SRI SHANMUGHA COLLEGE OF ENGINEERING AND TECHNOLOGY

(Approved By AICTE, Accredited by NAAC, Affiliated to Anna University)

Tiruchengode – Sankari Mani Rd, Pullipalayam, Morur (PO), Sankari (Tk), Salem 637304.

AI8211- CROP HUSBANDRY LABORATORY

DEPARTMENT OF AGRICULTURE ENGINEERING

Anna University - Regulation: 2017

B.E AGRICULTURE ENGINEERING – II SEMESTER

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RECORD NOTE BOOK

REGNO. _____

Certified that this is a bonafide observation of Practical work done by Mr/Ms/Mrs……of the…… Semester……. Branch during the Academic year……in the……laboratory.

Staff–in–Charge **Head of the Department**

Internal Examiner **External Examiner**

GENERAL INSTRUCTIONS

- All the students are instructed to wear protective uniform and shoes before entering into the laboratory.
- Before starting the exercise, students should have a clear idea about the principles of that exercise
- All the students are advised to come with completed recorded and corrected observation book of previous experiments, defaulters will not allowed to do their experiment.
- Don't operate any instrument without getting concerned staff member's prior permission.
- All the instruments are costly. Hence handle them carefully, to avoid fine for any breakage.
- Almost care must be taken to avert any possible injury while on laboratory work. In case, anything occurs immediately report to the staff members.
- One student from each batch should put his/her signature during receiving the instrument in instrument issue register**.**

Exp.No: 1

Date:

FIELD PREPARATION STUDIES

Preparatory Tillage:

It refers to tillage operations that are done to prepare the field for raising crops. It is divided into three types are,

(i) Primary Tillage:

The first outing and inverting of the soil that is done after the harvest of the crops or untilled follow, is known as primary tillage.

It is normally the de post operation pre-found during the period between two crops. Depth may range from 10.30 cm. It includes ploughing to cut and invert the soil for further operation. It consists of deep opening and invert the soil for further operation. It consists of deep opening and loosening the soil and bring out the desirable tilth. The main objective is to control weeds to incorporate crop stubbles and to restore soil structure.

(ii)Secondary Tillage:

It refers to shallow tillage operation that are done after primary tillage to being a good soil tilth. In this operation the soil is stirred and conditional by breaking the clods and crust, closing of cracks and crevices that from on drying incorporation of manure and fertilizes leveling, mulching forming ridges and furrows are the main objectives. It includes cultivating harrowing, pulverizing raking, leveling and ridging operation.

Tillage Implements:

(i)Primary Tillage Implements:

* Country plough
* Improved iron plough
* Bore plough
* Mould board plough

* Disc plough

* Reversible disc plough

* Turnrest plough

* Chisel plough

(ii) Secondary Tillage:

* Cultivators

* Harrows

* Spite tooth harrow

* Spring tine

* Chain harrow

* Disc harrow

* Intercultivating harrow

* Blade harrows

Exp.No: 2

Date:

SEEDS SELECTION AND SEED TREATMENT PROCEDURES

Seeds:

Seed is a fertilized ripened ovule consisting of three main parts namely seed coat, endosperm and embryo which is due course, endosperm and gives risk to a new plant. Seed is the nucleus of life. Endosperm is the storage organ for food substance that nourish coat the embryo during its development. Seed coat is the outer cover that protects or shields the embryo and endosperm.

Characteristics of a good quality seed:

* A Good quality seed quality possess the following pure, characteristics.
* Seed must be true to its type genetically pure, free from admixtures and should belong to the proper variety or strain of the crop and their duration should be according to agro climate and cropping system of the locality
* Seed should be pure, viable vigorous and have yielding potential
* Seed should be free from seed borne diseases and pest infection.
* Seed should be clean, free from weed seeds or any inert materials.
* Seed should be in whole and not broken or damaged. Crushed or peeled of way filled and half rotten.
* Seed should meet the prescribed uniform size and weight of the crop
* Seed should be as fresh as possible or of the not damaged or of the proper age
* Seed should contain optimum amount of moisture (8 to12%)
* Seed should have high germination percentage (more than 80%)
* Seed should germinate rapidly and uniformly when sown.

Seed Rate:

The quantity of seed required for sowing or planting is a unit area. The seed rate for a particular crop would depend not only on its seed size test weight but also on its desired population, germination percentage and purity percentages of seed. It is calculated as follows:

$$\text{Seed rate (kg)} = \frac{\text{No. of plants/ hill x test weight of the seed}}{\text{Spacing (cm}^2\text{)}} \times 100$$

Seed Treatment:

Seed treatment is a process of application either by miring or by coating or by soaking in solutions of chemicals or protectants (with fungicidal properties) nutrients hormones or growth regulator or subjected to a process wetting and drying or subjected to reduce control or repel diseases organisms, insects or either pests which attack seeds or seedlings growing there from seed treatment also includes control of pests when the seed is in storage and after it has been sour/ planted.

