

MAHARASHITRA AGRICULTURAL UNIVERSITIES EXAMINATION BOARD, PUNE
SEMESTER END THEORY EXAMINATION

B.Sc. (Agri.) Hons (PSTL)

Semester	: VI (New)	Academic Year	: 2017-18
Course No.	: AGRO-111	Title	: Fundamentals of Agronomy
Credits	: 2 (I+I)		
Day & Date	:	Time	: Total Marks : 40
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.		

Model Answers

SECTION "A"

Q.1. Define Agronomy and explain the scope of Agronomy with examples.

Agronomy is the branch of agriculture, which deals with the principles of crop production and field management. (1).

Scope of Agronomy: It is a dynamic discipline and scope of Agronomy is very vast. It includes methods of tilling the land, suitable period of its cultivation, right time and method of sowing seed, keeping farm implements and farm machinery in good shape and managing field crops in an efficient manner as an experienced farmer. Agronomy is also concerned with the management of livestock, including their feeding, care and disposal of farm and animal products like milk, eggs and meat as well as proper maintenance of farm accounts.

Agronomy also involves **agronomic research** on crops under different environmental conditions like varying soil, climate, irrigation, fertilizers etc. by conducting well laid-out experiments in field, pots and laboratories. It is also form suitable package of practices for crop under given set of soil and climatic conditions and transfer of these agro-techniques to the farmers for boosting the crop yields.

With the advancement of knowledge and better understanding of plant and environment, agricultural practices are modified or new practices developed for high productivity. For example, availability of chemical fertilizers has necessitated the generation of knowledge on the method, quantity and time of application of fertilizers. Similarly availability of herbicides for control of weeds has led to development of a vast knowledge about selectivity, time and method of application of herbicides. Gigantic irrigation projects are constructed to provide irrigation facilities. However, these projects are created side effects like water logging and salinity. To overcome these problems, appropriate water management practices are developed. Population pressure is increasing, but area under cultivation is static or slowly declining. More number of crops has, therefore, to be grown on the same piece of land in a year. As result, intensive cropping has come into vogue. Similarly, no tillage practices have come in place of clean cultivation as a result of increase in cost of energy. Likewise, new technology has to be developed to overcome the effect of moisture stress under dry-land conditions. As new varieties of crops with high yield potential become available, package of practices has to be developed to exploit their potential. (3).

Q. 2. Define tillage and explain objects of tillage.

Tillage: It is the mechanical manipulation of soil with tools and implements for loosening the surface crust and bringing about conditions favorable for germination of seed and the growth of crops. (1).

Objects of tillage are:-1) To make the soil loose and porous: This will enable rain or irrigation water to enter the soil easily and less loss of rainwater and soil due to runoff and erosion.

2) To aerate the soil: It enables the metabolic process of living plants, microorganisms to continue properly. This would result in rapid decomposition of organic matter and making plant nutrients available to crops.

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- 3) To have repeated exchange of atmospheric air with the soil air: It is necessary to introduce fresh air in the soil to keep the CO₂ concentration under check by suitable tillage operations.
- 4) To increase the soil temperature: This can be achieved by maintaining proper amount of air water in the soil and also by exposing the soil to the heat of sun.
- 5) To control weeds: Weeds are enemies of crops as they compete with the crops for plant nutrients, moisture, space and sunlight, which will result in poor crop yields.
- 7) To destroy insects: Insects are either exposed to sun's heat or to birds that would pick them up.
- 8) To break hardpan: Tillage with specially designed implement such as sub-soil plough (chisel plough) is often useful to break hardpan if any, formed just below the ploughing depth.
- 9) To incorporate organic manures and fertilizers in the soil: Organic manures such as F.Y.M. or compost and fertilizers should not be only spread on surface of soil, but properly incorporated (mix thoroughly) into the soil for minimizing the loss of plant nutrients.
- 10) To invert the soil to improve fertility.
- 11) To prepare seedbed for germination of seeds and growth of crop (3)

Q.3. Enlist various methods of sowing and describe drilling method of sowing.

Method of sowing: Seeds are sown either directly in the main field or in a nursery bed, where seedlings are raised and transplanted in the main field at appropriate age of seedlings. (1)

1. Broadcasting:
2. Drilling or Line sowing:
3. Dibbling:
4. Transplanting:
5. Planting:
6. Placing the seeds in plough furrow:

Drilling or Line sowing: To overcome the problems of broadcasting, drilling the seeds in line has come into practice. In this method the indigenous seed drill, two bowl seed drill or mechanical seed drill is used for placing seeds into the soil and then seeds are covered with the help of wooden plank or blade harrow. It is usual method of seeding in dry land agriculture. It is adopted for sowing crops like sorghum, pearl millet, upland rice, wheat, oat, soybean, chickpea, black gram, green gram, safflower etc.

