MAHARASHTRA AGRICULTURAL UNIVERSITY EXAMINATION BOARD, PUNE
SEMESTER END THEORY EXAMINATION
B.Sc (Hons) Agriculture

Semester :- I (New) Term:- First Academic Year :- 2024-25

Course No. :- AGRO-111 Title :- Fundamentals of Agronomy
Credits :- 3(2+1)
Day & Date :- Time(hrs):- 3 Total Marks:- 80

Note :
1) Solve ANY EIGHT questions from **SECTION 'A'**
2) All questions from **SECTION 'B'** are compulsory.
3) All questions carry equal marks.
4) Draw neat diagrams wherever necessary

SECTION –A

Q.1 A) Define the term Agronomy and describe in short the scope of agronomy. 1 4

Ans **Agronomy:** - Agronomy is a branch of agricultural science which deals with the principles and practices of soil, water and crop management.

In recent times, agronomy has achieved newer dimension and can be defined as a branch of agricultural science that deals with methods which provide favorable environment for plant growth.

Scope of Agronomy:-

Agronomy is a dynamic discipline. It has wide scope. Field of agronomy is very vast. It includes the art of soil management, crop production, and proper methods of tillage, suitable period for cultivation, right time of sowing, and proper methods of sowing i.e. crop management practices and maintaining farm implements and machineries in proper shape and managing the crops in efficient manner for obtaining maximum yield.

Beside this agronomy is also concerned with the management of livestock including their feeding, management and disposal of farm animal product like milk and eggs as well as proper maintenance of farm accounts. Agronomy also involves the scientific study of behavior of plant under different conditions like varying soils and climates, irrigation, fertilizers etc. by conducting the experiments in the field, pots and laboratories, it also involves the application of research outcome into develop suitable package of practices for particular crops under given set of soil and climatic conditions.

Agricultural practices are modified into new practices for higher productivity. For example there are number of agricultural inputs fertilizer, water, herbicides, seed and their utilization for higher productivity depends on their systematic use.

Fertilizer is a major input and their application necessary to crop that includes knowledge of method of application, time of application, quantity of application and form of application of fertilizer is very much essential.

Likewise the herbicide use to control weeds which is harmful to crop. The correct use of herbicide depends on their knowledge. The knowledge of selectivity of Herbicide is very important aspect in application methodology. Time of application and method of application of herbicides decides the crop yield and their effective use.

Water Management is one of the aspect of agronomy, Irrigation project (dams) are advantageous for multiple cropping but because of excess use of irrigation their other side effect like water logging and salinity create a problem for crop production, to overcome these problems appropriate water management practices are developed .

Population pressure increases but area under cultivation is static therefore it is necessary to grow more number of crops on the same piece of land. Multiple cropping/Intensive cropping concepts come in existence. Cost of tillage/energy increase. New technology developed to overcome the effect of moisture stress under dry land conditions. Under these condition new varieties of crop with high yield potential become available Package of practices has to be developed to exploit their full potential. Therefore there is more scope for soil, water and plant management to satisfy the need food grain production.

B) Classify crops on the basis of agronomic use with suitable example. 2 4

Ans Classification on the basis of use :

1)Cereal or grain crop – wheat, rice, jowar.
2)Legume or pulse crop – red gram, green gram, black gram, peas.
3)Fodder crop –e.g. fodder jowar, fodder maize.
4)Root crop – sugarbeet, carrot, turnip, sweet potato.
5)Tuber crop –is a short thickened underground stem e.g. potato.
6)Fibre crop – cotton, hemp, jute, ramie.
7)Sugar crop – sugarcane, sugarbeet.
8)Oil crop – groundnut, sesamum, safflower, mustard, linseed.
9)Drug crop – tobacco, pyrethrum, poppy.
10)Spice crop – chilli, turmeric, garlic.
11)Vegetable crop – brinjal, tomato, leafy vegetables.
12)Green manure crop – sunhemp, dhaincha, cowpea.

Q.2 A) Define the term seed and give the characteristic of good seed. 5-7 4

Ans **Seed-** Fertilized overy is known as seed having capacity to germinate or seed it also refers to the fertilized, matured ovule that contains an embryonic plant, stored material and a protective coat or coats.

Good seeds have the following characteristics:

Purity: Good seeds are pure and true to the chosen variety.
Germination: Good seeds have a high germination rate, usually over 80%.
Size and shape: Good seeds are uniform in size and shape, and are the correct color for the variety.
Vigor: Good seeds are vigorous and have high physiological stamina.
Freedom from pests and disease: Good seeds are free from pests, insects, pathogens, and seed-borne diseases.
Moisture content: Good seeds have the right moisture content for storage.
Longevity: Good seeds have a long shelf life.
Labeling: Good seeds are properly labeled.
Adaptability: Good seeds can adapt to a wide range of environmental conditions, such as temperature, humidity, rainfall, and sunlight.
Disease resistance: Good seeds can fight disease-causing agents.
High yield: Good seeds ensure a high yield

Care should be taken to place seed in moist zone. While covering seed moist soil should be placed first and then dry soil. At each place two or three seeds are dibbled and then after germination thinning is done to keep desired number of seedlings. Hand dibbling is also done by dropping the seed in plough furrow.

Advantages:

i) Seed required is less than broadcasting and drilling method.
ii) Plant to plant as well as row-to-row distance is properly maintained
iii) Crosswise intercultural operations can be carried out easily with mechanical means.
iv) Seed is placed at desirable depth and hence germination is uniform.
v) No implement is required for sowing.
vi) Intercropping is possible in case of wide spaced crops.

Disadvantages:

i) This is time consuming method and requires more labour hence it is costly in terms of labour requirement.
ii) It requires strict supervision.
iii) It is followed for limited crops, when seed material is costly or seed size is bold.

Transplanting:

Small seeded crops like rice, tobacco, chilies, tomato, etc are to sown shallow and need frequent irrigation for proper germination. Seedlings of some crops require extra care for establishing in the field because of their tenderness. Taking care of germinating seed or seedling on large area is problem with regards to application of water, weed control, pest control, etc. Therefore, seeds are sown in a small area called nursery and seedlings are grown with all necessary care. When the seedling attains certain stage, they are uprooted or pulled out from the nursery and replanted in the prepared main field. This method is known as transplanting. For good results, the seedlings are transplanted at optimum age and at proper depth. The thumb rule for the optimum age of seedling is one week for every month of total duration of the crop.