Method of Seed Treatment

1. **Dry Treatment** :

   Miring of seed with powder form of pesticides/ nutrients.

2. **Wet Treatment:**

   Soaking of seed in pesticides/nutrient solutions.

3. **Slurry Treatment**

   Dipping of seeds/seeding in slurry eg. Rice seedlings in slurry dipped in phosphate slurry.

4. **Pelleting:**

   It is the coating of solid materials in sufficient quantities to make the seeds largers, heavier and to appear uniform in size for sowing with seed drills. Pelleting with pesticides as a protectant against soil organisms, soil pests and as repellant against birds and rodents.

Exp.No: 3

Date:

SEED BED AND NURSERY PREPARATION

Selection of site:

* The nursery area should be nearer to the water sources
* Generally, the location should be practically, shaded (i.e) under the trees of if must not artificial shade is to be provided.
* It should be well protected from animals.
* Proper drainage facilities should be provided.

Selection of soil:

* A medium textured loam (or) sandy loam soil is preferred. Soil should be rich in organic matter, soil depth should be perfectly 15-25 cm

Types of nursery bed:

* Flat bed
* Raised bed nursery
* Raising nursery in containers Eg: Polybags, pots etc.

Types of nursery:

(i) Temporary Nursery

* It consists of raised nursery beds. It can be damaged from one place to another depending on needs.

(ii) Permanent Nursery

* Side walls with drainages holes are concentrated with concrete height of 75 cm. Seeds are sown in soil inside the concrete structure after removal of each batch of seedlings the soil is enriched with manures.

Preparation of nursery bed:

* The soil should be of fine tilth, free from unwanted materials
* Maximum 20 kg FYM/2x1m^2 bed
* Distance (or) Fytolon (or) Baristin drenching to check the soil borne diseases

Type of nursery beds:

* **Flat beds**

  Not useful for horticultural crops

* **Raised bed**

  Best system for vegetables

* **Permanent bed**

  For hybrid (For hybrid vegetables)

Seed sowing in beds:

Line sowing has the following advantages

- Easy to pull out the seedlings
- Diseases incidence will be minimum
- Optimum seed rate
- Cultural operation will be easy
- Higher percentage of germination

Sow the seeds in normed spacing in shallow lines of 1 cm depth at 10 cm apart the seeds will be covered with fine river sand the beds are covered with high materials like paddy straw followed by application of BHC 10% dust around the bed to prevent the entry of ants tumites.

Practical techniques for health in nursery:

* Optimum seed rate
* Avoid thick sowing
* Sowing depth should be apron 1 cm
* Maintenance of the bed free from weeds, pathogen, insects and nematodes
* Spread the seed on v-shaped furrows optimum distance between seeds to get stocky seedlings
* Never force the seedlings to grow fast fertigation or watering
* Hardening the seedling before pulling maximum retention of root
* Avoid prolonged shading

Seed Rate:

The quality of seed required for sowing on a unit area of land. The rate depends on test weight spacing / Plant population and germination percentage and germination percentage the seed rate can be calculated by the formula

$$\text{Seed Rate (kg/ha)} = \frac{\text{1000 Grain wt. (g) x No.of plants/ Hill}}{\text{Spacing (cm)}^2} \text{ x100}$$

Seed rate for Importance crops:

SI.No	Common Name	Scientific Name	Seed Rate
1	Rice	Oryza sativa, short duration medium duration and long duration	60 40 , 30
2	Wheat	Triticum sativum	125
3	Maize	Zea mays	20
4	Sorghum	Sorghum bicolor	10-15
5	Cucumber	Cucumis sativus	5
6	Ragi	Eleusine coracana	5
7	Redgram	Cajanus cajan	10-15
8	Black gram	Vigna mungo	20-25
9	Cowpea	Vigna unguiculata	20
10	Soyabeen	Glycine max	70-80
11	Greengram	Vigna radiata	20-25
12	Groundnut	Arachis hypogaea	125-140
13	Cotton	Gossypium	7-5 (delinted)
14	Sugarcane	Saccharum officinarum	75000 nos (two budded seeds)

Seed Rate Calculation:

$$\text{Seed Rate (kg/ha)} = \frac{\text{1000 Grain wt. (g) x No.of plants/ Hill}}{\text{Spacing (cm)}^2} \text{ x100}$$

1. **Rice**

2. **Groundnut**

3. **Sunflower**

4. **Maize**

Ex.No:4

Date:

SOWING AND TRANSPLANTING

Sowing:

Sowing is the placing of a specific quantity of seeds in the soil for germination and growth while planting is placing of plant propagates (may be seedlings, cuttings, Rhizomes, clones, tillers etc) in the soil to grow as plants.