Advantages:

- 1) Line sowing facilitates uniform depth of sowing at correct soil moisture level.
- 2) Less seed rate is required as compared to broadcasting method.
- 3) Spacing between crop lines is maintained uniformly and weeds can be controlled by inter cultivation in line sown crops.
- 4) Fertilizers are placed at sowing as well as in the standing crop by using drilling equipment, which increases fertilizer efficiency.
- 5) It is well suited for intercropping.
- 6) Uniform crop stand can be maintained by carrying out timely gap filling and thinning operations.

Disadvantages:

- 1) The seed drill can be used only when soil moisture is optimum or at Vapasa condition.
- 2) Plant to plant spacing within a line i.e. Intra row spacing is not maintained
- 3) Skilled person is required for sowing. (3)

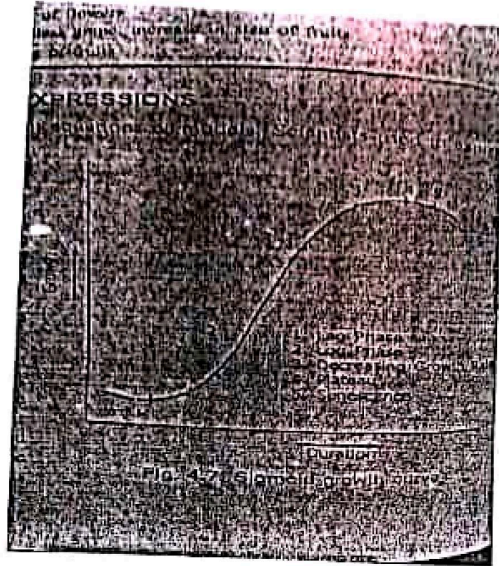
Q. 4. Define growth and development. Explain in brief about growth curve.

Growth: - It is an irreversible increase in mass or weight.

Development:- The development of a plant from germination to maturity can be considered as a series of discrete periods, each identified by an accompanying process of change in the structure, size or weight of specific organs. Or Plant development is a whole series of change which plant goes through its life cycle (2).

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Growth of a plant can be expressed in different equations or models. Growth curve (Sigmoid growth curve) – All plants pass through various stages of growth. Growth is best expressed by means of a curve plotted against time. Growth curves are helpful in understanding the general pattern of growth. The S-shaped or sigmoid curve is typical of growth pattern of individual organs, of a whole plant and of population of plants (Fig.).



It consists of five distinct phases: (1) an initial lag period during which internal changes occur that are preparatory to growth. The increase in size or weight is very slow or negligible during this period. (2) It is followed by log phase or log period of growth or the grand period of growth during which growth is very fast. The logarithm of growth when plotted against time is a straight line during this phase. (3) Subsequently, a phase in which growth rate gradually diminishes. (4) At plateau, organism reaches maturity and growth ceases. (5) Later, senescence and death of organism sets in, giving rise to another component of the growth curve. (3)

Q.5. Enlist the different methods of weed control and explain in detail about mechanical methods of weed control.

Methods of weed control (I).

- I) Preventive measures
- II) Control/ Curative measures
 - 1) Mechanical / Physical Methods
 - 2) Cropping or cultural methods
 - 3) Biological Methods
 - 4) Chemical methods
- III) Integrated weed management (IWM)
 - II) Control/ Curative measures:
 - 1) Mechanical / Physical Methods: Physical forces either manual, animal or mechanical power is used to pull out or kill weed. These are the costly and time consuming methods.
 - i) Hand pulling or hand weeding: Pulling the weeds by hand or hand weeding with the help of weeding hook is the oldest and most effective method for control of weeds.
 - ii) Hand Hoeing: In this method, the entire surface soil is dug to a shallow depth with help of hand hoes, weeds are uprooted and removed
 - iii) Tillage: It is one of the practical methods of destroying weeds of all categories.

- a) Deep ploughing: Weeds are buried deep in the soil and also exposed to heat of the sun by deep ploughing.
- b) Discing: helpful for cutting and burying of weeds.
- c) Harrowing with blade harrow is very effective for destroying newly germinated weeds before sowing of the crop.
- d) Interculturing: It is carried out with different types of hoes or mechanical weeders for control of weeds in between rows of the crop.
- iv) Mowing and sickling: This method is used in water lands, pastures, gardens and roadside. The implement Mower is used for cutting weeds. It does not destroy the weeds completely, but prevents seed production of cutting growing parts. Cutting above ground parts of weed with sickle is called sickling and it prevents seed formation.
- v) Flooding: It helps in controlling weeds like kans (*Saccharum spontaneum*) which grows luxuriantly in heavy ill drained soils during rainy season.
- vi) Burning: This method is adopted to destroy weeds in non-cropped areas like water lands, road sides, railway lines, bunds, etc. The flame throwers and steam boxes are used for burning weeds in advanced countries.
- vii) Digging: This method is useful for controlling perennial weeds like nutgrass, hariali etc. Digging is very useful for removing the underground propagating parts of weeds from the deeper layers of soil.
- viii) Mulching: The principle aim of this method is to cut off light and avoid all top growth of weeds. Organic and inorganic mulches are used for weed control.
- ix) Summer fallow: Deep summer ploughing control perennial weeds in dry farming areas.
- x) Dredging and Chaining: These methods are useful for controlling aquatic weeds. Removing of weeds along with their roots and rhizomes from the water with the help of mechanical force is called dredging. The floating aquatic weeds are removed by chaining. A heavy chain is pulled over the water bodies to collect the weeds (3).