Advantages

i) Transplanting saves irrigation water.
ii) It gives good stand establishment and increase in intensity of cropping.
iii) Seed required is less than broadcasting and drilling method.
iv) Plant to plant as well as row-to-row distance is properly maintained.
v) No implement is required for sowing.
vi) Intercropping is possible in case of widely spaced crops.

Disadvantage:

i) It is comparatively costly method and requires more labour.
ii) It requires strict supervision.
iii) It is followed for limited crops, when seed material is costly.

Planting:

It is the placing of vegetative part of crops in the soil like tuber of potato, mother sets of turmeric and ginger, sets of sugarcane, cuttings of grape vine.

Advantages:

1) Depth of planting can be easily maintained.
2) Row to row, as well as plant-to-plant distance is easily maintained.
3) Intercultural operation can be easily carried out with mechanical method.
4) Plant population can be adjusted.

Disadvantages:

1) It is comparatively costly method, as it requires more labour.
2) Skilled person is required to carryout sowing operation.

Putting the seeds in plough furrow:

This method is followed for crops like field bean or gram in some areas for

better utilization of residual soil moisture in which seeds is dropped behind the plough in furrow with the help of manual labour and is covered by successive turn of ploughing.

Advantages:

1) Useful under certain situation to drop the seed to proper layer in moist zone
2) Row to row distance can be maintained.

Disadvantage:

1. Suitable under certain situation only
2. Costly method as it requires more labour.

Sowing implements:

1) Plough: The seeds are dropped by hand in the furrow formed by the country plough. But dropping of seed is at uneven depth and also at uneven distance between plants.

2) Seed drill:

I) Mogha or akkadi : It consists of a funnel shaped structure (seed hopper) fixed on a bamboo tube (seed tube) through which seed is passed into the furrow opened by a plough or harrow. A tyne made up of wooden piece or horn, tapered to one end is tied on another end of the seed tube, which helps in placing seed at required depth i.e. at moist zone. All these parts are collectively tied with a rope and worked behind the plough or common blade harrow. It is also used to drill the fertilizer in standing crop.

3) Fertilizer cum seed drill: Drilling of seeds and fertilizer are done simultaneously by fertilizer-cum-seed drill. It is similar to seed drill but with extra tubes, hopper and opening on tyne for drilling fertilizer. Other parts are same as seed drill.

4) Mechanical seed drill: The seed drill consists of and seed drum with holes in the bottom plate. A rotating disc with holes or small spoon like structures in the circular path is fixed in the seed drum. When hole or small spoon of rotating disc and hole of bottom plate coincide, seed falls into the tube on its way into soil. The distance between two holes in rotating disc is proportional to the inter-row spacing of crop. For sowing seeds of different sizes, rotating disc with different sized holes is used. There is a provision for altering the distance between rows by changing distance between the tynes or seed drum.

Q.3 A) Define the term tillage and state various objectives of tillage. 8 4

Ans **Definition of Tillage: -** Tillage is the physical manipulation of soil with the help of tools and implements to result in a good tilth for better germination and sub sequent growth of crops.

Objectives of tillage: -

There are several objectives of tillage of which the most important are

1.To make the soil loose and porous:-

A good seedbed should be loose and porous for early seed germination and initial good stand of crop. This facilitate a more amount of water enters in to soil. Intimate contact between the soil particles is necessary to facilitate movement of water for quicker germination. Soil erosion as well as run off losses are reduces.

2.To remove the weeds:-Weed control is one of the important objectives of tillage.A weed is an unwanted plant found in field and that reduces the crop yield by competing with main crop for light, nutrients, water and space. Tillage operations with suitable tools reduce the intensity of weed in the field. The weed present in field is cuts, breaks and uprooted by tillage.

3.To mix the manures and fertilizers:-

Crop residues and farmyard manures are incorporated in to the soil by soil inversion action of tillage. Decomposition of this material is quicker when

incorporated in to the soil. Applied fertilizer mix in the soil uniformly and that reduces volatilization losses.

4.To aerate the soil:-

Tillage improves the soil aeration which helps in multiplication of micro-organism. More amount of oxygen is made available in soil this improves rate of decomposition by increasing microbial activity in soil. Nutrient availability in soil is improves. Increased aeration also helps in degradation of herbicide and pesticide residues and harmful allelopathic chemicals present in soil.

5.To increase the soil temperature:-

Tillage operations disturb the soil and expose in to direct sun light more is the soil is heated that maintain the optimum temperature in active root zone of crop. Also microbial activity accelerated, control air water ratio in soil that will be improving crop growth.

6.To remove the stubbles :-

Stubbles of the previous crop are remains present in the field that create problems to carry a sowing operation that also harbor the insect and pest. Tillage helps in removing stubbles of the previous crop and other sprouting materials of weeds.

7.To break the hard pan:-

Some times root growth of crop is affected because of presence of hard pan below the ploughing depth and that also reduces free drainage. Tillage with specially designed implements is used to break the hard pan for better root growth.

8.To invert the soil to improve the soil fertility:-

Lower layer of soil is less fertile as the nutrients are removed by the crops from this layer. While the upper layer of soil rich in organic matter. Therefore due to tillage operation inversion of soil takes place and upper fertile layer goes down and lower layer comes above.

9.To have repeated exchange of air:-

Plant roots presents in soil they need oxygen for respiration process constantly and this is only possible by intercultural operation in standing crop. i.e. Hoeing. Micro-organism presents in soil they are useful for nutrient availability to crop their activity depends on the oxygen supply in soil.

10.To destroy the insects:-

Insect's pests reduce the crop yield by damaging in various ways. After harvest of crop they complete their life cycle in soil of same field in dormant stage in the form of pupae and after sowing of next crop they damages crop at various stages. Tillage operation like deep ploughing expose the insects direct in sun's heat and also birds feed on the insects.

Tillage improves all physical, chemical and biological properties of soil and provides a suitable seed bed for sowing and subsequent growth of crop.

