Total phosphorus 1.0 to 1.50 %
4. Total potassium 0.60 %
5. Ca and Mg 22.00 to 70.00 m.e / 100 g
6. Available S 128 to 548 ppm
7. Copper 100 ppm

8. Iron 1800 ppm
9. Zinc 50 ppm

Besides the above nutrients the vermicompost also contains Protease, Lipase, Amylase, Cellulase enzymes

Conversion rates: 1000 earth worms may convert 5 kg waste material per day 1000 worms weighs about a kilogram

Advantage of vermicompost

1. Vermicompost is a rich source of nutrients, vitamins, enzymes, antibiotics and growth hormones. So it gives disease resistance to plansts. Nutrient content of vermicompost is higher than traditional composts. It is a valuable soil amendment.

2. Vermicompost harbours certain microbial populations that help in N fixation and P solubilisation. Its application enhances nodulation in legumes and symbiotic mycorrhizal associations with the roots.

3. Superiority of vermicompost over other synthetic growth media is more pronounced in plant nurseries. It can be used as rooting medium and for establishment of saplings in nurseries.

4. It improves taste, lusture and keeping quality of the produce.

5. It has immobilized enzymes like protease, lipase, amylase, cellulase and chitinese which keep on their function of biodegradation of agricultural residues in the soil so that further microbial attack is speeded up.

6. It does not emanate foul odour as is associated with manures and decaying organic wastes

Green Manure

Green un-decomposed plant material used as manure is called green manure. It is obtained in two ways: by growing green manure crops or by collecting green leaf (along with twigs) from plants grown in wastelands, field bunds and forest.

Green manuring is growing in the field plants usually belonging to leguminous family and incorporating into the soil after sufficient growth. The plants that are grown for green manure are known as green manure crops.

The most important green manure crops are sunnhemp, dhaincha, pillipesara, clusterbeans and Sesbania rostrata. Nitrogen fixation by leguminous green manure crops can be increased by application of phosphatic fertilizers. This phosphorus is available to succeeding crop after mineralization of the incorporated green manure crop.

Green-leaf manuring

Application to the field, green leaves and twigs of trees, shrubs and herbs collected from elsewhere, is known as green-leaf manuring. Forest tree leaves are the main sources for green-leaf manure. Plants growing in wastelands, field bunds etc., are another source of greenleaf manure. The important plant species useful for green-leaf manure are neem, mahua, wild indigo, glyricidia, Karanji (Pongamia glabra) calotropis, avise (Sesbania grandiflora), subabul and other shrubs.

Advantages

Several advantages accrue due to the addition of green manures.

- Organic matter and nitrogen are added to the soil.
- Growing deep rooted green-manure crops and their incorporation facilitates in bringing nutrients to the top layer from deeper layers.
- Nutrient availability increases due to production of carbon dioxide and organic acids during decomposition.
- Green manuring improves soil structure, increases water-holding capacity and decreases soil loss by erosion.
- Growing of green-manure crops in the off season reduces weed proliferation and weed growth. Green manuring helps in reclamation of alkaline soils. Root-knot nematodes can be controlled by green manuring.

Table5:Nutrient potentialof green manures

Green manure	**Biomass(tones)**	**Naccumulation**
		(Kg/ha)
Sesbaniaaculeate	22.50	145.00
S.rostrata,	20.06	146.00
Crotalariajuncea,	18.40	113.00
Tephrosiaperpurea	6.80	46.00
Greengram	6.50	60.20
Blackgram	5.12	51.20

Cow pea	7.12	63.30

Nutrientcontentofimportantgreenmanures

Crop	Nutrientcontent(%ondryweightbasis)		
	N	P	K
Greenmanure			
Sesbaniaaculeate	3.3	0.7	1.3
Crotalariajuncea	2.6	0.6	2.0
Sesbaniaspeciosa	2.7	0.5	2.2
Tephrosiapurpurea	2.4	0.3	0.8
Phaseolustrilobus	2.1	0.5	-
Greenleafmanure			
Pongamiaglabra	3.2	0.3	1.3
Glyricidiamaculeata	2.9	0.5	2.8
AzadirachtaIndica	2.8	0.3	0.4
Calatropisgigantecum	2.1	0.7	3.6

Biogas slurry is a good source of organic manure

The following are the different methods of applying bio-digested slurry as manure:

a) Airdriedbiogasslurrycanbeappliedbyspreadingonthelandatleastoneweekbeforesowingtheseedsortransplantingtheseedlings.

b) Theliquidslurrycanbemixeddirectlywiththerunningwaterinirrigationcanal

c) Biogasslurrycanalsobecoatedontheseedspriortosowing.

d) Thedigestedslurryis filtered in the layer of leaves and thesemi-solidslurrycanbetransportedeasilyandusedfortopdressing ofcrops likesugarcaneandpotato.

e) Biodigestedslurryisalsobeingusedto fishculture,whichactsas asupplementaryfeed.Onanaverage,15-25litreofwetslurrycanbeappliedperdayina1200sqpond.Slurrymixedwithoilcakeorrice-braninthe2-1ratioincreasesthe fishproduction remarkably

f) Thedigestedslurry,ifmixedwithAzospirillum,KMBandPSM@200mleach/acreensuresincreaseofyie ldminimum30%overslurryalone.

In general,organicmanures,about10t/hain theformofFYM or compostor bio-digestedslurry isrecommendedtobeappliedonceinthreeyearstomaintaintheorganiccontentofsoil,besidesprovidingnitrogen,phosphorusandpotassiumintheformof organicfertilizerstothecrop.

Table12 Nutrientcontentinbiogasslurry and FYM

Particulars	Nutrientcontent						
	Majorelement (percent)				Traceelement(ppm)		
	N	P	K	Fe	Mn	Zn	Cu
Biogas slurry	1.43	1.21	1.01	4200	550	150	52
FarmYardmanure	0.94	0.56	0.72	4000	490	100	45

Questions

A. Choose the correct answer

A1.	The optimum C:N ratio of the composting material is	
	a. 10:1 to 20:1	c. 30:1 to 40:1

	b. **20:1 to 30:1**	d. 40:1 to 50:1
A2.	Organic manure was mentioned in	
	a. Atharvaveda b. Mahabaratta	c. **Rigveda** d. Brahad-Samhita
A3.	The fertilizer preparation with *Rhizobium* culture is known as	
	q. Rhizobin r. Nitrosome	s. Nitricin t. **Nitrogin**
A4	---------------- earth worms may convert 5 kg waste material per day.	
	a. 250	c. 750
	b. 500	**d. 1000**
A5	The nutrient content of *Sesbaniaaculeate*	
	a.3.3% N, 0.7%P, 1.3%K	c. 2.7% N, 0.5%P, 2.2%K
	b.2.6% N, 0.6%P, 1.3%K	d. 2.3% N, 0.3%P, 0.8%K
A6	Esinea fetida is ----------------------- type of earth worm	
	a. Endogeic	c. Geophagus
	b. Epigeic	d. .Humus feeder

B. Short question

B1.	Differentiate green manure and green leaf manure
B2.	Mention the advantages of vermicompost
B3.	**Do organic farmers take any precautions when they apply manure on organic farms**

C. Brief question

C1.	**How are organic manures differing from fertilizers? How much of plant nutrients are provided by organic manures and give the beneficial of organic manures in the cultivation of crops**

Lecture-6 Off-farm resources; coir pith, press mud, oil cakes, fly ash , bio-compost, minerals, bone meal, bio-fertilizers, traditional preparations

Agro-industries generate residues like husk, hull, shell, peel, testa, skin, fibre, bran, linter, stone, seed, cob, prawn, low grade fish, leather waste, hair, bones, coir dust, saw dust, bamboo dust, etc. which could be recycled or used efficiently through agro-processing centres. In the last three decades, rice and sugarcane residues have increased by 162 and 172 %, respectively. Their disposal problem needs serious rethinking. To some extent these organic residues are used as soil conditioner, animal feed, fuel etc.,

Coir pith compost

The coir dust is a waste product of the coir industry and could be used as organic amendment. the coi rwaste accumulates in large quantities near the coir industrial units and it can be converted into valuable organic manure by proper composting with the aid of the mushroom fungus *Pleurotussojorcaju*. The composting reduces the volume by 42percent besides narrowing the C : N ratio. Once the compost is matured add potash mobilizing bacteria and phosphorus solubilizing bacteria at the rate of 400ml/tone increase the availability of P_2O_5 and K_2O within 20days.It has been found to be a good amendment for sodic soils and a moisture conserving material for rainfed crops. The use of coirpith without composting is, however,not advisable. In the fresh form it contains 8-12 percent soluble tannin-related phenolics which can inhibit microbial activity in the s oil and cause immobilization of nitrogen.

Composition of raw and composed coirpith

Properties	**Raw Coirpith**	**Composted coirpith**
Lignin (%)	30.00	4.80
Cellulose (%)	26.52	10.10
Organic carbon(%)	29.00	24.90
N (%)	0.26	1.06
P_2O_5 (%)	0.01	0.06
K_2O (%)	0.78	1.20
Ca (%)	0.40	0.50
Mg (%)	0.36	0.48
Fe (%)	0.07	0.09
Mn (ppm)	12.50	25.00
Zn (ppm)	7.50	15.80

Cu (ppm)	3.10	6.20
C:N ratio	112:1	24:1

Sugar factory waste-Press mud

Themajor sugar factory wastes are press mud, filter cakes bagasse and molasses. Press mud contains about 1.2 percent N, 3.82 percent P_2O_2, 1.42 percent K_2O and 11.1 percent CaO and is a good source of organic matter (4.4to35.8%).Because of high calcium content in the press mud ,it is used mainly to reclaim acidic soils substituting gypsum to some extent.

There are two forms of press mud :press mud with carbonate process having $CaCO_3$(66%) and organic matter (4.4%); presumed with sulphitation process having $CaSO_4$(9.3%) and organic matter(35.8%). The amount equivalent to one kg of 100 percent pure gypsum will be 0.88kg and 10.75kg of carbonated and sulphated press mud, respectively and in terms of sulphur4.0and57.8kg, respectively. Addition of press mud improves soil aeration and drainage in heavy soils, whereas in sandy soils it helps in improving the retention of moisture. When added to sugarcane fields it increased the cane yield, improved the juice quality and enhanced the ammonifying power of the soils.

Sugarcane trash

The sugarcane trash removed during cropping to prevent lodging of the canes and the dead leaves collected at the time of cane harvest are generally burnt in the field itself. The valuable nutrients are lost during the process. The trash may be converted into a very useful organic amendment by proper composting and adding mussoorie rockphosphate at the time of composting. As the pressmud itself is rich in Potash and Phosphorus, use of 400ml/tone of composted material with Potash Mobilizing Bacteria (*Fraturia aurientia)* and Phosphate Solubilizing Bacteria increases the availability of K_2O and P_2O_5 in the wastes. This may be used later like other organic amendments.

Oil cakes

Many oilcakes such as the castor, neem, madhuca, karanja, linseed, rapeseed and cotton seed which are non-edible oil cakes may serve as useful organic manure as these contain high amounts of plant nutrients. Most of the non-edible oil cakes are valued much for their alkaloid contents which inhibit the nitrification process in soils. Neem cake contains the alkaloids-nimbin and nimbicidine which effectively inhibit the nitrification process. Similarly, Karanjin (*Pongamia pinnata*) and (*Madhuca butyracea*)is a potent nitrification inhibit or equal in efficiency to nitropyrin in retarding the nitrification process of ammoniacal nitrogen and increasing the yield, nitrogen uptake and grain protein content of rice. Madhuca cake has been successfully used in coastal saline soils for cultivation of rice. soils. Neem cake contains the alkaloids-nimbin andnimbicidine which effectively inhibit the nitrification process .Similarly, Karanjin (*Pongamia pinnata*) and madhuca (*Madhuca butyracea*) is a potent nitrification inhibitor equal in efficiency to nitropyrin in retarding the nitrification process of ammoniac nitrogen and increasing the yield, nitrogen uptake and grain protein content of rice.

Fly ash

Fly ash is a useful organic amendment. At many places acidic mined lands exhibit reduced biological activity. In some strip mine sites with pH ranging from 2.6 to 4.7, the pH was found to range between 5.0 and 7.5 after 10 years of treatment with fly ash and the credit of vegetation on these sites was rated fair to good. With the exception of N, fly ash is rich in P_2O_5, K_2O, Ca and Mg and also contains elements like B, Mo and Zn which are essential for plant growth and are available to the vegetation raised on soils treated with fly ash. Mixing of potash mobilizing bacteria and phosphorus solubilizing bacteria at the rate of 400ml/tone increase the availability of $P_2O_5$and K_2O within 20 days

Saw Dust

It is possible to use waste products from timber industry as organic matter. Inoculation with cellulolytic strains of *Bacillus sp*., *Cephalosporium sp*. And *Streptomyces sp*. ha s been reported to increase the decomposition of sawdust and bark.Mixing of potash mobilizing bacteria and phosphorus solubilizing bacteria at the rate of 400ml/tonne increase the availability of P_2O_5 and K_2O within20days

The following criteria for judging a good quality compost may be as follows :

1. Dark brown to black.
2. Crumbly structure not packed or lumpy.
3. Largely insoluble in water.
4. C:N ratio from 10 to 20.
5. Dissolves to a large extent in dilute alkali.

6. Beneficial effect up on soil and growing vegetation.
7. Pleasant earthy smell.
8. Will not attract flies.

Leaf composting

Leaf composting, can be achieved by heap or ditch composting or by wind row composting. Wind row are preferred as they allow efficient handling of materials . Provide good aeration, allow sufficient absorption of water and are easy to be formed.

Formation of uniform-shaped wind row from 2.40m – 3.60m at the base and 2.40m-3.00 m high and of any convenient length. Windrow built too high will have excessive compaction at the base resultingn anaerobic conditions. Windrows built to olow willnot allow sufficientin sulation to sustain thermophilic temperature during cold weather. To ensure proper aeration,it Is important to break a parttightly compacted leaves.

Biocompost

Biocomposting is a process for the rapid conversion of organic waste into a thoroughly decomposed, stable and humus rich compost for used as a fertilizer and soil conditioner. The process is aerobic and the technology highlights the following activities for large and commercial scale Bio-composting.

Windrowing: The waste materials should be chopped in small size and formed in windrows of 3 meters width and 1.2 meters height, the length according to the availability of the land:

Inoculation: Mixed population of microorganisms are sprinkled over the windrows at the rate of 4kg/tone of waste materials. In case of liquid 2 litres/tone is enough as the population of fungus and bacteria is 100 times more than solid base inoculum.

Aero tilling: The windrow is aero tilled in alternative days by using special type of machine called “Aero tiller” or manual method. It helps for uniform mixing and provides oxygen to the microorganisms.

Application of Spent wash: To maintain the optimum moisture of 50-60% and to maintain temperature between 65-700c for high rate composting, the nutrient rich spent wash is sprayed on the windrows, if it is available. Otherwise, any wash like cow dung wash, vermiwash, kitchen wash, any animal wash etc. can be sprayed.

Bone meal

Long before synthetic commercial fertilizers were available, farmers turned to bone meal to enrich soils in need of amendment. Bone meal is made from steamed and crushed animal bones, and is rich in phosphorous, a mineral that plants need for healthy root development and flower growth. It also contains calcium and a little bit of nitrogen, both of which are beneficial to plants. Bone meal is taken up by plants slowly over time, so as long as it is used sparingly, there is little risk of 'burning' plants with too much of this fertilizer.

That makes bone meal an ideal supplement for bulbs and roses in particular, which flourish with an extra boost of phosphorous. A little bit goes a long way, so just one tablespoon is needed for every two square feet. When planting bulbs in the fall, ensure that their spring blooms will be spectacular by adding 1/2 teaspoon per plant to the backfill soil. You can also mix bone meal into the top one to three inches of soil in the spring for other plants.

Some gardeners are concerned about the use of bone meal due to the perceived risk of contaminating the soil or plants with prions, proteins from cow bones that cause bovine spongiform encephalopathy (BSE), better known as mad cow disease.

Mineral fertilizer

The mineral fertilizers, which are allowed in organic agriculture, are based on ground natural rock. However, they may only be used as a supplement to organic manures. If they contain easily soluble nutrients, they can disturb soil life and result in unbalanced plant nutrition. In some cases, mineral fertilizers are ecologically questionable as their collection and transport is energy consuming and in some cases natural habitats are being destroyed.

MINERAL FERTILIZERS ALLOWED IN ORGANIC FARMING – A BASIC OVERVIEW

Fertilizer	Origin	Characteristics	Application
Plant ashes	Burned organic material	Mineral composition similar to plants	To compost Around the bade of the plant
Lime	Ground lime stone algae	Buffers low pH Rich in trace elements	Every two to three years when soil pH is low
Stone powder	Pulverized rock	Trace elements The finer the grinding better the adsorbance	To FYM Reduces the volatilization of N and encourages the rotting process
Rock phophate	Pulverized rock containing P	Easily adsorbed to soil minerals Weekly adsorbed to organic matter Slow reaction	Rotting process To compost Not to reddish soil

Some important formulations for soil enrichment

Preparation of liquid manures Many variants of liquid manures are being used by farmers of different states. Few important and widely used formulations are given below:

Sanjivak – Mix 100 kg cow dung, 100 lit cow urine and 500 gmjaggery in 300 lit of water in a 500-lit closed drum. Ferment for 10 days. Dilute with 20 times water and sprinkle in one acre either as soil spray or along with irrigation water.

Jivamrut – Mix cow dung 10 kg, cow urine 10 lit, Jaggary 2 kg, any pulse grain flour 2 kg and Live forest soil 1 kg in 200 lit water. Ferment for 5 to 7 days. Stir the solution regularly three times a day. Use in one acre with irrigation water.

Amritpani - Mix 10 kg cow dung with 500 gm honey and mix thoroughly to form a creamy paste. Add 250 gm of cow desi ghee and mix at high speed. Dilute with 200 lit water. Sprinkle this suspension in one acre over soil or with irrigation water. After 30 days apply second dose in between the row of plants or through irrigation water.

Panchgavya – Mix fresh cow dung 5 kg, cow urine 3 lit, cow milk 2 lit, curd 2 lit, cow butter oil 1 kg and ferment for 7 days with twice stirring per day. Dilute 3 lit of Panchgavya in 100 lit water and spray over soil. 20 lit panchgavya is needed per acre for soil application along with irrigation water.

Enriched Panchgavya (or Dashagavya) – Ingredients - cow dung 5 kg, cow urine 3 lit, cow milk 2 lit, curd 2 lit, cow deshi ghee 1 kg, sugarcane juice 3 lit, tender coconut water 3 lit, banana paste of 12 fruits and toddy or grape juice 2 lit. Mix cow dung and ghee in a container and ferment for 3 days with intermittent stirring. Add rest of the ingredients on the fourth day and ferment for 15 days with stirring twice daily. The formulation will be ready in 18 days. Sugarcane juice can be replaced wit 500 g jaggery in 3 lits water. In case of non-availability of toddy or grape juice 100g yeast powder mixed with 100 g jaggery and 2 lit of warm water can also be used. For foliar spray 3-4 lit panchgavya is diluted with 100lit water. For soil application 50 lit panchagavya is sufficient for one ha. It can also be used for seed treatment.

BIOFERTILISERS

Atmosphere contains 78 % nitrogen and 0.03 % carbon dioxide. Plants are able to assimilate carbon dioxide through photosynthesis even when carbon dioxide content is less, but most of the plants cannot fix atmospheric nitrogen though it is abundant. Some microorganisms are capable of fixing nitrogen, while some can increase the availability of nitrogen and phosphorus.

Rhizobium species suitable for different crops	
Rhizobium sp	Crops
R. leguminosarum	Peas (Pisum) lathyrus, vicia, lentil (Lens)
R. Tripoli	Berseem (Trifolium)
R. phaseoli	Kidney bean (Phaseolus)
, R. lupine	Lupinus Ornithopus
R. meliloti	Melilotus, Lucerne (Medicago), Fenugreek (Trigonella)
R. japonicum	Soybean (Glycine)
Cowpea miscellany,	Cowpea, clusterbean, greengram, blackgram, redgram, groundnul, moth bean, dhaincha, sunnhemp, Glyricidia. Acacia. Prosopis. Dalbergia. Albizzia. Indigofera. Tephrosia. Atylosia. Stylo
Separate group	Bengal gram (gram)

Symbiotic Bacteria Bacteria belonging to the genus Rhizobium are capable of fixing atmospheric N2 in association with leguminous crops. Different species of Rhizobium are used for treating the leguminous crops

Rhizobium sp enter the roots of host plants and form nodules on the root surface. The bacteria depend on the host plant for carbohydrates and water while Rhizobium supplies N to the host. Nitrogen fixed by the Rhizobium is translocated through xylem vessels of the host plant mainly in the form of aspergine and to some extent as glutamine. Rhizobium species suitable for different crops are multiplied on a peat base in laboratories. This inoculum can be applied in three ways and among them, seed treatment is the best.

Seed Treatment. Depending on the seed rate, the required quantity of jaggary is boiled in water and cooled. Rhizobium inoculum (1.5 kg/ha) is mixed in the jaggary solution and sprinkled over the seeds. Then the seeds are thoroughly mixed to spread the inoculum over the entire surface of the seeds. Seeds are then shade dried.

Soil Treatment. The Rhizobium inoculum is mixed with soil and spread over the field.

Soil Application. If Rhizobium inoculum is not available, 200 kg of surface soil (2 to 10 cm depth) can be collected from the fields where that 'particular leguminous crop is grown luxuriantly and this soil can be broadcasted over the field where crop is grown for the first time.

Free living organisms

The important free living organisms that can fix atmospheric nitrogen are blue green algae (BGA), Azolla, Azotobacter and Azospirillum. Among them, BGA and Azolla can survive only in lowland conditions. Small quantity of inoculum of BGA and AzolIa can be obtained from laboratories and they can be multiplied in the farmers' fields for subsequent application.

Azotobacter and Azospirillum

Azotobacter chroccum is capable of fixing 20 to 30 kg N/ha. It can be applied by seed inoculation, seedling dip or by soil application. The inoculum required is 3 to 5 kg/ha. Application of 5 t/ha of farm yard manure helps in better growth of Azotobacter. Azotobacter can be used for rice, cotton and sugarcane. Azospirillum inoculum is used for sorghum.

Questions

A. Choose the correct answer

A1.	The fertilizer preparation with *Rhizobium* culture is known as	
	u. Rhizobin v. Nitricin	w. Rhizobin **x. Nitrogin**
A2.	*Rhizobium* species suitable for soybean	

	a. *Rhizobium tripoli* b. *Rhizobium phaseoli*	**c. *Rhizobium japonicum*** d. *Rhizobium meliloti*
A3	How much nitrogen may be fixed in Rhizobium legume association	
	a. 25-50 kg N/ha	c. 100-125 kgN/ha
	b. 50-100 kgN/ha	d. 150-200 kg n/ha
A4	Oil cake which can be fit for feeding livestock	
	a. Castor cake	**c. Groundnut cake**
	b.Mahua cake	d. Neem cake

B. Short question

B1.	Brief about any three traditional preparations
B2.	Write short notes about mineral fertilizers
B3.	Differentiate on farm and off farm manures

C. Brief question

C1.	Briefly discuss about the utilization of off farm resources in organic farming

Lecture-7 Organic waste recycling methods and techniques-composting, vermicomposting, *in situ* composting- System approach.

Compost

A mass of rotted organic matter made from waste is called compost. The compost made from farm waste like sugarcane trash, paddy straw, weeds and other plants and other waste is called farm compost.

The average nutrient content of farm compost is 0.5 % N, 0.15 % P2O5 and 0.5 % K2O. The nutrient value of farm compost can be increased by application of superphosphate or rock phosphate at 10 to 15 kg/t of raw material at the initial stage of filling the compost pit.

Farm compost is made by placing farm wastes in trenches of suitable size, say, 4.5 m to 5.0 m long, 1.5 m to 2.0 m wide and 1.0 m to 2.0 m deep. Farm waste is placed in the trenches layer by layer. Each layer is well moistened by sprinkling cow-dung slurry or water. Trenches are filled up to a height of 0.5 m above the ground. The compost is ready for application within five to six months.

Compost prepared by traditional method is usually low in nutrients and there is need to improve its quality. Enrichment of compost using low cost N fixing and phosphate solublizing microbes is one of the possible ways of improving nutrient status of the product. It could be achieved by introducing microbial inoculants, which are more efficient than the native strains associated with substrate materials.

Inoculation with Azotobacter/Azospirillum and phosphate solubilising culture in the presence of 1% rock phosphate is a beneficial input to obtain good quality compost rich in N (1.8%). The humus content was also higher in materials treated with microbial inoculants.

The following basic rules are important for the production of good quality compost:

1. The purpose of composting is to convert organic matter into growth promoting substances, for sustained soil improvement and crop production.

2. The organic matter is partially decomposed and converted by microbes. The conditions should be afavorable Moisture 50% aeration 50% and C:N ratio 30:1

3. Soil microorganisms constitute sufficiently to the decomposition of organic matter through their continuous activities. A typical compost earthworm is Eiseniafoetida.