Methods of Sowing:

Seeds are sown directly in the field (seed bud) or in (nursery bed) where seedlings are raised and transplanted later direct seedling may be done by

- Broadcasting
- Dibbling
- Drilling
- Sowing behind the country plough
- Planting
- Transplanting

Broadcasting:

Broadcasting is the scattering or spreading of the seeds on the soil which may be or may not be incorporation into the soil or similar other material. Broadcasting of seeds may be hands mechanical spreader or airplane. Broadcasting the seeds is the easy, quick and cheap method of seedlings. The difficulties observed in broadcasting are uneven distribution improper evenness of germination and uniformity in seedling vigour and establishment .Broadcasting is mostly suited for closely spaced and small seeded crops.

Dibbling:

Dibbling is the placing of seeds in a hole or pit made at a predetermined spacing and depth with a dipper or planter or very often by hand dippling is more laborious ,time consuming and expensive, compare to broadcasting but it require less seeds and gives rapid and uniform germination with good seedling vigour.

Drilling:

Drilling is a practice of dropping seeds in a definite depth covered with soil and compacted. Sowing implements like seed drill and seed fertilizer drill are used manures, fertilizers soil amendments, pesticides etc. may be applied along with seeds. Seeds are drilled continuously or at regular intervals in rows it requires more time, energy and cast but maintains uniform populations per unit area rows are set according to the requirements seeds are placed at uniform depth and compacted.

Sowing behind the country plough:

Sowing behind the country plough is an operation which seeds are placed in the plough furrow either continuously or at required spacing by a man working behind a plough. When the plough takes the new adjacent furrow the seeds in the previous furrow are closed by the soil closing the furrow depth of sowing is adjacent by adjusting the depth of the plough furrows.

Planting:

Planting seeds or seed material firmly in the soil to grow.

Transplanting:

Planting seedling in the main field after pulling out from the nursery it is done to reduce the main field duration of the crops facilitating to grow more numbers of crops in a year it is easy to give extra case for tender seedlings. For small seeded crops which require shallow sowing and frequent irrigation for proper germination raising nursery is the easiest way.

Ex.No:5

Date:

BIOMETRIC OBSERVATION

It is important to collect data on various growth and yield parameter which may facilitates to interpret the results in a better way. Generally growth parameter such as plant height, tiller production, leaf area index and dry matter production are recorded. In addition yield parameters may be recorded at different growth size viz,

- Tillering
- Primordial initiation
- Flowering and at harvest

Observation can also be taken at 20,40,60,80 & 100 days after planting or sowing appropriate method of sampling and proper measurement are important to get a valid data be the growth and yield parameter that should be recorded for important field crops are given below.

Rice:

- Plant height
- Leaf area index(LAT)
- Tiller production
- Dry matter production
- Number of panicles / m^2
- Number of spikelets / panicle
- Filled grains %
- Test grain weight
- Grain yield
- Straw yield

Wheat:

- Plant height
- Leaf area index
- Tillers / m row length
- Effective tillers / m row length
- No of spikelets / panicle
- No of grain / panicle
- Grain yield
- Straw yield

Maize:

- Cobs / plant
- Cob weight
- Grains / cob
- Test grain weight
- Grain weight
- Stover yield

Millets:

- No of effective tillers / hill
- Spikes / panicles
- 1000 grain weight
- Grain weight
- Straw yield

Pulses:

- No of pods / plants
- No of grains / pod
- Weight of pods / plant
- Grain yield

Groundnut:

- Number of pods / plant
- Mature pods / plant
- Immature pods / plants
- Pod / plant weight
- 1000 kernel / weight
- Pod yield
- Haulm yield
- Stover yield

Rapeseed mustard:

- Plant height
- Number of branches / plant
    i. Primary
    ii. Secondary
    iii. Tertiary
- Number of siliqua / plant
- Number of seeds / siliqua
- 1000 seed weight
- Seed yield

Sunflower:

- Head diameter
- Seed weight / plant
- 100 seed weight / plant
- Seed yield

Soybean:

- No of branches / plant
- No of pods / plants
- Pod / plant weight
- No of seed / pods
- Seed yield
- 100 seed weight

Sesame:

- Plant height
- Branches / plant
- Capsules / plant
- Length of capsules
- Seeds / capsules
- Test weight of seed
- Grain weight / plant
- Grain yield

Jute:

- Plant population / m^2
- Plant height
- No of branches / plant
- No of leaves
- Leaf area
- Diameter of stem
- Fiber yield
- Total capsule / plant
- Diameter of capsule
- Seeds / capsule
- Total weight of seed
- Seed yield

Cotton:

- No of monopodial and sympodial
- No of bolls / plant
- Seed cotton weight / boll
- Seed cotton yield
- Lint yield

Sugarcane:

- Length of millable cane
- No of internodes / cane
- Diameter of cane
- Cane weight
- No of millable cane / m^2
- Cane yield

Tobacco:

- Total cured leaf yield
- First grade leaf
- Leaf yield

Forages:

- Green forages yield

Green manures:

- Biomass production / unit area

Seed: Coriander

Date of sowing:

34 days after sowing

S.No	Plant height	No. of leaves	Leaf length	Leaf breadth	Leaf area
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Seed: Coriander

Date of sowing:

47 days after sowing

S.No	Plant height	No. of leaves	Leaf length	Leaf breadth	Leaf area
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Seed: Coriander

Date of Sowing:

61 days after sowing

S.No	Plant height	No. of leaves	Leaf length	Leaf breadth	Leaf area
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Dry matter production kg / hec

Fresh weight (grams)	Dry weight (grams)

Plant Population = Area / Spacing

Dry Matter Production (kg/hec) = Dry weight * Plant Production

Exp.No: 6

Date:

NUTRIENT MANAGEMENT STUDIES

Fertilizer requirement:

The nutrient requirement of crop varies and is made available to the plant by application of fertilizers. The manufacture nutrient content of fertilizer material also varies. It is calculated by the formula

$$\text{The amount of fertilizer to be applied} = \frac{100 \times \text{Recommended loss fertilizer to the applied}}{\text{Nutrient content in the fertilizer material}}$$

Example

Fertilizer recommended for Rice is 100-50-50 kg N, $P_2 0_5$, $K_2 0$ per hec. Calculate the requirement of urea, super phosphate and nutrient of potash.

Urea Requirement =

Super Phosphate =

Nutrient of Potash =

Conversion factors to workout quantity of fertilizer from nutrient:

Nutrient	Multiplication Factor	Fertilizer
Nitrogen	4.9	Ammonium Sulphate
Nitrogen	2.2	Urea
Nitrogen	4.0	Ammonium Chloride
Nitrogen	3.0	Ammonium Nitrate
Phosphoric acid (P_20_5)	6.25	Super Phosphate
Potash (K_20)	1.66	Nitrate of Potash
Potash (K_20)	2.0	Sulphate of Potash

General fertilizer recommendation for important crops:

Crop	Fertilizer Dose (kg/ha)		
	N	**P_20_5**	**K_20**
Rice	100-150	50-60	50-60
Wheat	80-120	40-60	40
Maize	135	60	40
Sorghum	100-120	50	40
Cumbu	100-120	40-60	30-40
Ragi	50-60	30-40	20-30
Pulses	25	50	-
Gingelly	25-30	20-30	20
Sunflower	40	20	20
Sugarcane	275	62.5	110
Cotton	100-120	60	60

Fertilizers calculated for top dressing to a hectare

Crop	Fertilizer N : P: K (kg)	Time 1 & Quality N (kg)	Time 2 & Quality N (kg)	IS Foliar application needed
Wheat	80:40:40	Basal 86.8	RI 86.8	Needed
Maize	135:62.5:50	Basal 73.3	2s DAS-73.3 4s DAS-146.6	Not Needed
Sorghum	90:45:45	Basal 97.3	95	Needed
Pearl	70:35:35	Basal 75.5	4S DAS 75	Not Needed
Finger millet	60:80:30	30 DAS 65.2	30 DAS 65.2	Not Needed
Green Gram	25:50	Basal 54.3	-	Needed
Black Gram	25:50	Basal 54.3	-	Needed
Cowpea	25:50	Basal 43.4	-	Needed
Soyabean	20:80:40	Basal 54.3	-	Needed
Chick Pea	25:50	Basal 54.3	-	Needed
Dhaincha	FYM	12.5 t/ha	-	Not Needed
Sunn hemp	FYM	12.5 t/ha	-	Not Needed
Fodder Sorghum	60:40:20	Basal 65.2	30 DAS 65.2	Not Needed
Cumbu Napier Hybrid	50:50:40	Basal 54.3	30 DAS 54.3	Not Needed

For foliar spray OAP applied at flowering stage. For all the crops P and K are applied at the full dose as based application.