B)Enlist modern concept of tillage and explain any one of them. 9-10 4

Ans Modern concept of tillage

In conventional tillage soil is open with mould board plough for primary tillage. The soil mass is broken in to loose system of clouds of mixed sizes. Subsequently, a fine seed bed is prepared by secondary tillage in which crushing of clods, repacking, incorporation of plant residue and fertilizer, smoothing of soil surface etc. In this process, energy is often wasted and sometimes soil structure is destroyed. Indian farmer open the soil with wooden plough, followed by running a blade harrow for secondary tillage. Finally planking is done to crush the clods and for microlevelling.

Recently considerable changes have taken place in tillage practices and several new concepts have been introduced, namely minimum tillage, Zero tillage and Stubble mulch farming.

The concept of minimum tillage was started in USA. The immedtiate cause for introducing minimum tillage was high cost of tillage due to steep raise in oil prices in 1974. In USA most of the tillage Operation perform by tractor mounted implement. they serch that weather several tillage operation carried out in the field are necessory or not.The continues tillage operation by heavy imlements or machinary destroyed the soil structure, soil pan become compact and soil erosion by wind and water takes place..

The important object of tillege is to control weeds but it can be controlled by apllication of herbicides. Research has shown that several tillage operation is rarely benificial and often destructive.all these reasons are led to the development and practice of minimum tillage , zero tillage and stubble mulch tillage.

Minimum Tillage :- Minimum tillage is aimed at reducing tillage operation to the minimum necessary requirement for ensuring/preparing good seed bed, rapid germination, satisfactory and favorable growing condition.

In this, tillage operations can be reduced by two ways.

A) By omitting operations which do not give much benefits when compared to cost.

B) By combining agriculture operations like seedling fertilizer application.

Minimum tillage produced by different methods as follows,

i) Row zone tillage:- After ploughing, secondary tillage opération like discing, harrowing etc.are redues. Means after primary tillage, the secondary tillage opérations done only in the Row zone.

ii) Plough-plant tillage: - after ploughing, a special seed drill is used the row zone is pulverized and seeds are sown.

iii) Wheel Truck planting: - ploughing is done as usual. Tractor is used for sowing and the wheels of the tractor pulverize the row.

Zero Tillage:- Zero tillage is an extreme from minimum tillage. Primary tillage is completely avoided and secondary tillage is restricted to seed bed preparation in the row zone only and it is option to where soil are subjected to wind and water erosion and were the timings of tillage more difficult and requirement of energy , laborer is to high.

Zero tilled soils are more homogeneous and in structure with more number of earthworms.

Till planting is one method of practicing zero tillage. Machinery accomplishes four tasks in one operation

- Cleaning of narrow strip over crop row
- Open the soil for seed insertion.
- Place and cover seed properly.

Weeds have to be destroyed before sowing the crop by application of paraquat, Glyphosate.

Stubble Mulch Tillage

Unnecessarily ploughing leads to soil erosion due to heavy rains and wind in arid lands.

A new approach developed for keeping soil protected at all times by growing a crop or by crop residue left on the surface during a follow periods known stubble mulch tillage or stubble mulch farming.

It is a year round system of managing a plant residue with implements which cuts the residue, loose the soil and kills the weeds. Stubble mulch farming begins with the harvest of crops. Sweep cultivator is used to cultivate the land to a depth of 12 to 15 cm in first operation. Sowing in stubble mulch farming is done in two ways

I) Similar to zero tillage, a wide sweep and trash bars are used to clear the strip narrow planter–shoe opens a narrow furrow into which seeds are planted.

ii) A narrow chisel of 5 to 10 cm width is worked through the soil at a depth of 15 to 30 cm leaving all plant residues on soil surface. The chisel breaks the tillage pan and surface cuts. Planting is done through residues with special planter

Ans A)**Define the term essential nutrient and give its classification with examples.** 4
12-13

Defination- An essential nutrient is a chemical element that a plant needs for its growth and development, and without which the plant cannot complete its life cycle

Plant Nutrient Elements:

Like animals and human beings, the plants also need food for their proper growth anddevelopment. The food of plants is constituted by several chemical elements that are called plant nutrients or plant food elements. There are 18 plant nutrient elements.

These are:

Classification of Plant Nutrients:

Based on the requirement of the nutrients by the plants, the plant nutrient elements are

classified as below:

1. Major or Macro Nutrients: The elements which are required by the plants in largequantities are called major or macro nutrients. These are: C, H, O, N, P, K, Ca, Mg and S.

These are also classified into two groups:

(i) Primary Nutrients: N, P and K are required by the plants comparatively in very largeamounts. Hence, these elements are called primary or main nutrient elements. The fertilizersof N, P and K are used by the farmers in large quantities. So, N, P, K are called fertilizerelements.

(ii) Secondary Nutrients: Plants require Ca, Mg and S also in large amounts but they haveless function to do as compared to the mainnutrients. Hence, these elements are calledsecondary nutrients. The importance of Ca, Mg and S is secondary to the manufactures ofNPK fertilizers.

2. Minor, Micro or Trace Nutrients: Seven nutrient elements namely iron, manganese,zinc, copper, molybdenum, boron and chlorine are utilized by field crops in very small quantities. Hence, these elements are called minor or macro nutrients. The micro nutrients are also as essential as macro nutrients for the plant growth.

These are: C, H, O, N, P, K, Ca, Mg and S. These are also classified into two groups: (i) Primary Nutrients: N, P and K are required by the plants comparatively in very large amounts. Hence, these elements are called primary or main nutrient elements.

B) Explain in short active and passive absorption. 14 4

Ans The two ways plants absorb water are active absorption and passive absorption:

Active absorption

In this process, root cells actively participate in the absorption of water. The root cells use adenosine triphosphate (ATP) generated by respiration to absorb water. The water moves from cell to cell through the plasmodesmata of the cell, which is known as the symplast pathway.

Passive absorption

In this process, root cells are not actively involved in the absorption of water. Instead, water is absorbed through the pull of transpiration. Transpiration is the rapid evaporation of water from the leaves. This creates a buildup of water in the xylem of the leaves, which causes a buildup of pressure. This pressure pushes water up from the xylem of the roots to the transpiring surfaces

External factors affecting absorption of water

1. Available soil water

Sufficient amount of water should be present in the soil in such form which can easily be absorbed by the
plants.