4. Certain additives accelerate the conversion and improve the final product. The materials such as lime, earth, gypsum, rock phosphate act as effective additives. The addition of nitrogen (0.1 to 1 %) is important in case of large C:N ratio of the composting material. Addition of lime (0.3 to 0.5 %), if sufficient lime is not present. The preparation of compost takes 2-3 months. The composition of compost varies with in wide limits.

Stages of composting

When organic material is composted in a batch, four stages of the composting process are apparent. Although the same phases occur during continuous composting, they are not as apparent as they are in a batch, and, in fact, they may be occurring concurrently rather than sequentially.

The four phases include:

1) themesophilic phase;

2) thethermophilic phase;

3) the cooling phase; and

4) the curing phase.

Immature compost can be harmful to plants. Uncured compost can produce phytotoxins (substances toxic to plants), can rob the soil of oxygen and nitrogen, and can contain high levels of organic acids.

Methods of composting

The process of composting was first initiated in England during the period of First World War (1914 -1918). The various systems of composting are 1. ADCO process (Agricultural Development Company) 2. Activated compost process 3. Indore process 4. Bangalore process 5. Coimbatore process 6. Rain -water compost 7.Vermicompost . Some are as follows

1. Indore process:

This process is developed in India by Howard and Ward at the Indian Institute of plant Industry, Indore Materials needed: a) Straw or organic farm wastes as basic raw materials b) Cattle dung as starter (urine, earth and wood ashes)

Procedure: A compost pit of dimensions of 30 x 14 x 3 feet with sloping sides (narrow at bottom and at wide surface) is prepared and the raw material is spread in layers of 3” thickness. A mixture of urine, earth, and wood ashes is sprinkled and this is followed by 2” layer of dung.

The pit is filled up this way until the material occupies a height of 3 feet above the ground level . As air can conveniently penetrate only to a depth of 1.5 to 2.0 feet extra aeration has to be provided, which is done by means of artificial vents (holes) of 4” diameter pipe for every 4 feet length of the pit. The pit is watered twice a day i.e., morning and evening with rose can. The material is turning over 3 times, i.e., First – at the end of the first fort night Second – at the end of the second fort night Third – when the material is two months old in the process of composting.

Observations: I. After 10 days of composting the following things happens A. Synthesis of humus begins i.e., development of fungi and the height of the material is reduced by half B. Check anaerobic decomposition, as indicated by the foul smell and fly breeding C. If there is an anaerobic decomposition ,turn over material for proper aeration D. If insufficient fermentation, hasten by watering the material.

II. At the end of two months A. Fungal activity is over B. Materials become dark C. Now the bacterial aeration takes place D. Stock the material on the ground after 2 months .So 25 % of additional free nitrogen will be fixed from atmosphere. Compost is ready by 3-4 months. One cattle pair produced 50-60 cartloads per year.

2. Bangalore process

This process of composting was developed by Dr.C.N.Acharya in 1949.

1. Basic raw material used: Any organic material 2. Starters or inoculants: FYM or mixture of dung and urine or litter [Undecomposed] 3. Additives:Bone meal or oil cakes, wood ash

Procedure [Pit size: 20 x 4 x 3 feet The basic raw material is spread in a pit of 20 x 4 x 3 feet dimensions to a depth of 6 " layer, moistened with 20-30 gallons of water if the material is dry. Over this FYM or preferably a mixture of dung, urine and litter (undecomposed) from the cattle shed is placed as a layer of 2" thickness. It is again covered on the top with a layer of earth to a thickness of 6”. It is beneficial to mix the earth with bone meal or oil cakes, wood ash etc., to improve manurial value of the compost .The piling of layers is continued till the heap raises above the ground level to a height of 2 feet.Then the heap is kept open for one week to facilitate aerobic decomposition. Later the heap is plastered with a layer of moist clay for anaerobic fermentation to occur. Fissures , or cleavages (cracks) that occur in the clay layer , have to be sealed off periodically .The compost will be ready in 4-5 months period starting from the day of preparation .This process is called as aerobic and anaerobic decomposition of compost. In this process the basic raw material is not so well decomposed as in the other methods .But organic matter and N contents are well conserved. The number of turnings are reduced .The out turn of the compost is relatively greater and cheapest process.

3. The coimbatore process:

The basic raw materials: 1.Raw organic matter 2. Starters : Powdered bone meal and cattle dung and water emulsion prepared by mixing Dung in water at 5-10 kg dung in 5-10 litres water. Procedure [Pit: 12 x 6 x 3 feet]: The basic raw material loosely spread [Pit: 12 x 6 x 3 feet] to a depth of 9" and water is sprinkled till the entire material is moist. Then about one kg of powdered bone meal is broadcasted uniformly above the layer and above this an emulsion of 5-10 kg of fresh cattle dung in 5-10 liters of water is applied. Repeat this process until a heap 2 feet above ground level is formed .Then the entire exposed surface area of heap is plastered with mud to facilitate

Semi-aerobic fermentation which would takes place for above 4-6 weeks depending upon the nature of the raw material. After 4-6 weeks, the mud plaster is removed to permit aerobic fermentation. If the heap has sunk unevenly which is a sign of defective fermentation, the material is reheaped after forking and moistened .The decomposition is complete in 3-4 months and is fit for application to the field.

Rain watered compost

In dry areas where it is difficult to obtain water for watering, the composting can be done with the aid of rain fall. The compost heap is built up as usual before the rains set in. The turnings are given during the rainy period at the end of rains the material will be ready for application. About 400 mm rain fall received in 3-4 months is considered sufficient.

Vermicompost

Soil fauna including protozoa to mammals though not considered major is the important source of nutrients. Among the soil fauna earthworms have attracted more attention than others because of their importance in agriculture. Earthworm gut is the site of production of genuine humic acids which are distinct from the polysaccharide-gum humic acids. About half of the gums secreted by earthworm are in form of mucoproteins that help stabilizing pore space distribution. The earthworm soil casts are richer in available plant nutrients (nitrate nitrogen, exchangeable Ca, Mg, K and P) and organic matter. The earthworms through their casts and dead tissues supply about 60-90 kg N to the soil. Earthworm eats on fungal mycelia. Earthworms convert farm waste and organic residues into high quality compost. For this, Eiseniafoetida, Perionyxexacavatus, Eudrilluseuginiae and Lumbriusrubellus are important. These species can be cultured on organic wastes and dung. The technique of culturing them is called vermiculture and using these for decomposing residue to make compost is called vermicomposting.

About 1000 adult earthworms can convert 5 kg waste into compost per day. The earthworm assimilate 5-10% of the substrate and rest passes through the alimentary canal and is excreted as cast. Earthworm cast contains nutrients, vitamins, hormones and antibiotics.

Vermi-compost is a stable fine granular organic matter, when added to clay soil loosens the soil and provides the passage for the entry of air. he multifarious effects of vermicompost influence the growth and yield of crops.

Definition of vermicomposting: Vermicomposting is a method of making compost, with the use of earthworms, which generally live in soil, eat biomass and excrete it in digested form. This compost is generally called vermicompost or Wormicompost.

Definition of Vermiculture: Vermiculture means scientific method of breeding and raising earthworms in controlled conditions.

Vermitechnology: Vermitechnology is the combination of vermiculture and vermicomposting. Thus, earthworms can be used in the following areas. 1. For development of arable soils, turnover of soil, break down of plant organic matter aeration and drainage 2. For production of useful products like vermifertilizer and worm tissue for animal feed. 3. For maintenance of environmental quality and monitor of the environment for soil fertility, organic and heavy metal non-biodegradable toxic material pollution.

Types of earthworms in vermicomposting Earthworms belong to phyllum Annelida of Animal Kingdom. They are long and cylindrical in shape and size having a large number of grooves. There are about 3000 species of earthworms in the world which are adapted to a range of environment. More than 300 species have been identified in India. Although, hermophrodite, two mature earthworms are required to propagate. At the time of egg laying, the clitellum is transformed into hard, girdle like capsule called cocoon. Shedding of cocoon ranges from 1 to 5, only a few of them survive and hatch. The juveniles and again formation of cocoons takes a period of 50-60 days. Normally, the average life span of earthworms varies with species ranging from 1 to 10 years.

Epigeics (surface feeders) are important in vermicomposting. The epigeics such as Eiseniafoetida and Eudriluseugeniae are exotic worms and Perionyxexcavatus is a native one being used for vermicomposting in India. Epianecic are feeders on leaf litter and soil at upper layers of soil. This group such as Lampitomauritii is indegenous and is active in in-situ decomposition of organic wastes and residues in soil. Both epigeics and epianecics groups of earthworms areslender, shorter in length and red to dark brown in colour. They have high reproduction activityand efficient in recycling of organic materials. Increased attention has been paid to Eiseniafoetida and Eudriluseugeniae which have been found to be potential agent in vermicomposting of wide range of agricultural wastes and can grow at a wide range of temperature varying from 0-40 ◦C. However, the optimum temperature ranges from 20-30 ◦C.

Mechanism of vermicomposting Materials consumed by worms undergo physical breakdown in the gizzard resulting in particles < 2 μ, giving thereby an enhanced surface area for microbial processing. This finally ground material is exposed to various enzymes such as protease, lipase, amylase, cellulase and chitinase secreted into lumen by the gut wall and associated microbes. These enzymes breakdown complex biomolecules into simple compounds. Only 5-10% of the ingested material is abosrbed into the tissues of worms for their growth and rest is excreted as cast. Mucus secretions of gut wall add to the structural stability of vermicompost.

Vermiculture industry or vermicompost preparation: 1. Basic raw material: Any organic material generated in the farm like bhusa, leaf fall etc., Horse dung, due to the risk of Tetanus virus, lethal to human beings is not advisable to be used as feeding material for earthworms. Paddy husk, merigold and pine needles have also advised to be used as feeding materials for earthworms. 2. Starter: Cow dung , Biogas slurry, or urine of cattle 3. Soil animal: Earth worms (Species: Eiseniafoetida) 4. Thatched roof/vermished.

Favourable conditions of earth worms in the composting material: A. pH: Range between 6.5 and 7.5 B. Moisture: 60-70% of the moisture below and above range mortality of worms taking place C. Aeration: 50% aeration from the total pore space D. Temperature: Range between 18 ^{0}C to 35 ^{0}C

Procedure It is mostly prepared in either pit or heap method. The dimensions either heap or pit are 10 x 4 x 2 feet. The length and width can be increased or decreased depending on the availability of material but not the depth because the earthworms' activity is confined to 2 feet depth only. First of all select a site which is not under any economic use and is shady and there is no water stagnation. The site should also be nearby to water source. 1st layer: bedding material of 1" thick with soft leaves 2nd layer: 9" thick organic residue layer finely chaffed material 3rd layer: Dung + water equal mixture of 2" layer. Continue the layer up to pile to ground level in the case of pit method and upto 2′ in heap or surface bed method. Protect the worms against natural enemies like ants, lizards, snakes, frogs, toads etc., Maintain proper moisture and temperature by turnings and subsequent staking. At the day of 24th, 4000 worms are introduced in to the pit [1m2 =2000 worms] without disturbing the pit by regular watering the entire raw material will be turned into the vermicompost in the form of worm excreta. The turnover of the compost is 75% [the total material accommodated in the pit is 1000 kg; the out turn will be 750 kg]

Harvesting of the vermicompost from the pit Stop watering before one week of harvest. Sometimes the worms spread across the pit come in close and penetrate each other in the form of ball in 2 or 3 locations. Heap the compost by removing the balls and place them in a bucket. However, under most instances, top layer has to be disturbed manually. Earthworms move downward and compost is separated. After collection of compost from top layers, feed material is again replenished and composting process is rescheduled. The material is sieved in 2 mm sieve, the material passed through the sieve is called as vermicompost which is stored in a polythene bags

Precautions 1. Do not cover vermicompost beds/heaps with plastic sheets because it may trap heat and gases. 2. Do not overload the vermicompost heap to avoid high temperature that adversely affect their population. 3. Dry conditions kill the worms and waterlogging drive them away. Watering should be done daily in summer and every third day in rainy and winter season. 4. Addition of higher quantities of acid rich substances such as tomatoes and citrus wastes should be avoided. 5. Make a drainage channel around the heap to avoid stagnation of water particularly in high rainfall areas in rainy season. 6. Organic materials used for composting should be free from non-degradable materials such as stones, glass pieces, plastics, ceramic tubes/bulbs etc.

Natural enemies and their control The important natual enemies of vermiculture are ants, termites, centipedes, rats, pigs, birds etc. Preventive measures include treating of the site with chlorpyriphos 20 EC at 2 ml/l or 4% neem based insecticide before filling the heap.

Transportation of live worms Live earthworms can be packed with moist feed substrate in a container (card board/plastic) with provision of aeration. Feed substrate quantity should be roughly 0.5-1.5 g/individual for 24 hours of transportation journey. Culture should contain cocoon, juveniles and adults because sometimes adults do not acclimatize to new environment and may even die. Under such circumstances cocoons are helpful for population build up of earthworms.

Conversion rates: 1000 earth worms may convert 5 kg waste material per day 1000 worms weighs about a kilogram

Advantages of composting over direct application: 1. There will be no immobilization in compost because of narrow C:N ratio 2. Application is easy, because the compost is humified and have a structure of crumb and granular. 3. It is hygienic, pathogens and weeds seeds are destroyed.

The rate of application is as Field crops 5-6 t/ha; vegetables 10-12 t/ha; flower plants 100-200 g/sqft; fruit trees 5-10 kg/tree.

Nutrient content & Advantage of vermicompost(Refer previous lectures)

In-situ vermicomposting can be done by direct field application of vermicompost at 5 t/ha followed by application of cowdung (2.5 cm thick layer) and then a layer of available farm waster about 15 cm thick. Irrigation should be done at an interval of 15 days.

System approach in recycling of on farm wastes

Farming system is having different components for different situation. However, some basic components exist in any farming system maintained under varied conditions. They are,

1. Crop components and related cropping system in intensive cropped area
2. Crop residue management
3. Allied enterprises. The enterprises may be animal / Alternate land use system / Sericulture / fish farming
4. Recycling of the wastes of allied enterprises.

Questions

A. Choose the correct answer

A1.	The fertilizer preparation with *Rhizobium* culture is known as	
	a. Rhizobin b. Nitricin	c. Rhizobin **d. Nitrogin**
A2.	*Rhizobium* species suitable for soybean	
	a. *Rhizobium tripoli* b. *Rhizobium phaseoli*	**c. *Rhizobium japonicum*** d. *Rhizobium meliloti*
A3	How much nitrogen may be fixed in Rhizobium legume association	
	a. 25-50 kg N/ha	c. 100-125 kgN/ha
	b. 50-100 kgN/ha	d. 150-200 kg n/ha

A4	Oil cake which can be fit for feeding livestock	
	a. Castor cake	**c. Groundnut cake**
	b.Mahua cake	d. Neem cake

B. Short question

B1.	What is composting? Can composting manage all our wastes?
B2.	Write a comment about vermitechnology

C. Brief question

C1.	**Briefly discuss about the different methods of composting**

Lecture-9. Soil and crop management in organic farming; Inter cropping and companion planting, crop rotation, green manures, cover crops and mulching

In many traditional agricultural systems a diversity of crops in time or space can be found. Knowing that different plants have different requirements for nutrients, a good crop planning and management is required in order to optimise the use of nutrient in the soil. Crop rotation, intercropping, cover crops and green manures represent the main alternatives to the farmers to manage soil health and fertility.

1. Crop Rotation

Crop rotation refers to the sequence of crops and cover crops grown in a specific field. Crop rotation is one of the primary management tools essential to the success of low-input and organic farm systems. Well-planned rotation schedules are designed to manage short-term and long-term fertility, to reduce weed pressure, to disrupt pest and disease cycles, and to optimize crop production. Crop rotation schedules take into account factors such as crop family, plant rooting depths and crop nutrient needs. Rotations often include the use of cover crops, green manures and legumes.

Crop rotation brings the following benefits (IIRR and ACT 2005):

It improves soil structure: some crops have strong, deep roots. They can break up hardpans and tap moisture and nutrients from deep in the soil. Others have many fine, shallow roots. They tap nutrients near the surface and bind the soil. They form many tiny holes so that air and water can get into the soil.

It increases soil fertility: legumes (such as groundnuts and beans) fix nitrogen in the soil. When their green parts and roots rot, this nitrogen can be used by other crops such as maize. The result is higher, more stable yields, without the need to apply expensive inorganic fertilizer.

It helps control weeds, pests and diseases: planting the same crop season after season encourages certain weeds, insects and diseases. Planting different crops breaks their life cycle and prevents them from multiplying.

It produces different types of output: growing a mix of grain, beans, vegetables and fodder means a more varied diet and more types of produce to sell.

In some ways, crop rotation takes the place of ploughing the soil:

it helps aerate the soil, recycles nutrients, and helps control weeds, pests and diseases. Intercropping, strip cropping and relay cropping bring many of the same advantages as rotation.

2. Intercropping

Intercropping refers to the practice of growing two or more crops in close proximity: growing two or more cash crops together, growing a cash crop with a cover crop, or other non-cash crop that provide benefits to the primary crop (Mohler and Johnson 2009).

However, this practice requires additional management to keep competition between intercropped species in balance. When two or more crops are growing together, each must have adequate space to maximize cooperation and minimize competition between them. Intercropping typically refers to larger-scale, mechanically managed cropping systems with alternating rows or strips of compatible crops. To accomplish this, four things need to be considered:

1) Spatial arrangement

2) Plant density

3) Maturity dates of the crops being grown

4) Plant architecture

There are at least four basic spatial arrangements used in intercropping. Most practical systems are variations of these:

Row intercropping—growing two or more crops at the same time with at least one crop planted in rows. This can be beneficial in situations when using tall crops to reduce drought or heat stress of shorter crops, by providing shade and reducing wind speed.

Strip intercropping—growing two or more crops together in strips wide enough to permit separate crop production using machines but close enough for the crops to interact, for example, intercropping beans and maize. Legumes have a nitrogen-fixing bacteria associated with their roots. Consequently they compete slightly with non-legumes for nutrients, and in some cases even supply nitrogen to adjacent plants.

Relay intercropping—planting a second crop into a standing crop at a time when the standing crop is at its reproductive stage but before harvesting. The lettuce will use the space that is not yet occupied by the tomatoes and is harvested about the time the tomatoes are branching out to cover the width of the bed.

Mixed intercropping—growing two or more crops together in no distinct row arrangement (for further details of possible combination. Some crops may also be sown as a border crop or as a trap crops at the hedges of the main crop to reduce pests

3.Companion planting

Companion planting is a small-scale method of intercropping, which refers to the practice of planting one kind of plant next to another or others that help it thrive. It is often associated with small-scale organic gardening (the type of gardening I have exclusively done for the past 18 years) or other biodynamic planting methods, and it is a favorite technique of farmers seeking to produce more yield in less space.

usually refers to small-scale planting of vegetable, herb and flower crops selected based on the benefits they provide to neighboring plants.

Benefits of companion planting might include

providing shade or trellis support, suppressing weeds, providing nutrients, decreasing pest problems, or increasing pollination through the attraction of beneficial insects.

Factors to consider for successful companion planting

Crop density, ratio and interplanting

Crop density refers to the amount of space a plant, or plants occupy. The more space a plant takes up, the more likely it is to crowd out, or compete with, other nearby plants, even those that would otherwise make good companions.

Ratio refers to the number of plants “A” planted alongside plants “B.”

Interplanting refers to pairing taller plants with shorter ones that grow under them.

4. Cover crops

Every plant which covers the soil and improves soil fertility can be a cover crop. It could be a leguminous plant with other beneficial effects, or it could be a weed characterised by its rapid growth and enormous production of biomass. The most important property of cover crops is their fast growth and the capacity of maintaining the soil permanently covered.

Cover crops are grown to protect, maintain and enrich the soil. They provide benefits to organic systems that include adding organic matter to soil, encouraging beneficial soil microbes, cycling nutrients, retaining soil moisture, preventing erosion, smothering weeds, and providing habitat for beneficial insects. Selection of legume cover crops can enhance fertility through the fixation of atmospheric nitrogen. When included as part of the crop rotation with primary crops, cover crops help manage insect pests and weed and disease problems by disrupting their life cycles.

The following characteristics make an ideal cover crop:

- The seeds are cheap, easy to get, to harvest, to store and to propagate
- Be of rapid rate of growth and be able to cover the soil in short time
- Be resistant against pests and diseases
- Produce large amounts of organic matter and dry material
- Fix nitrogen from the air and provide it to the soil
- Have a de-compacting root system and regenerate degraded soils
- Easy to sow and to manage as single crop or associated with other crops
- Can be used as fodder, grains as food grains

Cowpea (*Vigna unguiculata*) is an important grain legume throughout the tropics and subtropics. It has some properties which make it an ideal cover crop:

- It is drought tolerant and can grow with very little water
- It can fix nitrogen and grows even in very poor soils
- It is shade-tolerant and therefore compatible as an intercrop

- It yields eatable grains and can be used as an animal fodder rich in protein
- It is quite resistant to pest attack

Other legumes used as cover crops are alfalfa (Medicago sativa), crimson clover (Trifolium incarnatum), Faba beans (Vicia faba) and hairy vetch (Vicia vellosa).

Some cover crops are used to improve the soil structure and to add organic matter to the soil; examples of non-legumes crops used for this purpose include barley (Hordeum vulgare), buckwheat (Fagopyron esculentum), oats (Avena sativa), annual rye (Lolium multiflorum), winter wheat (Triticum aestivum).

5.Green manures

A green manure is a type of cover crop grown primarily to build and maintain soil organic matter. Green manure is often grown for a specific period and then plowed under and incorporated into the soil.

As they are usually cut before flowering, growing a green manure is thus different from growing a legume crop in the rotation. Once worked into the soil the fresh plant material releases nutrients quickly and will be fully decomposed within a short period of time. Old or coarse material (e.g. straw, twigs, etc.) will decompose at a slower rate than fine material and will therefore contribute more to the build-up of soil organic matter than to fertilizing the crop.

GREEN MANURES HAVE A NUMBER OF BENEFITS:

- They penetrate the soil with their roots, make it more friable and bind nutrients, which would otherwise be washed away.
- They suppress weeds and protect the soil from erosion and direct sunlight.
- If legume plants are used, nitrogen is fixed from the air into the soil.
- Some green manures can be used as fodder plants or even to provide food for human consumption (e.g. beans and peas).
- By decomposing, green manures release all kinds of nutrients in the correct mixture for the main crops to utilise thus improving their yield.
- The incorporated plant material encourages the activity of soil organisms, and builds up organic matter in the soil. This improves soil structure and water holding capacity.

Green manuring is thus an inexpensive way to improve soil fertility and the nutrition of the main crops grown.

6.Mulches

Mulch is a protective covering overlaid on the ground to suppress weeds, regulate soil temperature, retain soil moisture, and prevent erosion. Mulches provide weed control by smothering weed seedlings and blocking light from the soil surface, preventing the germination of weed seeds. By shading soils in the warm summer months and helping to insulate the soil during cool weather, mulches help to regulate soil temperature. The mulch covering retains soil moisture by preventing water losses through evaporation from sun and wind. Mulch protects the soil from erosion by covering the soil and protecting it from heavy rains. Commonly used mulches include straw, compost, grass clippings, plastic, biodegradable mulch and landscape fabric.

Living Mulches

Living mulches are low-growing vegetative cover crops that are intercropped with cash crops. Living mulches are used to extend cover crop benefits into the growing period of the cash crop. Benefits may include weed control, increased fertility and increased soil moisture. Living mulches may be planted either before or after the cash crop. It is important that the characteristics of the living mulch complement those of the cash crop. Typically, living mulches should germinate and grow in the shade and be low-growing relative to the main crop. Living mulches are not appropriate for all situations. They can compete with cash crop for moisture and nutrients so they are not recommended for low growing, shallow-rooted or drought-susceptible crops.

Questions

A. Choose the correct answer

A1.	Crops which can be grown in an alley cropping practice	
	a. Row/cereal and forage crops b. Fruits crops	c. Biomass producing crops **d. All the above**
A2.	The relative land area under sole crops that is required to produce the yields achieved in intercropping	
	a. LER b. CEY	c. RCC d. RYT
A3	How much nitrogen may be fixed in Rhizobium legume association	
	a. 25-50 kg N/ha	c. 100-125 kgN/ha
	b. 50-100 kgN/ha	d. 150-200 kg n/ha
A4	Oil cake which can be fit for feeding livestock	

	a. Castor cake	**c. Groundnut cake**
	b.Mahua cake	d. Neem cake

B. Short question

B1.	What is composting? Can composting manage all our wastes?
B2.	Write a comment about vermitechnology

C. Brief question

C1.	**Briefly discuss about the** different methods of composting

Lecture -10 Weeds-Ecology- habitat management of weeds- Non-chemical weed management methods; Preventive, Physical, cultural, use of tools and implements and biological measures- good crop husbandry practices.