Fertilizer Calculation

$$\text{Amount of the Fertilizer to be applied} = \frac{100 \text{ X RDF}}{\text{Nutrient content in the Fertilizer}}$$

1. **Rice**

2. **Sugarcane**

3. **Cotton:**

4. **Pulses (Red Gram):**

5. **Maize:**

Expt. No: 7

Date:

WATER MANAGEMENT & IRRIGATION SCHEDULING

All the crop plants have an optional moisture regime and any derivation from the optimum result in advice effect heading to poor growth, yields and even the quality of the produce. It is therefore necessary then an ideal soil moisture level is maintained for better growth, yield and quality of the crop.

Irrigation at the critical of crop growth stages:

The critical growth stages are most sensitive to shortage of water and the yields of the crops is reduced drastically if the crop is not irrigated at these stages. There are critical growth stages are different for different crops.

Rice:

- Seedling
- Maximum Tillering
- Particle initiation
- Flowing and soft dough (or) milky stage

Coheat:

- Grown root initiation
- Tillering
- Jointing
- Boot leaf
- Flowering
- Milky and dough

Maize:

- Seeding - 2 weeks after sowing
- Tasting - 6 weeks after sowing
- Silking - 10 weeks after sowing
- Dough - 12 weeks after sowing

Sorghum:

- Seeding - 2-4 weeks after sowing
- Pre-flowering -12-14 weeks after sowing
- Flowering - 12-16 weeks after sowing
- Dough – 17 weeks after sowing

Pulses:

- Early growth stage
- Post flowering stage (or) pod filling

Irrigation Scheduling:

Irrigation scheduling is the process used by irrigation system managers to determine the correct frequency and duration of watering.

The following factors may be taken into consideration:

- ❖ Precipitation rate of the irrigation equipment how quickly the water is applied often expressed in inches or mm per hour.
- ❖ Distribution uniformity of the irrigation system how uniformly the water is applied, expressed as a percentage the higher the no, the more uniform.
- ❖ Soil infiltration rate –how quickly the water in absorbed by the, rate of which also decreases as the soil becomes water, also often expressed in inches or mm per hour.
- ❖ Slop (topography) of the land being irrigated as this affects how quickly runoff occurs, often expressed as percentage i.e: distance of fall divided by 100 units of horizontal distance (1ft of fall 100ft (30m) would be 1%).
- ❖ Soil available water capacity expressed in units of water per foot of soil.
- ❖ Effective rooting depth of the plant to be watered, which affects how much water can be stored in the soil and made available to the plants.
- ❖ Overwatering and then allow the soil to dry out in between watering, to allow air to enter the soil and encourage root development but not so much that plant is stressed beyond what is allowable.

- In recent years more sophistical bed irrigation controllers have been developed that receive it input from either a single on-site weather station or form a network of station and automatically adjust the irrigation schedule accordingly.
- Other devices helpful in irrigation scheduling are rain sensors, which automatically shut off an irrigation system when it rains, and soil moisture sensing devices such as capacitance sensors, tensiometers and gypsum blocks.

Ex. No: 8

Date:

WEEDS MANAGEMENT STUDIES

Definition:

Weeds are the plants, which grow where these are not wanted (Jethro, Tul 1731) coined the word weed can also be referred to as plants out of place.

Methods of Weed Control:

Weed control and weed management are the two terms often used in weed science. Weed control is the process of limiting infestations or other operations can be carried out efficiently. The primary objective of weed management is to maintain an environment that is a determined to weeds as possible.

Weed management method can be broadly grouped into preventive and curative and can be further broadly categorized into Mechanical, Agronomical, Biological and Chemical Methods. Any one of combination of methods can be employed for effective and managements.

Preventive Methods:

It comprises all measures taken to hinder the introduction and spread of weeds. It includes clean cultivation use of clean seeds. Keeping seed bed free from weeds keeping bunds and irrigation channels free of weeds, keeping tool and machinery clean and control of weeds.

Control Measures:

1. **A Mechanical Method:**
   - Mechanical control involves the usage of different tool implement and machinery for weed control.
   - Mechanical or physical method of weed control are being employed ever since man begin to grow crops.

a) Tillage:

In a non-distributedly soil deeply buried dormant seeds return their viability for many years. Number of weed seeds in the ploughed layer can be reduced by repeated village that simulates emergences.

b) Hoeing:

Hoe has been the most appropriate and widely used weeding tool for centuries. It is however still a very useful implements to obtain results effectively and cheaply.

c) Hand weeding:

It is done by physical remove or pulling out of weeds by hand or removal by implements. It is very effective against annual biennials and control only upper position of perennials.

d) Digging:

Digging is useful in the case of perennial weeds to remove the underground propagation parts of weeds for deeper layer of soil.

e) Sickling:

Sickling is also done by hand with the help of sickle to remove the top growth of weeds to prevent seed production and to store the underground parts.

f) Mowing:

It is a machine. Machine operated practice mostly. Done on roadsides and in lawns.

g) Burning:

Burning or fire is often an economical and practical means of controlling weeds.

i. Dispose of vegetation
ii. Destroy dry drops of weeds that have natured
iii. Kill green weed growth in situations are impracticable.

h) Flooding:

Flooding is successful against weed species sensitive to longer periods of submerge in water.

i) Solarisation:

Solarisation is a method of heating the surface soil by using plastic sheets placed on moist soil to trap the solar rotation found effective against inhibited but dormant seeds.