2. **Concentration of soil solution**

Increased concentration of soil solution (due to presence of more salts in the soil) results in higher OP.

3. **Soil air**-Absorption of water is retarded in poorly aerated soils because in such soils deficiency of O2 and consequently the accumulation of CO2 will retard the metabolic activities of roots like respiration. This also inhibits rapid growth and elongation of the roots so that they are deprived of fresh supply of water in the soil. Water logged soils are poorly aerated and hence, are physiologically dry. They are not good for absorption of water.

4. Soil temperature

Increase in soil temperature up to about 30°C favours water absorption. At higher temperature water absorption is decreased. At low temperature also water absorption decreased so much so that at about 0°C, it is
almost decreased. This is probably because at low temperature.

1. The viscosity of water and protoplasm is increased
2. Permeability of cell membrane is decreased
3. Metabolic activity of root cells are decreased
4. Root growth and elongation of roots are checked.

Q.5 Ans.	**Give in detail the classification of manures and fertilizers including bio-fertilizer along with examples.** 15-17	8

Manures:

Manures are plant and animal waste that are used as sources of plant nutrients. They release nutrient after their decomposition. Manures can be grouped into bulky organic manures and concentrated organic manures based on concentration of the nutrients.

1) Bulky organic manures:

Bulky organic manures contain small percentage of major (N, P & K) nutrients and they are applied in large quantity. Farm yard manure (FYM), compost and green manure are the most important and widely used bulky organic manures.

2) Concentrated organic manures:.

1) Plant origin (Oil cake):

a) Non edible oil cakes: Non-edible oil cakes are not fed to animal and especially used for horti crop

b) Edible oil cakes: Edible oil cakes are fed to cattle and also used as manure.

. 2) Animal origin: e.g. Blood meal, Fish meal, Bone meal etc.

Fertilizer:

Fertilizers are industrially manufactured chemicals containing plant nutrients. Nutrients content is higher in fertilizer than in organic manures and nutrient availability is faster.

Fertilizers are classified into straight, complex and mixed fertilizers.

1) Straight fertilizers are those which supply only one primary plant nutrient. e.g. Urea, ammonium sulphate..

2) Complex fertilizers contain two or three primary plant nutrients. These primary nutrients are chemically combined. They are usually in granular from e.g. Diammonium phosphate, nitrophosphtes.

3) Mixed fertilizers are physical mixture of straight fertilizers. They contain two or three primary plant nutrient mixed fertilizer are mixed either mechanically or manually.

Fertilizers are also classified into

Low and high analysis fertilizers

based on concentration of primary plant nutrient in them. The low analysis fertilizers contain less than 25% of primary plant nutrient e.g. single super phosphate (16% P_2O_5). In high analysis fertilizers total content of primary nutrient is above 25% e.g. Urea (46%N)

1) Solid and 2) Liquid fertilizers. Most of the fertilizers are in solid form. The solid fertilizers are in several from viz. powder (Single super phosphate). Crystals (Ammonium sulphate), Prills, (Urea, Diammonium phosphate), granules, Super granules and briquettes (Urea briquettes). Liquid fertilizers are of two type 1) Clear liquid fertilizers and 2) Suspension liquid fertilizers. When nitrogenous, phosphates, potassic and other fertilizer materials are completely dissolved in water, are called clear liquid fertilizers. Suspension liquid fertilizers are those in which some of the fertilizers materials are suspended as fine particles.

Fertilizers are also grouped on the nutrient present in the fertilizers.

1) Nitrogenous fertilizers:

b) Ammoniacal fertilizers- c) Nitrate-Ammoniacal fertilizers- Contain nitrogen in both ammoniacal and nitrate form e.g. Ammonium nitrate, Calcium ammonium nitrate.

d)Amide fertilizers- Contain nitrogen in the form of amide. These fertilizers are also known as organic fertilizers because they contain carbon atoms e.g. Urea Co (NH_2), calcium cyanide.

2) Phosphatic fertilizers:

Fertilizer containing phosphorus is called as phosphatic fertilizer. Phosphorus content in fertilizer is expressed in oxidized form (P_2O_5), while its content in soil and plant is expressed in elemental form (p). Phosphatic fertilizer are further classified into three groups based on there availability to crop and solubility.

a) Phosphatic fertilizer containing water soluble phosphoric acid e.g. single super phosphate, double super phosphate, triple super phosphate, ammonium phosphate.

b) Phosphatic fertilizer containing citric acid soluble phosphoric acid e.g. basic slag, dicalcium phosphate.

c) Phosphatic fertilizer containing phosphoric acid non soluble in water e.g. rock phosphate, raw bone meal.

3) Potash fertilizers:

Potash or potassium containing fertilizer is called as potassic fertilizer. They are further classified according to presence or non presence of chloride.

a) Chloride form e.g. potassium chloride or muriate of potash

b) Non chloride form e.g. potassium sulphate, potassium nitrate

Micronutrient:

The seven micronutrients essential for plants are Boron (B), Chlorine (Cl), Copper (Cu), Iron (Fe), Maganese (Mn), Molybdenum (Mo) and zine (Zn.) Micronutrient fertilizers are broadly grouped into (1) Inorganic salt and (2) Chelates.

Inorganic salt:

Supplying micronutrients are salts e.g. zinc sulphate, copper sulphate, ferrous sulphate etc. These are readily soluble in water and can be used as soil application and for foliar spray.

Chelates:

Chelate is words derived from the Greet ward 'Chela' meaning Crab's claw. Chelates are oragano-metallic molecules of varying sizes and shapes in which the organic part binds the nutrient in a ring like structure. Common chelating agents used in chelating micronutrients are. Ethylene diamine tetra acetic acid (EDTA), Hydroxyethyl ethylene diamine triacetic (HEDTA), Diethylene triamine penta acetic acid (DTPA). Nitrilo triacetic acid (NTA).

Biofertilisers :

1) Saprophytes: Micro-organisms which are capable of decomposing organic matter at a faster rate can be used as a fertilizer for quick release of nutrients, e.g. Aspergillus, penicillium, trichoderma.

