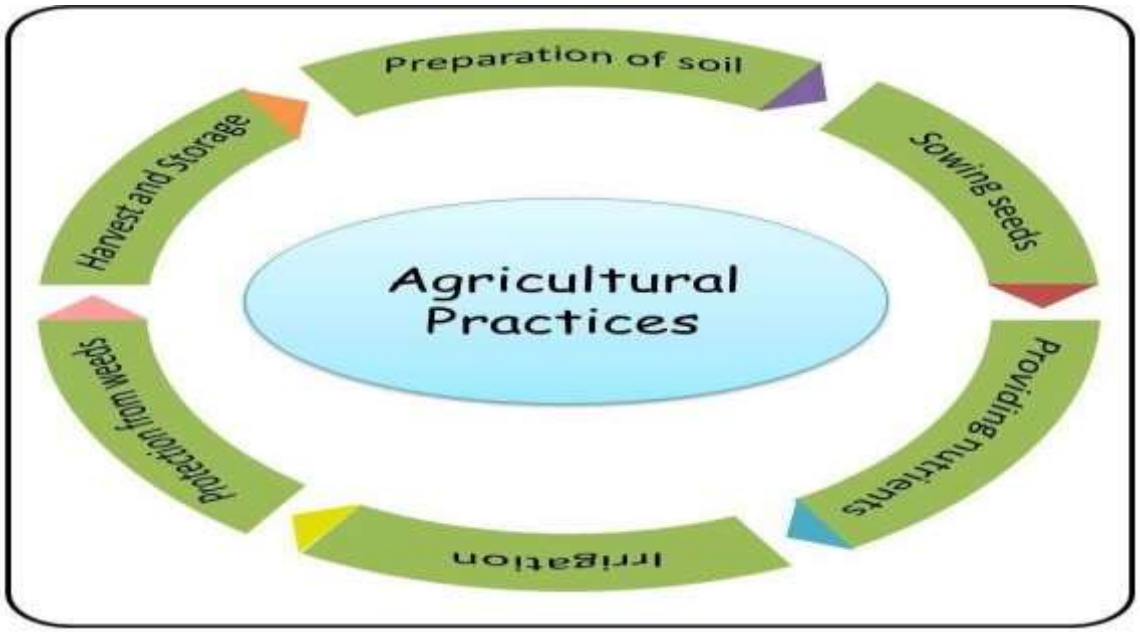
SRM VALLIAMMAI ENGINEERING COLLEGE
(An Autonomous Institution)

SRM Nagar,Kattankulathur – 603 203.

DEPARTMENT OF AGRICULTURAL ENGINEERING

AG3464 - CROP HUSBANDRY LABORATORY



(REGULATION 2019)

LABORATORY INSTRUCTION MANUAL

ACADEMIC YEAR : 2024-2025 (EVEN)

B.Tech., AGRICULTURAL ENGINEERING

IV SEMESTER

Prepared by

DINESH. R /AP/AGRI

AG3464 CROP HUSBANDRY LABORATORY LTPC

OBJECTIVES:

- To provide hands on experience to students to prepare land for cultivation.
- To introduce the different crop production practices in wetland, dry land and garden land through hands on experience and demonstrations.
- To have hands on experience on nutrient management.
- Experimental study on water management and irrigation scheduling.
- To introduce about the harvesting tools and their techniques.

LIST OF EXPERIMENTS:

1. Identification of field and horticultural crops and field preparation studies.
2. Seed moisture - estimation of seed rate, germination of seeds, Seed selection and seed treatment procedures.
3. Seed bed and nursery preparation, Sowing/Transplanting.
4. Fertilizers-type, estimation of recommended dose.
5. Water management and irrigation scheduling
6. Weeds, identification of major weed type, demonstration on simple weeding implements. Herbicide uses and caution.
7. Pest identification and control, demonstration of IPM methods
8. Harvesting methods for various field and horticultural crops and implements used.
9. Post harvesting Practices.
10. Biometric observations.

TOTAL: 60 PERIODS

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	2	2	1	1	1	2	2	2	1	2	3	3	2	3	2
2	3	1	-	3	2	1	3	-	-	-	2	2	2	2	2	1
3	2	2	2	1	1	1	2	2	2	2	1	2	3	2	3	2
4	3	1	-	3	2	1	3	-	-	-	2	2	2	2	2	1
5	3	1	-	3	2	1	3	-	-	-	2	2	2	2	2	1

EX NO: 01
DATE:

Identification of field and horticultural crops and field preparation studies.

TILLAGE:

1. It is a mechanical manipulation of the soil.
2. Tillage is the preparation of soil for planting.
3. Tillage is the manipulation of soil into a desire condition by mechanical tools such as pulverization, cutting, movement of soil.
4. Soil tillage is to change its structure to kill weeds and to manage crop residues.
5. Soil structure modification is often necessary to facilitate intake, storage and transmission of water.

AIM:

To know about the field layout preparation.

MATERIALS REQUIRED:

1. Spade
2. Hand hoe
3. Plough
4. Measuring tape
5. Rope

PROCEDURE:

1. Plough the land during summer to economize the water requirement to initial preparation of land.
2. Flood the field for one or two days before ploughing and allow water to soak.
3. Keep the surface of the field covered with water.

Special technology for problem soil:

1. For Sodic soil with pH values of more than 8.5,
    a) Plough at optimum moisture level, apply gypsum at 50% gypsum requirement.
    b) Provide drainage for leaching out soluble salts and apply green leaf manure 5 tonnes/hector.
2. For Saline soil with EC values more than four decimals,
    a) Provide lateral and main drainage channel
    b) Apply green leaf manure tonnes/hectare
3. For acidic soil,
    a) Apply lime based on the soil analysis.
    b) Lime is applied 2.5 tonnes/hector before last ploughing.

Ploughing:

1. Plough the field with iron plough once or twice.
2. Plough the field with fine tilth, it provides good germination.
3. Spread the manures on the unploughed field and incorporating manures in the soil.
4. Application of FYM 12.5 tonnes or any compost along with 2Kg of Azos spirillium, Phospho bacteria.

5. Apply well decompose poultry manure at the rate of 5 tonnes/hector to improve the physical properties of the soil.
6. Form ridge and furrows based on spacing requirements.
7. Form irrigation channels across the furrows.

Rice:
1. Clay or clay loamy soil is most suitable for rice cultivation.
2. Such soils are capable of holding water for long time.
3. Rice is a semiaquatic crop grows best under submerged condition.

Primary Tillage for Rice:
1. Ploughing is the primary tillage operation which is perform to cut, break and invert the soil partially or completely suitable for sowing seeds.

Secondary Tillage for Rice:
1. Harrowing is the secondary tillage operation which is done to smoothening and pulverizing the soil as well as to cut the weeds and mix the materials to the soil.
2. Puddling - It is done in a paddy field with standing water of 5-10 cm of depth after initial ploughing with country plough.

Levelling:
1. Land levelling is expected to bring permanent improvement in the value of land.
2. Perfect land levelling for efficient weed and water management.

EX NO: 02
DATE:

Seed moisture - estimation of seed rate, germination of seeds, Seed selection and seed treatment procedures

AIM:

To select the seed and seed treatment procedure for successive germination.

MATERIALS REQUIRED:

1. Ground nut
2. Sesame
3. Cotton
4. Sugarcane
5. Cumbu
6. Sunflower
7. Wheat
8. Red gram
9. Green gram
10. Gingely
11. Black gram
12. Rice
13. Seed rotating drum
14. Water
15. Bio fertilizers
16. Captan
17. Thiram

PROCEDURE:

1. Selection of seeds:

a) Seed selection plays an important role in cultivation practice.
b) The seed selected for cultivation should be of uniform size, age and free from contaminants.
c) They should also have good germination capacity.

2. **Separation of quality seeds**:

a) Separate good seed and bad seed for paddy, soak them in water, the inviable and infilled seeds are floated.
b) For pulses having a separate sieves in different sizes to remove damage and infilled seeds.

3. Seed rate:

a) The seed rate varies according to crop to crop and varieties to be cultivated.

4. Germination Test:

a) Germination test is the most important quality test for evaluating the planting value of seed lot.