2. Cultural Methods:

Various cultural measure such as choice of crop, varieties planting density geometry intercropping, crop rotation and fertilizer and irrigation management.

a) Crop Varieties:

Maize has the biggest weed suppressing ability (92%) compared to other crops pearl millet 88%, sorghum 81%, cowpea 85%, pigeon pea 54%, groundnut – 62%, castor – 51%,

grown in Odisha state semi trial – rice variety "kalinga-3" is superior to smoothie weeds than dwarf cultivates.

b) Plant Population:

Plant Population and row arrangement also affect the weed growth higher. Plant population and narrow row spacing for can put pressure on the availability of space for weed growth. A narrow (15 cm) spacing was found superior to wide (30-45 cm) spacing yield in upland rice.

c) Inter Cropping:

Inter Cropping suppresses weeds better than sole cropping and thus provide an opportunity to utilize crops then as tools for weed management of cowpea and Soyabean effectively smoother weeds.

d) Crop Rotations:

In Monoculture a number of used species persist and expand rapidly while crop rotation helps to intercept the life cycle of weeds. Scripus martinus persist when dry land crops are rotated twice.

3. Biological Method of Weed Control:

Biological management is a broad then the term of the exploitation of living organisms or their product to reduce or prevent the growth and reproduction of weeds. Among them insects are one of the important groups. Biological control is widely accepted as an important methods of weed control.

e) Use of Insects:

Certain species have been introduced in the regions where some used such as Cactus cloth weed, lantana. During 1860's a cochineal insect, pactylopics. Ceylonicus was used in south India to control prickly pear cactus opuntia vulgaris. The Mexican beetle is found to have (great potential to bring about permanent reduction in the density of parthenium hysterophorus in the part of India.

f) Bio herbicide:

Bio herbicide are the biological control agents applied in similar ways as that of chemical herbicides to control weeds. Most commonly used microorganisms are fungus and hence they called mycoherbicide.

4. **Chemical Method of Weed Control:**

Use of herbicide is wide spread world-wide. In the recent decades took place principally at the expense of fungicide share of 40% in 1960 & 25% in 1995. Wheat 42% Rice 30% and Tea Plantation (23%).

Classification of Herbicides:

I. **Pre-Planting:**

Herbicide applied before the crops plant.

Eg: glyphosate or paraquat is applied to rice follow fields.

II. **Pre-Emergence:**

Herbicides are applied before the emergence of crops or weed. In annual crops.

Eg: Butachlor to rice, Isoproturon to wheat and atrazine to sugarcane.

III. **Post-Emergence:**

Herbicides treatment inferred after the emergence of crops or weeds is preferred to as post-emergence application.

Eg: Propanil to rice and 2, 4-D to rice/wheat.

Ex. No: 9

Date: **INTEGRATED PEST MANAGEMENT STUDIES**

IPM is defined as the Intelligent Selection and use of pest control tactics that will ensure favorable economical and sociological consequences.

Methods of Integrated Post Management:

I. Cultural Method or Use of Agronomic practices:

a. Crop rotation
b. Crop refuse destruction
c. Tillage of soil
d. Variation in time of planting or harvesting
e. Pruning or thinning
f. Fertilizer Management
g. Inter Cropping
h. Trap crop

II. Host Plant Resistance:

a. Antixenosis
b. Antibiosis
c. Tolerance

III. Mechanical Method Pest Control:

a. Hand destruction
b. Exclusion by screens, barriers
c. Trapping, suction devices, collecting machine
d. Crushing and grinding

IV. Physical Methods:

a. Heat
b. Cold
c. Energy – High trap, radiation.
d. Light regulation
e. Sound

V. **Biological Method:**

a. Production and encouragement of N
b. Introduction, artificial and colonizing specific parasitoids and predators.
c. Pathogens or insects like virus, bacteria, fungi & protozoa.
d. Use of botanicals like neem pungam.