2) Symbiotic bacteria: Bacteria belonging to the genus Rhizobium are capable of fixing atmospheric nitrogen in association with leguminous crops. Rhizobium species suitable for different crops are multiplied on a peat base in laboratories.

3) Free living organism: The important free living organisms which can fix atmospheric nitrogen are blue green algae, Azolla, Azatobacter and rhizospirillum. Among them, blue green algae and Azolla can survive only in lowland condition.

4) Mycorrhiza and phpspho-Micro organisms: Phosphorus availability and fertilizer phosphorus use efficiency can be increased with mycorrhiza, phosphate solublising bacteria and fungi. Some micro-organism like Psuedomonas striate, Aspergillus awaneorii, Bacillus polymyxa, Penicillium digitatumete and Bacillus megathesium var. phosphaticum (phosphobacterins) are capable of solublising phosphate. Mycorrihizae are the fungus attached to roots. VAM (Vesicular arbuscular mycorrhiza) helps in absorption of P and other micronutriets.

Q.6	A)Describe in short various kinds of soil water.	21-24	4

Kinds soil water:-

It is mainly classified into three categories *viz*. hygroscopic water, capillary water and gravitational water.

Hygroscopic water:- It is that part of soil water, which is very tightly held on the surface of soil particles; in very thin film by the forces of adhesion and cohesion. It is mostly in vapors form & the force with which it is held on the surface of soil particles is estimated at about 10,000 atmospheres at the outer side of the hygroscopic film and 31 atmospheres at inner side. Hygroscopic water is not available to the plant and agriculturally it has no importance. The absorption of moisture by soil varies with the humidity of the atmosphere. More humid the atmosphere more will be the absorption, by soil.

The maximum quantity of water absorbed by any soil in a saturated atmosphere (99% R.H.) at 250C temperature is known as hygroscopic coefficient of soil.

As this hygroscopic water is not of any use to the plants for growth, however at the time of acute water shortage in the soil it may be of little help in at least sustaining the life of the plants, particularly desert plants, and certain bacteria are also capable of using it for their benefit.

Capillary water :-

When soil particles absorb water even after the hygroscopic coefficient is reached the additional water is also held around the particles in the form of thin film. This retention of film of water continues until the film becomes quite thick and the micro pores inside the soil mass also get filled with water. The capillary water is that water which is held in the soil in excess of hygroscopic water, but is upto the point where the gravity pull begins to move the water downwards, when free drainage conditions exist in the soil.

Capillary water is rather loosely held water (from 31 atmospheres to ⅓ atmosphere tension) in the form of film around the soil particles and also in finer or micro-pores and is capable of movement within soil. The plant food nutrients are dissolved in it and therefore, it is the most useful water for plants.

Gravitational water:-

When maximum capillary capacity of a soil gets satisfied any further addition of water comes under the force of gravity. This water starts moving as free water through the macro-pores and is called gravitational water. It is excess superfluous and as such it is of no use to the plant. Usually within 2-3 days after irrigation or heavy rain all such water drains down from the soil surface.

	B)Give in details about different methods of irrigation.	21-24	4
Ans			

Check Basin method :

Most common method of irrigation. Suitable for close growing crop like groundnut, vegetable, flowering plants etc. Field is divided into small plots surrounded by bunds on all four sides. Water from the main channel is supplied to the field channels and to the check one after another

Basin or Ring :-

When the plants are widely spaced the ring method is suitable. Rings are formed around each tree. The rings are circular basins formed around each tree. The ring basin are small when plant is young, the size is increased as the plant grows.

Border method :-

Field is laid out into long narrow strips, bordering with small bunds. Length of strip ranges from 30 to 100 m and width from 3 to 15 m.

Furrow irrigation :-

Water is applied by running small streams in furrows between the crop rows. Water infiltrates into the soil and spreads laterally to irrigate the areas between the furrows.

Corrugated furrows :-

It consist of running water in small furrows called corrugation which direct the flow down the slope generally used for non-cultivated crops, close growing crops such as grain crops, pasture growing on steep slops.

Sub – irrigation :-

In sub – irrigation water is applied below the ground surface by maintaining an artificial water table at depth depending upon soil texture and the depth of plant roots.

Sprinkler irrigation :-

Water is spread into the air and allowed to fall on the ground surface somewhat resembling rainfall. The spray is developed y the flow of water under pressure through the small nozzles. Pressure is obtained by pumping.

Type of sprinkler systems

1) Rotating head :-

2) Perforated pipe system :

Surge irrigation

In furrow irrigation, large stream sizes are used to encourage rapid advance of water along furrow and to ensure uniform infiltration over the entire furrow length.

Microirrigation and its type

Drip irrigation, components and merits and demerits. Fertigation, Defination and advantages.

Micro Irrigation - Latest method of irrigation in which plant provided water frequently with a volume of water approaching the consumptive use of the plants. Minimizes the conventional losses as deep percolation, runoff, and evaporation. Water is conveyed with small diameter pipes upto the plant and applied through immiter.

Types of micro-irrigation system :-

Application of water above surface :-

1) Drip :-

Application of water at very slow rate usually drop by drop. Application rate usually 2 to 16 liters/hrs. operating pressure 1 to 1.5 kg/cm2.

Types of drippers :-

a) Pressure compensating drippers :-

b) Pressure non-compensating dripper (button type drippers) :-

c) Self flush dripper :-

d) Micro tube :-

e) Integrally fitted drippers :-

f) Inline dripper :-

g) Flow adjustable dripper :-

2) Micro jet :-

In micro jet irrigation water is passed through nozzles with pressure and it hits on surfaced placed above the nozzle to produce fine jets (stream or shoot of water).

3)Micro sprinkler :-

In micro sprinkler the water is distributed in fine spray with the help of spinner (rotating part) after coming out through nozzle with pressure. Distribution of water is uniform as compared to micro jet. However system as costly as compared to micro jet.

4)Bubbler :-

This system is a combination of micro irrigation and basin method. In this method water is conveyed up to the tree like micro irrigation thorugh pipes and it is applied with the help of bubblers having high application rate.

5) Pulseter :-

pulseters are placed on laterals. In the pulseter pressure valve is provided with stress the water for few seconds and throws out in micro spray at regular interval. Benefit of pulseter is to provide enough time interval to infiltrate, the applied water in to the soil.