5. Sprouting Test:

a) A hand full of seed is tied with white clo9th and soaked for 12 hours.
b) Keep the seeds in paddy stray and roll and tie it. Dip it in water for a minute and keep aside for 24 hours. Count the seeds have germinated.

c) Take a wet gunny bag, fold it, put the seeds in-between two layers and place the bag in the dark for a day.

Germination test for pulses:

1. For pulse seeds germination, soak seeds in equal amount of water for 8-10 hours till they absorbs all the water and get swelled up.
2. Now tie up these soaked seeds in a muslin cloth and put it in a warm place. Do not let the muslin cloth dry up.
3. In 12 - 24 hours seeds will start sprouting.
4. In summers, seeds take less time in sprouting.

EX NO: 03
DATE:

Seed bed and nursery preparation, Sowing/Transplanting.

AIM:
To prepare seed bed and nursery bed.

EQUIPMENTS REQUIRED:
1. Spade
2. Garden rack
3. Measuring tape
4. Farm Yard Manure(FYM)

PROCEDURE:
1. Types of Nursery bed:
- a) There are three types of nursery bed,
  - i. Flat Nursery bed
  - ii. Raised Nursery bed
  - iii. Sunken Nursery bed

2. Flat Nursery Bed:
- a) It is prepared during spring summer when there is no fear of rain.
- b) In areas where is the soil varies form light sandy to sandy loam, there is no problem with water logging.
- c) The land proposed for the nursery is prepared by ploughing well and mixed well with well rotted FYM at 10 Kg/m^2.
- d) The land is divided into small plots or beds.
- e) In between the two rows of beds a central irrigation channel is prepared through which each bed is connected.

3. Raised Nursery Bed:
- a) This type of nursery especially useful when there is a problem of water logging during the rainy season and due to which there is a fear of damage to the plant due to damping off disease.
- b) A raised bed of 10 to 15 cm height is prepared from the ground level.
- c) Stubbles, stones are removed from the bed and FYM at rate of 10 Kg/m^2 is thoroughly mixed with the soil.
- d) A distance of 50 to 60 cm is left between two rows of bed for easy cultural activities.
- e) The seeds are sown in rows over the beds.

4. Sunken Nursery Bed:
- a) This type of bed is useful and prepared mostly during the winter season.
- b) The nursery is prepared 10 to 15 cm down from the soil surface.
- c) The air blow across the surface of the soil and the seedling in sunken nurseries is not hit by the cool breeze of the air.
- d) Covering of sunken bed with polythene sheets becomes easy which is required protecting the seedlings from the cool air

NURSERY MANAGEMENT

AIM:

To know about nursery sowing.The nursery is classified into two types:

1) Dry nursery.
2) Wet nursery.

PROCEDURE:

Wet nursery:

Nursery area:

Select 20 cents (800 m2) of land area near to water source for raising seedlings for one hectare.

Seed rate:

1) 30 kg for long duration.
2) 40 kg for medium duration.
3) 60 kg for short duration varieties and 20 kg for hybrids.

Forming Seedbeds:

1) Mark plots of 2.5m breadth with channels 30cm wide all around the seedbeds.
2) Length of the seed bed may vary from 8 to 10m according to soil and slope of the land.
3) Collect the puddled soil from the channel and spread on the seedbeds or drag a heavy stone along the channel to lower it, so that the seed bed is at a higher level.

Sowing:

1) Sow the sprouted seeds uniformly on the seedbed having thin film of water in the surface.

Dry nursery:

1) Dry ploughed field with fine tilth is required.
2) Nursery area with sand and loamy soil status is more suitable for this type of nursery.
3) Area 20 cents.Plots of 1 to 1.5 m width of beds and channels may be formed. Length may be according to the slope and soil. Raised beds are more ideal if the soil is clayey in nature.
4) Seed rate and seed treatment as that of wet nursery.
5) Sowing may be dry seeding. Seeds may be covered with sand and finely powdered well decomposed farm yard manure.
6) Irrigation may be done to wet the soil to saturation.
7) Optimum age for transplanting – 4th leaf stage.
8) This type of nursery is handy in times of delayed receipt of canal water.
9) During transplanting seedlings may be dipped in 2% $ZnSO_4$ or ZnO for 30 min and then transplanted.

EX:NO:04
DATE:

Fertilizers-type, estimation of recommended dose.

AIM:

To know about nutrient management.

PRINCIPLE:

Integrated Nutrient Management refers to the maintenance of soil fertility and of plant nutrient supply at an optimum level for sustaining the desired productivity through optimization of the benefits from all possible sources of organic, inorganic and biological components in an integrated manner.

CONCEPTS

1. Regulated nutrient supply for optimum crop growth and higher productivity.
2. Improvement and maintenance of soil fertility.
3. Zero adverse impact on agro – ecosystem quality by balanced fertilization of organic manures, inorganic fertilizers and bio- inoculant

DETERMINANTS

1. Nutrient requirement of cropping system as a whole.
2. Soil fertility status and special management needs to overcome soil problems, if any
3. Local availability of nutrients resources (organic, inorganic and biological sources)
4. Economic conditions of farmers and profitability of proposed INM option.
5. Social acceptability.
6. Ecological considerations.
7. Impact on the environment

ADVANTAGES

1. Enhances the availability of applied as well as native soil nutrients
2. Synchronizes the nutrient demand of the crop with nutrient supply from native and applied sources.
3. Provides balanced nutrition to crops and minimizes the antagonistic effects resulting from hidden deficiencies and nutrient imbalance.
4. Improves and sustains the physical, chemical and biological functioning of soil.
5. Minimizes the deterioration of soil, water and ecosystem by promoting carbon sequestration, reducing nutrient losses to ground and surface water bodies and to atmosphere

COMPONENTS:

SOIL SOURCE:

Mobilizing unavailable nutrients and to use appropriate crop varieties, cultural practices and cropping system.

MINERAL FERTILIZER :

Super granules, coated urea, direct use of locally available rock PO4 in acid soils, Single Super Phosphate (SSP), MOP and micronutrient fertilizers.

ORGANIC SOURCES :

By products of farming and allied industries. FYM, droppings, crop waste, residues, sewage, sludge, industrial waste.

BIOLOGICAL SOURCES :

Microbial inoculants substitute 15 - 40 Kg N/ha

NUTRIENT CONENT OF SOLID FERTILISEERS:

	Material	Total Nitrogen (N)	Ammoniacal nitrogen (N)	Nitrogen Nitrate (N)	Nitrogen in form of urea (amide) (N)	Neutral ammonium citrate soluble phosphate (P_2O_5)	Water soluble phosphate (P_2O_5)	Water soluble potash (K_2O)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
I	**Nitrogenous fertilisers**							
1.	Ammonium Sulphate	20.6	20.6					
2.	Ammonium chloride	25.0	25.0					
3.	Calcium Ammonium Nitrate	25.0	12.5	12.5(max)				
4.	Calcium Ammonium Nitrate	26.0	13.0	13.0(max)				
5.	Calcium Nitrate	15.5	1.1(max)	14.4				
6.	Urea	46.0			46.0			
II	**Phosphatic fertilisers**							
7.	SSP 14% SSP 16%						14.0 16.0	