VI. **Chemical Methods:**

a. Attractants
b. Propellants
c. Insecticides, oc, op, carbamates, pyrethroids, etc.
d. Insect growth inhibitors
e. Chemosterilants

VII. **Behavioral Methods:**

a. Pheromones
b. Allelochemicals

VIII. **Genetic / Biotechnology Method:**

a. Release of genetically incompatible/steroid parts.
b. Transgenic plant.

IX. **Regulatory / legal Method:**

a. Plant / Animal quarantine
b. Eradication and suppression programme.

Ex. No: 10

Date: **HARVESTING**

Removal of entire plant or economic parts after maturity from the field is called harvesting. It includes the operation of cutting, picking, plucking, digging as a combination of these for removing the useful part of or economic part from the plant/crops.

Methods of Harvesting:

Harvesting is done by either manually or by mechanical means.

Manual:

Sickle is the important tool used for harvesting. The sickle to sharp curved and serrated for harvesting of plants with thick and woody stems. Now-a-days improved type of sickle in available which reduce the druggery of harvesting laborers.

Mechanical:

- Harvesting with the use of implement or machines
- Implements/Machinery used for threshing and drying

Assessing Maturity:

Crops can be harvested by assessing the maturity.

a) **Physiological Maturity:**

Refers to a development stage after which no further increases in dry matter occurs in the economic part. Crop is considered to be at physiological maturity when the translocation of photosynthetic to the economic part is stopped.

b) **Harvest Maturity:**

Generally occurs seven days after physiological maturity the important process during this period is loss of moisture from the plants external symptoms of physiological maturity.

The Major Symptoms of Physiological Maturity of Some Field Crops are as Follows:

I. **Wheat and Barley:**

Complete loss of green colour from the glumes.

II. **Maize and Sorghum:**

Black layer in the Placental region of grain.

III. **Pearl Millet:**

Appearance of bleached pendude.

IV. **Soyabean:**

Loss of green colour from leaves.

V. **Red gram:**

Green pods burning brown about 25 days after flowering.

Harvest Maturity Symptoms:

A. **Rice:** Hard and Yellow Colored Grains
B. **Wheat:** Yellowing of spikelets
C. **Sorghum, Pearl Millet, Foxtail Millet:** Yellow colored ears with hard grains
D. **Ragi:** Brown colored ears with hard grains.
E. **Pulses:** Brown colored pods with hard seeds inside the pods.
F. **Groundnut:** Inner side of pods turn dark from the light colour.
G. **Sugarcane:** Leaves turns yellow sucrose content is less than 15% and brain reading is more than 18%.
H. **Tobacco:** Leaves slightly turn yellow in colour and spikes appear on the leaves.

Ex. No: 11

Date: **POST HARVEST**

In Agriculture, Post-harvest handling is the stage of crop production immediately following harvest, including cooling, cleaning, sorting, and packing. The instant a crop is removed from the ground or separated from its parent plant, it begins to deteriorate.

Threshing or Shelling Operations:

- Threshing or Shelling Operations follow the harvest and whatever pre-drying of the crop in undertaken.
- These Operations may be carried out in the field or on the farm, by hand or with the help of animals or machines.
- Depending on the influences of agronomic, economic and social factors, threshing or shelling is done in different ways.
- Threshing or shelling by hand with sample tools.
- Threshing with the help of animals or vehicles.
- Mechanical threshing or shelling with simple machines operated manually.
- Mechanical threshing or shelling with motorized equipment.

Hard Threshing:

One of the simplest systems for threshing rice is to pick up the sheaf of rice and strike the panicles against a hard surface.

Another frequently – used method of threshing rice is to trample is underfoot.

Hand Shelling:

The easiest traditional system for shelling maize is to press the thumbs on the grains order to detach them from the ears.

Another simple and common shelling method is rub two ears of maize against each other. These methods require a lot of labour, however, it is calculated that a worker can hand shell only a few kg on hour.

Threshing with Animals or Vehicles:

If drought animals are available and there are large quantities of rice, threshing can be done by driving the animals over a layer of sheaves about 30 cm thick.

Threshing with Hand-Driven Machines:

Machines driven by a manual device or a pedal are often used to improve yield and working conditions during threshing.

By means of the handle or pedal a big drum fitted with metal rings or teeth is made to rotate. The rice is threshed by hand-holding the sheaves and pressing the panicles against the rotating drum.

Maize Shelling with Hand-Operated Machines:

Manual shellers, which are relatively common and sometimes made by local artisans, permit easier and faster shelling of ears of maize.

These come in several models, some of them equipped to take a motor, they are generally driven by a handle or a pedal.

Threshing or Shelling with Motorized Equipment:

In describing operations of threshing or shelling with motorized equipment the principal reference will be to motorized threshing machines. Although they are gradually being replaced by combine-harvesters, these machines still have an important place in the post-harvest production process, especially for their convertibility.