Weed management

1. Maintaining soil health – Free from a large weed seed bank, tubers and seed setting

   1. Preventing the seed sources to the soil
   2. Preventing weed seed spread – Forage sanitation, clean machinery and clean seed
   3. Seed germination inducement – Seed bed preparation and stale seed bed technique

2. Crop rotation/Intercropping

3. Smothering crops/ Competitive ability

   1. Proper crop selection
   2. Intercropping
   3. Time of sowing
   4. Seed rate
   5. Spacing
   6. Depth of sowing

Nonchemical weed control measures

Management of weeds is an important component of organic production system as elimination of weeds is expensive and hard to achieve. The basic approach is to minimize production losses caused by weeds, though weed may exist as part of whole system.

In the organic agriculture one may often identify weeds as the key problem. Weed population can increase rapidly during the early stages of conversion, although there are evidences that population stabilize with increased time of organic farming.

- Preventing the accumulation of chemical residues
- Alternate weed management techniques leading to less yield reductions and minimum disturbance to environment
- An understanding of crop-weed ecology and its management is essential for weed control in organic farming system
- All means other than synthetic chemicals could be tried to minimize/manage the weeds in the organic production systems.

Indirect means

Preventing the spread of the weeds

1.General sanitation

1. Keeping neighbouring areas clean so as to prevent movement of seeds to the cropped field
2. Removing weeds along fence lines, shelter belts and other non-cropped areas
3. Timely planning and executing weeding operation

2.Forage sanitation

a. Animal feeds should be free from weed seeds
b. Some weeds are alive in the composted manures and have to be prevented
c. Cleaning the equipments and machinery
d. Use of clean seeds

Reducing the intensity of weeds

1.Maintaining a healthy soil

a) By tillage

Maintaining favourable condition of soil is a first line of defence against weeds

Frequent shallow ploughings given before panting are very effective in controlling annual weeds. This technique of sowing crop seed in the relatively weed free soil is termed as Stale seed bed . Being less expensive this may form an important component of integrated weed management system in many places.

Deep ploughing during summer months is very effective against deep rooted perennial. Weeds as it would expose the underground vegetative parts to hot weather.

Interploughing: could also control weeds without chemicals

Pearlmillet – Thinning and weeding

Cotton - Ridging and weeding

Crop rotations

Each crop has its own characteristic weeds and they thrive well when the same crop is grown successively. Monoculture of cereals and use of harmone herbicides have led to serious problem of grassy weeds in many parts of the worlds

Example. High population of Xanthium pensylvanium were associated with Soybean than with corn regardless of weed control measures

Cyperusrotundus a noxious weeds in the upland situation in controlled by puddling the soil and taking up rice cultivation.

Trap cropping; A susceptible crop such as sorghum or sudan grass may be grown before the main crop season to induce germination of striga seeds before it is destroyed. Crops such as groundnut, linseeds, Cowpea, Cotton, Sunflower etc. form good rotational crops as they induce germination but are not practiced by striga.

Enhancing the growth of the crop and suppressing the weeds

Any crop management technique that contributes to vigorous completion crops are considered tools of weed management.

1. Choice variety of the crop
2. Intercropping
3. Time of Sowing/planting
4. Seed rate
5. Row spacing
6. Depth of sowing

To achieve above considerations

Good field preparation and fine seed bed preparation

A favourable land configuration for seed/seedling establishment

Direct measures

1. Mechanical- hand hoeing, use of weeders
2. Hand weeding
3. Off-season tillage
4. Inter ploughing
5. Mulching
6. Mowing
7. Burning
8. Flaming
9. Soil solarisation
10. Controling before seed set

MECHANICAL WEED CONTROL

Mechanical or physical methods of weed control are being employed, ever since man began to grow crops. The mechanical methods include tillage, hoeing, hand weeding, digging, cheeling, sickling, mowing. burning, flooding, mulching etc.

Tillage: Tillage removes weeds from the soil resulting in their death. It may weaken plants through injury or root and stem pruning, reducing their competitiveness or regenerative capacity. Tillage also buries weeds. Tillage operation includes ploughing, discing, harrowing and leveling which is used to promote the germination of weeds through soil turnover and exposure of seeds to sunlight which can be destroyed effectively-later. In case of perennials, both top and underground growth is injured and destroyed by tillage.

Hoeing: Hoe has been the most appropriate and widely used weeding tool for centuries. It is however, still a very useful implement to obtain results effectively and cheaply. It supplements the cultivator in row crops. Hoeing is particularly more effective on annuals and biennials, as weed growth can be completely destroyed. In case of perennials, it destroyed the top growth with little effect on underground plant parts resulting in regrowth.

Hand weeding: It is done by physical removal or pulling out of weeds by hand or removal by implements called khurpi, which resembles sickle. It is probably the oldest method of controlling weeds and it is still a practical and efficient method of eliminating weeds in cropped and non-cropped lands. It is very effective against annuals and biennials and controls only upper portions of perennials.

Digging: Digging is very useful in the case of perennial weeds to remove the underground propagating parts of weeds from the deeper layer of the soil.

Cheeling: It is done by hand using a cheel hoe, similar to a spade with a long handle. It cuts and shapes the above ground weed growth.

Sickling and mowing: Sickling is also done by hand with the help of sickle to remove the top growth of weeds, to prevent seed production and to starve the underground parts. It is popular in slopy areas, where only the tall weed growth is sickled leaving the root system to hold the soil in place to prevent soil erosion.

Mowing is a machine operated practice mostly done on roadsides and lawns.

Burning: Burning or fire is often an economical and practical means of controlling weeds. It is used to (a) dispose of accumulated vegetation (b) destroy dry tops of weeds that have matured and (c) kill green weed growth in situations, where cultivations and other common methods are impracticable.

Flooding: Flooding is successful against weed species sensitive to longer periods of submergence in water. Flooding kills plants by reducing oxygen availability for plant growth. The success of flooding depends upon complete submergence of weeds for longer periods.

Merits of mechanical method

1. Oldest, effective and economical method
2. Large area can be covered in shorter time
3. Safe method for environment
4. Does not involve any skill
5. Weeding is possible in between plants
6. Deep rooted weeds can be controlled effectively

Demerits of mechanical method

1. Labour and time consuming
2. Possibility of damaging crop
3. Requires ideal and optimum specific condition

Tools and implements used in Mechanical weed control

Weed control is one of the expensive operation in crop production. Majority of Indian farmers use hand-hoe for weeding, which demand 300 to 500 man hours/ha depending on the weed infestation.

On an average the cost of weeding in agricultural crops comes to about 1/3 of the total cost of cultivation. Both mechanical and chemical methods are effective for controlling weeds, but mechanical weeding is preferred because herbicide application are generally expensive and selective and some herbicides are injurious to crops and human lives. Mechanical weeding controls the weeds between the crop rows and keeps the soil surface loose, which results in between aeration and moisture conservation.

Tools

Hand hoe: This is the most common tool used in hand weeding. It consists of 2½ - 4" blade which is attached with a wooden handle of about 60°. By using this, space between row crops can be tilled to a depth of 1". Hoeing uproots weed plants and the uprooted plants dry completely within a period of 2-3 days. The efficiency is 20 cents / day.

Spade: It is shaped like a hoe but the iron blade will be longer in size. It will be 7" in width and 9-12" in length. Length of the handle and the angle with which it is attached to the blade varies from place to place. It is used for crops like banana, sugarcane and its efficiency is 15 cents / day.

Crow bar: It is used to remove the underground propagating weeds by hands.

IMPLEMENTS

Country plough. It is used for opening the soil, preparation of seed bed, covering the manure in the land and removing the weeds.

Blade Harrow: It is different from conventional type of harrow, in that there are no tynes. It is attached with a horizontal blades of 30-90 cm length and 5 cm wide with sharp blades, which almost work like a cultivator. It cuts the soil and travel below the surface of soil to 7.5-10 cm depth and remove the surface layer from the soil below and leave its original position. The separated layer is slightly disturbed. At the same time, the weeds in the fields are also cut from under the surface of the soil. This eradicates all the weeds except those which have underground bulbs. It is mainly used in row crops in heavy black soils for weeding. It's efficiency is 2 acres/day.

Junior hoe: It is a cattle drawn implement, suitable for intercultural operations. It is designed for loosening the soil and eradication of weeds in between crop rows. The blades that move horizontally under the soil and cut the shallow rooted weeds. This is used in garden land crops of sugarcane and cotton. The efficiency is 0.75 acres/day

Rotary weeder: Japanese rotary weeder: It is one of the labour saving hand-operated implements used for weeding in paddy crop. It consists of two small toothed rollers (or) drums mounted in a frame provided with handle. Each roller consists of about 5 toothed blades. This implement, while working is pushed and pulled alternatively by the operator in between rows of paddy. The float provided will guide the implement from sinking into the puddle. The idea of using the weeder is to bury the weeds so as to decompose them and add organic matter to the soil The coverage is 0.20 ha per day of 8 hr. with one man labour.

Function:

1. Stirs the myre (soil mixed with standing water)
2. The toxic gases are expelled from the rootzone due to stirring
3. Weeds are uprooted and burried
4. Mixes fertilizers effectively.

5. Facilitate aeration to roots
6. Increase the microbial activity

Disadvantages

1. Difficult to work in puddled condition by the human labour.
2. It does not suit to the present day cultivars with a spacing of 12.5 or 15 cm between rows.

Dry land weeder

a. Peg type: Dry land weeder with long handle is suitable for weeding in row crops under rainfed and irrigated condition. It is easily operated by a man or woman. The weeder is useful and economic under ideal soil conditions i.e. When the soil moisture is about 10 per cent. It performs well in plain fields, where the weeds are shallow rooted and the land is not too thickly infected with weeds. The blade can be adjusted to the defined angle and depth. The peg type permit the movement of the roller in clay soil without getting clogged.

b. Star type: The function and operations are similar to the peg type weeder excepting that star type roller facilitates easier operation to the weeder in loamy and sandy soils.

Both tools can cover an area of 15 cents per day.

Engine operated weeder: The machine is operated by a 2.2. KW petrol start kerosene run engine. A sweep type blade made of steel is fixed at the back of the machine. Sweep blades of 300, 370 and 450 mm width can be fitted to the machine depending on the row to row spacing. A tail wheel is provided behind the blade to maintain the depth of weeding. Provisions have been made in the machine to raise or lower the blade so as to have the desired depth of weeding. The coverage is 0.8 to 1.0 ha per day of 8 hours with a simple operator. Depth of weeding varies from 40 to 50 mm. The machine consumes 0.75 lit of kerosene per hour. Cost of machine is Rs.18,000/=. It is designed by Zonal Research Centre (ZRC), College of Agricultural Engineering (CAE), TNAU, Coimbatore. It is useful in wide spaced crops like cotton, maize, tapioca, orchards and coconut.

Bush clearing machine: Cleaning the land from the bush plants like parthenium by manual labour is tedious and time consuming. The parthenium plants may be allergic to human labours. A machine for the mechanical cutting of such bushy plants has been developed as an attachment to the prime mower of self propelled paddy harvesting machine.

11. The attachment consists of a one metre long shaft carrying 6 mm size 250 mm long mild steel chain pieces with circular steel pieces as cutting elements at the tip. When the shaft rotates at 1000 revolution per minute the plants are cut by impact. The machine can negotiate soft and hard terrain as well since it is equipped with two iron cage wheels for traction.

Biological control

In biological control of weeds, there is always a fear of biological control agents attacking the cop plants and also a plant considered as a weed in one place may not be so in another place.

Example.

Control of Eupatorium odorata by leaf eating caterpillar Parenchactuspseudoinsulata

Lantana by Telenomiascrupulosa

Water hyacinth by Neochetinaeichorniae, N. Bruchi

Variety of aquatic weed by Chinese grass carp

Weeds in flooded rice field – tadpole shrimp

Mycoherbicides

Soil borne fungi – *phytophthorapalmivora*conrol of milk weed Moreniaodorata

It is marketed as Devine, Causes lethal root rot of host plant

Herbiaceae : It is marketed in Japan

Allelochemicals – Biolophos is a natural phytotoxin isolated from the fermentation froth of Streptomyces hygrocopicus, S. Viridochromogenes and exhibits strong herbicidal activity against a wide range of grass and broad leaf weeds.

Monitoring of weeds: Systematic monitoring of weeds would help to device effective ways to tackle current emerging problems of shift of grassy weed flora like Echinochaloasp annual sedges like Cyperusiria, Fimbristilismiliacea and broad leaf weeds Sphenenocleazeylanica. Similarly appearance of propanil herbicide resistant biotypes of Echinochloasp in rice has become a problem.

Ecological management: Ecological management (cultural management) aims by attacking ecological weak points of weeds during field operations such as ploughing, water management, crop season, crop rotation, intercropping etc.

Ploughing is usually done at optimum soil moisture content by which time the weeds seeds start emerging. Hence emerging weed seedlings are buried or exposed to hot Sun for drying in perennial weeds, ploughing is effective to control emergence whose propagules are formed at relatively shallow position within soil. Intensive puddling is very effective for weed control in lowland rice.

Water management practices are very effective for weed control especially in lowland rice. Continuous land submergence beyond 5cm depth for rice is very effective against several weeds and can substitute for weed control.

Lowland rice crop rotation with an upland crop is effective against moisture loving weeds. The population of scirpusmaritimus and echinochloa increases with continuous cropping of lowland rice but decline when rice is rotated with and upland crop. Similarly population of celosia Argentina increases due to continuous growing of short saturated crops such as groundnut but decreases considerably when rotated with tall crops such as sorghum, maize, pearl millet etc.

Biological management: biological weed control using insects, pathogens, fish and snails (bio agents) appears to be ideal for reducing the inputs of herbicides. Some promising examples include:

Outstanding and feasible examples of biological weed control

Weed control by Bio-agents

SI. No.	Weed species	Agent	
1.	*Eichhornia crassipes*	*Neochetina eichhornea,* N.bruchi(Hyacinth weevil)	
2.	*Salvinia molesta singularis* Grass hopper.	Curculinoid weevil - *Crytobagus* *Paulinia acuminata*	(water fern)
3.	*Alternanthera philoxaroides*	Flea beetle. *Agaiees hygrophila*	
4.	*Tribu/us terrestris*	*Microlarinus lypriformis, M./areynil*	
5.	*Opuntia dilleni*	Cochineal scale insect - *Dactylopius tomentosus, D. indicus*	
6.	*Lantana camara*	*Crocidosema lantana, Teleonemia scrupulosa*	
7.	*Parthenium hysterophorus*	*Zygrogramma biecolarata*	

Bio herbicides: Although herbicides are effective for weed control, there has been increasing concern about their safety for food products, their adverse effect on environment and widespread weed resistance to herbicides. These factors along with rising prohibitive costs have provided the impetus to develop alternative weed management strategies. In this contest, biological control has an alternative or supplement weed management appears to play a major role in crop production. Biological approach includes bio control agents such as insects, nematodes, fungi and bacteria as well as plant based chemicals that exhibit herbicidal properties. A bio-herbicide is a plant pathogen use for weed control through application of its inoculums.

The bio-herbicide approach involves spray of specific fungal spores or its fermentation products against the target weed. These preparations are called *'Mycoherbicides'* .

Mycoherbicides and target weed

No.	Product	Content	Target weed
1.	Devine	*Phytophthora palmivora*	Strangle vine *(Morrenia odorata)* in citrus
2.	Collego	*Colletotrichum gloeosporoides*	Joint ventch *Aeschyomone virginica* - rice, soybean
3.	Bipolaris *halepens*	*Bipolaris sorghicola*	Jhonson grass - *Sorghum*
4.	Bioloph	*Steptomyces hygroscopius*	Non-specific: general vegetation
5.	ABG 5003	*Cercospora rodmani*	Eichhornia crassipes
6.	VELGO	*Colletotrichum cocodes*	Abutilon theopharsti
7.	BIOMAL	*Colletotrichum gloeosporoides f.sp.malvae*	Malva pustilla
8.	*CASST*	*Alternaria cassiae*	Cassia obtusifolia

Non-specific agents : Grasscarp or white amur feeds several weed species like Lemna, Hydrilla, Potamogeton.Besides silver carp, common carp also feed large amount of algae.

Competitive plants: The weed parthenium is suppressed by growing *Cassia sericea.* The plant leachates of Cassia have 'Kolinei' which accumulate in the soil and interfere with the germination of parthenium.

Paragrass - *Brachiaria mutica* has been found highly competitive to *Typha sp.* in ditches.

Biological control of weeds in crop fields in India

eg. Control of *Ludwlgia parviflora* in rice by steel blue beetle*(Haltica cynea)*

Control of *Cyperus rotundus* by *Bactra verultana.*

The present system of plant protection, which relies heavily on agrochemicals, is no more viable from ecological and economical viewpoint. It is time to look at traditional plant protection practices as they hold greater promise in the context of sustainable agriculture. Necessity of their integration with chemical control methods is strongly felt, as the traditional methods are simple and economical with least fear of environmental pollution.

Bio-technology in weed control

The microbial toxins and allelochemicals could be manipulated to produce commercial herbicides. BioherbicidesCollego and Biopolaris are used for controlling grass and broad-leaved weeds in rice. In India, bioherbicides for weed control have not yet developed to the extent of practical application. Agronomic practices Agronomic measures necessary for higher yields are at the same time are directed at preventing mass multiplication of weeds. Stale seed bed It involves the removal of successive flushes of weeds before sowing a crop. Weeds that germinate after land preparation are destroyed mechanically, manually or chemically. In mechanical or manual method, soil disturbance should be as shallow as possible. Crop stand Closure the spacing or higher the seed rate, better the crop can compete with weeds due to its smothering effect on weeds. Nutrient management Nutrient application should be timed to prevent weed proliferation and yet to obtain maximum benefit from the applied nutrient. Intercropping and Relay cropping Intercropping upland rice with groundnut, soybean, or green gram minimizes weed density leading to yield advantage. A pulse crop is usually broadcast as relay crop into standing rice crop 10-15 days before harvest. As soon as rice crop is harvested the pulse crop cover the field in dry season and suppress the weed growth.

Cultivars High yielding cultivars are less competitive against weeds than traditional cultivars. For rainfed areas, heavy tillering varieties of medium stature may be better suited than semi-dwarf varieties. Herbicides Non chemical methods of weed control when integrated with one manual weeding are as effective as standard rice herbicides at different ecosystems throughout the country.

Preventive measures

Several preventive measures may be applied at the same time. The importance and effectiveness of the different methods depend to a large extent on the weed species and the environmental conditions. However, some methods are very effective for a wide range of weeds and are therefore regularly used:

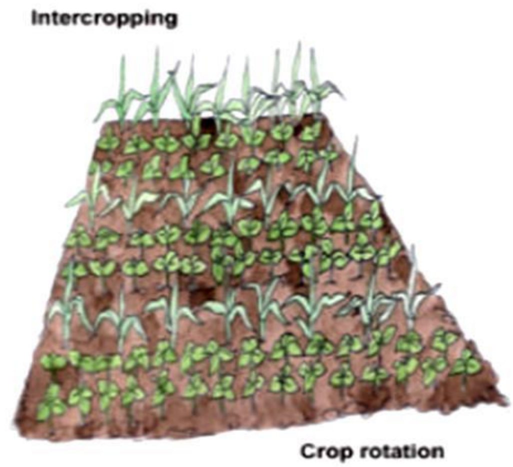
 Choice of crops and varieties: tall crops and varieties with broader leaves will compete better with late occurring weeds than small varieties with narrow leaves. Some varieties will inhibit and suppress weeds while others will tolerate them. For example, there are witch weed (Striga) resistant maize and cowpea cultivars in many countries which give better performance at the same level of weeds where other varieties are more affected

Mulching: the weeds find it difficult to receive enough light to grow and may not be able to pass through the mulch layer. Dry, hardy material, that decomposes slowly, keeps its effect longer than fresh mulch material.

 Living green cover: The cover competes successfully against the weeds for light, nutrients, and water and therefore helps to prevent weed growth by winning the competition for resources. The cover crops usually used are legumes, which improves soil fertility on top of suppressing weeds. For example, a ground cover of desmodium (*Desmodium uncinatum*) or silver leaf, inter-seeded among maize, reduces striga weed and fixes nitrogen at the same time.

 Crop rotation: Rotation of crops is the most efficient measure to regulate seed and root weeds. Changing the conditions of the crop interrupts the living conditions of the weeds thus inhibiting their growth and spread.

 Intercropping (mixed cropping and under-sowing): Intercropping with fast growing weed-suppressive species (“smoother crop” or “living mulch”) between rows of main crop species is effective in weed control. There are different examples sowing cowpeas and egusi melons or pumpkins as intercrops in cassava to reduce weed occurrence.

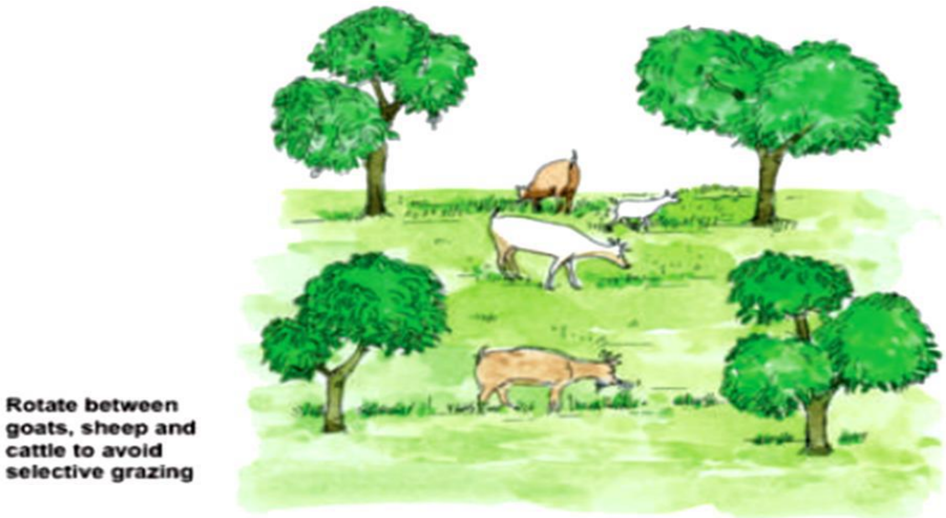


Sowing time and density: Optimum growing conditions enhance the optimum crop plant development and their ability to compete against weeds. Proper crop spacing will ensure that minimum space is available for the growth of weeds and will minimize competition with weeds. This will effectively restrict weed development. In order to apply this approach, the limiting weeds must be known and the seasons in which they occur. A weed calendar of the area or region, if available, might be of help. It will be used to manage weeds in a targeted fashion with proper timing and effect.

- **Balanced fertilization**: it can support an ideal growth of the crop, which promotes the growth of the crop over the weeds.

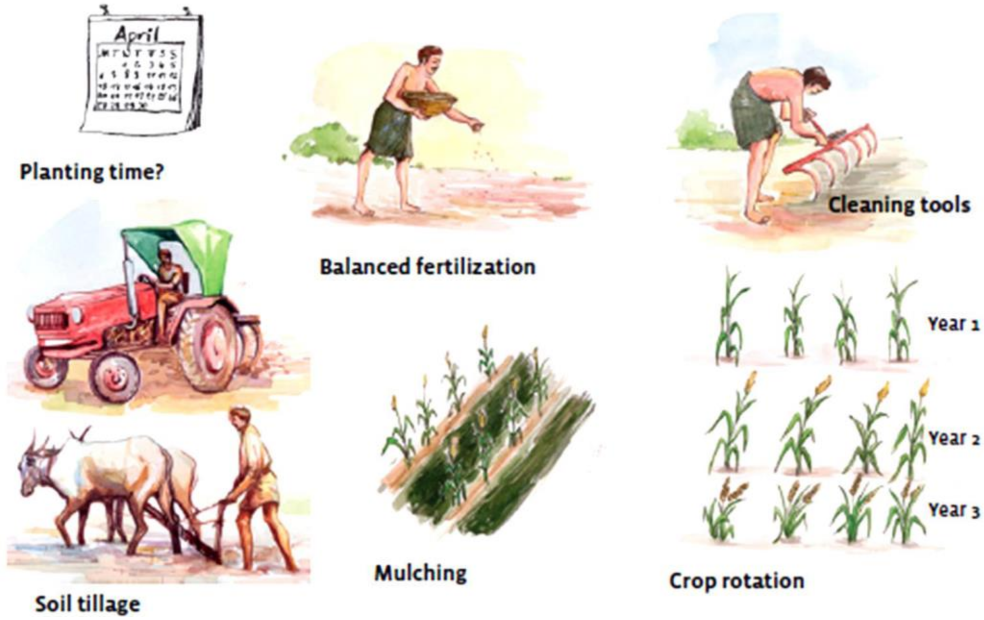
- **Soil cultivation methods** can influence the total weed pressure as well as the composition of weeds. For example, minimum-tillage systems can increase the weed pressure. Because weed seeds can germinate between soil cultivation and sowing of the crop, weed cures before sowing can be effective at reducing weed pressure. Use of superficial stubble treatment works against persisting weeds. It should be done under dry weather conditions to allow the weed roots which have been brought to the surface to dry out.