8.	Rock Phosphate (powder/granular)					18.0		
III	**Potassic fertilizers**							
9.	Potassium chloride (powder/granular)							60.0
10.	Potassium Sulphate							50.0
11.	Potassium Magnesium Sulphate							22.0
12.	Potassium Schoenite							23.0
IV	**Complex fertilizers**							
13.	Ammonium Phosphate							
	11-52-0	11.0	11.0			52.0	44.2	
	1846-0	18.0	15.5		2.5(max)	46.0	41.0	
14.	Ammonium Phosphate Sulphate							
	16-20-0	16.0	16.0			20.0	19.5	
	20-20-0	20.0	18.0		2.0(max)	20.0	17.0	
	18-9-0	18.0	18.0			9.0	8.5	
15.	Ammonium Phosphate Sulphate Nitrate 20-20-0	20.0	17.0	3.0(max)		20.0	17.0	
16.	Nitrophosphate 20-20-0 23-23-0	20.0 23.0	10.0 11.5	10.0(max) 11.5(max)		23.0 23.0	12.0 18.5	
17.	Ammonium Nitrate Phosphate 23-23-0	23.0	13.0	10.0(max)		23.0	20.5	
18.	Urea Ammonium Phosphate 28-28-0 24-24-0 20-20-0	28.0 24.0 20.0	9.0 7.5 6.4		16.5(max)	28.0 24.0 20.0	25.2 20.4 17.0	
19.	Potassium Nitrate (cystalline/prilled) (13-0-45)	13.0		13.0				45.0
20.	Mono Potassium Phosphate (0-52-34)						52.0	34.0
21.	NPK fertilisers 15-15-15 10-26-26 12-32-16 22-22-11 14-35-14 17-17-17 14-28-14 19-19-19 17-17-17 20-10-10	 15.0 10.0 12.0 22.0 17.0 14.0 19.0 17.0 20.0	 7.5 7.0 9.0 7.0 14.0 5.0 8.0 5.6 8.5 3.9	 7.5 8.5	 3.0(max) 3.0(max) 15.0(max) 12.0(max) 6.0(max) 13.4(max) 17.1(max)	 15.0 26.0 32.0 22.0 35.0 17.0 28.0 19.0 17.0 10.0	 4.0 22.1 27.2 18.7 29.0 14.5 23.8 16.2 13.6 8.5	 15.0 26.0 16.0 11.0 14.0 17.0 14.0 19.0 17.0 10.0

NUTRIENT CONENT OF LIQUID FERTILISERS:

	Material	Total Nitrogen (N)	Ammoniacal nitrogen (N)	Nitrogen Nitrate (N)	Urea Nitrogen (N)	Total phosphate (P2O5)	Poly phosphate (P2O5)	Maganesium (MgO)
1.	Urea Ammonium Nitrate	32.0	7.7	7.7	16.6(max)			
2.	Superphosphoric Acid					70.0	18.9	0.5(max)
3.	Ammonium Polyphosphate	10.0	10.0			34.0	22.1	0.5(max)

NUTRIENT CONENTS OF MICRONUTRIENT FERTILISERS:

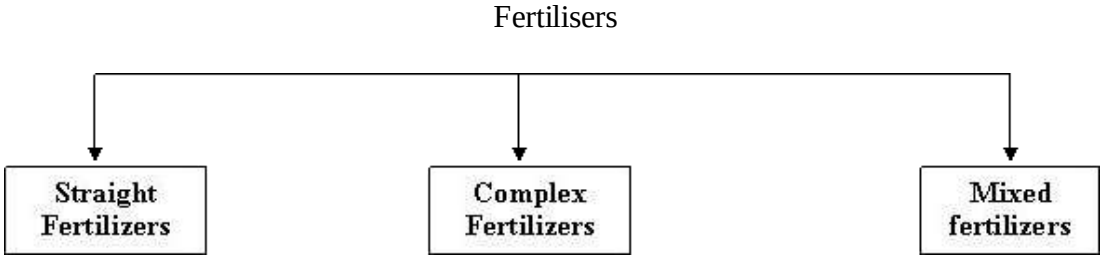
Sl. No	Name	Formula	Element/Forms	Contents(%)
1.	Zinc Sulphate*	ZnSO4.7H2O	Zn	21.0
2.	Mangnese Sulphate*	MnSO4	Mn	30.5
3.	Ammonium Molybdate	(NH4)6 Mo7)244H2O	Mo	52.0
4.	Borax(for soil application)	Na2B4O7.5H2O	B	10.5
5.	Solubor(follar spray)	Na2B4O7.5H2O + Na2B10O16.10H2O	B	19.0
6.	Copper Sulphate*	CuSO4.5H2O	Cu	24.0
7.	Ferrous Sulphate*	FeSO4.7H2O	Fe	19.5
8.	Chelated Zn	as Zn-EDTA	Zn	12.0
9.	Chelated Fe	as Fe-EDTA	Fe	12.0
10.	Zinc Sulphate monohydrate	ZnSO4.H2O	Zn	33.0

Average sulphur content
i) $ZnSO_4$ = 15%
ii) $MnSO_4$ = 17%
iii) $CuSO_4$= 13%
iv) $FeSO_4$ = 19%

FERTILIZER

Fertilizer is any material of natural or synthetic origin added to the soil to supply one or more plant nutrients.

CLASSIFICATION OF FERTILISERS

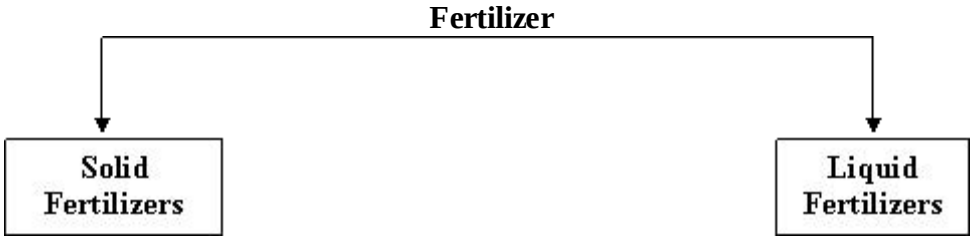


1. Straight fertilizers: Straight fertilizers are those which supply only one primary plant nutrient, namely nitrogen or phosphorus or potassium.
eg. Urea, ammonium sulphate, potassium chloride and potassium sulphate.

2. Complex fertilizers: Complex fertilizers contain two or three primary plant nutrients of which two primary nutrients are in chemical combination. These fertilisers are usually produced in granular form.
eg. Diammonium phosphate, nitrophosphates and ammonium phosphate.

3. **Mixed fertilizers**: are physical mixtures of straight fertilisers. They contain two or three primary plant nutrients. Mixed fertilisers are made by thoroughly mixing the ingredients either mechanically or manually.
Fertilisers can also be classified based on physical form:

1. Solid
2. Liquid fertilizers



Solid fertilizers are in several forms *viz.*

1. Powder (single superphosphate),
2. Crystals (ammonium sulphate),
3. Prills (urea, diammonium phosphate, superphosphate),
4. Granules (Holland granules),
5. Supergranules (urea supergranules) and
6. Briquettes (urea briquettes).

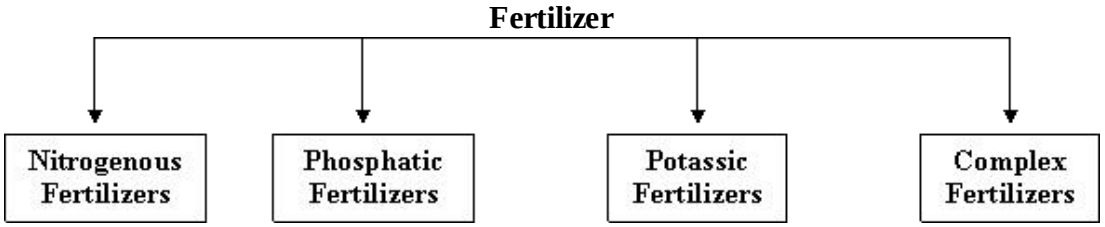
Urea prills

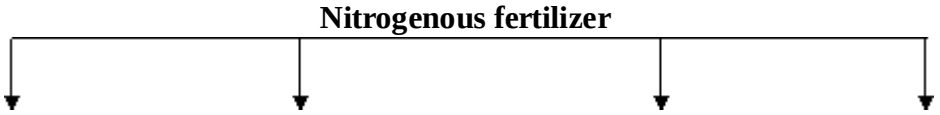
Granulated urea

Ammonium sulphate

Liquid fertilizers:

1. Liquid form fertilizers are applied with irrigation water or for direct application.
2. Ease of handling, less labour requirement and possibility of mixing with herbicides have made the liquid fertilisers more acceptable to farmers.





Ammoniacal	Nitrate	Ammoniacal and Nitrate	Amide fertilizer
1. Ammonium Sulphate 2. Ammonium chloride 3. Anhydrous ammonia	1. Sodium Nitrate 2. Calcium Nitrate 3. Potassium Nitrate	1. Ammonium Nitrate 2. Calcium Ammonium Nitrate 3. Ammonium Sulphate Nitrate	1. Urea 2. Calcium Cynamide

A. Nitrogenous fertilizers

1. Nitrogenous fertilizers take the foremost place among fertilizers since the deficiency of nitrogen in the soil is the foremost and crops respond to nitrogen better than to other nutrients.