By the simple replacement of a few accessions and the appropriate changes in setting these machines can treat different kinds of grain. (Eg: Rice, Maize, Sorghum, Beans, Sunflowers, Wheat, Soyabean, etc.)

Drying Process:

Drying of products can thus be obtained by circulating air at varying degree of heat through a mass of gram. As it moves the air imports heat to the grain, while absorbing the humidity of outermost layers.

Natural Drying:

The natural drying method which uses the technique illustrated in the chapter on pre drying consists essentially of exposing the threshed products to the air (in sun or shade).

To obtain the desired moisture content the grain is spread in thin layers on the drying floor, where it is exposed to the air (in sun or shade) for a maximum of 10-15 days.

Artificial Drying:

The introduction of high yielding crop varieties and the progressive mechanization of agriculture row make it possible to harvest large quantities of grain with a high moisture content in a short time.

Artificial Drying and Dryers:

- In its construction, the basic elements of a dryer one.
- The body of the dryer which contains the grain to be dried.
- The hot air generator which permits heating of the drying air.
- The ventilator, which permits circulation of the drying air though the mass of grain.

Drying and Static Dryers:

A Current of hot air moves from bottom to top through a thick layer a grain. Drying of the mass of grain does not take place in a uniform fashion, as it moves from the bottom to the top, the drying air imparts heat to the region and absorbs moisture, losing its "drying power" in the process.

The lower layers will therefore dry more rapidly than the upper ones.

- Area of any grain
- Drying area
- Area of humid grain

Drying and Continuous Dryers:

- A continuous flow of grain is passed in a thin layer through a shaft traversed by a current of very hot air.
- In its movement, the mass of grain is constantly stirred.
- In this case, the mass of dried grain has a fairly uniform moisture content.

Main Technical Features of Dryers:

The most suitable choice and optimal use of a dryer depend on the relationship between certain technical features of the appliances and local production needs.

The Main technical features of the dryer are,

- Evaporating power
- Air renewal or specific flow
- Specific thermal consumption

❖ **Evaporating Power:**

In order to define the type of dryer needed, it must first be determined how much water per hour is to be eliminated during drying.

Thus figure should completely reflect local needs for drying the products. It can be deduced through analysis of the data on annual and seasonal production.

❖ **Air Renewal Output:**

The air renewal of a dryer, or its specific flow, indicates the quantity of air per hour that passes through a cubic meter of product. Its unit of measurement is the cubic meter of air per cubic meter of product ($m^3/h/m^3$).

❖ **Specific Thermal Consumption:**

The specific thermal consumption of a dryer indicates the quantity of heat, necessary to eliminate a kg of water from the mass of product to be dried.

❖ **Outer Drying Method:**

We have seen that natural drying is show and entails get risks of loss of products on the other hand, artificial drying is fairly costly.

❖ **Cleaning of Grains:**

Winnowing of grain and Pulses is a common practice in every home in Himachal. It is performed using a container made of tin called stoop or chhaj. The grains are placed in the chhaj and slow winnowing leads to separation of dirt and husk from the grain. Almost all the types of dry grain like wheat, maize, paddy, pulses, etc. can be cleaned in this manner.

Packaging of Food Commodities Fresh Products:

Different types of containers are used for packaging food commodities. In lower areas of himachal containers made of bamboo sticks called Ddalh are used in the fields, for packing grain,

maize cobs, potato, ginger, turmeric, etc. and also for carrying the material from the field to the house.

- **Packing of Pickles:**

  In lower parts of pickled mangoes, galgal, lime, etc. are packed in earthen pots. The earthen pots are sterilized using fumes generated from burning red chillies along with Asafoetida (Hing) and a little mustard oil. The top of the container is covered with a lid made of wood.

Storage of Food Commodities:

- **Food Grains:**

  Food grains like maize, wheat and paddy are stored in special structures made of bamboo called peri or peru.

  Prior to use, these structures are plastered on the inside, with a mixture of cow dung and clay. These containers are placed on the ground floor and grain is loaded into them from a hole made on the roof of the first floor called Baurh.

  To take our grains, as per need, a special opening is provided near the bottom opening is provided each peri. Interestingly, these structures are invariably kept in a separate room called over and access to which is allowed only to very flow persons.

Use of Neem Leaves / Turmeric / Mustard Oil / In Storage:

The use of neem as a pesticide is now well documented. Similarly walnut, Bhera, and mint leaves also seem to possess certain antimicrobial or pesticidal properties, which help in grain storage. The antimicrobial substance in mustard is allyl isothicyanate. The turmeric power also appears to perform a similar function.