Application of water below surface :-

Biwall irrigation tube is dual chamber linear discharge tube. It is especially designed for row crops. The water flows inside the main chamber and passes through inner orifice into the secondary chamber.

Q.7 **A) Define the term weed and give different weed control methods.** **25-26** **4**

Ans

Weed:-

A weed is an unwanted plant which observed in the field is not sown by the farmer and competes with main crop for light, nutrient, moisture and space and reduces the crop yield in various ways.

Control Measures

Mechanical method	**Cropping or cultural method**	**Biological method**	**Chemical method**
1. Hand pulling 2. Hoeing 3. Tillage 4. Mowing 5. Flooding 6. Burning 7.Smothering with non living material mulch 8. Dredging and chaining	1. Crop rotation 2. Kind of crop 3. Crop variety 4.Use of fertilizers 5.Dateof sowing 6.Spacing 7.Inter cropping	1. Parasites 2. Predators 3. Pathogens	A) Selective 1.Foliage application a. Contact b. Translocated 2.Soil application B)Non-selective 1.Foliage application a. Contact b. Transocated

B)write different approaches of scheduling of irrigation and explain any one of them. **21-24** **4**

Ans

There are several methods for scheduling of irrigation based on 1) Plant 2) Soil moisture and 3) Climatological data.

Plant basis :-

1) Visual symptoms of plants :-

Plant it self indicates the moisture tress through symptoms like rolling curling of leaves, pale green colouration, drooping leaves etc. The water requirement varies with the stage of crop growth. However, the water requirement cannot be quantified. These visual sings of plant wilting can be used to schedule irrigation of crops.

2) Critical growth stage approach :-

In this method irrigation is based on distinct stages of growth. In each crop there are some growth stages at which moisture tress leads to non-recoverable yield loss. These stages are known as critical growth stage or moisture sensitive period.

Canopy temperature or leaf water potential :-

When transpiration is normal, due to its cooling effect, canopy temperature is less than ambient temperature indicating availability of enough soil moisture.

4) Profile modification :-

This method also known as soil cum sand mini plot technique is used for scheduling irrigation to crops. The principle involved in this method is to reduce

artificially, the available water holding capacity of soil in root zone depth in mini plot by mixing sand with it.

5) **Increased plant stand :-**

An area of about 1.0 m2 is sown with the same crop to maintain about four times the plant population compared with that in the surrounding area.

Soil moisture studies :-

The available soil moisture in the root zone is a good criteria for scheduling irrigation. When the soil moisture in a specified root depth is depleted to a particular level, it is to be replenished by irrigation. The soil moisture is estimated by both direct and indirect methods. Direct methods involve determination of water in soil while indirect methods estimate amount of water through the properties of water in the soil. The most common instruments used for estimating soil moisture by indirect methods are

1) **Tensiometer 2) Gypsum block 3) Depth moisture gauge (neutron moisture meter) 4) Feel a appearance method.**

In this method soil sample is taken in the hand observed for its feel and appearance. It gives an idea of soil moisture content of soil but do not give real value of the amount of water in the soil. However, for an expert irrigator it is the guide for scheduling of irrigation to a particular crop.

Climatological approach :

Evapotranspiration depends primarily on climatic factors such as temperature, radiation, wind velocity, relative humidity and so on. The amount of evaporation is obtained from evaporimeter and when it reaches to a particular level irrigation is scheduled. There are two type of evaporimeter.

1) U.S. Weather Bureau class-I open pan-evaporimeter
2) Sunken screen pan evaporimeter designed by Sharma and Dastane in 1966.

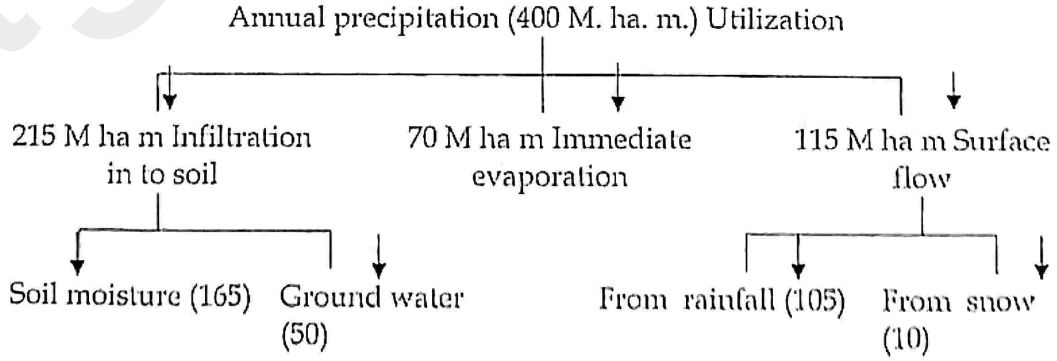
Q.8	**A)Describe in short water resources of India.**	20	4

Ans

Rain fall

India is vast country with geographical area of 329Mha. Rainfall is dependent in different degrees, on the Southwest mansoon, Northeast mansoon, on shallow cyclonic depression and disturbance and violent local storms. The average annual rainfall in India is about 1190mm. India receives most of its rainfall from the Southwest mansoon originating in the India ocean. The variation in rainfall over the country is from 10,000mm

The average rainfall of India is 1190 mm while the geographical area of India 329 million hectare. When converted into hectare meters over 329 M ha of land area (Million ha) it works out to 400 M ha m (Million hectare meters). Out of which 300 M. ha. m. is received during monsoon season and remaining daring the rest of the year (100 M.ha. m.).



The status of net and gross areas irrigated in different regions (1994-95) shows that North India had the highest area followed by the Western India. The Eastern India had the least area irrigated. Uttar Pradesh had the highest gross area irrigated followed in descending order by Punjab.

Considering the percentage of net area irrigated to net area cultivated in 10 states, Punjab had highest area irrigated (93.7%) followed by Haryana (76.4%), Uttar Pradesh (67.4%), Tamilnadu (50.1%), Bihar (47.9), Andhra Pradesh (38.2%), Madhya Pradesh (29.6%).Gujrath – 31.2%

Rajasthan – 28.5%, Maharashtra – 14.3%

Irrigation development in India –

Modern large scale irrigation works may be said to have begun in the third decade of the nineteenth century with the Cauvery delta system in south India and the construction of the Yamuna Canals in North India. The Gidavari delta system was undertaken in 1846 and Krishna delta system in 1951.