2. More than 80 per cent of the fertilizers used in this country are made up of nitrogenous fertilizers, particularly urea.
3. It is extremely efficient in increasing the production of crops and the possibilities of its economic production are unlimited.

The nitrogenous fertilizers can be further classified as given below:

1. Ammoniacal fertilizers

1. Ammoniacal fertilizers contain the nutrient nitrogen in the form of ammonium or ammonia.
2. Ammoniacal fertilizers are readily soluble in water and therefore readily available to crops.
3. Except rice, all crops absorb nitrogen in nitrate form. These fertilizers are resistant to leaching loss, as the ammonium ions get readily absorbed on the colloidal complex of the soil.

a) *Ammonium sulphate* [(NH4)2 S04]

1. It is a white salt completely soluble in water containing 20.6 .per cent of nitrogen and 24.0 per cent of sulphur.
2. It is used advantageously in rice and jute cultivation.
3. It is easy to handle and it stores well under dry conditions. But during rainy season, it sometimes forms lumps.
4. It can be applied before sowing, at the time of sowing or as a top-dressing to the growing crop.

b) *Ammonium chloride* (NH4Cl)

1. It is a white salt contains 26.0 per cent of nitrogen.
2. It is usually not recommended for tomato, tobacco and such other crops as may be injured by chlorine.

c) *Anhydrous ammonia* (NH4)

1. It is a colourless and pungent gas containing 82.0 per cent nitrogen.
2. It is the cheapest and can be applied directly to soil by injection using blade type applicator having tubes.
3. It becomes liquid (anhydrous ammonia) under suitable conditions of temperature and pressure.

2. Nitrate Fertilizers

1. Nitrate fertilizers contain the nitrogen in the form of NO3
2. These ions are easily lost by leaching because of the greater mobility of nitrate ions in the soil.
3. Continuous use of these fertilizers may reduce the soil acidity as these nitrogenous fertilizers are basic in their residual effect on soils.

a) *Sodium nitrate* (NaNO3)

1. Sodium nitrate is a white salt containing about 15.6 per cent of nitrogen.
2. It is completely soluble in water and readily available for the use of plants as such, without any chemical change in the soil.
3. It is easily lost by leaching and denitrification.
4. When large quantities of sodium nitrate are added year after year, the nitrate ions are absorbed by crops and sodium ions accumulate and affect the structure of the soil. Sodium nitrate is also known as *chile salt peter* or *chilean nitrate.*
5. Sodium nitrate is particularly useful for acidic soils

b) *Calcium nitrate* [Ca (NO3)2]

1. It is a white crystalline hygroscopic solid soluble in water containing 15.5 per cent nitrogen and 19.5 per cent calcium.
2. The calcium is useful for maintaining a desirable soil pH.

Calcium nitrate

c) *Potassium nitrate* (KN03)

1. The purified salt contains 13.0 per cent nitrogen and 36.4 per cent potassium.
2. The nitrogen of the potassium nitrate has the same properties and value as that of the sodium nitrate.

3. Ammoniacal and nitrate fertilizers

These fertilizers contain nitrogen in both ammonium and nitrate forms. The nitrates are useful for rapid utilization by crops and the ammonical is gradually available.

a) *Ammonium nitrate* (NH4N03)

1. It is white, water soluble and hygroscopic crystalline salt containing 35 per cent nitrogen half as nitrate nitrogen and half in the ammonium form.
2. In the ammonium form, it cannot be easily leached from the soil.
3. This fertilizer is quick-acting, but highly hygroscopic and not fit for storage.
4. It has an acidulating effect on the soil.
5. It is dangerous in pure form because of explosion hazard.

b) *Calcium ammonium nitrate* (CAN)

1. Calcium ammonium nitrate is a fine free-flowing, light brown or grey granular fertilizer, containing 26 per cent of nitrogen.
2. It is almost neutral and can be safely applied even to acid soils.
3. Half of its total nitrogen is in the ammoniacal form and half is in nitrate form.
4. It is made harmless by adding lime.

Calcium ammonium nitrate

c) *Ammonium sulphate nitrate* [(NH4)2S04 NH4NO3]

1. It contains 26 per cent nitrogen, three fourths of it in the ammoniacal form and the rest (6.5 per cent) as nitrate nitrogen.
2. In addition to nitrogen it contains 12.1percent sulphur.
3. It is a mixture of ammonium nitrate and ammonium sulphate.
4. It is available in a white crystalline form or as dirty-white granules.
5. It is readily soluble in water and is very quick-acting.
6. Its keeping quality is good and it is useful for all crops.
7. Its acid effect on the soils is only one-half of that of ammonium sulphate.
8. It can be applied before sowing, at sowing time or as a top-dressing.

4. Amide fertilizers

1. Amide fertilizers are readily soluble in water and easily decomposable in the soil.
2. The amide form of nitrogen is easily changed to ammoniacal and then to nitrate form in the soil.

a) *Urea* [CO (NH2)2]

1. It is the most concentrated solid nitrogenous fertilizer, containing 46 per cent nitrogen.
2. It is a white crystalline substance readily soluble in water.
3. It absorbs moisture from the atmosphere and has to be kept in moisture proof containers. It is readily converted to ammoniacal and nitrate forms in the soil.
4. The nitrogen in urea is readily fixed in the soil in an ammoniacal form and is not lost in drainage.
5. Urea sprays are readily absorbed by plants.
6. It may be applied at sowing or as, a top-dressing.
7. It is suitable for most crops and can be applied to all soils.

b) *Calcium cyanamide* (CaCN2)

1. Calcium cyanamide or nitrolime contains 20.6 per cent of nitrogen.
2. It is a greyish white powdery material that decomposed in moist soil giving rise to ammonia.

B. Phosphatic fertilizers

1. Phosphatic fertilizers are chemical substances that contain the nutrient phosphorus in absorbable form (Phosphate anions) or that yield after conversion in the soil.

Super phosphate [Ca (H2PO4)2)

1. This is the most important phosphatic fertilizer in use.
2. It contains 16 Per cent P2O5 in available form.
3. It is a grey ash like powder with good keeping or storage qualities.
4. Phosphatic fertilizer hardly moves in the soil and hence they are placed in the, root zone.

Triple super phosphate:

1. The concentrated super phosphate is called as *Triple super phosphate* and it contains 46 per cent P2O5.
2. This fertilizer is suitable for all crops and all soils.
3. In acid soils, it should be used in conjunction with organic manure.
4. It can be applied before or at sowing or transplanting.

C. Potassic fertilizers

1. Potassic fertilizers are chemical substances containing potassium in absorbed form (K+).

2. There are two potassium fertilizers *viz*., muriate of potash (KCI) and sulphate of potash (K2S04).
3. They are water soluble and so are readily available to plants.

a) *Potassium chloride* (KCI)

1. Potassium chloride or muriate of potash is a white or red, crystal containing 60.0 per cent K2O.
2. It is completely soluble in water and therefore readily available to the crops.
3. It is not lost from the soil, as it is absorbed on the colloidal surfaces.
4. It can be applied at sowing or before or after sowing.
5. The chlorine content is about 47.0 per cent.
6. Its chlorine content is objectionable to some crops like tobacco, potato, etc where quality is the consideration.

b) Potassium sulphate (K2S04)

1. Potassium sulphate or sulphate of potash is a white salt and contains *48* per cent K2O.
2. It is soluble in water and therefore readily available to the crop.
3. It does not produce any acidity or alkalinity in the soil.
4. It is prefered for fertilization of crops like tobacco, potato etc., where quality is of prime importance.
5. It is costly because it is made by treating potassium chloride with magnesium sulphate. .

E. Secondary major-nutrient fertilizers

a. Magnesium fertilizers

These are chemical substances containing the nutrient magnesium in the form of magnesium cations (Mg2+).

Magnesium Sulphate (MgSO4)

The utilization rate of magnesium fertilizers decreases w,ith incr,easing potassium supplies.
b. Calcium fertilizers

1. These are the chemical substances containing the nutrient calcium in absorbable calcium cations ('Ca2+) form.
2. The raw material of calcium fertilizers is lime found in nature.