- **Pasturing**: in perennial crops like coffee, mangoes, avocadoes or cocoa, the use of sheep and goats to reduce rampant weed growth is becoming common. In case of cattle, broadleaf weeds tend to predominate due to the cattle preference for grasses. Therefore, it is necessary to rotate with sheep and goats which prefer broadleaves to overcome this selective grazing



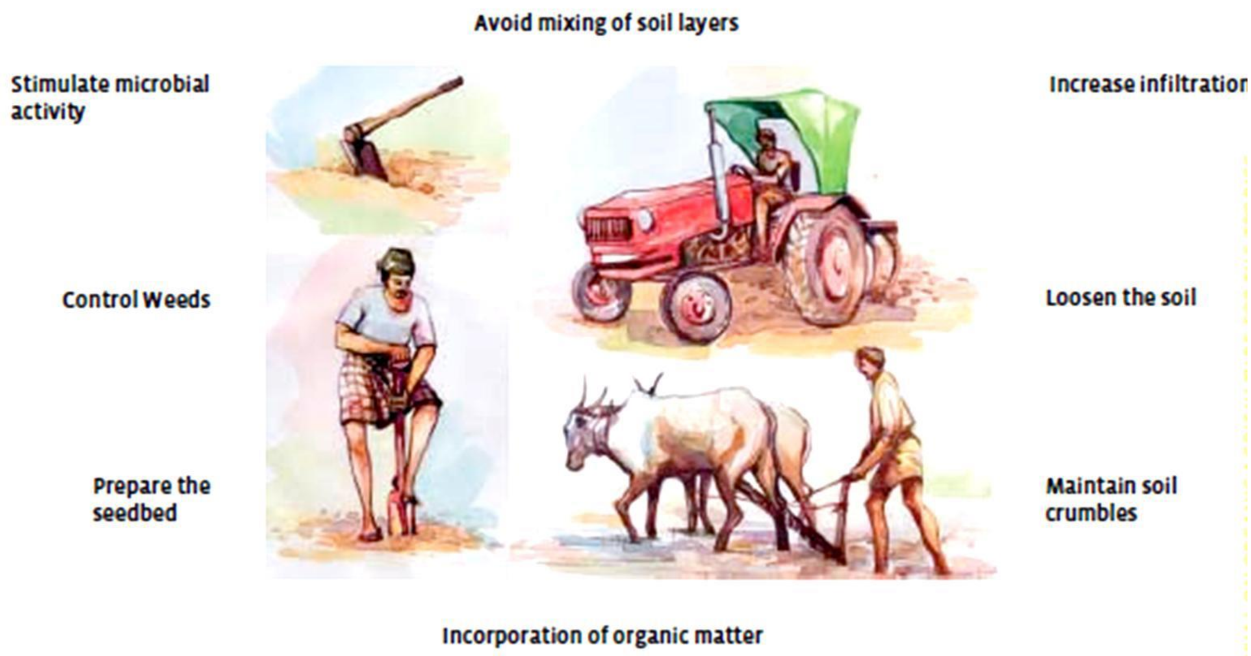
 Prevent insemination of crops by weeds by avoiding the introduction of weed seeds into the fields through tools or animals; and by using only weed free seed materials

Manual weeding is probably the most important one. As it's very labour intensive, reducing weed density as much as possible in the field will bring less work later on and should therefore be aimed at. There are different tools to dig, cut and uprooting the weeds; hand, ox-drawn and tractor-drawn tools. Using the right tool can increase work efficiency significantly.
Weeding should be done before the weeds flower and produce seeds.



Flame weeding is another option: Plants are heated briefly to 100°C and higher. This provokes coagulation of the proteins in the leaves and a bursting of their cell walls. Consequently, the weed dries out and dies. Although it is an effective method, it is quite expensive, as it consumes a large amount of fuel gas and n

- Loosen the soil to facilitate the penetration of plant roots
- Improve the aeration (nitrogen and oxygen from the air)
- Encourage the activity of the soil organisms
- Increase infiltration of water
- Reduce evaporation
- Destroy or control weeds and soil pests
- Incorporate crop residues and manures into the soil
- Prepare the site for seeds and seedlings



INTEGRATED WEED MANAGEMENT

Throughout the world, economic crop production is impossible without a well planned weed management programme. Weed problem persists because of the inability to cope with their great reproduction capacity and massive recycling potential. As there are many kinds of weeds with varying germination periods and highly differing lifecycles, weed management requires an integrated approach based on through knowledge of biology and ecology of the species. Integrated weed management (IWM) involves the concept of multiple tactics of weed management, maintenance of weed population below economic injury level and conservation of environmental quality. A successful IWM strategy has the principle of enhancing farmers' profitability, environmental protection and responsiveness to consumer preference.

Weeds vary so much in their growth habit and life cycle under different ecosystems and growing seasons that no single method of weed management can provide effective weed control. Continuous use of one method of weed control creates problems of buildup of weeds that are tolerant to that particular method of weed control. Similarly, shift in weed flora from annual grasses to sedges and appearance of resistant biotypes due to continuous use of some herbicides has been reported. Long term strategy to minimize weed problem is through IWM than with weed control.

Major components of IWM include:

• Monitoring weeds, shifts in weed flora, appearance of resistant weeds and introduction of new weeds,

• Emphasis on ecological, biological and biotechnological methods of environmental safety, and

• Low cost agronomic strategy for weed management in IWM systems.

State seedbed,

Balanced fertilizer use,

Higher plant population,

Intercropping / relay cropping, and

Use of competitive cultivars,

Supplement herbicide use at minimum possible rate.

Questions

A. Choose the correct answer

A1.	Bioagent used for the control of *Parthenium hysterophorus* is	
	a. *Pauliniaoa chiminata* b. *Cassida* spp	c. *Neochetina bruchi* **d. *Zygograma bicolorata***
A2.	Devine is a	
	a. Chemical fertilizer b. **Bio-herbicide**	c. Bio-fertilizer d. Pesticide
A3	______________ is useful for patch or spot control of obnoxious / perennial weeds	
	a. Mowing	**c. Digging**
	b. Chaining	d. Dredging
A4	Oil cake which can be fit for feeding livestock	
	a. Castor cake	**c. Groundnut cake**

	b.Mahua cake	d. Neem cake
A5.	______________ provides an opportunity to utilize crops themselves as tools of weed management	
A6.	The hand hoe first animal drawn implement was invented by ______________	
A7	Collego is an example of ----------------------------	

B. Short question

B1.	Write short notes on cultural method of weed control
B2.	What are aquatic weeds? Give two examples for aquatic weeds
B3.	Discuss about Myco-herbicides

C. Brief question

C1.	Give a detailed account on mechanical method of weed control. Write its merits and demerits?

Lecture-11 Integrated pest and disease management- bio-control agents, bio-rotational pesticides, minerals , botanicals, soaps, trap crops, bird perches and traditional preparations- Sanitation

INTEGRATED DISEASES AND PEST MANAGEMENT

Definitions of 'pest' (noun) 1. An annoying person or thing; a nuisance. 2. An injurious plant or animal, especially one harmful to humans. 3. A deadly epidemic disease; a pestilence.

Integrated Plant protection

Plant protection (against pests, diseases and weeds) determines the effectiveness of other inputs in crop production. Exclusive reliance on pesticides, fungicides and herbicides resulted in pesticide and herbicide resistance, pest resurgence, residues and environmental pollution. This led to the development of integrated plant protection strategies, which are components of sustainable agriculture with a sound ecological foundation. Integrated plant protection should be understood as an ideal combination of agronomical, biological, chemical, physical and other methods of plant protection against entire complex of pests, diseases and weeds in a specified farming ecosystem, with the object of bringing down their infestation to economically insignificant levels with minimum interference on the activity of natural beneficial organisms. The essence of integrated plant protection concept lies in the harmonious integration of compatible multiple methods use singly or in combination against insect pests, pathogens and weeds.

a. Integrated disease management

For mitigating the loses due to diseases, several methods such as fungicides, organ mercurial, chemotherapy, thermotherapy, cultural methods and host resistance are employed. However, no single method is effective in controlling a disease. Therefore, integrated disease management (IDM) became imperative for effective disease control. Integrated disease management in organic farming combines the use of various measures. The usefulness of certain measures depends on the specific crop-pathogen combination. In many crops, preventative measures can control diseases without the need of plant protection products. However, for certain disease problems, preventative measures are not sufficient. For example, organic apple production strongly depends on the multiple uses of plant protection products. All the cultural methods discussed under IPM hold well for IDM also. Broad based tentative IDM components are being adopted for disease control. However, all these components are not feasible for any specific ecosystem or any specific disease. For many other diseases the role of host resistance, cultural methods and chemical methods are integrated. Solar heat therapy (drying the seed in hot sun after harvest and again before sowing) is a common practice in our agriculture. Among mechanical methods for prevention and against spread of diseases uproot and burn is the age old and the best method so far. It is better to prevent and control vectors against spread of diseases. Disease affected plants are to be uprooted and burnt and alternate and collateral host-crops, grasses, stubbles etc. destroyed. Disease can affect any part of a plant. Disease may be fungal, bacterial and viral. Viral diseases are more serious than fungal and bacterial.

Disease management in organic cropping systems combines various components which can be divided into strategic preventative measures, tactical preventative measures and control measures. For each crop-pathogen relationship and cropping system such components will contribute to different extent to disease management (Termorshuizen, 2002). The development of integrated disease management systems depends on thorough knowledge of the cropping systems as well as of the pathogen and can only be achieved by interdisciplinary research.

Bio-pesticides:

Natural occurrence of diseases caused by micro-organisms is common in both insects and weeds and is a major natural mortality factor in most situations. Use of micro-organisms for pest control involves their culture in artificial media and later introduction of larger amounts of inoculums in to the field at appropriate time. Many fungi and bacteria can be handled in this way but insect viruses have the limitation that they have to be raised in living insects. As the biocontrol agents (microbial pathogens) are applied on the targeted pests in much the same way as chemical pesticides, they are often termed as bio-pesticides or natural pesticides.

Bacillus thuringensis, a bacterial pathogen infesting a wide range of insect pests, is the most common microbial insecticide in use today. It is used against caterpillars that attack a wide range of crop. Unlike most other chemical insecticides, it can be used on edible products up to the time of harvest. It is selective in action and does not harm parasites, predators or pests. The bacteria come in several commericla formulations such as Dipel, Delfin, Halt, Spicturin, Biolep, BioAsp etc. Another bacterium B popilaleis also commonly available against white grub Popillae japonica and Hototricha sp. Amongst insect pathogenic fungi, commercial preparations of Verticillium lecanii are available for the control of aphids, thrips and white fly under glass house conditions.

Botanicals:

Some weeds like Lantana, notchi, tulsi, adathodaetc act as natural repellant to many pests. Trees like pungam, wood apple, anona and their byproducts have excellent insecticidal value in controlling diamond back moth, heliothis, white flies, leafhoppers and aphid infestation.

Most commonly used botanicals are neem (Azadirachtaindica), pungamia (Pungamiaglabra) and mahua (Madhucaindica). Neem seed kernel extract (2 to 5%) has been found effective against several pests including rice cutworm, diamond back moth, rice BPH, rice GLH, tobacco caterpillar, aphids and mites. The pesticidal ingredients of neem formulations belonging to general class of natural products called triterpenes, more specifically, limonides. They act as repellents and also disrupt growth and reproduction in insects. Commonly known limonoids are azadirachtin, meliantriol, salannin, nimbin and nimbidin. The efficiency of vegetable oils in preventing infestation of stored product pests such as bruchids, rice and maize weevils has been well documented. Root extracts of asparagus work as a nematicide for plant parasitic nematodes. Similarly leaf extracts of many plants can inhibit a number of fungal pathogens.

Trap crops

A **trap crop** is a plant that attracts agricultural pests, usually insects, away from nearby crops. This form of companion planting can save the main crop from decimation by pests without the use of pesticides

Examples of trap crops include:

- Alfalfa planted in strips among cotton, to draw away lygus bugs, while castor beans surround the field, or tobacco planted in strips among it, to protect from the budworm *Heliothis*
- Rose enthusiasts often plant *Pelargonium* geraniums among their rosebushes because Japanese beetles are drawn to the geraniums, which are toxic to them.
- Chervil is used by gardeners to protect vegetable plants from slugs.
- Rye, sesbania, and sicklepod are used to protect soybeans from corn seeding maggots, stink bugs, and velvet green caterpillars, respectively.
- Mustard and alfalfa planted near strawberries to attract lygus bugs, a method pioneered by Jim Cochran
- Blue Hubbard squash is planted near cucurbit crops to attract squash vine borer, squash bugs, and both spotted and striped Cucumber beetle.

Bird perches

Bird perches are resting places for predatory **birds** to rest and to look for preys; such as insect pests of cotton, peanuts, and cowpeas. Predatory **birds** prefer to look for prey in **field** crops where they have places to rest. To make **bird perches**, use bamboo or wooden poles or tree branches.

Traditional preparations

I. Maize seeds are soaked in cow urine for 10-12 hours before sowing. According to farmers, this treatment increases resistance against insect pests.

2. Rice seedlings raised from seed treated with extract of neem kernel are vigorous and resistant to leafhopper.

3. In paddy, spraying a solution of 4 l of cow urine and 10 g asafoetida in 10 l of water, repel the sucking pests (aphids,jassids).

4. In paddy, spraying a solution of cow dung prepared by mixing 3 kg cow dung in 3 litres of water against the control of paddy blast and bacterial blight.

5. In case of insect holes made by shoot borer and bark eaters in mango tree, jaggery is placed in the holes to attract other predators (ants), so that they will feed upon the insects present in the hole. Similarly the practices of pouring kerosene in holes and 'blocking holes with cow dung.

6. For prevention of infestation of shoot borer in mango tree, common salt is mixed with soil near the collar region of the tree.

7. In case of 'bunchy top' disease in chilies dusting of ash; use of *gugul (Commiphora wightii)* smoke; spray of sour butter milk; spray of liquid waste of tanned leather, and spray of cow/goat urine

8. A peculiar method of controlling diseases in chilli was observed in which the twigs of *aak (Calotropis* spp.) are placed in chilli field in between rows. Similarly some farmers placed fresh cow dung near the collar

region of plant to prevent it from fungal diseases viz., damping off and die back.

9. In case of soil-borne diseases viz., root rot, collar rot, etc. and termites, the castor cake, karanj cake, or neem cake

10.In case of sugarcane crop, use of common salt (100-125 kg/ha) during intercultural operations.

According to farmers, the salt is effective against termite problem.

11.During sprouting of sets in sugarcane crop, putting stems of *aak (Calotropis* spp.) in the irrigation channels is effective against control of termites, white grub, and borers.

12.Use of kerosene was also common against control of termites in the field

Questions

A. Choose the correct answer

A1.	Which among these can be used as seed treatment against soil borne fungal diseases in organic farming?	
	a. Benlate b. Bavistin	**c. Trichoderma** d. Trichogramma

B. Short question

B1.	Write the difference between organic and conventional farming with respect to plant protection
B2.	State the mechanisms involved in biocontrol
B3.	Brief about Bio- pesticide

B4.	Brief about panchagavya preparation

C. Brief question

C1.	**Describe the principles and strategies of crop protection in organic farming**

Lecture-12 Organic certification- Procedures – certification agencies in India- Labelling and accreditation processes

Organic Certification

Organic certification- It is a certification process for producers of organic food and other organic agricultural products. In general, any business directly involved in food production can be certified, including seed suppliers, farmers, food processors, retailers and restaurants. Requirements vary from country to country, and generally involve a set of production standards for growing, storage, processing, packaging and shipping that include:

- Avoidance of synthetic chemical inputs (e.g. fertilizer, pesticides, antibiotics, food additives, etc) and genetically modified organisms;
- Use of farmland that has been free from chemicals for a number of years (often, three or more);
- Keeping detailed written production and sales records (audit trail);
- Maintaining strict physical separation of organic products from non-certified products;
- Undergoing periodic on-site inspections.

Purpose of certification

Organic certification addresses a growing worldwide demand for organic food. It is intended to assure quality and prevent fraud. For organic producers, certification identifies suppliers of products approved for use in certified operations. For consumers, "certified organic" serves as a product assurance, similar to "low fat", "100% whole wheat", or "no artificial preservatives".

Certification is essentially aimed at regulating and facilitating the sale of organic products to consumers. Individual certification bodies have their own service marks, which can act as branding to consumers. Most certification bodies operate organic standards that meet the National government's minimum requirements.

The certification process

In order to certify a farm, the farmer is typically required to engage in a number of new activities, in addition to normal farming operations: • Study the organic standards, which cover in specific detail what is and is not allowed for every aspect of farming, including storage, transport and sale.

- Compliance - farm facilities and production methods must comply with the standards, which may involve modifying facilities, sourcing and changing suppliers, etc.
- Documentation - extensive paperwork is required, detailed farm history and current set-up, and usually including results of soil and water tests.
- Planning - a written annual production plan must be submitted, detailing everything from seed to sale: seed sources, field and crop locations, fertilization and pest control activities, harvest methods, storage locations, etc.
- Inspection - annual on-farm inspections are required, with a physical tour, examination of records, and an oral interview.
- Fee – A fee is to be paid by the grower to the certification body for annual survellence and for facilitatining a mark which is acceptable in the market as symbol of quality.
- Record-keeping – written, day-to-day farming and marketing records, covering all activities, must be available for inspection at any time. In addition, short-notice or surprise inspections can be made, and specific tests (e.g. soil, water, plant tissue analysis) may be requested. For first-time farm certification, the soil must meet basic requirements of being free from use of prohibited substances (synthetic chemicals, etc) for a number of years. A conventional farm must adhere to organic standards for this period, often, three years. This is known as being

in transition. Transitional crops are not considered fully organic. A farm already growing without chemicals may be certified without this delay.

Certification for operations other than farms is similar. The focus is on ingredients and other inputs, and processing and handling conditions. A transport company would be required to detail the use and maintenance of its vehicles, storage facilities, containers, and so forth. A restaurant would have its premises inspected and its suppliers verified as certified organic.

Certification system in India

In India, there are two accreditation systems for authorizing Certification and Inspection agencies for organic certification. National Programme on organic Production (NPOP) promoted by Ministry of Commerce is the core programme which governs and defines the standards and implementing procedures. National Accreditation Body (NAB) is the apex decision making body. Certification and Inspection agencies accredited by NAB are authorized to undertake certification process. The NPOP notified under FTDR act and controlled by Agricultural Processed Foods Export Development Authority (APEDA) looks after the requirement of export while NPOP notified under APGMC act and controlled by Agriculture Marketing Advisor, Directorate of Marketing and Inspection looks after domestic certification. Currently 20 certification agencies have been authorized to undertake certification process Details of the system are available at www.apeda.com/npop. In 2006, India’s organic certification process under NPOP has been granted equivalence with European Union and Switzerland. It has also been recognized for conformity assessment by USDA’s NOP.

National Programme on Organic Production - National Program on Organic Production (NPOP) was launched during 2001 under the Foreign Trade & Development Act (FTDR Act). The document provides information on standards for organic production, systems criteria, and procedures for accreditation of Inspection and Certification bodies, the national organic logo and the regulations governing its use.

Scope

The NPOP shall, among others, include: (i) Policies for development and certification of organic products, (ii) National standards for organic products and processes, (iii) Accreditation of programmes to be operated by Inspection and Certification Agencies and (iv) Certification of organic products

Operational Structure:

National Steering Committee for National Programme for Organic Production, is the apex policy making body and operates the entire programme through National

Accreditation Body (NAB), Technical Committee (TC) and Evaluation Committee (EC).

Agricultural and Processed Food Products Export Development Authority (APEDA) is the secretariat and implementation office for NPOP for export while Agriculture Marketing Advisor, Directorate of Marketing and Inspection, Department of Agriculture and Cooperation is the secretariat and implementation office for NPOP for domestic certification.

National Standards for Organic Production (NSOP) National Standards for Organic Production are grouped under following six categories: 1) Conversion 2) Crop production 3) Animal husbandry 4) Food processing and handling 5) Labeling 6) Storage and transport

Standard requirements for crop production, food processing and handling are listed below:

1. Conversion Requirements- The time between the start of organic management and cultivation of crops or animal husbandry is known as the conversion period. All standard requirements should be met during conversion period. Full conversion period is not required where organic farming practices are already in use.

2. Crop Production

2.1 Choice of crops and varieties – All seeds and planting materials should be certified organic. If certified organic seed or planting material is not available then chemically untreated conventional material can be used. Use of genetically engineered seeds, pollen, transgenic plants are not allowed.

2.2 Duration of conversion period – The minimum conversion period for plant products, produced annually is 12 months prior to the start of the production cycle. For perennial plants (excluding pastures and meadows) the conversion period is 18 months from the date of starting organic management. Depending upon the past use of the land and ecological situations, the certification agency can extend or reduce the minimum conversion period.

2.4 Fertilization policy – Biodegradable material of plant or animal origin produced on organic farms should form the basis of the fertilization policy. Fertilization management should minimize nutrient losses, avoid accumulation of heavy metals and maintain the soil pH. Emphasis should be given to generate and use own onfarm organic fertilizers. Brought in fertilizers of biological origin should be supplementary and not a replacement. Over manuring should be avoided. Manures containing human excreta should not be used on vegetation for human consumption.

2.5 Pest disease and weed management including growth regulators – Weeds, pests and diseases should be controlled preferably by preventive cultural techniques. Botanical pesticides prepared at farm from local plants, animals and microorganisms are allowed. Use of synthetic chemicals such as fungicides, insecticides, herbicides, synthetic growth regulators and dyes are prohibited. Use of genetically engineered organisms or products is prohibited.

2.7 Soil and Water conservation – Soil and water resources should be handled in a sustainable manner to avoid erosion, salination, excessive and improper use of water and the pollution of surface and ground water. Cleaning of land by burning (e.g. slash and burn and straw burning) should be restricted. Clearing of primary forest for agriculture (jhuming or shifting cultivation) is strictly prohibited.

3. Collection of non-cultivated material of plant origin and honey – Wild harvested products shall only be certified organic, if derived from a stable and sustainable growth environment and the harvesting shall not exceed the sustainable yield of the ecosystem and should not threaten the existence of plant or animal species. The collection area should not be exposed to prohibited substances and should be at an appropriate distance from conventional farming, human habitation, and places of pollution and contamination.

4. Food processing and handling

General principles - Organic products shall be protected from co-mingling with nonorganic products, and shall be adequately identified through the whole process. Certification programme shall regulate the means and measures to be allowed or recommended for decontamination, clearing or disinfection of all facilities where organic products are kept, handled, processed or stored. Besides storage at ambient temperature the following special conditions of storage are permitted.

Controlled atmosphere, cooling, freezing, drying and humidity regulation.

Pest and disease control – For pest management and control following measures shall be used in order of priority

Preventive methods such as disruption, and elimination of habitat and access to facilities. Other methods of pest control are: Mechanical, physical and biological methods Permitted pesticidal substances as per the standards and Other substances used in traps.

Irradiation is prohibited. Direct or indirect contact between organic products and prohibited substances (such as pesticides) should not be there.

5. Packaging Material used for packaging shall be ecofriendly. Unnecessary packaging material should be avoided. Recycling and reusable systems should be used. Packaging material should be biodegradable. Material used for packaging shall not contaminate the food.

6. Labelling When the full standard requirements are met, the product can be sold as “Organic”. On proper certification by certification agency “India Organic” logo can also be used on the product.

7. Storage and transport Products integrity should be maintained during storage and transportation of organic products. Organic products must be protected from co-mingling with non-organic products and must be protected all times from contact with the materials and substances not permitted for use in organic farming.

Grower Group Certification System This system is based on the internal quality system and shall apply to producer groups, farmer’s cooperatives, contract production and small scale processing units. The producers in the group must apply similar production systems and the farms should be in geographical proximity.

Constitution of group The group should have a legal status or constitution of the organization and shall be presented by an organizational chart.

Internal quality system Group certification is based on the concept of an Internal Quality System comprising of the following: -

- Implementation of the internal control system
- Internal standards
- Risk assessment.

An external inspection and certification body should be identified for conducting annual inspection of the individual group / unit. The external inspection agency shall evaluate by checking the IQS documentation, staff qualifications and re-inspecting some farms.

Developing IQS The following are the minimum requirements for setting up an IQS for grower groups:

- Development of Internal Control System (ICS)
- Identification of producer groups
- Creation of awareness about group certification
- Identification of qualified personnel for maintaining the internal control system
- Give necessary training in production and IQS development
- Preparation of IQS manual containing policies and procedures
- Implementation of the policies and procedures
- Review and improvement of the IQS document for maintaining a harmonized IQS.

The system is operated through following workers

1. Internal quality system manager (IQS Manager)
2. Internal inspectors

3. Approval manager / committee

4. Field officers

5. Purchase officers

6. Warehouse manager

7. Processing manager (in case of processing unit)

Internal standards -The internal standards shall be prepared in local language by the IQS manager for the region of operations under the framework of NPOP standards. If the farmers are illiterate, the internal standards shall contain illustrations in the text for better understanding.