Table : Major irrigation projects completed from 1820-1930.

Sr. No.	Project	Year of completion	Area irrigated (000 ha)
1.	Western Yamuna canal	1820	431
2.	Ganga canal	1856	655
3.	Lower Ganga canal	1880	506
4.	Sirhind canal	1884	935
5.	Couvery delta system	1889	434
6.	Godavary delta system	1890	497
7.	Krishna delta system	1898	405
8.	Sarda canal	1930	525

After independence (1947), the major irrigation schemes taken up are Bhakra Nangal, Gandak, Hirakud, Nagarjunsagar, Chambal, Kosi, Damodar Valley, Mahi, Rajasthan canal. Sriram sagar, Srisailam, Sardar Sarovar etc. The list of important reservoirs (more than 2 thousand million cubic meters capacity at their full reservoir level) is given in table.

Full reservoir level and capacity of important reservoirs in India.

Sr. No.	Name	Location	Full reservoir level (m)	Live capacity at full level (TM cum)
1.	Nagarjuna Sagar	Andhra Pradesh	179.83	6.841
2.	Sriram Sagar	Andhra Pradesh	332.54	2.300
3.	Srisailam	Andhra Pradesh	269.75	8.288
4.	Ukai	Gujarath	105.16	7.100
5.	Gobind Sagar	Himachal Pradesh	515.11	7.172
6.	Pong Dam	Himachal Pradesh	426.70	7.119
7.	Linganamakki	Karnataka	554.43	4.294
8.	Tungbhadra	Karnataka	497.74	3.276
9.	Gandhi Sagar	Madhya Pradesh	399.90	6.827

10.	Jayak Wadi	Maharashtra	463.91	2.171
11.	Koyana	Maharashtra	657.91	2.677
12.	Hirakud	Orissa	192.02	5.822
13.	Balimela	Orissa	462.08	2.676
14.	Mettur	Tamil Nadu	240.79	2.647
15.	Ramganga	Uttar Pradesh	365.30	2.053
16.	Rihand	Uttar Pradesh	268.22	8.967

TMCum – Thousand Million Cubic meter

B)Define the alleopathy .write its effect on crop and weed. 27 4

Ans

Defination-Allelopathy is a biological phenomenon where plants or microorganisms produce biochemicals, called allelochemicals, that affect the growth of other organisms. These chemicals can have either positive or negative effects on the growth of the surrounding plants.

Crop rotation

When an allelopathic crop is included in a crop rotation, it can reduce weed infestation in the following crop. For example, growing wheat after sorghum can reduce weed infestation because sorghum releases allelochemicals. However, the allelopathic crop can also negatively affect the germination of the following crop.

Mulching

Mulch can suppress weed infestation. Inorganic mulches can more efficiently change the soil environment, while organic mulching materials are more environmentally friendly.

Allelopathic species

Some plant species have potent allelochemicals that can be used as natural herbicides. For example, black walnut contains juglone, which is toxic to tomato and alfalfa plants. Sorghum contains sorgoleone, which is a potent bioherbicide. Alfalfa is a well-known example of an allelopathic crop that is often used as mulch.

Q.9 **A)Define the term cropping system and give its classification with examples.** 28-29 4

Cropping system: - Cropping system is important component of farming system. It represents cropping pattern used on the farm and their interaction with other farm resources, other farm enterprises and available technology which determine their make up.

Classification:

Crop rotation: - Crop rotation refers recurrent succession of crop on the same piece of land either in a year or over a longer period of time.

Types of cropping system: - Depending on the resources and technology available, different types of cropping system adopted on farms.

1)Monocropping / Monoculture:-

Monocropping or Monoculture refers to growing of only one crop on a same piece of land year after year. It may due to climatologically and socio–economic condition or due to specialization of farmer growing a particular crop. Rice crop is grown in konkan region.

2)**Multiple cropping:-**

Growing of two or more crop on the same piece of land in one calendar year is known as multiple cropping systems. It is intensification of time and space dimension, i.e. more number of crops grown within a year and more number of crops grown on the same piece of land at any given period. It includes

intercropping, mixed cropping and sequence cropping.

Intercropping: - intercropping is growing of two or more crop simultaneously on the same piece of land with a definite row pattern. For example, growing setaria + red gram in 5: 1 ratio i.e. after every five rows of setaria, one row of red gram is sown.

Mixed cropping:- is the growing of two or more crops simultaneously on the same piece of land without any row pattern. It is common practice in most of the dryland tracks of india. Seeds of different crops are mixed in certain proportion and are sown.

Sequence cropping:-Sequence cropping can be defined as growing of two or more crops in sequence on the same piece of land in a farming year. Depending on the number of crops grown in an year, it is called as double, triple, and quadruple cropping involving two, three and four crops in a year.

Relay cropping:- Relay cropping refers to planting of the succeeding (next) crop just before harvesting of the preceding crop (first).

Ratoon cropping or rationing refers to raising a crop with regrowth coming out of root or stalks after harvest of crop.

Advantages :-

1. Insurance against total crop failure.
2. Better utilization of available resources.(land, laboure,solar energy)
3. Soil fertility improved.
4. Increases total crop productivity per unit area.
5. Soil erosion is minimizes.
6. One crop provides shelter to other.

Disadvantages:-

1. Care should be taken while selection of crop.
2. Difficult to carry field operation.
3. Weed control through herbicide is difficult.
4. More labore and input required.

	B) Explain in short various soil moisture constants.	**21-24**	**4**

Ans

Soil moisture constants are values that describe soil moisture and the relationship between soil and water. These constants are important in agriculture.

1.Field capacity: It is the capacity of the soil to retain water against the downward pull of the force of gravity. At this stage, only micropores or capillary pores are filled with water and plants absorb water for their use. At field capacity, water is held with a force of 1/3 atmosphere. Water at field capacity is readily available to plants and microorganisms.