Calcium Chloride (CaCl2 6H2O)

1. It contains at least 15 per cent calcium.
2. It is highly water soluble and can, therefore, be dissolved for application as a foliar nutrient.

c. Sulphate Fertilizers

1. These are chemical substances containing the nutrient sulphur in the form of absorbable sulphate anions (SO_4^{2-}).
2. The sulphur requirements of plants are about two third of their phosphorus requirements.
3. Substantial sulphur supplies occur as minor constituents of various N, P and K fertilizers.
4. Fertilization with sulphur becomes necessary with increasing removal from the soil with rising agricultural production especially in plants with high sulphur requirements. e.g. mustard

D. Micronutrient Fertilizers

1. The importance of fertilization of crops with micro-nutrients is increasing mainly because of greater removal from the soil, intensive liming of soil, intensive drainage of soil, higher use of nitrogenous, phosphatic and potassic fertilizers etc.
2. There are seven essential micronutrients required by plants.

These are iron, manganese, zinc, copper, chlorine, boron and molybdenum.

a. lron fertilizers

1. These are generally water soluble substances, predominantly sprayed as foliar nutrients on the crops.
2. Plants absorb iron in the form of Fe^{2+}.

Commonly used iron fertilizers are as follows.

Ferrous sulphate **($FeSO_4 \cdot 7H_2O$)**	It is a water soluble fertilizer containing 20 % Fe
Fe – Chelates Fe-EDTA Fe-EDDPA	Suitable for application as foliar nutrients

b. Manganese fertilizers

The manganese (Mn) fertilizers are as follows:

Manganous Sulphate ($MnSO_4 \cdot 7H_2O$)	It is the well known water soluble Mn fertilizer. It is pink salt containing 24 % Mn. It dissolves in water and is suitable for foliar application.
Mn – chelates (Mn – DTA)	It contains 13 % Mn. It plays an important role in the crop fertilization.

c. Zinc fertilizers

Zinc (Zn) fertilizers play an important role in Zn deficient areas.

Zinc sulphate	It is water soluble whitish salt containing 23 % Zn.

(ZnSO4 7H2O)	It is applied as foliar nutrient. Its acidic action causes corrosion damage to plants
Zinc-oxide(ZnO)	It contains 70 % Zn. It is slightly soluble in water It is used as slow acting foliar nutrient

d. Copper Fertilizers

Copper fertilizers have been used to correct copper (Cu), deficiencies.
Copper sulphate (CuSO4 5H2O) – 25 % Cu
Copper sulphate (CuSO4 H2O) – 36 % Cu

e. Boron Fertilizers

Borax (Na2B4O 10H2O)	It contains 11 % B It is water soluble white salt It can be applied as a soil dressing or foliar application
Boric acid (H3BO3)	It contains 18 % B It is a white crystalline powder It is applied as a foliar nutrient

f. Molybdenum Fertilizers

Sodium molybdate (Na2MoO42H2O)	It contains 40 % Mo
Ammonium molybdate (NH4)6Mo7O244H2O)	It contains 54 % Mo

1. These are water soluble salts which contain Mo
2. They are suitable for soil application and foliar application as wel

Fertiliser Grade

1. Fertiliser grade refers to the guaranteed minimum percentage of nitrogen (N), phosphorus (P) and potash (K) contained in fertiliser material.
2. The numbers representing the grade are separated by hyphens and are always stated in the sequence of N, P, and

For example, label on the fertilizer bag with a grade 28-28-0 indicates that 100 kg of fertiliser material contains 28 kg of N, 28 kg of *P* and no potash.

1. Different grades of fertilisers are available in India.

Some of them are:
28-28-0
20-20-0
14-35-14

17-17-17
14-28-14 etc.

FERTILIZER RATIO

It refers to the ratio of the percentage of N, *P2O5* and K2O in the fertilizer mixture e.g., the fertilizer grade 12-6-6 has a fertilizer ratio of 2:1:1.

SUPPLIERS OF PLANT NUTRIENTS

These are straight fertilizers added to supply the plant nutrient mentioned in the grade.

CONDITIONERS

These are low grade organic materials like peat soil, paddy husk, groundnut hulls etc., which are added to fertilizer mixtures during their preparation for reducing hygroscopicity and to improve their physical condition.

Peat soil

Paddy husk

FILLER

A filler is a weight make material like sand, soil, coal powder etc, added to the fertilizer ingredients so as to produce a mixture of the desired grade.

Coal powder

Sand

NEUTRALIZERS OF RESIDUAL ACIDITY

These are the materials like dolomite, lime stone etc, added in fertilizer mixtures to counteract the acidity of nitrogenous fertilizers.

EX:NO:05
DATE:

Water management and irrigation scheduling

AIM:

To know about irrigation management and necessity of irrigation.

PROCEDURE:

Necessity of Irrigation

1)Uncertainty of monsoon rainfall:

80% of rainfall in India is received during monsoon period. Monsoon rainfall is very uncertain. So irrigation is very important to supply water to plants also and when needed.

2)Uneven distribution of rainfall:

To compensate the uneven distribution in an area, supplemental irrigation is needed.

3)Effect of winter rainfall (N India)/ Effect of SWM in S. India:

Supplemental irrigation is inevitable in the regions due to poor rainfall.

4)Cultivation of high yielding crops:

High yielding crops produce heavy biomass and economic yield. Higher biomass need more water for its production. Hence supplementation of water as irrigation is essential.

5)Difference in water holding capacity of the soil:

Sandy soil - low WHC – frequent irrigation. Clay soil - high WHC - frequency is less.

Role of water for growth and development of crops:

- Water is a constituent of protoplasm
- Water acts as a solvent. Plants can absorb nutrients when these nutrients are dissolved in water
- Water is used for transpiration carrier of nutrients from the soil to green plant tissues.
- They are used for photosynthesis and the end product is also conveyed through water to various plant parts
- Water forms over 90% of the plant body by green or fresh weight basis.
- Plants can synthesis food through photosynthesis only in the presence of water in their system.
- Water helps to maintain the turgidity of cell walls. Water helps in cell enlargement due to turgor pressure and cell division which ultimately increase the growth of plant.
- Water is essential for the germination of seeds, growth of plant roots, and nutrition and multiplication of soil organism.
- Water is essential in hydraulic process in the plant. It helps in the conversion of starch to sugar.
- Water helps in the transpiration, which is very essential for maintaining the absorption of nutrient from the soil.
- Water regulates the temperature and cools the plant.
- Water helps in the chemical, physical and biological reaction in soil.

So, water is applied externally, if availability seems limited through soil, not sufficient to meet the requirement due to drought or excess losses. We call the external application of water to the soil to supplement the requirement as `**Irrigation**'.

In Tamil Nadu the percentage ranges from as low of 0.1% in Nilgris to a high of 88% in Thanjavur district. Arcot districts and Kanchipuram register 50 to 78%. Dharmapuri (19%), Salem (23%) and Dindigul (29%) are the districts which need greater effort to increase the irrigated area.

Development of irrigation in India:

- Irrigation has been practiced in India and other Asian countries from early times. Of course civilization started through irrigation systems. All these early civilization are in South and South West Asia. In Tamil Nadu the early Chola kingdom is reported with well developed technologies for irrigation management. The check dam at Kallanai to regulate the river for irrigation is a typical example.

Water Requirements of Agricultural Crops in Surface Irrigation Methods

(5cm depth at each irrigation)

Crop	Duration	Total Water Requirement (mm)
Rice	110	1250
Sugarcane	360	2200
Groundnut	105	510
Sorghum	105	500
Maize	100	500
Ragi	95	310
Cotton	165	600
Blackgram	65	280
Soybean	85	320
Sesame	85	150
Sunflower	110	450

Critical Stages for Irrigation:

Crops	Critical Stages
Rice	Initial tillering, flowering
Wheat	Most critical stage: Crown root initiation, tillering, jointing,. booting, flowering, milk and dough stages
Wheat	Boot stage, dough stage
Pulses	Flowering and podding.
Peas	Pre bloom stage.
Berseem	After each cutting.
Gram	Pre flowering and flowering.
Pigeonpea	Flower initiation, pod filling.
Sorghum	Initial seedling, pre flowering, flowering, grain formation.
Barley	Boot stage, dough stage
Maize	Early vegetative, taselling and silking stage.