Conflict of interest -The IQS personnel shall not have any conflict of interest that might hinder the work. All possible conflicts shall be declared in a written statement. In such cases, the IQS shall ensure that alternative solutions are found.

Scope of certification- The certification shall be granted to the group with reference to the regulations / standards adopted by the group.

Procedure for implementation of ICS 1. Registration of members - All members of the group will be formally (legally) registered under a single entity. 2. Provision of documents to the members of the grower group - Each member of the grower group will be supplied with docket in local languages, which will contain – Copy of IQS manual, Internal standards document, NPOP document, Definition of the production unit, .. Farm Entrance Form, Field records, Written contract, Annual farm inspection checklist and Information on training programmes and provision of advisory services

Internal inspections -At least two inspections of the group (one in growing season of each crop) shall be carried out by the internal inspector and will be documented. The inspection will be carried out in presence of the member or his representative and must include a visit of the whole farm, storage of inputs, harvested products, post harvest handling and animal husbandry. In case of non-compliance, the results will be reported to the IQS manager and all measures should be taken according to the internal sanction procedures.

External inspections- The external Inspection and Certification Agency will re-inspect some of the farms for the evaluation of the grower group for efficient internal control system for compliance with the NPOP Standards. The sampling plan for inspection shall be based on the inspector's perception of risk.

Yield estimates -Yields will be estimated for each crop for individual farmer in the group. This activity should be carried out especially during harvesting and should be counter-checked with the estimates during buying.

Certification Procedure in brief

- Application is made to the certification agency in the prescribed format with necessary farm and process details
- Screening of application by certification agency and if necessary further details/clarification sought
- Cost estimate comprising of certification charge, inspection charge, travel cost, reporting cost, laboratory charges etc is sent for acceptance
- Acceptance of cost by the grower/producer
- Signing of agreement between grower/producer and certification agency
- Certification agency seeks cropping/production/cultivation /processing plan and supply a copy of the standards to the grower/producer to follow
- Certification agency raises an invoice and asks the producer to release 50% of the certification cost in advance
- Grower/producer pays the fee
- Inspection schedule is worked out
- Inspection is carried out at one or more than one occasion
- If required unannounced inspection can also be done. In case of doubt the inspection team can also draw plant/soil/raw material/input/product sample for laboratory analysis.

• Inspection report/(s) submitted to the certification committee

• Certification agency asks for final payment

• Final payment is made

• Certification is granted

• Grower/producer releases the stock for sale with Certification Mark (India Organic Logo)

Questions

A. Choose the correct answer

A1.	Expand IFOAM	
A2.	NPOP	
	a. National Programme on Organic Propaganda	**c. National Programme on Organic Production**
	b. National Programme on Organic Promotion	d. National Programme on Organic Price
A3	APEDA is under the	
	a. Ministry of Commerce	c. Ministry of Industry
	b. Ministry of Agriculture	d. Ministry of Finance

B. Short question

B1.	Define Organic Certification. State the Purpose of certification
B2.	Comment about a).APEDA b). NPOP
B3	Discuss about transition period in organic production system

C. Brief question

C1.	Enumerate the organic certification process and organic certification system in India

<u>**LIST OF ACCREDITED CERTIFICATION BODIES UNDER NPOP**</u>

e of the ification gency	Contact Person & Address	Accreditation No.	Validity of Current Accreditation	Scope of Accredit-ation	Certifica
Veritas ation India vt. Ltd.	**Contact Person**: Mr. Kaushik Sengupta Product Manager (Food -India) **Address:** Marwah Centre, 6th Floor Opp. Ansa Industrial Estate Krishanlal Marwah Marg Off Saki-Vihar Road Andheri (East), Mumbai-400 072 Maharashtra Tel. No: 022-66956300, 56956311 Fax No. 022-66956302/10 Email:kaushik.sengupta@in.bureauveritas.com	NPOP/NAB/001	31-05-2016	NPOP USDA NOP	
RT India .	**Contact Person:** Mr. Anil Jadhav Chief Executive Officer **Address:** 1st Floor, Vatika Business Park, Block -2, Sector- 49,Sohna Road, Gurgaon – 122018, Haryana, India Telephone: +91-124-6999959 Email: anil.jadhav@ecocert.com	NPOP/NAB/002	22-08-2017	NPOP USDA NOP	

e of the ification gency	Contact Person & Address	Accreditation No.	Validity of Current Accreditation	Scope of Accredit-ation	Certifica
trol Pvt.	**Contact Person:** Mr. Umesh Chandrasekhar Director **Address:** No. 3627, 1st Floor, 7th Cross, 13th ' G ' Main, H.A.L. 2nd Stage, Bangalore-560 008. Tel. No: +91-80-25285883, 25201546, 25215780 Fax: 0091-80-25272185 Email: imoind@vsnl.com Web: www.imo.ch	NPOP/NAB/003	28-09-2016	NPOP USDA NOP	
rganic tion **RT)**	**Contact Person:** Ms. Amrutha Liz Mathew Executive Director **Address:** Thottumugham P.O. Aluva-683 105, Cochin (Kerala) Telefax: 0484-2630908-09/2620943 Email: info@indocert.org	NPOP/NAB/004	24-10-2017	NPOP USDA NOP	

e of the ification gency	Contact Person & Address	Accreditation No.	Validity of Current Accreditation	Scope of Accredit-ation	Certifica
uality ation Pvt.	**Contact Person:** Mr. Bobby Issac Director **Address:** Chenathra, Theepany, Thiruvalla - 689 101 (Kerala) Tel. No: 0469 2606447 Fax: 0469 2631902 Email: info@laconindia.com Web: www.laconindia.com	NPOP/NAB/006	31-10-2017	NPOP USDA NOP	
Asia Agri ation (P)	**Contact Person:** Mr. Sandeep Bhargava Chief Executive Officer **Address:** H-08, Mansarovar Industrial Area, Mansarovar Jaipur-302020, Rajasthan Phone & Fax- 0141-2395481,6541882, 6541883(Direct) Email:- info@onecertasia.in Web site:- www.onecertasia.in	NPOP/NAB/008	26-10-2018	NPOP USDA NOP Livestock w.e.f 08.04.2016	(*w.e.f: 2*

e of the ification gency	Contact Person & Address	Accreditation No.	Validity of Current Accreditation	Scope of Accredit-ation	Certifica
ia Pvt. Ltd.	**Contact Person:** Mr. Amresh Pandey Technical Manager -Organic Certification **Address:** SGS India Pvt Ltd 226,Udyog Vihar, Phase-I Gurgaon-122016 Haryana Tel: + 91 124 6776300 Ext 6379 91 124 6776379 (Direct) Fax: +911246776403/04 Mobile: + 91 9871794709 Email: amresh.pandey@sgs.com	NPOP/NAB/009	01- 05-2017	NPOP (not for EU) USDA NOP	

e of the ification gency	Contact Person & Address	Accreditation No.	Validity of Current Accreditation	Scope of Accredit-ation	Certifica
Union tions	**Contact Person:** Mr. Dirk Teichert Managing Director **Address:** Plot No. C-113, Pawane MIDC, Navi Mumbai - 400709 Tel: +91-22-61294300 Fax:+91-22-61294217 Mobile:09930453754 Email: cuc@controlunion.in Website: www.controlunion.com	NPOP/NAB/0010	28-05-2017	NPOP USDA NOP Livestock w.e.f 21.04.2016	(*w.e.f:*
hand State ation	**Contact Person:** Ms. Damayanti Rawat Director **Address:** **Third Floor, Krishak Bhavan** **Mussoorie By Pass Ring Road** **Nehru Gram, Dehradun, Uttarakhand** **Tel : 0135 2671734** Email: info@usoca.org Website: www.usoca.org	NPOP/NAB/0011	13-11-2015	NPOP USDA NOP	

e of the ification gency	Contact Person & Address	Accreditation No.	Validity of Current Accreditation	Scope of Accredit-ation	Certifica
rganic ation	**Contact Person :** Mr. Mandar B Navare Chief Operating Officer **Address:** **Holkar House, First Floor, Sr no: 54, Near Nikhil Garden, Wadgaon Bk. Pune 411041** **Phone /fax: 020-65410070** **Email: ceo@aoca.in** Website: www.aoca.in	NPOP/NAB/0012	09-01-2016	NPOP	
an Organic ation (ROCA)	**Contact Person:** Mr. Madhu Sudan Sharma Director **Address:** 3rd Floor, Pant Krishi Bhawan, Janpath, Jaipur 302 005 Rajasthan Tel. No.: 0141-2227104, Tele Fax: 0141-2227456 Email: rocajpr.cb@gmail.com	NPOP/NAB/0013	09-10-2016	NPOP USDA NOP **(w.e.f 01-07-2015)**	

e of the ification gency	Contact Person & Address	Accreditation No.	Validity of Current Accreditation	Scope of Accredit-ation	Certifica
rganic ation	**Contact Person:** Dr. (Mrs.) M. Usha Managing Director **Address:** Plot no-54,Ushodaya Enclave Mythrinagar, Miyapur Hyderabad-500050 Telangana Phno: 040-65276784 Fax: 040-23045338 Email : voca_org@yahoo.com vedicorganic.2008@gmail.com Website: www.vediccertification.com	NPOP/NAB/0014	30-09-2017	NPOP USDA NOP **(w.e.f 01-10-2011)**	
ndian for ation of Products)	**Contact Person:** Prof: Dr. K. K. Krishnamurthi President **Address:** Indian Society for Certification of Organic Products (ISCOP) 135, Ponnurangam Road West R.S. Puram, Coimbatore-641002 Tamil Nadu Phone:0422-2544199/ 0422-2546160 Mobile:91 94432 43119 Email: profdrkkk@yahoo.com Website:www.iscoporganiccertification.org	NPOP/NAB/0015	30-09-2017	NPOP	

e of the ification gency	Contact Person & Address	Accreditation No.	Validity of Current Accreditation	Scope of Accredit-ation	Certifica
rt India	**Contact person:** Mr. K. K. Gupta Director **Address:** A Wholly Owned Subsidiary of Tata Projects Limited Fourth Floor, Mithona Towers-I, 1-7-80 to 87, Prenderghast Road, Secunderabad - 500 003, Telangana, India Tel : +91 - 40 – 65181222 Fax: +91 – 40 - 66172535 Email: kkgupta@foodcert.in Website: www.foodcert.in	NPOP/NAB/0016	30-09-2017	NPOP USDA NOP (w.e.f 1-6-2011)	
ganic ations Pvt.	**Contact person:** Mr. Narayana Upadhyaya Director **Address:** Aditi Organic Certifications Pvt. Ltd. No. 531/A, Priya Chambers Dr. Rajkumar Road, Rajajinagar 1st Block, Bangalore - 560010 Tel.: +91-80-32537879 Fax: +91-80-23373083 Mobile: +91-9845064286 Email: aditiorganic@gmail.com Website: www.aditicert,net	NPOP/NAB/0017	30-09-2017	NPOP USDA NOP (w.e.f 1-6-2010)	(***w.e.f:***

e of the ification gency	Contact Person & Address	Accreditation No.	Validity of Current Accreditation	Scope of Accredit-ation	Certifica
sgarh ation India T)	**Contact person:** Shri. B.K. Sinha (IFS) Chief Executive Officer **Contact address:** Campus SFRTI Near Vidhan Sabha Zero point, Baloda Bazar Road, Raipur, Chhattisgarh 493 111 Tel: +91-771-2283249 Fax : +91-771-2283249 Email: cgcert@gmail.com	NPOP/NAB/0018	15-09-2018	NPOP	
adu ation ent)	**Contact person:** Mr. R. Jayasundar Director **Contact address:** 1424 A, Thadagam Road G.C.T Post, Coimbatore – 641013 Tamil Nadu Tel.: 0422 2435080 Fax: 0422 2457554 Email: tnocdcbe@gmail.com Website: www.tnocd.net	NPOP/NAB/0019	30-09-2018	NPOP	

e of the ification gency	Contact Person & Address	Accreditation No.	Validity of Current Accreditation	Scope of Accredit-ation	Certifica
India Pvt.	**Contact Person**: Mr. Ashish Gaur Head - Certification (Food Services) **Address:** E-20, Block B-1 Mohan Cooperative Industrial Estate Mathura Road New Delhi - 110 044 Ph : +91-11-4159 5420/ +91 9899461610 Fax : +91-11-4159 5475 E-mail : ashish.gaur@intertek.com Website : www.intertek.com	NPOP/NAB/0020	19-05-2016	NPOP USDA NOP **(w.e.f 01-10-2011)**	
Pradesh Organic ation	**Contact Person :** Mr. R.S. Charmkar Managing Director **Address:** Vasundhara, B-II Office Complex Gautam Nagar Bhopal 462 023 Madhya Pradesh Tel : 0755 2600609 E-mail : md.mpsoca@gmail.com	NPOP/NAB/0022	30-09-2017	NPOP **(w.e.f 01-10-2011)**	

e of the ification gency	Contact Person & Address	Accreditation No.	Validity of Current Accreditation	Scope of Accredit-ation	Certifica
India Pvt.	**Contact Person :** Mr. Dilip Dhaker Managing Director **Address :** 1, Silver County, S No 3, C wing, Pune-Mumbai Highway Ambegaon Bk Pune 411041 Maharashtra Tel. No: 020-65310070 Email: info@biocertindia.com Website : www.biocertindia.com	NPOP/NAB/0023	**Terminated** ***(with effect from 4th August 2015)***	NPOP USDA NOP **(w.e.f 01-12-2011)**	

e of the ification gency	Contact Person & Address	Accreditation No.	Validity of Current Accreditation	Scope of Accredit-ation	Certifica
State **ation (OSOCA)**	**Contact Person:** Mr. Aditya Kumar Patra Quality Manager **Address:** Plot No.-326, Baramunda, Bhubaneswar, Odisha, 751003 Phone-(0674) 2563639/2561783 Fax.- (0674)2562078 Mobile No.- 9437211001 Email : ceoosoca@gmail.com directorossca@rediffmail.com Website : www.ossopca.org	NPOP/NAB/0025	31-5-2018	NPOP	

e of the ification gency	Contact Person & Address	Accreditation No.	Validity of Current Accreditation	Scope of Accredit-ation	Certifica
Organic ation Agro .	**Contact Person:** Mr. Sanjay Deshmukh Managing Director **Address:** Office No.2 Karan Plaza-II Near Rozary School Warje Pune - 411058 Maharashtra State Tel- 91-20-65218063 Cell no. 09822006586 E mail-nocaindia@gmail.com Web site: www.nocaagro.com	NPOP/NAB/0026	14-02-2017	NPOP	N O (*w.e.f:1*
t ation . Pvt. Ltd.	**Contact Person:** Dr. Pushkar Kulshrestha CEO **Address:** C-122, Gauridham Colony Khargone Madhya Pradesh 451001 Tel : +91-7282-231271/203017 Fax : +91-7282-231271 E-mail: cert.fair@gmail.com Website: www.faircert.com	NPOP/NAB/0027	14-02-2017	NPOP	

e of the ification gency	Contact Person & Address	Accreditation No.	Validity of Current Accreditation	Scope of Accredit-ation	Certifica
Organic s ation (GOPCA)	**Contact Person:** Shri R. A Oza Quality Manager **Address:** Beej Pramanan Bhavan Opp. Gokul House Nr. Shyamal Cross Rd, Satellite Ahmedabad- 380015, Gujarat Tel : +079-26740031 Fax : +079-26740031 E-mail: dirgopca@gmail.com Website: www.gopca.in	NPOP/NAB/0028	19-06-2017	NPOP (w.e.f 20.06.2014)	
adesh State ation	**Contact Person:** Shri. Bhanu Pratap Singh Joint Director **Address:** Government Garden Campus Kariyappa Road, Alambagh Lucknow 226 005 Uttar Pradesh Tel : +91 – 0522 - 2451639 E-mail: upsoca.org@gmail.com Website: www.upsoca.org	NPOP/NAB/0029	19-06-2017	NPOP (w.e.f 20.06.2014)	

e of the ification gency	Contact Person & Address	Accreditation No.	Validity of Current Accreditation	Scope of Accredit-ation	Certifica
ka State ation	**Contact Person:** Mr. S.S. Parashiva Murthy Deputy Director **Address:** Opp. Bellary Hospital, Bellary Road Hebbal, Bengaluru 560 024 Tel : +91 – 80- 23418302 FAX : +91 – 80 - 23415506 E-mail: ksocabng@gmail.com Website: www.kssoca.in	NPOP/NAB/0030	16-08-2018	NPOP (w.e.f 17.08.2015)	

Lecture-13 Crop production standards- NPOP guidelines- Principles, recommendations and standards- Quality considerations- Assessment methods – Premium and export opportunities

Introduction

In order to assure the consumer that a product is produced organically, a kind of quality control is needed. The organic quality is based on standards, inspection, certification and accreditation. All organic food is produced and handled according to strict rules called ‘organic standards’. These standards cover all aspects of food production from animal welfare and wildlife conservation, to not allowing artificial food additives. All organic forms are visited at least once a year by a certifying inspector to check that standards are met. Organic standards do not define a quality status which can be measured in the final product (E.g. quality of pesticide residues, heavy metals, etc.). They define the way of production (E.g. that no chemical pesticides and fertilizers are used). There are organic standards at the national as well as international level.

Standards

Standards are rules of production for organic agriculture. They determine the production process within the ecological and social environment through which then product emerges. There are standards at various levels

1. International standards: International standards are those standards for organic agriculture approved by international bodies and recognised by legal authorities. E.g. Codex Alimentarius Commission guidelines.

IFOAM basic standards: They were first published in 1980. Since then they have been subjected to biennial review and publication. These basic standards define organic products grown, produced and handled. They reflect the current state of organic production and processing methods.

Codex alimentarius: The codex guidelines for organically produced food will be regularly reviewed at least every four years based on given codex procedure.

2. Regional / supranational standards

Different regions in the world are involving regional or supranational standards for organic agriculture. E.g. European Union Council's regulations.

European Union Council's regulations: The European Union regulation on organic production lays down minimum rules governing the production, processing and import of organic products, including inspection procedures, labelling and marketing for the whole of Europe. Each European country is responsible for enforcement and for its own monitoring and inspection system. Applications, supervision and sanctions are dealt with at regional levels.

3. National standards

National standards are basic organic agriculture standards prepared by respective countries on the basis of which detailed standards are prepared by certification agencies and statutory boards for the development of crops.

Some of the national standards are

1. USDA standards
2. Canadian organic standards
3. Australian organic standards

Organic standards

- The use of synthetic pesticides, weedicides and agro-chemicals led to contamination of products and the quality of the produce is under question.
- Thus, pesticide residue laboratories were set up to test the pesticide contamination in food and drink, but it did not prevent terrestrial and aquatic ecosystem on land and water.
- Thus, the clean and uncontaminated food can only be obtained by growing than in places, which is not contaminated and not applied with toxic chemicals.
- The standards are set which makes the food products to be grown under specified conditions, using only permissible inputs, following organic principles during

growing, harvesting, processing, packing and transportation and the same came to be known as ‘organic standards’.

- Organic standards are sets of definitions, requirements, recommendations and restrictions regarding the practices and materials that can be used within certified organic production and processing systems. Organic standards also cover such aspects as the transport, storage and marketing of organic products.
- Organic standards typically contain lists of materials that are permitted as farm and processing inputs, such as fertilizers, pesticides and food additives. All other materials should be considered as prohibited unless the relevant certification programme approves their use.
- Organic standards generally emphasis the use of good management practices to minimise the need for inputs wherever possible. Organic standards address such broader aspects as biodiversity, native vegetation retention, waterway management, animal husbandry, ethics and waste management.

NPOP

- In India, standards for organic agriculture were announced in May, 2001 and the National Programme on Organic Production (NPOP) is administered by Agricultural and Processed food products Export Development Authority (APEDA) using the IFOAM basic standards under the Ministry of Commerce.
- It includes definite principles, basic standards of production, documentation, inspection and certification guidelines.
- The Government has set the frame conditions in which the organic sector of a country operator which include content and legal status of organic standards, the regulations concerning the use of organic claims and labels, the legislation on consumer protection and the accreditation system.
- As per the national accreditation policy, all certifying agencies operating in India are to obtain accreditation from any one of the accrediting agency appointed by the Government of India (E.g. Spice Board, Coffee Board, Tea Board, APEDA, etc.).

NPOP guidelines

Formation of Organic Farmers Group

- Farmers with similar farming and production should be brought together preferably in the same village in contiguous areas.

Conversion Period in Organic Farming

- It is the time between the start of organic management and certification of crops.
- Conversion period varies from 1 to 3 years depending on the current usage of chemical fertilizers, pesticides and false usage of lands.
- It is determined by certification agencies, while deciding the period, ecological regions are considered.

Plant and Planting Material

- All seed and planting material essentially used from the same farm or other organic farming farms which are adopted to local soil and climatic conditions.

Fertilisation Policy in Organic Farming

- Biodegradable materials are encouraged. Poultry manure, if it is produced outside the farm, is avoided.
- They set limitations for use of biodegradable material.
- Excess use of it also pollute environment.
- Manures containing human excreta should not be directly used on crops which are used for direct consumption.
- Carbon based materials should form the basis for nutrition.
- Some of the mineral fertilizers have restricted use and can be used as supplementary to manures. E.g. Lime, gypsum, rock phosphate, KNO_3 are permitted.

Permitted: FYM, urine, crop residues, mulches, cover crops, poultry manure, biofertilizers, BD preparation, vermicompost, botanical extracts, etc.

Restricted: Use of Blood meal, bone meal, compost, city waste, FYM from other farm.

Restricted Minerals: NaCl, KSO_4, gypsum, $MgSO_4$, lime, rock phosphate.

National Standards of Organic Farming

Ministry of Commerce Under the “National Programme for Organic Production” has prescribed National Standards for Organic Production. These standards are grouped under following six categories:

1. Conversion
2. Crop production
3. Animal husbandry
4. Food processing and handling
5. Labeling
6. Storage and transport

1. Conversion Requirements

The time between the start of organic management and cultivation of crops or animal husbandry is known as the conversion period. The whole farm including the livestock should be converted to the standards over a period of time. All standard requirements should be met during conversion period. If the whole farm is not converted then the two must be separate and inspectible. Regular inspections during the conversion period should be carried out.

Simultaneous productions of conventional or in conversion and\or organic which can not be distinguished clearly are not allowed. To ensure clear separation the certification programme shall inspect the whole production system. Full conversion period is not required where organic farming practices are already in use. But this has to be verified by the inspection agency.

Maintenance of organic management

Organic certification is based on continuance. The certification programme should certify the production, which is likely to be maintained on a long term basis. The converted land and animals shall not get switched back and forth between organic and conventional management.

Landscape

Organic farming should contribute beneficially to the ecosystem. Areas which should be managed properly and linked to facilitate biodiversity are:

- Extensive grassland
- All areas which are not under rotation and are not heavily manured
- Pastures, meadows, orchards, hedges, hedgerows etc

- Ecologically rich fallow land or arable land
- Ecologically diversified field margins
- Waterways, pools, springs, ditches, wetland, swamps

The certification programme shall set standards for a minimum percentage of the farm area to facilitate biodiversity and nature conservation.

2. Crop Production

2.1 Choice of crops and varieties – All seeds and planting materials should be certified organic, well adapted to local climatic conditions and resistant to pests and diseases. If certified organic seed or planting material is not available then chemically untreated conventional material can be used. Uses of genetically engineered seeds, pollen, transgenic plants are not allowed.

2.2 Duration of conversion period – The minimum conversion period for plant products, produced annually is 12 months prior to the start of the production cycle. For perennial plants (excluding pastures and meadows) the conversion period is 18 months from the date of starting organic management. Depending upon the past use of the land and ecological situations, the certification agency can extend or reduce the minimum conversion period.

2.3 Diversity in crop production – Diversity in crop production is achieved by a combination of (a) versatile crop rotation with legumes and (b) by appropriate coverage of the soil with diverse plant species during the year of production that, taken into account pressure from insects, weeds, diseases and other pests, while maintaining or increasing soil health and fertility.

2.4 Fertilization policy – Biodegradable material of plant or animal origin produced on organic farms should form the basis of the fertilization policy. Fertilization management should minimize nutrient losses, avoid accumulation of heavy metals and maintain the soil pH. Emphasis should be given to generate and use own on-farm organic fertilizers. Brought in fertilizers of biological origin should be supplementary and not a replacement. Over manuring should be avoided. Manures containing human excreta should not be used on vegetation for human consumption.

In case of deficiency mineral fertilizers can be used as supplementary source and should be applied in their natural composition. Minerals containing high concentrations of heavy metals should be avoided.

Biofertilizers can be used safely under all ecosystems and in all the crops.

2.5 Pest disease and weed management including growth regulators – Weeds, pests and diseases should be controlled by a number of preventive cultural techniques, such as suitable rotations, green manures, a balanced fertilization programme, early and pre-drilling seed bed preparations, mulching, mechanical control and the disturbances of pest development cycles.