2. Wilting coefficient: The stage at which plants start wilting for want of water is termed the Wilting Point and the percentage amount of water held by the soil at this stage is known as the Wilting Coefficient. It represents the point at which the soil is unable to supply water to the plant. Water at wilting coefficient is held with a force of 15 atmospheres.

3. Hygroscopic coefficient: The hygroscopic coefficient is the maximum amount of hygroscopic water absorbed by 100 g of dry soil under standard conditions of humidity (50% relative humidity) and temperature (15°C). This tension is equal to a force of 31 atmospheres. Water at this tension is not available to plant but may be available to microorganisms.

4. Available water capacity: The amount of water required to apply to a soil at the wilting point to reach the field capacity is called the "available" water. The water supplying power of soils is related to the amount of available water a soil can hold. The available water is the difference in the amount of water at Field Capacity (0.3 bar) and the amount of water at the Permanent Wilting Point (15 bars).

	5. Maximum water holding capacity: It is also known as maximum retentive capacity. It is the amount of moisture in a soil when its pore spaces, both micro and macro-capillary, are completely filled with water. It is a rough measure of total pore space of soil. Soil moisture tension is very low between 1/100th to 1/1000th of an atmosphere or pF 1 to 0.			
Q.10	**A) Give the classification of weed on the basis of life cycle with examples.**	25-26	4	
Ans	Based on life cycle Based on life span (Ontogeny), weeds are classified as Annual weeds, Biennial weeds and Perennial weeds. **a. Annual Weeds** Weeds that live only for a season or a year and complete their life cycle in that season or year are called as annual weeds. These are small herbs with shallow roots and weak stem. Produces seeds in profusion and the mode of propagation is commonly through seeds. After seeding the annuals die away and the seeds germinate and start the next generation in the next season or year allowing. Most common field weeds are annuals. The examples are a. Monsoon annual-Commelina benghalensis, Boerhavia erecta b. Winter annual-Chenopodium album **b. Biennials** -It completes the vegetative growth in the first season, flower and set seeds in the Succeeding season and then dies. These are found mainly in non-cropped areas. Eg. Alternanthera echinata, Daucus carota **(c) Perennials** Perennials live for more than two years and may live almost indefinitely. They adapted to withstand adverse conditions. They propagate not only through seeds but also by underground stem, root, rhizomes, tubers etc. And hence they are further classified into i. Simple perennials: Plants propagated only by seeds. Eg. Sonchus arvensis ii. Bulbous perennials: Plants which possess a modified stem with scales and reproduce mainly from bulbs and seeds. Eg. Allium sp. iii. Corm perennialsb Plants that possess a modified shoot and fleshy stem and reproduce through corm and seeds. Eg. Timothy (Phleum pratense)			
	B)Write short notes (any two)		4	
	1.Integrated nutrient management : 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. Concept Regulated nutrient supply for optimum crop growth and higher productivity.Improvement and maintenance of soil fertility.Zero adverse impact on agro – ecosystem quality by balanced fertilization of organic manures, inorganic fertilizers and bio- inoculant. **Advantages** Enhances the availability of applied as well as native soil nutrients Synchronizes the nutrient demand of the crop with nutrient supply from native and applied sources. Provides balanced nutrition to crops and minimizes the antagonistic effects resulting from hidden deficiencies and nutrient imbalance. Improves and sustains the physical, chemical and biological functioning of soil.Minimizes the deterioration of soil, water and ecosystem by promoting	18, 19,		

carbon sequestration, reducing nutrient losses to ground and surface water bodies and to atmosphere

2. Desirable characteristic of green manuring crop

1.It should be a legume with good nodulation and rapid nitrogen fixation even under unfavorable condition.

2. It should have less water requirement and should be capable of growing on poor soils.

3. It should have a deep root system.

4. The plant should be able to produce heavy tender growth early in its life cycle.

5. It should be easily decomposable in the soil.

3.Sustainable crop production

Sustainable crop production is a method of farming that minimizes environmental impact while still producing high-quality food. Here are some principles of sustainable crop production:

Soil health-Maintain soil structure, fertility, and biodiversity through crop rotation, cover cropping, and reduced tillage.

Water efficiency-Use efficient irrigation, rainwater harvesting, and drought-resistant crops.

Biodiversity-Encourage biodiversity through polyculture, agroforestry, and conservation of native plants.

Pest and disease management-Reduce chemical pesticides by using integrated pest management (IPM) strategies, such as biological control, crop diversification, and resistant crop varieties.

Economic viability-Increase productivity and profitability while reducing inputs and minimizing environmental impacts.

	SECTION-B	Lect. No.	MKS.
Q.11	**A)Answer in one sentence.**		
	1.What is the average rainfall of India-1190 mm	20	1
	2.Give one examples of C4 crop plants- Maize, sorghum, bajara	3	1
	3.What do you mean crop and variety- A crop is a plant grown in large quantities for food, and a crop variety is a population of plants within a species that has been cultivated to produce specific characteristics	5-	
	4. Abbreviation FYM stands for **Farm yard manure**	15-17	1
	5. Abbreviation NADEP stands for **Narayanrao Devrao Pandharpande**	18	1
	6. At which temperature soil is heated in oven for moisture estimation- 105 ^{o}c	21-24	1
	7. Who is considered as father of tillage- **Jethro Tull**	8	1
	8. Which implementt is used for drilling method of sowing- **Seed drill.**	5-7	

Q.12	A)Define the following terms.			
	1.	**Growth-** Growth is a term that is used to describe progressive changes in size and morphology during the development of an individual.	4	1
	2.	**Crop geometry-** crop geometry refers to the arrangement of plants in rows and columns in a field, and the shape of the space available to each plant.	11	1
	3.	**Tilth-** Physical condition of soil resulting from tillage.	8	1
	4.	**Manure-** Plant and animal origin material used as source of essential nutrient.	15-16	1
	B)	**Fill in the blanks**		
	1.	Growing of two or more crops on the same piece of land with definite geometrical proportion is known as **Intercropping**	28-29	1
	2.	**Glyricidia, Pongamia, and Subabul** is an example of green leaf manuring plant.	15-17	1
	3.	Tensiometer is used to measure **soil moisture**	21-24	1
	4.	4.Major portion of rainfall receives in India from **south –west** monsoon.	8	1

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