EX:NO:06
DATE:

Weeds, identification of major weed type, demonstration on simple weeding implements. Herbicide uses and caution.

AIM:

To know about integrated weed management .

PROCEDURE:

ABOUT WEED

Weeds are unwanted and undesirable plants which interfere with the utilization of land and water resources and thus adversely affect human welfare. They can also be referred as plants out of place.

Weeds compete with the beneficial and desired vegetation in crop lands, forests, aquatic systems etc. and poses great problem in non-cropped areas like industrial sites, road/rail lines, air fields, landscape plantings, water tanks and water ways etc.,

Weeds are an important factor in the management of all land and water resources, but its effect is greatest on agriculture. The losses caused by weeds exceed the losses caused by any other category of agricultural pests. Of the total annual loss in agriculture produce, weeds account for 45%, insect 30%, disease 20% and other pests 5%.

Integrated weed management

RICE

Critical period of weed control	20-30 DAT
Cultural method	1) Hand weeding 2) Hand pulling 3) Pudding 4) Flooding
Mechanical method	1) Weeder (Float) 2.Conoweeder/Rotary weeder
Chemical method	Apply pendimethalin 1.0kg/ha on 5 days after sowing or Pretilachlor + safener (Sofit) 0.45kg/ha on the day of receipt of soaking rain followed by one hand weeding on 30 to 35 days after sowing.
Biological method	1. *Hirsch – Manniella spinicaudata* is a rice root nematode which controls most upland rice weeds 2. *Azolla*
Remarks	**I. Substitution and preventive method:** a) Stale seed bed technology b) Land preparation c) Water management

WHEAT

Critical period of weed control	15 – 30 DAS
Cultural method	a) Hand Hoeing b) Inter cultivation c) Criss-cross sowing
Chemical method	1. 2, 4D (1 – 1.5 kg ai/ha) 2. Mixture of Isoproturan (0.75 kg ai/ha) and 2, 4D (0.4 kg ai/ha) during 30- 35 DAS
Remarks	II. Complimentary weed control methods a) Cultivars b) Seedling age /planting method c) Fertilizer management d) Cropping system

SORGHUM

Critical period of weed control	21 – 42 DAS
Cultural method	1. Hoe and hand weed on the 10th day of transplanting if herbicides are not used. 2. Hoe and weed between 30 - 35 days after transplanting and between 35 - 40 days for a direct sown crop
Chemical method	1. Apply the pre-emergence herbicide Atrazine 50 WP - 500 g/ha on 3 days after sowing as spray on the soil surface 2. If pulse crop is to be raised as an inter-crop in sorghum do not use Atrazine.
Remarks	1. Inclusion of cotton crop in the rotation

MAIZE

Critical period of weed control	Maize 2 to 6 Weeks
Cultural method	One hand weeding on 40-45 days after sowing
Chemical method	1. Pre-emergence application of Atrazine (1-2 kg ai/ha) 2. Combined application of Alachlor (2 kg/ha) and atrazine (1kg/ha) is more effective and have wider spectrum of control

GROUNDNUT

Critical period of weed control	Upto 45 days
Cultural method	After 35 - 40 days one hand weeding may be given.

Chemical method	1. Alachlor (1-5 kg/ha) – pre emergence application

SUNFLOWER

Critical period of weed control	4-6 weeks
Cultural method	Hoe and hand weed on the 15th and 30th day of sowing and remove the weeds. Allow the weeds to dry for 2 - 3 days in the case of irrigated and then give irrigation.
Chemical method	1. Apply Fluchloralin at 2.0 l/ha before sowing and incorporate or apply as pre-emergence spray on 5 day after sowing followed by irrigation or apply Pendimethalin as pre-emergence spray 3 days after sowing.

COTTON

Critical period of weed control	First 45 days
Cultural method	1. One hand weeding on 45 DAS will keep weed free environment upto 60 DAS 2. Hoe and hand weed between 18th to 20th day of sowing, if herbicide is not applied at the time of sowing
Chemical method	1. Diuron (0.5 – 1.5 kg/ha), Monuron (1-1.5 kg/ha), Fluchloralin (1-1.5 kg/ha) applied as preemergence/ preplanting

PULSES

Critical period of weed control	First 30-35 days
Cultural method	1. One hand weeding on 30 days after sowing gives weed free environment throughout the crop period 2. If herbicides are not applied give two hand weedings on 15 and 30 days after sowing.
Chemical method	1. Fluchloralin (1-1.5 kg/ha), Pendimethalin (0.5-1.0 kg/ha) as Pre emergence (preplanting incorporation)

TOBACCO

Critical period of weed control	First 9 weeks
Chemical method	1. Fluchloralin (2-3 kg/ha), Pendemethalin (1-1.5 kg/ha) as pre-emergence application

SUGARCANE

Critical period of weed control	4 to 5 months
Cultural method	Remove the weeds along the furrows with hand hoe.
Mechanical method	If herbicide is not applied work the junior-hoe along the ridges on 25, 55 and 85 days after planting for removal of weeds and proper stirring
Chemical method	1. Pre-emergence herbicides like atrazine (2 to 3 kg/ha) Simazine (2 to 3 kg/ha), Alachlor (1.3 to 2.5 kg/ha) etc., will generally last for 8 to 12 weeks 2. To obtain best results sequential application of Preemergence and post emergence herbicides or post emergence herbicides like Glyphosate (0.8 to 1.6 kg/ha) Paraquat (0.4 to 0.8 kg/ha).

EX:NO:07
DATE:

Pest identification and control, demonstration of IPM methods

INTEGRATED PEST MANAGEMENT:

"IPM is a sustainable approach to managing pests by combining biological, cultural, physical and chemical tools in a way that minimizes economic, health, and environmental risks."

AIMS OF IPM:

- Reduce the use of synthetic organic pesticides
- That are environmentally sound
- Pest minimal risk of human health
- Re-useable return on investment
- Provide consumable safe food.

PRINCIPLES OF IPM:

- Identification of key pests and beneficial organisms
- Defining the management unit, the Agro-ecosystem
- Development of management strategy
- Establishment of Economic thresholds (loss & risks)
- Development of assessment techniques
- Evolving description of predictive pest models

TOOLS OF IPM:

Monitoring: Keep tracks of the pests and their potential damage. This provides knowledge about the current pests and crop situation and is helpful in selecting the best possible combinations of the pest management methods.

Pest resistant varieties: Breeding for pest resistance is a continuous process. These are bred and selected when available in order to protect against key pests.

Cultural pest control: It includes crop production practices that make crop environment less susceptible to pests. Crop rotation, cover crop, row and plant spacing, planting and harvesting dates, destruction of old crop debris are a few examples. Cultural controls are based on pest biology and development.

Mechanical control: These are based on the knowledge of pest behaviour. Hand picking, installation of bird perches, mulching and installation of traps are a few examples.

Biological control: These include augmentation and conservation of natural enemies of pests such as insect predators, parasitoids, pathogen and weed feeders. In IPM programes, native natural enemy populations are conserved and non-native agents are released with utmost caution.

Chemical control: Pesticides are used to keep the pest population below

economically damaging levels when the pests cannot be controlled by other means. It is applied only when the pest's damaging capacity is nearing to the threshold.