Botanical pesticides prepared at farm from local plants, animals and microorganisms are allowed. Thermic weed control and physical methods for pests, disease and weed management are permitted. Use of synthetic chemicals such as fungicides, insecticides, herbicides, synthetic growth regulators and dyes are prohibited. Use of genetically engineered organisms or products is prohibited.

2.6 Contamination control - All attempts should be made to minimize contamination from outside and with in the farm.

2.7 Soil and Water conservation – Soil and water resources should be handled in a sustainable manner to avoid erosion, salination, excessive and improper use of water and the pollution of surface and ground water. Cleaning of land by burning (e.g. slash and burn and straw burning) should be restricted. Clearing of primary forest for agriculture (jhuming or shifting cultivation) is strictly prohibited.

3 Collection of non-cultivated material of plant origin and honey – Wild harvested products shall only be certified organic, if derived from a stable and sustainable growth environment and the harvesting shall not exceed the sustainable yield of the ecosystem and should not threaten the existence of plant or animal species.

The collection area should not be exposed to prohibited substances and should be at an appropriate distance from conventional farming, human habitation, and places of pollution and contamination.

4. Animal Husbandry

4.1 Maintenance\rearing of animals

The certification programme shall ensure that the management of animal environment takes into account the behavioral needs of the animal and provides for :

a. Sufficient free movement

b. Sufficient fresh air and day light

c. Protection against excessive sunlight, temperature, rain, wind etc.

d. Enough lying and resting area

e. Ample access to fresh water and feed and

f. Proper environment for their biological and ethological needs

Poultry and rabbits should not be kept in cages. Land less animal husbandry system shall not be allowed.

4.2 Length of conversion period – The whole farm including livestock should be converted to organic according to the standards. Animal products may be certified organic only after the farm has been under conversion for at least 12 months and the required standards have been achieved. Length of the conversion period can be extended at the discretion of the certification agency. In case of dairy and egg production the conversion period shall be 30 days at minimum.

4.3 Brought-in animals

All organic animals should be born and raised on the organic holding. When organic livestock is not available the certification programme shall allow brought-in conventional animals according to the specified age limits e.g. 2 days old chicken for meat production, 18 weeks old hen for egg production, 2 weeks old for any other poultry, piglets up to 6 weeks old after weaning and calves up to 4 weeks old which have received colostrums and are fed a diet consisting mainly of full milk.

4.4 Breeds and breeding

Breed should be chosen which are adapted to the local conditions. Breeding goals should not be in opposition to animal's natural behavior and be directed towards good health.

Artificial insemination is allowed. Embryo transfer techniques are not allowed. Hormonal heat treatment and induced births are not allowed unless applied for medical reasons. Use of genetically engineered species or breeds is not allowed.

4.5 Mutilations

Mutilations of animals in any form are not allowed. Certification programme may allow following exceptions – Castration, tail docking of lambs, dehorning, ringing and mule sing etc.

4.6 Animal nutrition

The livestock should be fed 100% organically grown feed of good quality. All feed should come from the farm itself or be procured from the region. The certification programme shall draw up standards for feed and feed ingredients.

Where it proves impossible to obtain certain feeds from organic farming sources, the certification programme shall allow a percentage of feed consumed by farm animals to be sourced from conventional farms subject to a maximum prescribed limit.

`Synthetic growth promoters or stimulants, synthetic appetizers, preservatives, artificial colouring agents, urea, farm animal by products to ruminants, droppings, dung or other manure, feed subjected to solvent extraction (soy and rapeseed meal), pure amino acids and genetically engineered organisms or their products are strictly prohibited in the feeds.

Vitamins, trace elements and supplements shall be used from natural origin. Certification programme can define conditions for use of vitamins and minerals from synthesized or unnatural sources. For fodder preservation bacteria, fungi and enzymes, by products of food industry (such as molasses) and plant based products can be used.

4.7 Veterinary medicines

Management practices should be directed to the well being of animals, achieving maximum disease resistance. Natural medicines and methods including homeopathy, ayurvedic, unani medicines and acupuncture shall be emphasized.

Conventional veterinary medicines are allowed when no other justifiable alternative is available, but in all such cases the withholding period should be double the legal period.

Use of synthetic growth promoters, substances of synthetic origin for production, stimulation or suppression of natural growth and hormones for heat induction is prohibited.

Vaccinations shall be used only when diseases are known and are expected to be a problem. Legally required vaccinations are allowed. Genetically engineered vaccines are not allowed.

4.8 Transport and slaughter

Transport and slaughter should minimize stress to the animal. Transport medium should be appropriate for each animal and the animals are fed and watered during transport. Each animal shall be stunned before being bled to death. The equipment used for stunning should be in good working order.

No chemical synthesized tranquilizers or stimulants shall be given prior to or during transport.

5. Bee keeping

Bee keeping is considered to be part of animal husbandry. The general principles therefore also apply to bee keeping.

Bee hives shall be situated in organically managed fields and/ or wild natural areas. Hives shall not be placed close to field or other areas where chemical pesticides and herbicides are used. Each bee hive shall primarily consist of natural materials. Wing clipping and Veterinary medicines are not allowed. While working with bees no repellent consisting of prohibited substances shall be used. For pest and disease control and for hive disinfection following products are allowed

Caustic soda, lactic, oxalic, acetic and formic acids, sulphur, enteric oils and *Bacillus thuringensis*.

6. Food processing and handling

6.1 General principles - Organic products shall be protected from co-mingling with non-organic products, and shall be adequately identified through the whole process. Certification programme shall regulate the means and measures to be allowed or recommended for decontamination, clearing or disinfection of all facilities where organic products are kept, handled, processed or stored. Besides storage at ambient temperature the following special conditions of storage are permitted.

Controlled atmosphere, cooling, freezing, drying and humidity regulation.

6.2 Pests and disease control – For pest management and control following measure shall be used in order of priority

Preventive methods such as disruption, and elimination of habitat and access to facilities.

Mechanical, physical and biological methods

Permitted pesticidal substances as per the standards and

Other substances used in traps.

Irradiation is prohibited. Direct or indirect contact between organic products and prohibited substances (such as pesticides) should not be there.

6.3 Ingredients, Additives and processing aids

100% of the ingredients of agricultural origin shall be certified organic. For the production of enzymes and other microbiological products, the medium shall be composed of organic ingredients.

In case where an ingredient of organic origin is not available, the certification programme may allow use of non-organic raw material subject to periodic re-evaluation. The same ingredient with in one product shall not be derived both from organic and inorganic origin. Minerals, vitamins and similar isolated ingredients shall not be used. The use of additives and processing aids shall be restricted.

Preparations of microorganisms and enzymes commonly used in food processing can be used. But no genetically engineered microorganisms and their products shall be used.

7. Processing methods - Processing methods should be based on mechanized, physical and biological processes, so that the quality of organic ingredients is maintained through the process. Some of the approved processes are: Mechanical and physical, biological, smoking, extraction, precipitation and filtration.

Extraction shall only takes place with water, ethanol, plant and animal oils, vinegar, carbon-di-oxide, nitrogen or carboxylic acids and all these shall be of food grade quality.

8. Packaging

Material used for packaging shall be ecofriendly. Unnecessary packaging material should be avoided. Recycling and reusable systems should be used. Packaging material should be biodegradable. Material used for packaging shall not contaminate the food.

9. Labeling

When the full standard requirements are met, the product can be sold as "Organic". On proper certification by certification agency "India Organic" logo can also be used on the product.

10. Storage and transport

Products integrity should be maintained during storage and transportation of organic products. Organic products must be protected from co-mingling with non-organic products and must be protected all times from contact with the materials and substances not permitted for use in organic farming.

Organic food products exported from India

Organic cereals: Wheat, rice, maize or corn

Pulses: Redgram, black gram

Fruits: Banana, mango, orange, pineapple, passion fruits, cashewnut, walnut.

Oilseeds and oils: Soybean, sunflower, mustard, cotton seed, groundnut, castor

Vegetables: Brinjal, garlic, potato, tomato, onion.

•Herbs and spices: Chilli, peppermint, cardamom, turmeric, black pepper, white pepper, amla, tamarind, ginger, vanilla, cloves, cinnamon, nutmeg, mace.

•Others: Jaggery, sugar, tea, coffee, cotton, textiles

Potential products

Rice, cereals products, pulses, honey, canesugar, jaggery, fruits (juices, concentrates and nectars), herbs and spices and peanuts.

Export oppurtunities

• Conducive agro-climatic conditions

• Prevailing traditional farming

• Many areas are not yet exposed to chemicals

• Progressive farmers

• Availability of manpower

• Government initiatives

Questions

A. Choose the correct answer

A1.	**IFOAM basic standards** were first published	
	b. 1980 b. 2002	c. 1992 d. 2004
A2.	National Programme for Organic Production comes under	
	a. Ministry of Agriculture **b. Ministry of commerce**	c. Ministry of Health d. Ministry of external affairs
A3	The main market for exported organic products is ----------------- for India	
	a. USA b. Japan	**c. Europe** d. Africa

B. Short question

B1.	Write short notes about NSOP
B2.	Discuss about organic food products exported from India

C. Brief question

C1.	**Describe brief about crop production standards for organic culture**

Lecture-14 Indigenous technical knowledge (ITK) in organic agriculture – rationale and principles- General , indigenous practices for soil, nutrient, weed, water, pest and disease management in farming- ITK's in farmers practices

Indigenous Knowledge Systems:

Definition and Concepts

The term 'indigenous' is often interchangeably used with terms such as 'traditional' or local' (Wang, 1988).

Fisher (1989) defined the term 'indigenous' as "systems that are generated by internal initiative within a local community itself."

He further stated that the term indigenous should be used in preference to traditional because the term 'traditional' implies continuity where as indigenous refers to a new development.

Indigenous knowledge (IK) is the systematic body of knowledge acquired by local people through the accumulation of experiences, informal experiments, and intimate understanding of the environment in a given culture.

IK is local knowledge that is unique to a given culture or society (Warren, 1987).

McClure (1989) defined IKSs as the sum of experience and knowledge of a given ethnic group that forms the basis for decision-making in the face of familiar and unfamiliar problems and challenges.

According to McClure (1989, p. 1);

Indigenous knowledge systems permeate all that we do and think and believe. Some indigenous knowledge is fact as Western scientists know and define fact. Some of it is belief as philosophers and theologians define belief. And a lot of it is folk wisdom. Indigenous knowledge systems are learned ways of looking at the world. They have evolved from years of experience and trial-and-error problem solving by groups of people working to meet the challenges they face in their local environments, drawing upon the resources they have at hand. Indigenous knowledge system is a broad topic which cuts across many disciplines and professions.

Indigenous knowledge system is an integrative concept which keeps the focus on the individual or group as it functions in the local setting and it facilitates bringing together the social scientist and the biological scientist on collaborative work within a task environment.

IK is the information base for a society which facilitates communication and decision-making (Warren, 1990). IK is the actual knowledge of a farming population which reflects their experiences based on traditions as well as recent experiences with modern technologies (Haverkort, 1991). This knowledge is far more than technical methods and cultivation practices of farmers. It entails many kinds of insights, wisdom, perceptions, and practices related to people's resources and environments. It is not static. Experimentation, screening, and integration of knowledge represent activities of farming, as much as tilling of the soil.

Value of Indigenous Knowledge

IK is dynamic, changing through indigenous mechanisms of creativity and innovativeness as well as through contact with other local and international knowledge systems (Warren, 1990).

IKSs are tuned to the needs of local people and the quality and quantity of available resources (Pretty and Sandbrook, 1991).

Their efficiency lies in the capacity to adapt to changing circumstances. IKSs often are elaborate, and they are adapted to local cultural and environmental conditions (Warren, 1987).

IKSs reflecting agriculture are often broad, detailed, and comprehensive, although this is not always the perception among agricultural scientists and development workers (Thurston, 1992).

In fact, it has often been overlooked by western scientific research and development (Warren, 1990). Any development program should respect and reinforce indigenous knowledge by emphasizing and restoring local knowledge (Salas and Tillman, 1989). According to Norgaard (1984, p. 7);

Peasant societies have developed their own logic in the use of nature partly based on a wealth of local experimentation (Salas and Tillman, 1989). By recording these systems, the agricultural extensionists can understand better the basis for decision-making within a given society. IK may not always be as abstract as scientific knowledge; it is often concrete and relies strongly on intuition, historical experiences, and directly perceivable evidence (Farrington and

Martin, 1987). Hence, IK is key to successful participation of resource-poor farmers. The salient features of IKSs according to Thrupp (1989, p. 139-140) are as follows:

IKSs are adaptive skills of local farmers usually derived from many years of experience and often have been communicated through "oral traditions" and learned through family members over generations.

IKSs pertain to various cultural norms, social roles, or physical conditions. Such knowledge is not a static body of wisdom, but instead, usually consists of dynamic insights and techniques which are changed over time through experimentation and adaptations to environmental and socioeconomic changes. IKSs are not possessed by only one sector of the society. For example, in many cultures, women and elders have impressive insights into certain aspects of a culture. Sometimes, researchers have been unaware of such perceptiveness among rural people due partly to their biased focus on land-owning male farmers, neglecting other members of society.

By comparing and contrasting IKSs with the scientific technologies of International Agricultural Research and Development Centers (lARDCs) and regional research stations, it is possible to see where technologies can be utilized to improve upon local systems (Warren, 1987). They have evolved from years of experience and trialand-error problem-solving by groups of people working to meet the challenges they face in their local environments, drawing upon the resources they have at hand (Roling and Engel, 1988).

IKSs are as ancient as human civilization. IKSs are time-tested management practices of land and thus pave the way for a sustainable agriculture (Venkataratnam, 1990).

Farmers are the best sources of local knowledge, in that they are well informed about their own situations, their resources, what works and doesn't work, and how one change impacts other parts of their system (Butler and Waud, 1990), Policy actions, especially in the 1990s, should give attention to actively preserving this diversity of knowledge. This can be done by recording, classifying, and disseminating this knowledge, and by creating awareness and supporting projects among local populations so they themselves are able to treasure and to preserve such knowledge for their own advancement.

Consequences of Disregarding Indigenous Knowledge Systems

Undermining farmers' confidence in their traditional knowledge can lead them to become increasingly dependent on outside expertise (Richards, 1985; Warren, 1990). Atteh (1989, p. 12) stated that indigenous knowledge systems of local people are considered as 'unproductive' and 'primitive.' Small-scale farmers are often portrayed as backward, obstinately conservative, resistant to change, lacking innovative ability, and even lazy (IFAP, 1990, p. 24). The International Federation of Agricultural Producers (IFAP) enumerated certain reasons for such a perception:

1. Lack of understanding of traditional agriculture which further leads to a communication gap between promoters and practitioners giving rise to myths;

2. The accomplishments of farmers often are not recognized, because they are not recorded in writing or made known; and

3. Poor involvement of farmers and their organizations in integrating, consolidating, and disseminating what is already known. One of the greatest consequences of the under utilization of IKSs, according to Atteh (1989, p. 30), is the:

Loss and non-utilization of IK [which] results in the inefficient allocation of resources and manpower to inappropriate planning strategies which have done little to alleviate rural poverty. With little contact with rural people, planning experts ^d state functionaries have attempted to implement programs which do not meet the goals of rural people, or affect the structures and processes that perpetuate rural poverty. Human and natural resources in rural areas have remained inefficiently used or not used at all. There is little congruence between planning objectives and realities facing the rural people. Planners think they know what is good for these 'poor', 'backward', 'ignorant', and 'primitive' people.

Indigenous Knowledge on Food Production

Small-scale farmers have access to a systematic and historic body of knowledge which may influence their food production practices (Fernandez and Salvatierra, 1989). Balasubramanian (1987, p.9) depicted how Tamil Nadu farmers with their vast experience handed down from generation to generation utilize the microclimate in a skillful manner:

1. In Cauvery delta of Tamil Nadu, black gram {Phaseolusmungo) and green gram (Phaseolusaureus) are sown as relay crops in rice fields after the long duration rice crop. Farmers sow the gram seeds in a standing rice crop just one week before the harvest of the long duration rice crop. The moisture level and soil condition of the standing rice crop is optimum for the germination and establishment of the gram seedlings. After the harvest of the paddy crop, the seeds get the required sunshine and yield is good. The entire crop is grown under zero cultivation.

2. In certain pockets of the Tanjore Delta of Tamil Nadu, peanuts are sown in late December, immediately after the harvest of the rice crops. The peanuts are grown without irrigation. The water requirements are met from the soil moisture stored from the previous rice crop. The farmers weed the peanuts by hand at the 20th and 40th days after sowing. During hand weeding at the 20th day, the soil clods are broken and fine tilth is produced to act as a soil mulch. This soil mulch maintains the soil temperature and prevents soil moisture evaporation.

3. The available micro-climatic conditions in the bunds of the paddy fields are utilized for growing crops such as pulses, and vegetables.

Crop Protection

Traditional systems of crop protection, rooted in the simple practices that farmers have learnt from their long association with the land, its flora and fauna, were based on ecofriendly systems of suitable cultural practices, judicious rotation of crops, and knowledge of pests and their life cycles. Some of the traditional methods of cultivation, which has direct bearing on pest control, are:

I. Maize seeds are soaked in cow urine for 10-12 hours before sowing. According to farmers, this treatment increases resistance against insect pests.

2. Rice seedlings raised from seed treated with extract of neem kernel are vigorous and resistant to leafhopper.

3. In paddy, spraying a solution of 4 l of cow urine and 10 g asafoetida in 10 l of water, repel the sucking pests (aphids,jassids).

4. In paddy, spraying a solution of cow dung prepared by mixing 3 kg cow dung in 3 l of water was observed in the study area against the control of paddy blast and bacterial blight.
5. In case of insect holes made by shoot borer and bark eaters in mango tree, jaggery is placed in the holes to attract other predators (ants), so that they will feed upon the insects present in the hole. Similarly the practices of pouring kerosene in holes and ‘blocking holes with cow dung were also observed in the area.
6. For prevention of infestation of shoot borer in mango tree, common salt is mixed with soil near the collar region of the tree.
7. In case of ‘bunchy top’ disease in chilies dusting of ash; use of *gugul (Commiphora wightii)* smoke; spray of sour butter milk; spray of liquid waste of tanned leather, and spray of cow/goat urine was recorded in the tribal areas.
8. A peculiar method of controlling diseases in chilli was observed in which the twigs of *aak (Calotropis* spp.) are placed in chilli field in between rows. Similarly some farmers placed fresh cow dung near the collar region of plant to prevent it from fungal diseases viz., damping off and die back.
9. In case of soil-borne diseases viz., root rot, collar rot, etc. and termites, the castor cake, karanj cake, or neem cake were used as a control measure.
10. In case of sugarcane crop, use of common salt (100-125 kg/ha) during intercultural operations was found to be common. According to farmers, the salt is effective against termite problem.
11. During sprouting of sets in sugarcane crop, putting stems of *aak (Calotropis* spp.) in the irrigation channels is effective against control of termites, white grub, and borers.
12. Use of kerosene was also common against control of termites in the field.

Weather Forecast

In recent times, there has been a growing demand for more accurate and reliable weather forecasts. Modern scientific knowledge and modern methods of weather forecasting have originated recently. But, ancient indigenous knowledge is unique to our culture. India had a glorious scientific and technological tradition in the past. Our ancient astronomers and astrologers made a scientific study of meteorology. Even today, it is common that village astrologers (Pundits) are correct in surprisingly high percentage of their weather predictions. Unfortunately, with the evident of so-called scientific technologies during the past one-century, even if these are reductional and uni-dimensional in nature, the ancient knowledge, which is holistic and multidimensional in nature, has been sidelined and totally neglected by today's so-called scientific minded rationalists.

The most common methods of predicting rainfall are :

1. Rain bird; if the rain bird gives eggs at the ground level then, there will be less rain however; if the eggs are laid at higher elevation then it is the indication of more rains. The local people assume that eggs of rain bird are laid on such a height that in case of more or less rains, the eggs will not be submerged in rainwater. Similarly, if the nanow ends of all the four eggs of rain bird are downwards, then it is the indication of good rainfall through out the season.

2. When the adventitious roots of the banyan tree *(Ficus bengalensis)* start sprouting (tillering), then the local people assume that the rains will appear within 2-4 days.

3. In castor *(Ricinus spp.)* and *ber (Ziziphus nummularia)* when the buds start sprouting, then it is predicted that rains will appear within 10-15 days.

4. The rains will appear after 10-15 days of flowering in *babul* tree *(Acacia nilotica).*

5. As soon as the neem kernels ripen and start falling, it is expected that there will be rains after 10-15 days.

6. Rain may come if damsel fly flies at ground surface, frogs make noise and ants move in line from one place to another.

The farmers were also forecasting rains by observing the direction of wind/clouds. According to them Westerly winds/clouds meant good rainfall. Similarly Northwesterly clouds will bring hailstorm and meager rains.

Animal Management

Some of the indigenous practices used by the tribals in the area of animal management are as under :

1. Castration in males is done by destroying the spermatic cord with a stone/hammer and applying cow dung / karanj oil as an antiseptic.
2. In case of respiratory distress, animals are branded with hot iron rod on the neck.
3. Treatment of bloat is done by drenching indigenous materials like;
   . A mixture of 0.5 of buttermilk + 100 g mustard oil + 100 g ground rapseed.
   . Bark of *roheda* tree *(Tecomella undulata)* ground and mixed with water.
   . A mixture of *meerchu* (local herb) ground 25 g + 0.5 I buttermilk + 25 g of rapeseed + 1 small onion + 50 g of mustard oil + 25 g of common salt.
   . Bark of *haru* tree ground and soaked in water.
   . A mixture of butter milk + common salt + onion + raw custard apple
   . Roots of date palm tree 200 g (ground) and mixed with water.
   . 5-10 leaves of custard apple (ground) and black cumin (50 g) mixed with buttermilk.
4. In case of FMD (foot and mouth disease). a small fish wrapped with a piece of bread is fed to the diseased animal till the animal is not completely cured.
5. For deworming the following measures are taken:
   . Drenching with copper sulfate 25 g in one litre of water.
   . Dilute neem solution
   . Sesame leaves crushed, mixed with water. and strained, are drenched.

6. For control of external parasites. kerosene is applied on the body of animal with the help of cotton gauze.
7. To facilitate normal pasturition, cows buffaloes are fed crushed wheat soaked in water and mixed with jaggery and ghee oil for one month prior to calving.
8. For treatment of anestrus in buffaloes, following measures are taken:
   - Match stick (two match boxes) wrapped in a piece of bread is fed to animals.
   - Seeds of datura *(Datura fastuosa)* 4-5 are fed
   - Dry flowers of mahua tree *(Madhuca indica)* 250 g boiled in llitre are fed for 5 days.
   - 250 g flowers of *khakra (Butea monosperma)* boiled in llitre of water are fed for 4-5 days.
   - Crushed sorghum (2 kg) soaked in water is fed for 2-3 days.
   - Droppings of poultry mixed with bread or concentrate is fed.
9. In case of pneumonia, cactus (used for fencing) is burnt and the ash mixed with water is. drenched twice to the animal.
10. In case of fractures, (a) leaves of *khakra (Butea monosperma)* are bandaged all over the affected part and splints of bamboo are tied around it. (b) eggs of local poultry breed given.
11. In case of excessive salivation (FMD) a tuber *sooran (Amorphallus campanulatus)* is ground and drenched with water.
12. To increase milk production the following methods are adopted:
   - Feeding of boiled crushed maize 1/2 kg to a cow and I kg to a buffalo for about one month.
   - Feeding leaves of *sem (Dolichos purpureus)* and *chan ber (Ziziphus nummularia)* increases milk production.
   - After calving, the milk left after sucking of calves is again fed to the cow/buffalo for 15-20 days.

13. Disease Management : Dipping the foot of animal in its urine for the control of foot and mouth disease; dipping the tail in hot water or by applying powdered camphor for overcoming tail neurosis; feeding ground neem leaves for internal parasites; feeding sprouted whole wheat for 10-15 days continuously for anoestrus, etc. The findings portray that a lot of wisdom still exists in rural areas but there is uncertainty about their expert validation.

ITK in farmers practice

Farmers constantly learn and unlearn, choosing appropriate knowledge in their struggle for a sustainable livelihood. Let's take a look at a few important examples of ITK still prevalent in field:

Milk treatment:

Reduction of viral diseases has been found to occur mostly in infected plants of Solanaceae, Piperaceae and Malvaceae families by milk spray. It was tested that fresh milk spray reduces nearly 73 per cent of TMV infections in tobacco. Fermented buttermilk (1l in 20 l of water) sprayed on tobacco plants cures leaf curl disease. Fresh goat milk sprayed over plants like chilli (Capsicum annum), brinjal and species like black pepper also helps control fruit and leaf curl. The neutral to near-neutral pH of milk not only washes off the fungal spores but the adhesive property of milk fat also prevents germination of spores.