Crop protection :: IPM :: Components

The major components of IPM in increasing order of complexity are as under:

1. Cultural practices.
2. Mechanical practices
3. Regulatory practices
4. Biological practices
5. Chemical practices.

Cultural practices

- Cultural methods of pest control consists of regular farm operations in such a way which either destroy the pests or prevent them from causing economic loss. The various cultural practices have been grouped as under.
- Preparation of nurseries or main fields free from pest infestation by removing plant debris, trimming of bunds, treating of soil and deep summer ploughing which kills various stages of pests. Proper drainage system in field be adopted.
- Testing of soil for nutrients deficiencies on the basis of which fertilizers should be applied.
- Selection of clean and certified seeds and treating seeds with fungicide or biopesticides before sowing for seed borne disease control.
- Selection of seeds of relatively pest resistant/tolerant varieties which play a significant role in pest suppression.
- Adjustment of time of sowing and harvesting to escape peak season of pest attack.
- Rotation of crops with non-host crops. It helps in reduction of incidence of soil borne diseases.
- Proper plant spacing which makes plants more healthy and less susceptible to pests.
- Optimum use of fertilizer. Use of FYM and biofertilizers should be encouraged.
- Proper water management (alternate wetting and drying to avoid water stagnation) as the high moisture in soil for prolonged period is conducive for development of pests especially soil borne diseases.
- Proper weed management. It is well known fact that most of weeds besides competing with crop for micronutrients also harbour many pests.
- Setting up yellow pan sticky traps for white flies and aphids at far above canopy height.
- Synchronized sowing. Here community approach is required to sow the crops simultaneously in vast area so that pest may not get different staged crops suitable for its population build up and if pest appears in damaging proportion, control operation could be applied effectively in whole area.
- Growing trap crops on the borders or peripheries of fields. There are certain crops which are preferred more by a pest species are known as trap crops for that pest. By growing such crops on the border of the fields, pest population develop there which can be either killed by using pesticides or its natural enemies are allowed to develop there for natural control.
- Root dip or seedling treatment in pest infested area.

- Inter-cropping or multiple cropping wherever possible. All the crops are not preferred by each pest species and certain crops act as repellents, thus keeping the pest species away from preferred crops resulting in reduction of pest incidence.
- Harvesting as close as to ground level. This is because certain developmental stages of insect pests/diseases remain on the plant parts which act as primary inoculum for the next crop season. Hence, harvesting crops at ground level will lessen the incidence of pests in next season.
- Before planting, nursery plants be sprayed/dipped in copper fungicide/biopesticide solutions to protect the plants from soil borne diseases.
- While pruning fruit trees, remove crowded/dead/broken/diseased branches and destroy them. Do not pile them in the orchards which may act as source of pest infestation.
- Large pruning wounds should be covered with Bordeaux paste/paint to protect the plants from pest/disease attack.
- For excellent fruit set, pollinizer cultivars should be planted in required proportion in the orchards.
- Keeping bee hives or placing flower bouquets of pollinizer cultivars facilitate better pollination and subsequent fruit set.

Regulatory practices:

In this process, regulatory rules framed by Govt. are brought into force under which seeds and infested plant materials are not allowed to enter the country or from one part to other parts of the country. These are known as quarantine methods and are of two types i.e. domestic and foreign quarantine.

Mechanical practices:

- Removal and destruction of egg masses, larvae, pupae and adults of insect pests and diseased parts of plants wherever possible.
- Installation of bamboo cage cum bird perchers in the field and placing parasitized egg masses inside them for conservation of natural enemies and withholding of pest species wherever possible.
- Use of light traps and destruction of trapped insects.
- Use of rope for dislodging leaf feeding larvae e.g. caseworm and leaf folders.
- Installation of bird scarer in the field where required.
- Installation of bird perchers in the field for allowing birds to sit and feed on insects and their immature stages viz., eggs, larvae and pupae.
- Use of pheromones for mating disruption and kill zone creation.
- Use of pheromone traps for monitoring and suppression of pest population.
- Use of pheromone traps for mass traping.

Genetical practices:

- Selection of high yeilding varieties for different crops.
- Selection of comparatively pest resistant/tolerant varieties
- Use of genetically modified seeds e.g. B.t. cotton
- Release of sterile males of insects in sufficient number in field to compete with fertile males. Sterility in males is induced in laboratory either through chemosterilants or through radiation.

Biological practices:

Biological control of insect pests and diseases through biological means is most important component of IPM. In broader sense, biocontrol is use of living organisms to control unwanted living organisms (pests). In other words, deliberate use of parasitoids, predators and pathogens to maintain pest population at level blow those causing economic loss either by introducing a new bioagent into the environment of pest or by increasing effectiveness of those already preset in the field.

Parasitoids: These are the organisms which lay eggs in or on the bodies of their hosts and complete their life cycles on host bodies as a result of which hosts die. A parasitoid may be of different type depending on the host developmental stage in or on which it completes its life cycle. For example, egg, larval, pupal, adult, egg-larval and larval pupal parasitoids. Example are different species of Trichogramma, Apanteles, Bracon, Chelonus, Brachemeria, Pseudogonotopus etc.

Predators: These are free living organisms which prey upon other organisms for their food. Examples are different species of spiders, dragon flies, damsel flies, lady bird beetles, Chrysopa species, birds etc.

Pathogens: These are micro-organisims which infest and cause diseases in their hosts as a result of which hosts are killed. Major groups of pathogens are fungi, viruses and bacteria. Some nematodes also cause diseases in some insect pests. Important examples of fungi are different species of Hirsutella, Beauveria, Nomurae and Metarhizium which have been reported to infest and kill large number of insects (upto 90%) in the fields. Among viruses, most important examples are of nuclear polyhedrosis virus (NPV) and granulosis viruses. Outbreak of viruses in armyworms, cut worms, leaf folders, hairy caterpillars and plant hoppers have been reported many times. Among bacteria, Bacillus thuringiensis (B.t.) and B. popillae are very common examples.

Biocontrol Practices

Diseases of pests can be mass multiplied in the laboratory at a low cost in liquid or powdered formulations that can be sprayed like ordinary chemical pesticides. These formulations are known as biopesticides. The different types of biocontrol practices are grouped as under:

a. **Introduction**

In this process, a new species of bioagent is introduced into a locality for its establishment against its host. This is done only after thorough laboratory examination and field trials for its efficacy.

b. **Augmentation**

In this process, the population of natural enemies already present in the area is increased by releasing either laboratory reared or field collected bioagents of same species in such number as would require to suppress the pest population in that area.

c. **Conservation**

This is most important component of biological control and plays a major role in pest suppression. In this process, natural enemies present in the nature are protected from being killed. The different practices required to protect the natural enemies are as below.

- Collection of parasitised egg masses and placing them in bamboo cage-cum-bird perchers for allowing emergence of parasitoids and withholding of pest larvae.

- Educating farmers through field days, radios & TV to differentiate pests and defenders and sparing the defenders during field sprays.
- Chemical spray should be adopted as last resort and that too after observing pest defender ratio and economic threshold level (ETL).
- Use of broad spectrum pesticides should be avoided.
- Only selective and relatively environmental friendly (REF) pesticides should be used where necessary.
- As far as possible strip or spot application of pesticides be carried out.
- Adjustment of time of sowing and harvesting to avoid the peak season of pest attack.
- Growing trap crop on the borders of main fields before the actual sowing of crop to trap pest and develop natural enemies.
- Root dip/seedling treatment for gall midge prone area.
- Crop rotation and inter-cropping also help in conservation of defenders.
- Recommended dose and concentration of pesticides should be used.

Chemical practices

Use of chemical pesticides is the last resort when all other methods fail to keep the pest population below economic loss. Although there is a great advancement in pest management research, yet pesticides would continue to play an important role in crop protection in view of complexity of pest problems. Therefore, use of pesticides should be need based, judicious, based on pest surveillance and economic threshold level (ETL) to minimise not only the cost involved, but also to reduce associated problems. While going for chemical control, we must understand thoroughly what to spray, when to spray, where to spray and how to spray, keeping in mind the following points.

- ETL and pest defender ratio must be observed
- Relatively safer pesticides should be selected e.g. neem based and biopesticides.
- If pest is present in strips or isolated patches, whole field should net be sprayed.

Relevance of IPM practices are more important in vegetable and fruit crops because of their unique mode of consumption by human being. Pesticides which are generally highly toxic and are known to have toxic residual effects could not be recommended off hand. To get more profit, farmers do not wait until waiting periods of pesticides and harvest the crop to market the same. This leads to pesticides poisoning, chronic effects, in some cases even deaths. Thus, we have to be more careful and cautious in applying pest control practices in field crops.

EX:NO:09
DATE:

GREEN MANURES

AIM:

To know about the green manures and green leaf manuring.

PROCEDURE:

Green manuring & Green leaf manuring :

- Green manuring:
  - Growing of crop purposely and incorporating it in the soil for manuring.
- Green leaf manuring:
  - Collecting green leaves from all available sources and using for manuring.