Neem and ash:

Before transplanting paddy, seedlings are kept in small plots of pounded water mixed with ash and pulverised neem seeds. For a plot of 15 sq. feet, half a kilogram of neem seeds and a kilo of ash is sufficient for mixing with water to accommodate 50 bundles of seedling at a time for a period of one hour. Treated seedling produce a crop free of pest and diseases.

Lantana leaves:

Leaves of lantana, an obnoxious weed, can be utilised to preserve and process sweet potatoes. Insect attack can be restricted to a bare minimum with no use of poisonous insecticides.

Inducing conception:

An indigenously developed concept of giving tonic to dairy animals is gaining popularity. When cows fail to conceive, a tonic made of the bark of Cassia fistula, tender leaves of jackfruit tree, roots of Plumbago zeylanica and leaves of clerodendrum inerme are powered and the mixture is fed to animals along with jaggery.

Deworming:

A reddish-brown powder collected from the fruit of the widely grown kaamal tree (Mallotus philippinenis) is used for the treatment of worm infection/constipation in cattle and buffaloes. Depending on the type of ailment, 50-60 g of kamila powder mixed in lukewarm water/butter milk is administered orally.

Treating fractures:

A paste for treating a fractured bone of an animal is prepared by mixing 500 g bark of khakhra (Butea monosprema) and 500 g seed of guvar (Delonix elata).

Udder swelling:

A few days after calving, dairy cows suddenly stop milking due to swelling of the udder. To treat this, pulverised quartz stones are passed through a muslin cloth, mixed with butter and smeared over the udder. It is applied twice a day till the animal is cured.

Enhancing soil fertility

Animal bones are hurried in the basin area of the plants. The animal bones improves soil fertility by adding phosphorus to soil.

Fruiting in apple

It is believed that if an old leather shoe is hung on the non-bearing apple tree, the tree starts fruiting.

Fruiting in walnut in Kinnaur

A hole is bored into the trunk of the walnut tree(s) up-to the hollow pith region. This results in oozing out of extra water present in this region and the tree starts bearing fruits because the water present in the pith retards the movement of nutrients from the roots to the upper region. Additionally, the branches of the non-bearing trees are pruned for bringing it to bear fruits.

Crop rotation and double cropping

This practice is specific to remote locations of Lahaul (Miar nallah) in Himachal Pradesh. Rotation starts with barley in the first year, and buckwheat during the second year. The rotation sequence is governed by the quantity of available manure. Ordinarily one-third of the total holding is thoroughly manured during the year for barley cultivation. In the following year the soil retains a good deal of fertility for buckwheat for which no additional manure is added. In the third year the same field wheat is sown. The remaining two thirds of the holdings are similarly treated in succession. Barley requires heavy doses of organic manure for better crop harvest However, the organic content of the soil after the harvesting of barley is sufficient to raise a good produce of millets followed by wheat This helps to meet the challenges of limited availability of organic manure for successful management of soil fertility levels.

Shangma Stone for Weed Control

In Changthan area of Ladakh, a light bluish local stone called Shangma is used for weed control because it seems to possess toxic properties. Pieces of stones are spread over a small heap of soil, in the middle of fields in the month of December. This soluble stone, when mildly irrigated, percolates into the field. The postponement of sowing by two weeks and this practice of allowing the stones to percolate into the field is done probably to regulate toxicity levels for crop management.

Crushing of coriander seeds with shoe before sowing

Coriander seeds in Kinnaur, and other regions of Himachal Pradesh, are crushed by being trampled upon by leather shoes before sowing for better germination. While the exact use of this technique is a subject for research, it appears that this mechanical exercise exerts just the right pressure to break the hard testa without causing any injury to the seed itself, thereby facilitating germination.

Distribution of organic manure

In Ladakh and in other regions after every seven steps taken by a woman, 20 to 25 kg of organic manure is scattered in the fields. This technique aims at uniform distribution of organic manure. It is reported that the quantity of manure spread is optimum for the plot of land falling in the range of seven steps taken by the woman.

Use of smoke for protecting fruit crops from frost damage

In the lower areas of Himachal Pradesh, Mango plants are mostly damaged by frost injury during winter months i.e. December and January (Fig. 2.16). Smoke layer protects the mango plants from frost injury. This practice is common in the lower areas of Himachal Pradesh.

Use of walnut and swetflag leaves against pests in stored grains

In rural areas of Himachal Pradesh, it is an old practice to use walnut leaves and leaves of a pond weed, commonly known as sweetflag, Acorus calamus as a protection for both grain and clothes against insect damage. To achieve protection a layer of leaves of walnut is spread over grain stored in gunny bags. Likewise, shade dried leaves of sweetflag are powdered and put over grain stored in gunny bags to protect it from damage due to stored grain pests.

Walnut leaves are astringents and the aqueous extract of fresh leaves possesses bactericidal action while mature leaves contain 9-11 per cent tannin. Tannins are known to act as feeding deterrents. Sweetflag leaves and rhizomes have many chemical ingredients including an essential oil, the oil of calamus, which primarily contains asarone.

Depending upon quantity of asarone (cis as well as trans), its effect on insects may be attractant, antifeedant, repellent, antigonadal or insecticidal. However, since the active principal is present only in meagre amounts (in the leaves) this treatment may not be able to afford protection for long periods.

PANCHAKAVYA

It is an organic product derived from five products evolving from cow, and it has been used in Indian medicine since time immemorial. ``I have modified this Panchakavya by adding a few more ingredients and the modified version has a lot of beneficial effects on a variety of crops and livestock", said Dr. K. Natarajan, President of the Rural Community Action Centre (RCAC), a non-governmental organization, actively engaged in promoting the concepts of organic farming and bio-diesel in the rural areas of Tamil Nadu.

An allopathic medical practitioner with deep conviction in ecological farming and sustainable agriculture, Dr. Natarajan combined his traditional knowledge and wisdom on the value of cow's products and medicinal herbs to develop this Panchakavya. He has done extensive research with his Panchakavya on various crops, animals and even earthworms. His findings have been validated by leading research institutes in the country, and he was awarded the prestigious "Srishti Sanman" by a leading developmental organization in Ahmedabad.

"The present form of Panchakavya is a single organic input, which can act as a growth-promoter and immunity booster. It is essentially a product containing 4 kg gobar gas slurry, 1 kg fresh cow dung, 3 litres of cow urine, 2 litres of cow's milk, 2 litres of cow's curd, 1 kg cow's ghee, 3 litres of sugarcane juice, 12 ripe bananas, 3 litres of tender coconut water, and 2 litres of toddy (if available). This will make about 20 litres of Panchakavya. The concoction is stored in a wide-mouthed earthen pot or concrete tank in open. Sufficient shade should be provided, and the contents should be stirred twice a day, both in the morning and the evening. In seven days, the modified Panchakavya will be ready, and it can be diluted before use on plants and animals," says Dr. Natarajan.

The cost of production of a litre of Panchakavya is around Rs. 35, and it can be brought down substantially if the farmers use their own cows' products. The Panchakavya is diluted to three per cent and sprayed on crops to get the best results. Three litres of Panchakavya is diluted with 100 litres of water and sprayed over crops to get rid of pests and diseases and also get higher yields.

Seeds can be soaked and seedlings can be dipped in 3 per cent solution of Panchakavya for about 30 minutes before sowing to get good results from the crops.

Various crops such as rice, a variety of vegetables, fruit crops such as mango, banana, guava, acid lime cash crops such as sugarcane, turmeric, jasmine and moringa and plantation crops have responded extremely well to application of Panchakavya. Earthworms grew faster and produced more vermi-compost when treated with this solution.

When sprayed with Panchakavya, the plants produce larger leaves, and develop denser canopy. The stem produces lateral shoots and much more sturdy branches to bear heavy yields.

The rooting is profuse and dense, and penetrating to deep layers. Roots helps in better intake of nutrients and water. Plants are able to stand protracted drought conditions, and needed less than a third of the irrigation in regular times," explains Dr. Natarajan. The Panchakavya has been field-tested by a network of organic farmers in the country.

Panchakavya has several beneficial effects on animals and fish as well. When fed to cows at 200 ml per day, they turned healthier and produced milk with high fat content. Their rate of conception increased, and the various common ailments were completely cured.

Similar effects were found in sheep and goats. When mixed with the poultry feed or drinking water at the rate of 5 ml per bird per day, the birds became disease-free and healthy. They laid larger eggs for longer periods.

In the broilers, the weight gain was impressive and the feed to weight conversion ratio improved. In the fishponds, the addition of Panchakavya increased the growth of phyto and zoo plankton, which contributed to improved fish feed availability and thus increased fish growth, according to Mr. Natarajan

Separation of Good Quality Seeds

When the seeds are soaked in water, the unviable seeds will float on the surface of the water. These seeds can be removed and the seeds that sink into the water can be used for cultivation. By this method, the damaged seeds can be removed easily. l Take some water in a vessel and drop an egg in it. Keep adding salt to it slowly until the egg reaches the surface of the water. When the seeds are dropped in this water, the good quality seeds will sink into the water. Remove the unviable seeds that float on the surface of the water. Wash the selected seeds in good water for 2-3 times to remove the salt deposits. If this is not done, the germination capacity of the seeds will be affected. By this method, the unviable seeds can be removed completely. This method should be followed when there is more of chaff.

Seed Treatment

Seed treatment using Cow’s urine : Dilute 500 ml of cow’s urine in 2½ litres of water.

Tie the seeds to be sown in small bags and soak them in cow's urine extract for half an hour. Shade dry the seeds before sowing. Seed treatment using Sweet flag extract : Powder 500 g of sweet flag rhizome and dilute it in 2½ litres of water. This is the uantity required fortreating seeds to be sown in one acre. Tie the seeds in small bags and soak them in this extract for half an hour. Dry the seeds in shade before sowing.

AMIRTHAKARAISAL

10% Amirthakaraisal should be sprayed before transplanting. Otherwise for 1 acre of land, 300-500 litres of Amirthakaraisal should be mixed with water and irrigated.

Preparation of Amirthakaraisal

Fresh cow dung – 10 kg

Cow's urine – 10 litres

Jaggery - 1 kg

Water – 100 litres

The above mentioned ingredients should be added to a cement tank and mixed well. The

extract would be ready for use the next day. It improves the soil fertility and gives good yield.

Top Dressing

After weeding, 25 kg of neem cake or groundnut cake should be applied as top dressing. 50-75 kg of vermicompost or 50 kg of bone meal can be applied as top dressing. For medium and long duration varieties, 25 kg of ground nut cake should be applied as top dressing after 50-60 days of transplantation.

Spraying of Panchakavya

Panchakavya is a growth promoter produced with the combination of five products obtained from the cow along with few other bioproducts.

Method of Preparation

Cow dung - 5 kg

Cow’s urine - 3 litres

Ghee - 1 litre

Cow’s Milk - 2 litres

Curd - 2 litres

Tender coconut - 3 litres

Cane juice or jaggery - 3 litres (or) 1kg

Yellow plantain - 12 nos (or) honey ½ kg

Add cow dung, cow’s urine and ghee in a mud or cement tank of 30-litre capacity. Stir this well in morning and evening for a week. The methane gas gets released from this. To this mixture, add milk, curd, tender coconut, yellow plantain (ripe) and jaggery. After a week’s time, this extract can be filtered and used. For coarse varieties, one spray of 3% panchakavya should be given during tillering and bootling stage.

lFor fine varieties, one spray of 3% panchakavya should be given during the bootling stage.

Spray of Tender Coconut and Buttermilk

Extract

To maintain uniform flowering, one sp ray of 10%buttermilk extract or 3% tender coconut should be given during the bootling stage. Pest, Disease Management

Pests such as stem borer, brown plant hopper, green leaf hopper, ear head bug and diseases such as blast, brown plant hopper and tungro virus have challenged our farmers to a great extent. It is highly essential to control them at early stages inorder to

avoid heavy loss. Some of the non chemical practices to control pests and diseases are given below:

Keeping Neem cake bags in Irrigation Canals

The gunny bags should be filled with neem cake and placed along the water canals. Neem cake gets dissolved in the water flowing along the canals and irrigates the field. This practice prevents attack of pests and diseases affecting the roots and tillers of

the crop. The bags should be replaced once in 15 days. This should be kept until the crop attains the milky stage.

Use of Plants with Pest Repellent Properties

Neem cake / Neem

leaves, Vitex leaves,

Morinda leaves, Calotropis

leaves and Jatropha leaves

are used for this purpose. Any two of the above mentioned leaves are taken and pound well. The pound leaves are taken in a mud pot and thrice the quantity of water

is added to it. The mouth of the pot is tied with a cloth and left as such for three days. Then, these pots are placed on all the four corners of the field. In the evening, the mouth of the pots should be opened and stirred well. The unpleasant odour which emanates from this pot prevents the entry of pests into the field.

Neem seed kernel extract

3–5 kg of Neem kernel is required for an acre. Remove the outer seed coat and use only the kernel. If the seeds are fresh, 3 kg of kernel is sufficient. If the seeds are old, 5 kg is required. Pound the kernel gently and place it in an earthen pot. To this, add 10 litres of water. Tie the mouth of the pot securely with a cloth. Leave it as such for 3 days. Filter it after 3 days. On filtering 6-7 litres of extract can be obtained. The shelf life of this is about one month. 500–1000 ml of this extract is used forone tank (a tank of 10 litre capacity). 500-1000 ml of extract should be diluted with 9½ or 9 litres of water before spraying. Khadi soap solution @ 10 ml/litre (100 ml/tank) should be added to help the extract stick well to the leaf surface. The concentration of the extract can be increased or decreased depending on the intensity of the pest attack. It controls sap feeders and all kinds of larvae. Note : This extract can be stored for a period of one month. The seeds used for preparing this extract should be at least 3 months old.

Kashayam Preparation

The plants selected for kashayam preparation should be collected without the roots. The plants should be cut into small pieces and used. For one acre of crop, 2 kg of the cut plants should be mixed with 8 litres of water. This has to be taken in a wide mouthed vessel and boiled untilthe extract reduces to 2 litres. This has to be cooled and filtered. 300 ml of this extract should be diluted with 100 ml of soap solution and 9.4 litres of water to obtain one tank capacity of the extract.

Plants used in kashayam preparations - Pests and diseases controlled Andrographis paniculata - All kinds of larvae Sida spinosa - Aphids and Sap feeders

Questions

A. Choose the correct answer

A1.	Vermicompost recommendation for a hactare	
	a. 2.5 kg/ha **b. 5 kg/ha**	c. 10 kg/ha d. 12.5 kg/ha
A2.	--------------------- Kg of Neem kernel is required for an acre	
	a. 3-5 Kg b. 5-7 kg	c. 7-10 Kg d. 10-12 Kg
A3	Shangma is a ------------- used for weed control	
	a. herb	**c. stone**
	b. pond weed	d. effluent
A4	An obnoxious weed, can be utilised to preserve and process sweet potatoes.	
	a. Parthenium	c. Thorn apple
	b.Giant Salvinea	**d. Lantana**

B. Short question

B1.	Enumerate ITK practice in crop protection
B2.	Narrate the ITK practices followed in animal management

C. Brief question

C1.	**Briefly discuss about the** ITK in farmers practices

Lec 15. Benefits and Problems of Organic Farming

Organic agricultural practices are based on a maximum harmonious relationship with nature aiming at the non-destruction of the environment. The developed nations of the world are concerned about the spreading contamination of poisonous chemicals in food, feed, fodder and fibre. Naturally, organic farming system is looked upon as one of the means to remedy these maladies there. However, the major problem in India is the poor productivity of our soils because of the low level content of the organic matter. The efficiency of the organic inputs in the promotion of productivity depends on the organic contents of the soil. There were many resemblances of organic farming principles in the traditional agriculture of India. But the former gives a more open and verifiable scientific foundation than the latter.

Healthy Foods

A study conducted in USA on the nutritional values of both organic and conventional foods found that consumption of the former is healthier. Apples, pears, potatoes, corn, wheat and baby foods were analyzed to find out 'bad' elements such as aluminum, cadimum, lead and mercury and also 'good' elements like boron, calcium, iron, magnesium sellenium and zinc. The organic food, in general, had more than 20 per cent less of the bad elements and about 100 per cent more of the good elements.

Improvement in Soil Quality

Soil quality is the foundation on which organic farming is based. Efforts are directed to build and maintain the soil fertility through the farming practices. Multicropping, crop rotations, organic manures and pesticides, and minimum tillage are the methods employed for the purpose. Natural plant nutrients from green manures, farmyard manures, composts and plant residues build organic content in the soil. It is reported that soil under organic farming conditions had lower bulk density, higher water holding capacity, higher microbial biomass carbon and nitrogen and higher soil respiration activities compared to the conventional farms (Sharma, 2003). This indicates that sufficiently higher amounts of nutrients are made available to the crops due to enhanced microbial activity under organic farming.

Increased Crop Productivity and Income

The Central Institute for Cotton Research, Nagpur conducted a study of economics of cotton cultivation in Yavatmal district of Maharashta. The cost of cultivation of cotton was lower in the organic farming than in the modern system. The low costs were due to the non-use of fertilizers and chemical insecticides. As a result of the low yields during the conversion period, the net income from the organic farm was lesser than the conventional farm. But the yield under organic method increased progressively equalling it to that of the conventional system by the sixth year. The input costs were low under organic farming and with a 20 per cent of premium prices of output, the net income increased progressively from fourth year under organic fanning. The appreciation of net income from organic cotton cultivation by the sixth year was 80 per cent over the conventional crop (Sharma, PD, 2003).

Low Incidence of Pests

The study of the effectiveness of organic cotton cultivation on pests at the farm of Central Institute for Cotton Research, Nagpur revealed that the mean monthly counts of eggs, larva and adults of American Boll worm were far lesser under organic farming than under the conventional method (Sharma, PD, 2003).

Bio-control methods like the neem based pesticides to Ti-ichoderma are available in the country. Indigenous technological products such as Panchagavya (five products of cow origin) which was experimented at the University of Agricultural Sciences, Bangalore found to control effectively wilt disease in tomato (Prakash, TN, 2003).

Employment Opportunities

According to many studies, organic farming requires more labour input than the conventional farming system. Thus, India which has a very large amount of labour unemployment and under employment will find organic farming an attraction. Moreover, the problem of periodical unemployment will also get mitigated because of the diversification of the crops with their different planting and harvesting schedules resulting in the requirement of a relatively high labour input.

Indirect Benefits

Several indirect benefits from organic farming are available to both the farmers and consumers. While the consumers get healthy foods with better palatability and taste and nutritive values, the farmers are indirectly benefited from healthy soils and farm production environment. Eco-tourism is increasingly becoming popular and organic farms have turned into such favourite spots in countries like Italy. Protection of the ecosystem, flora, fauna and increased biodiversity and the resulting benefits to all human and living things are great advantages of organic farming which are yet to be properly accounted for.

Problems and Constraints

The most important constraint felt in the progress of organic farming is the inability of the government policy making level to take a firm decision to promote organic agriculture. Unless such a clear and unambiguous direction is available in terms of both financial and technical supports, from the Centre to the Panchayat levels, mere regulation making will amount to nothing. The following are found to be the major problem areas for the growth of organic farming in the country:

Lack of Awareness

It is a fact that many farmers in the country have only vague ideas about organic farming and its advantages as against the conventional farming methods. Use of bio-fertilizers and bio pesticides requires awareness and willingness on the part of the farming community. Knowledge about the availability and usefulness of supplementary nutrients to enrich the soil is also vital to increase productivity.

Farmers lack knowledge of compost making using the modern techniques and also its application. The maximum they do is making a pit and fill it with small quantities of wastes. Often the pit is flooded with rainwater and result is the top of the compost remains under composted the bottom becomes like a hard cake. Proper training to the farmers will be necessary to make vermicompost on the modern lines.

Attention on the application of composts/organic manure is also lacking. The organic matter is spread during the months when the right moisture level is absent on the soil. The whole manure turns into wastes in the process. The required operation is of course labour intensive and costly, but it is necessary to obtain the desired results.

Output Marketing Problems

It is found that before the beginning of the cultivation of organic crops, their marketability and that too at a premium over the conventional produce has to be assured. Inability to obtain a premium price, at least during the period required to achieve the productivity levels of the conventional crop will be a setback. It was found that the farmers of organic wheat in Rajasthan got lower prices than those of the conventional wheat. The cost of marketing of both types of products was also same and the buyers of wheat were not prepared to pay higher prices to the organic variety (Rao, 2003).

Shortage of Bio-mass

Many experts and well informed farmers are not sure whether all the nutrients with the required quantities can be made available by the organic materials. Even if this problem can be surmounted, they are of the view that the available organic matter is not simply enough to meet the requirements.

The crop residues useful to prepare vermi-compost are removed after harvest from the farms.and they are used as fodder and fuel. Even if some are left out on the farms termites, etc destroy them. Experiments have shown that the crop residues ploughed back into soil will increase productivity and a better alternative is conversion into compost.

The small and marginal cultivators have difficulties in getting the organic manures compared to the chemical fertilizers, which can be bought easily, of course if they have the financial ability. But they have to either produce the organic manures by utilizing the bio-mass they have or they have to be collected from the locality with a minimum effort and cost. Increasing pressure of population and the disappearance of the common lands including the wastes and government lands make the task difficult.

Inadequate Supporting Infrastructure

In spite of the adoption of the NPOP during 2000, the state governments are yet to formulate policies and a credible mechanism to implement them. There are only four agencies for accreditation and their expertise is limited to fruits and vegetables, tea, coffee and spices. The certifying agencies are inadequate, the recognized green markets are non-existent, the trade channels are yet to be formed and the infrastructure facilities for verification leading to certification of the farms are inadequate.

High Input Costs

The small and marginal farmers in India have been practicing a sort of organic farming in the form of the traditional farming system. They use local or own farm renewable resources and carry on the agricultural practices in an ecologically friendly environment. However, now the costs of the organic inputs are higher than those of industrially produced chemical fertilizers and pesticides including other inputs used in the conventional farming system.

The groundnut cake, neem seed and cake, vermi-compost, silt, cow dung, other manures, etc. applied as organic manure are increasingly becoming costly making them unaffordable to the small cultivators.

Marketing Problems of Organic Inputs

Bio-fertilizers and bio-pesticides are yet to become popular in the country. There is a lack of marketing and distribution network for them because the retailers are not interested to deal in these products, as the demand is low. The erratic supplies and the low level of awareness of the cultivators also add to the problem. Higher margins of profit for chemical fertilizers and pesticides for retailing, heavy advertisement campaigns by the manufacturers and dealers are other major problems affecting the markets for organic inputs in India.

Absence of an Appropriate Agriculture Policy

Promotion of organic agriculture both for export and domestic consumption, the requirements of food security for millions of the poor, national self-sufficiency in food production, product and input supplies, etc. are vital issues which will have to be dealt with in an appropriate agriculture policy of India. These are serious issues the solution for which hard and consistent efforts along with a national consensus will be essential to go forward. Formulation of an appropriate agriculture policy taking care of these complexities is essential to promote organic agriculture in a big way.

Lack of Financial Support

The developing countries like India have to design a plethora of national and regional standards in attune with those of the developed countries. The adoption and maintenance of such a regulatory framework and its implementation will be costly.

The cost of certification, a major component of which is the periodical inspections carried out by the certifying agencies, which have freedom to fix the timings, type and number of such inspections appears to be burdensome for the small and marginal farmers. Of course, the fees charged by the international agencies working in India before the NPOP was prohibitive and that was a reason for the weak response to organic agriculture even among the large farms in the country. No financial support as being provided in advanced countries like Germany is available in India. Supports for the marketing of the organic products are also not forthcoming neither from the State nor from the Union governments. Even the financial assistance extended to the conventional farming methods are absent for the promotion of organic farming.

Low Yields

In many cases the farmers experience some loss in yields on discarding synthetic inputs on conversion of their farming method from conventional to organic. Restoration of full biological activity in terms of growth of beneficial insect populations, nitrogen fixation from legumes, pest suppression and fertility problems will take some time and the reduction in the yield rates is the result in the interregnum. It may also be possible that it will take years to make organic production possible on the farm.

Small and marginal farmers cannot take the risk of low jaelds for the initial 2-3 years on the conversion to organic farming. There are no schemes to compensate them during the gestation period. The price premiums on the organic products will not be much of help, as they will disappear once significant quantities of organic farm products are made available.

Inability to Meet the Export Demand

The demand for organic products is high in the advanced countries of the west like USA, European Union and Japan. It is reported that the US consumers are ready to pay a premium price of 60 to 100 per cent for the organic products. The upper classes in India are also following this trend as elsewhere. The market survey done by the International Trade Centre (ITC) during 2000 indicates that the demand for organic products is growing rapidly in many of the world markets while the supply is unable to match it.

India is known in the world organic market as a tea supplier and there is a good potential to export coffee, vegetables, sugar, herbs, spices and vanilla. In spite of the several initiatives to produce and export organic produces from the country, the aggregate production for export came to only about 14000 tonnes. This also includes the production of organic spices in about 1000 ha under certification. Some export houses like Good Value Marketing Ltd and Burmah Trading Corporation are also engaged in exporting of organic fruits, vegetables and coffee from India. The country could export almost 85 per cent of the production indicating that demand is not a constraint in the international markets for organic products.