Importance of green manuring

1. Leguminous green manure fix atmospheric nitrogen
   - Green leaf additions 20-40 kg N
   - Root fixes 5-20kg
   - There is saving in the N budget
2. They decompose easily without leaving much residue
   - Cattle manure leaves more humus than GM
3. Leguminous green manure fix atmospheric nitrogen
   - Green leaf additions 20-40 kg N
   - Root fixes 5-20kg
   - They There is saving in the N budget
4. decompose easily without leaving much residue
   - Cattle manure leaves more humus than GM
5. GM withdraws plant nutrients from lower layers and leaves on surface
6. Subsidiary objectives of GM are:
   - They are 'catch crop' to the nutrients being lost before next crop
   - Shade crop: to provide shade in young orchards besides adding N
   - Cover crop: Clothing the soil with vegetative cover in hill slopes during rainy season.
     1. Also to check wind erosion
   - Forage crop: few cuttings as fodder and then as GM
     1. Pillipesara (Phaseolus trilobus) is broadcast in standing rice.

Green manuring possibilities:

- Rainfed dry lands
  - Only hardy crops
  - Or where there is high rainfall
- Irrigated dry lands
  - It has to be fitted between two main crops
  - GM crop should be quick growing and producing heavy foliage in short period
  - It should be leguminous crop
  - Capable of raising with little cost
- Wetlands
  - In between two rice if the period available is 40-60days

- After the rice but sown as rice fallow / self sown Tephrosia purpurea
- Before rice if rain is there under prepared field.

Green manure suitable for S. India

Daincha - Sesbania aculeata

- Tolerant to drought, stands under flood
- Vigorous growth produces good biomass
- Can be incorporated within 45 days
- 10-20 t of green matter
- Easy decomposition
- Seed rate 20 kg

Sesbania speciosa

- Resembles daincha
- Can be cultivated in the standing water
- Biomass production is higher than S. aculeata
- Seed rate 15 kg
- It can be even in the bunds
  - To be used as GLM
  - To have seed production

Sesbania rostrata

- As intercrop along rice
- As daincha it can be cultivated
- Germination requires seed scarification
- More suitable to summer
- Stem nodulating GM
- Seed rate 15-20 kg

Kolunchi / wild indigo (Tephrosia purpurea)

- Suitable for sandy soil
- It is very hardy and drought tolerant
- Self sown crop is possible if sown 3-4 times
- Mature seeds remain dormant in the rice soil
- More suitable for single cropped wetlands
- Not graced by cattle
- Seed scarification is needed
- Seed rate 15-20 kg

Indigo / Avuri (Indigifera tinctoria)

- It is long duration crop resembles kolunchi
- It is more leafy
- Also a medicinal plant of today
- Comes up well in clayey soil
- One or two irrigations are needed
- Seed rate 15 kg

Sunnhemp - Crotalaria juncea

- Vigorous growing
- Comes well in loamy soil under irrigation
- Seed rate 25-35 kg /ha
- Subject to complete defoliation by insects
- Susceptible to water logging

Pillipesara -Vigna trilobata (Syn: Phaseolus trilobus)

- It is pulse crop
- Sown as rice fallow pulses in AP

- Early slow growth
- Graced by animals and then allowed to grow
- Green matter produced is 8 – 10t if allowed for six weeks
- Seed rate 10-15 kg

Sowing of Green manure crops

Done by different ways:

- Broadcasting on standing crops (rice)
- Broadcasting after field preparation
- Drum seeding in rice inter rows

Seeds to be scarified, if hardy like Kolunchi or S. rostrata

- o Hot water treatment
- o Mixed with sand and pounding to abrade the seeds for germination

Green leaf manure - GLM

Leguminous trees

- Pungam
- Cassia
- Subabul
- Gliricidia
- Trees & shrubs
- Neem
- Calotropis
- Ipomoea
- Pungam - Pongamia glabra

Evergreen trees

- Can be grown in all the places
- Drought tolerant
- Seeds oil producing
- Medicinal value

Konnai – Cassia spp

- Establishes in all places
- Drought tolerant

Subabol - Luecaena leucocephala

- Forage cum GLM
- Live fencing
- Leguminous tree
- Bund, border, and waste lands

Gliricidia maculata

- Tree
- Bund and border crop
- Allay cropping

Gliricidia maculata

- Tree
- Bund and border crop
- Allay cropping

Kattamani -Ipomoea spp.

- Many spp
- Water loving
- Shrub

• Spread through water
• Propagation – plant material, seeds

Erukku - Calotropis gigantea

• Wasteland weeds
• Water loving
• Spread through canal bunds
• Seeds - source of propagation

Green manure N content:

Green manure	N content (%)	N accumulation (kg/ha)
Crotolaria juncea	2.8 – 3.2	80 – 130
Sesbania aculeata	2.6 – 3.2	130 – 185
S. rostrata	3.2 – 3.4	170 – 220
S. speciosa	2.3 – 3.1	115 – 160
Phaseolus trilobus	2.2 – 2.8	85 – 115
Tephrosia purpurea	2.9 – 3.2	70 - 115

Green leaf manure – N Content

Tree	Botanical name	N (%)
Pungam	*Pongania glabra*	1.3 – 1.5
Neem	*Azardirachta indica*	1.0 – 1.2
Konnai	*Cassia florida*	1.4 – 1.6
Glyricidia	*Gliricidia maculata*	2.3 – 2.8
Vahai	*Albizzia lebbek*	1.1 – 1.4
Erukku	*Calotropis gigantea*	1.4 – 1.5
Subabul	*Leucaena lucocephala*	3.5 – 3.7

Green manuring GM & GLM

- GM – part of cropping, requires all inputs
  - GLM – it is an input, saves land and time
- GM – fixes nutrients and alters the position
  - GLM – adds as external
- GM – not possible to all the crops
  - GLM – possible to all the crops.

EX:No:09
DATE:

Harvesting Methods For Various Field And Horticultural Crops And Implements Used HARVESTING

AIM:

To harvest the matured crop and know about the criteria for harvesting of crops.

PROCEDURE:

HARVESTING:

Harvesting is the process of removal of entire plants or economic parts after maturity. The economic product may be grain, seed leaf, root or entire plant. The remaining portion of the stem that is left on the field after harvest is known as stubble.

CRITERIA FOR HARVESTING OF CROPS:

Crops	Maturity Symptoms and Criteria for harvesting
Rice	1. 32 days after flowering 2. Green grains not more than four to nine per cent 3. Percentage of milky grains less than one per cent 4. Moisture content of grains less than 20 per cent 5. 80 per cent panicles straw coloured and grains in lower portion of panicle in hard dough stage. At least five hills are to be studied at maturity
Sorghum	1. 40 days after flowering 2. Grain moisture content less than 28 per cent 3. Yellow coloured ears with hard grains
Pearl Millet	28 to 35 days after flowering Compact ears, on pressing hard seeds come out
Finger millet	Brown coloured ears with hard grains
Maize	1. Less than 22 to 25 per cent moisture in grain 2. Husk colour turns pale brown 3. 25 to 30 days after tasseling
Wheat	About 15 per cent moisture in grain Grains in hard dough stage Yellowing of spikelets
Sugarcane	1. The ratio of brix between top and botton part of cane nearly one 2. Brix 18 to 20 per cent 3. Sucrose 15 per cent
Redgram	1. 35 – 40 days after flowering 2. 80 – 85 per cent of pods turn brown
Blackgram Greengram	Pods turn brown or black with hard seeds inside pods
Groundnut	1. Pods turn dark from light colour. 2. Dark coloured patches inside the shell. 3. Kernels red or pink 4. On pressing the kernels, oil is observed on fingers
Cotton	Bolls fully opened
Sugarcane	Leaves turn yellow, sucrose content more than 10 per cent and brix reading more than 18 per cent

MOISTURE CONTENT OF GRAINS FOR SAFE STORAGE:

Crops	Moisture Content (%)
Paddy, raw rice	14
Parboiled rice	15
Wheat, barley, maize, sorghum, pearlmillet, finger millet and pulses	12
Groundnut pods, rape and mustard	6