Vested Interests

Hybrid seeds are designed to respond to fertilizers and chemicals. The seed, fertilizer and pesticide industry as also the importers of these inputs to the country have a stake in the conventional farming. Their opposition to organic farming stems from these interests.

Lack of Quality Standards for Biomanures

The need for fixing standards and quality parameters for biofertilizers and biomanures has arisen with the increasing popularity of organic farming in the country. There are a very large number of brands of organic manures, claiming the high levels of natural nutrients and essential elements. But most farmers are not aware of the pitfalls of using the commercially available biomanure products. While the concept of organic farming itself lays great stress on the manures produced on the farm and the farmers' household, many of the branded products available in the market may not be really organic. Elements of chemicals slipping into the manures through faulty production methods could make the product not certifiable as organic. The process of composting which is a major activity to be carefully done is achieved usually by one of the two methods, vermi-composting or microbe composting. While the former is ideal for segregated waste material without foreign matter, microbe composting is suitable for large scale management of solid wastes, especially in cities and metres. Even though the farmers are using manure produced by different methods, proper parameters for biomanure are yet to be finalized. Most farmers are still unaware of the difference between biomanure and bio-fertilizer, it is point out. While biomanure contains organic matter, which improves the soil quality, bio-fertilizers are nutritional additives separated from the organic material, which could be added to the soil, much like taking vitamin pills. Biofertilizers do nothing to enhance soil quality while the loss of soil quality has been the major problem faced by farmers these days.

Improper Accounting Method

An understanding of the real costs of erosion of soil and human health, the loss of welfare of both humans and other living things and the computation of these costs are necessary to evaluate the benefits of organic farming. These costs will have to be integrated to a plan for the implementation of organic agriculture.

A recent study shows the inappropriateness of the cost and return accounting methods adopted to find out the economics of the organic farming (Prakash, 2003). An economic evaluation of the bad effects of inorganic agriculture and their internalization through environmental taxes is proposed for a market based approach to promote organic farming in India.

Political and Social Factors

Agriculture in India is subject to political interventions with the objectives of dispensing favours for electoral benefits. Subsidies and other supports from both the Central and state governments, government controlled prices of inputs like chemical fertilizers, the public sector units' dominant role in the production of fertilizers, government support/floor prices for many agricultural products, supply of inputs like power and water either free of cost or at a subsidized rate, etc. are the tools often used to achieve political objectives. Any movement for the promotion of organic farming in India will have to counter opposition from the sections who benefit from such policies in the conventional farming system. The political system in a democracy like India is likely to evade the formulation of policies, which affect the interests of the voting blocks unless there are more powerful counter forces demanding changes.

In the absence of alternative employment opportunities and other considerations, the organized workforce particularly in the public sector fertilizer, pesticide and seed industries is also likely to oppose moves on the part of the government to promote organic farming on a large scale.

Questions

B. Short question

B1.	What is organic farming? Explain why the use of organic farming should be encouraged in India
B2.	Write the benefits of organic farming

C. Brief question

C1.	describe briefly about the problems and constraints in organic farming

Lecture-16 organic farming ; promotional activities; role of government and NGO's-Action plan- Policy considerations

Government Role in Promotion of Green Agriculture in India:

Increasing Investments: As part of 10th Five year Plan, Government of India has earmarked about Rs. 100 crores for the promotion of organic agriculture in the country. The main components of this initiative include farming of standards, negotiating with different countries and putting in place a system of certification for organic products.

Promoting Input Market: Central Government is also promoting the production and use of bio-fertilizer to make it popular. Government has initiated a project "National Project on Development and Use of Bio fertilizers" for this purpose. Main objectives of this project are as following:

i. Production and distribution of Bio fertilizers (BFs)
ii. Developing Standards for different BFs and Quality control
iii. Releasing of grants for setting up BF units
iv. Training and Publicity

Promoting green agriculture market*:* To promote the organic agriculture in India government has also taken some initiative in recent past.

APEDA (Planning Commission, 2001) is the nodal agency to promote the Indian organic agriculture and its exports opportunities.

National Steering Committee under the Chairmanship of Secretary Commerce has already outlined and approved the National Program for Organic Production (NPOP) by May 2001 (www.apeda.com).

Under this program, National Organic Standards have been evolved.

This apart, it has also developed Criteria for Accreditation of certification agencies, Accreditation Procedure and Inspection and Certification Procedures. In developing these standards and procedures due attention is paid to the guidelines as enumerated by international organizations such as International Federation for Organic Agricultural Movement (IFOAM), EU Regulations and FAO Codex Standards.

As part of this program, a National Logo for organic products on behalf of Govt. of India has also been developed (http://www.apeda.com/organic.htm).

Some of the other efforts towards promotion of organic exports include attempts to collaborate with all the major organic importing countries. Towards this APEDA is deliberating with European Union for inclusion of India in the list of third countries under Article 11 of the EU regulations No 2092/91 so that India's National Programme for Organic Production gets the required recognition under the EU regulations.

Facilitating Factors for Greening of Indian Agriculture: Organic agriculture provides economic opportunities for different stakeholders. Some of the drivers that facilitate growth of organic agriculture in India are

- Growing export market for organically produced crops
- Price premium for organically produced agriculture products from10% to 100%
- Diverse agro-climate regions across the country that provides environment for wide range of crops that can cater to different market demands.
- Increasing awareness & health consciousness especially among certain sectors of domestic consumers.
- Availability of comparatively cheap labor for labor-intensive organic agriculture
- Huge numbers of small farmers those who do the traditional farming with very limited capacity to pay for most of the chemical inputs into agriculture
- Presence of Non-Government Organizations (NGOs) as active promoters of Organic farming in different agro-climatic regions
- Increasing involvement of private companies in field of agricultural extension, trade, consultation and other services
- Enhanced Government attention and support for organic agriculture through various policy initiations and action programs.

Factors Constraining Greening of Indian Agriculture:

Though there are positive signs for green agriculture in India it is not growing at a pace to enhance its market attractiveness so as to motivate larger section of farming community to opt for organic agriculture. Major problems that hinders the growth organic agriculture in India can be listed as follows:

Factors limiting Bio-inputs Market:

Producers'/Distributors'/Traders' point of view:

- Lack of proper infrastructure for distribution and conservation of bio-inputs, existence of poor quality bio-inputs in market reduces the credibility of input providers. Lack of quality control mechanisms for bio-inputs furthers the mistrust among farmers. Given the low penetration of bio-inputs market and the limited shelf-life it is incentivizing the traders to store and sell bio-inputs

From Users' (farmers') point of view:

- Bio-fertilizers and bio-pesticides are perceived as less yielding. Unsuitability climatic regions and soil conditions for specific strains of organic production. Limited shelf life Given the mandated gestation period of around three years for a conventional farm to become an organic farm the benefits perceived by farmers in general and small and marginal farmers in particular tend to be limited as they have short term orientation. As a result even if they are aware they are hesitant to switch over to organic (green) agricultural practices.

From Promoters' (Government's) point of view:

- Agricultural departments, research institutions and extension services have for long been oriented towards chemical input agriculture as a result there is a requirement for reorienting these officials towards organic (green) agriculture
- Changing the cropping and cultivation patterns is slow and time-consuming process given the high levels of illiteracy and large number of small and marginal farmers it makes the change process difficult.
- Subsidies on chemical fertilizers and pesticide impede the growth of organic agriculture.

Limiting factors organic produce market:

- Lack of market information in general and organic market information in particular is biggest drawback for Indian agriculture. The current information base is low and even the limited information available does not get disseminated due to lack of adequate channels for dissemination. As a result farmers are in a predicament as they are unable to attune their production practices as per the market changes. Marketing network specifically for organic products has not yet developed both in the domestic as well as export market.

- Quality of Indian food industry is always a constraint for growth, low consistency of quality and contamination in food products is a hindrance in capturing the available market especially the international market.
- Given the high levels of transaction costs for getting farms certified as organic it is a major deterrent for enhancing organic production in the country. As the certification process for organic farming is very lengthy and complex, the cost of certification is also unaffordable for small farmers {Rs.22000 to Rs.29200 per certification} (Garibay S V and Jyoti K, 2003).
- Government has shown limited interest for organic agriculture, though the activities from government side are increasing but till date there is no direct support from government side in terms of subsidy or market support towards organic agriculture.
- Lack of proper infrastructure in terms of roads from remote villages, cold storage facilities and slow transportation infrastructure affects the cost, quality and reach of producers and
- Indian organic agriculture is very fragmented and there are no organizations for managing the entire value chain of organic products.

Large number of these problems listed above are due to the relatively newness of this sector from the point of view of different places

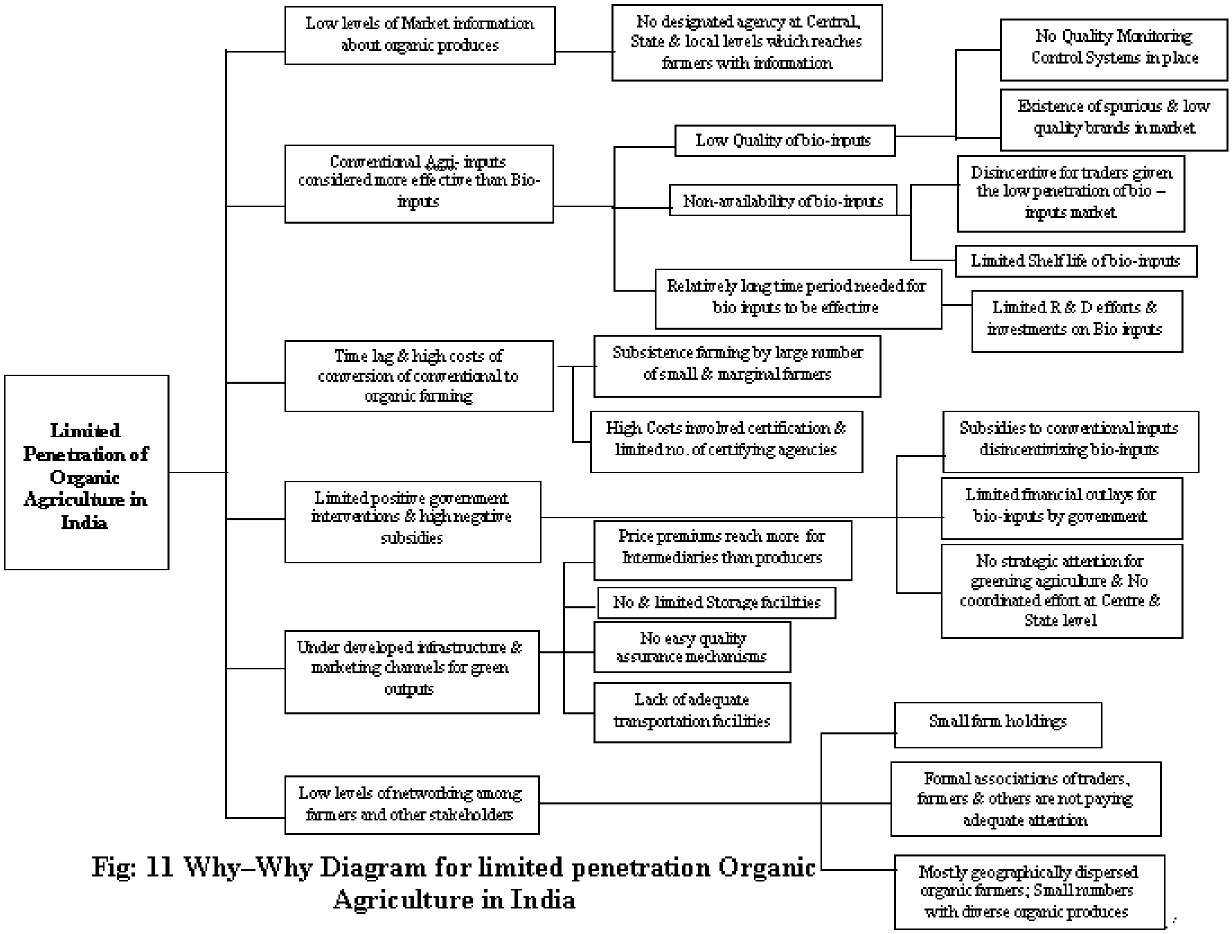


Fig: 11 Why–Why Diagram for limited penetration Organic Agriculture in India

Recommendations

Focus group discussions with different stakeholders like farmers, traders of green agricultural inputs, government officials involved in promotion of organic agriculture, agricultural scientists, extension officers and NGO's have revealed that multi-pronged initiatives (Fig: 12) at different levels would contribute towards enhancing greening of Indian agriculture[2].

From Policy perspective:

Experience elsewhere shows (Box: 1) that government has to play a key role in developing organic agricultural production and enhancing marketing opportunities (Scialabba Nadia, 2000). Towards this there is a need to have policy framework to address greening agriculture in India. Policy change in favour of organic agriculture can make positive difference for changing the market condition in terms of encouraging production of bio-inputs, which in turn can propel changes in cropping pattern in favour of organic practices.

From Farmers Perspective:

- Gradual phasing out subsidy on synthetic fertilizers / pesticides and initiating promotion of bio-inputs
- Financial assistance for converting the traditional farm in to organic farm
- Collaborative engagement with NGOs, who are actively working in the rural areas
- Special insurance scheme for organic farm
- Promote contract farming based on organic agriculture

From NGO's perspective:

Non-Government Organizations have being playing crucial role in promoting organic agricultural practices in the country. An illustrative example of public private partnership is the successful story of Spice Board's involvement of NGOs to enhance organic production of spices in Kerala, Tamilnadu, Andhra Pradesh and North Eastern states

From Traders Perspective:

- Ministry of Commerce and Trade should have a dedicated cell for providing organic agricultural export market potentials in different parts of the world and the price premium that different products attract.
- Establishment of Special Organic Agriculture Trade Zone (OATZ) for domestic as well export market
- Providing special tax relaxation for traders/exporters those who have organic trading/export.
- In order to enhance the domestic organic agricultural market government need to make efforts towards promotion of organic food processing industries by providing subsidies and financial assistance as well as facilitates to market development. As the shelf life of some of the organic produce is shorter establishment of dedicated cold storage facilities could help in enhancing the prospects of exports.

From Green Input Producers Perspective:

- Popularization of existing scheme for promotion of bio-fertilizers and other bio-inputs.
- Marketing of bio-inputs thorough govt. network and the network of co-operative societies at village level .
- Improving infrastructure facilities like roads, transportations, storage facilities etc and Promotion of corporate research for organic agronomic practices, bio- control of diseases and pest, bio-fertilizers etc.

From Institutional Perspective:

There is urgent need for giving strategic attention to organic farming efforts. This requires inter ministerial coordination among various ministries at the Centre. Towards this forming a Steering Committee consisting of various Ministries at Central Government level would be a move in the right direction. Such as..

- Ministry of Agriculture,
- Ministry of Commerce & Trade,
- Ministry of Environment,
- Ministry of Science & Technology,
- Ministry of Finance etc.

Such committee would helps on increasing effectiveness of policies & programmes evolved towards promotion of organic agriculture.

At the state level some of the important institutions that require coordinated action plan include: Agriculture universities, State agriculture department, Private business organizations and NGOs

Each of these institutions can enhance their contribution towards greening agriculture by developing a detailed program of action. In the following an attempt has been made to briefly dwell action programs for some of these institutions. For instance:

Agriculture Universities can have action programs by reorienting their current 1) Educational activities 2) Research Agenda and 3) Extension services Programmes

AOFG

Since 2001, AOFG India has been promoting a number of activities and projects. The current projects are:

Organic Agriculture in Rural Development (OARD).

30 NGOs are involved in the promotion of organic agriculture in rural development. 2 villages have been adopted by each of the thirty NGOs. Training and support services are provided by AOFG-India. The main goal of the project is to reach the message of organic agriculture in rural areas and demonstrate the same for rural development, poverty reduction, ecological farming, natural resource management, biodiversity conservation and protection of environment.

AOFG India Project on "Fairtrade and Organic Farming in India".

This is an ambitious project of the farmer associations and farmer companies providing quality extension through farmer field schools, value addition, supply chain and marketing. The commodity focus are : Coffee, spices, cotton and fruits. The project is funded by SHGW, AC Laren, The Netherlands. The project started during 2006. As part of the project, four farmer limiteds were set up and 15,000 farmers are associated as members and producers of the farmer companies.

AOFG India Assisted Cotton Project

AOFG India is assisting the Cotton project being implemented at Amaravati and Adilabad. The project is currently work with 6,500 farmers of Amaravati, Maharastra and Kagaznagar, Adilabad, Andhrapradesh.

The potential for organic farming in the drylands of India

Specific benefits of organic farming for the dry lands of India

Soil and climate conditions in India's dry lands make them particularly well suited to organic agriculture. These marginal lands, with their marginal soils, tend not to respond well to intensive farming practices. They are actually better suited to low-input farming systems that make ample use of biodiversity (Sharma 1998). In turn, organic farming, with its central focus on maintaining and improving soil health, its avoidance of pollutants, and its reliance on local inputs and labor, can materially advance the economic and ecological health both of the drylands and of the people who live there.

In terms of input supply, the drylands are very rich in local resources suitable for supporting organic farming:

- Some of the best sources of biopesticides, like neem (*Azadirachta indica*), Karanji (*Pongimia pinnata*), and *Calatropis* spp, are abundantly available in drylands (Rajeshwar Rao 1999).
- Similarly, minerals like rock phosphate, gypsum and lime are available naturally in large quantity in Rajasthan. These minerals help improve soil conditions and supply plant nutrients.

Strategies for promoting organic farming in drylands

As shown above, there is immense potential for adoption of organic farming in India's drylands Socio-economic and ecological reasons also favor it many aspects of drylands that would pose constraints for the intensive agriculture system of the Green Revolution can be converted into opportunities for organic farming. The following specific steps would go a long way towards promoting this development.

1. Popularize organic farming without compulsion of certification.

2. Promote ley farming.

3. Integrate efforts of supporting agencies.

4. Encourage decentralized input supply.

5. Adopt improved methods of composting.

6. Increase public awareness and build capacity.

7. Subsidize organic inputs and produce.

A. Choose the correct answer

A1.	---------------------------- is the nodal agency to promote the Indian organic agriculture and its exports opportunities	
	c. National steering committee b. **APEDA**	c. NPOP d. Ministry of Commerce and Trade
A2.	Expand OATZ	

B. Short question

B1.	Strategies for promoting organic farming in drylands
B2.	Narrate the role of NGOs in organic farming

C. Brief question

C1.	Describe the factors constraining greening of Indian Agriculture

Lec 17. Economic evaluation of organic production systems- Cost- benefit analysis and comparison with conventional systems

Income of a farmer is the difference between cost of production and returns. Consequently, the income can not only be improved by achieving higher yields, but also by reducing the cost of production. Some ways to reduce expenses are given below.

Optimizing Recycling

An effective way to reduce expenses on manure inputs is to recycle a maximum of material on the farm. For example kitchen waste, together with organic materials from the fields can be turned into compost. Pruning from trees and hedges can be used as firewood and their twigs and leaves as mulching material. Most important for an efficient recycling of nutrients is the management of the farmyard manure Whatever nutrients the farmer manages to recycle does not have to be purchased from outside.

Minimizing External Inputs

Organic farming is supposed to be a kind of low external input agriculture. However, some organic farms are heavily depending on purchased organic manures, commercial organic pesticides and other inputs. Besides a better recycling of nutrients (see above), there are some more ways to reduce expenses: • Use local plants to prepare your own botanical pesticides • Produce your own crop seeds and seedlings • Look out for locally available sources of manures, e.g. waste from agricultural processing plants • Grow your own food, e.g. vegetables, staple food, fruits, cereals • Keep animals to produce your own manure, milk, eggs, meat etc. • Produce fodder from your own farm instead of buying (organic) fodder from outside • Share equipments and machines with your neighbours and get them assembled locally instead of buying or importing • Use locally available materials for constructions (e.g. compost pits, sheds, tools etc.) • Join with other farmers to form saving groups in order not to rely on loans with high interests

Reducing the work load

Even if labour compared to input costs may be cheap in many tropical countries, farmers will in the long run invest their own or hired labour only if there is sufficient benefit from its results. There are many ways to reduce the amount of work in the farm. Preventive measures of organic pest and disease management, for example, help to reduce future work. Reduced soil cultivation through the use of mulch, partial weed tolerance or the clever arrangement of shed systems in animal husbandry are other frequently practised methods. Certain activities however should not be neglected even if they pay off only after a certain period of time, as it is the case with measures to build up soil organic matter contents.

Discussion: How to reduce expenses? Discuss with the participants the above principal options to reduce expenses of production. How can costs be avoided in local conditions? How can farmers reduce their workload? Note down the single suggestions on the board in keywords.

As discussed above, a positive balance between costs and returns is the base for an economically sound way of doing organic farming. The returns are the product of the total outputs and their price achieved in the market. To increase the returns therefore, the following approaches can be used:

Increasing the production

Total farm productivity can be improved by using more suitable varieties of crops which give good yield in local conditions. Crop yield can sometimes be increased though better nutrient management and more efficient pest and disease management. Additional crops can be integrated in the cropping system through mixed cropping or crop rotation, thus using the available space more efficiently Another option is to integrate animal husbandry in the farm for getting additional products Value addition on the farm In order to increase the market value of the farm products, farmers can: • Choose products, which are of high market value (e.g. medicinal plants, spices, etc.) • Achieve a better quality for the products, e.g. by improved handling, • Engage in simple on-farm processing like threshing, milling, fermenting, grading, cleaning etc. • Produce processed goods, e.g. jams, dried fruits, pickles etc. • Produce dairy products (cream, butter, cheese, yoghurt, curd etc.) • Store products, as off-season prices are sometimes considerably higher for certain crops

Discussion: Increasing the product value Discuss with the participants options for value addition in local conditions. In which crops can a better quality product achieve better market prices? Which options for on-farm processing do farmers have? How can farmers join together to improve the value of their products?

Accessing better markets

The income depends on the quantity of yield and on the prices of the products paid in the market. In some countries, farmers get exploited by middle men who pay low but sell at a high price. If this is the case, direct marketing of products can be an option.

Many farmers expect to get a premium price for their organic products, as they are of better quality (less pesticide residues, better taste etc.). In many countries, however, the market for organic products with premium prices is still very small. Wholesalers may offer sales guarantee in return for a regular supply of certain items. As a single farmer may not be able to provide a sufficiently big quantity to the wholesaler, forming producers association can be advantageous.

Export markets are promising due to the sometimes high premium price paid for organic quality. However, it is very difficult to meet the requirements of these markets, and usually only groups of farmers linked with professional traders are capable of surpassing the hurdles. Successful marketing requires specific know-how, which cannot be dealt with in this manual due to limited space.

Diversity to reduce the economic risk

The income of many farmers depends directly on the sale of the harvest of one or two crops. If prices for these commodities drop, these farmers inevitably face tremendous problems. Even with stable prices, large losses can occur when yields suddenly drop, e.g. due to pest or disease incidence which could not be sufficiently controlled.

Diverse farms with a range of crops will suffer less from price fluctuations or yield reductions of single crops. Crop diversity therefore is not only helpful for establishing a balanced ecosystem and avoiding the spread of pests and diseases. It also helps the farmers to avoid taking a high economic risk.

ECONOMICS OF ORGANIC Vs CONVENTIONAL FARMING

Organic and conventional farming belong to two different paradigms. The fundamental difference between the two competing agricultural paradigms is as follows.

Difference between organic and conventional farming

Organic Farming	Conventional Farming
Decentralization	Centralization
Independence	Dependence
Community	Competition
Harmony with nature	Domination of nature
Diversity	Specialization
Restraint	Exploitation

Practices under organic and conventional farming

Organic Farming	Conventional Farming
Ecological orientation	Chemical and fossil intensive inputs
Fossil fuel emits less green house gases	There is emission of green house gasses such as, CO_2,NO_2 and CH_4
Cycle of nutrient produced within the farm	Off farm inputs
Weed control by crop rotation and cultural practices.	Weed control by herbicides.
Pest control based on bio pesticides and bio control agent.	Pest control by chemical pesticides.
No pollution	Considerable pollution
Conservation of soil health, flora and fauna	Deterioration of soil health, adverse impact on flora and fauna

Questions

A. Choose the correct answer

A1.	IFS leads to	
	a. Low Benefit-Cost Ratio b. **High Benefit-Cost Ratio**	c. Both A and B d. None of the Above
A2.	Which objective favours Benefit-Cost ratio?	
	a. High Input use efficiency b. Cash flow round the year	c. Profitability d. Productivity

B. Short question

B1.	How can we evaluate the organic production systems?
B2.	How can we reduce the expenses in organic farming?
B3.	Does organic farming ensure the food security?

B4.	**Why does organic food sometimes cost more?**

C. Brief question

C1.	**Briefly analysis the organic production systems compared with conventional systems**