Q. 6. Define plant ideotype and explain types of plant ideotype.

Definition of plant ideotype: According to Warshner (1969), an Ideotype is a biological model, which is expected to perform or behave in a predictable manner within a defined environment. The term plant ideotype is often known as **model plant type, ideal plant type, ideal model plant type** etc. (1)

Types of ideotype: The most widely accepted classifications of plant ideotypes are as below:

I. Isolation ideotype: An isolation ideotypes are also known as **space-planted ideotypes** which have the potential to perform better when they are planted in a defined row- to-row and plant-to-plant spacing. In case of cereals isolation ideotype is maximum free tillering, leafy spreading plant that is able to explore the environment as fully as possible. It is unlikely to perform well at different crop densities.

II. Competition ideotype: The competitive ideotypes are those ideotypes which perform well in genetically heterogeneous population rather than in a homogenous population. In case of cereals competition ideotype is tall, leafy, free tillering plant that is able to shade its less aggressive neighbour and thereby gain a more share of nutrients and water.

III. Crop ideotype: This ideotype perform best at commercial crop densities because it is a poor competitor.

IV. Market ideotype: These ideotypes includes traits like seed colour, seed size, cooking and baking quality etc. So these ideotypes have their importance in improving the quality of the food grain or a product which may fetch higher price in the market and gave more remunerative returns per rupee of the invested money. These ideotypes focus on an improvement of the product quality and to make the product highly acceptable and to give higher monetary returns.

V. Climatic ideotype: They include traits important in climatic adaptation such as heat and cold resistance, maturity duration, drought resistance etc. Therefore, these are the ideotypes which

perform better under stressed conditions by making modification/alterations in the genetic makeup to make them more adaptable under harsh climatic conditions.

VI. Edaphic ideotype: They include traits importance in soil adaptation viz., salinity tolerance, mineral toxicity/deficiency tolerance etc. The plant ideotype, which exhibit alteration in their genetic behaviour so as to make them more comfortable under edaphic (soil) stress conditions.

VII. Stress ideotype: The stress ideotypes shows resistance to biotic and abiotic stress, disease/pest resistance ideotype, drought resistance etc. i) Abiotic stress - Drought resistance, Mineral stress, Heat and cold resistance. ii) Biotic stress - Disease resistance, Insect-pest resistance.

A drought-tolerant variety is one that produces a high grain yield relative to other cultivars under drought stress. (3).

Q. 7. Define crop rotation and explain in brief advantages of crop rotation.

Crop rotation: Refers to recurrent succession of crops on the same piece of land either in a year or over a longer period of time. Component crops are so chosen so that soil health is not impaired. e. g. Cotton – gram. sugarcane – wheat. (1).

Advantages of an ideal crop rotation:

1. There is over all increase in yield of crops mainly due to maintaining physical-chemical properties of soil. Soil fertility is restored by fixing atmospheric nitrogen, encouraging microbial activity (more organic matter) and protecting soil from erosion, salinity and acidity.
2. It helps in controlling insects, pests and soil borne diseases. It also controls weeds. e. g. repeated wheat culture (growing) increases wild oats and *phalaris* infestation. Similarly growing berseem continuously encourages chikori (kasani) infestation, but an alternate cropping of berseem and wheat helps in controlling kasani as well as wild oats and phalaris.
3. Prevent or limit periods of peak requirements of irrigation water. Crops requiring high irrigation if followed by light irrigation, this will not affect or deteriorate the soil physical condition.
4. It facilitates even distribution of labour. Following crop rotation could make proper utilization of all resources and inputs. Family and farm labour, power, equipment and machines are well employed throughout the year.
5. Farmers get a better price for his produce due to higher demand in local market. So there is regular flow of income over year.
6. Inclusion of crops of different feeding zones (root system) and nutrient requirement could maintain the better balance of nutrient in soil. Growing crops of different root depths avoids continuous depletion of nutrients form same depth. e. g. **deep rooted crops** take nutrients from deeper zone and during that period upper zone get enriched. Similarly, **surface feeding roots** take nutrients from upper zone when lower zone get enriched. So growing same crop without rotation results in loss of soil productivity and impoverishment of particular depth. The ideal crop rotation fully utilized the nutrients from entire soil mass and cost of cultivation is reduced.
7. Diversification of crops reduces risk of financial loss due unfavourable conditions. Diversification of crops means variety of crops can be grown for meeting the domestic needs of farmers and livestock, to reduce risk of market fluctuations, mechanism of farming, growing expensive crops. So all variety of crops are grown in rotation for more benefit.
8. It improves soil structure, percolation and reduces chances of creation of hard-pan in sub soil and also reduces soil erosion.
9. Some crop plants are found to produce phytoalexins when they get infected by diseases. Repeated cultivation of such crops results in harmful effects over crop plants and lower crop yield is obtained. e.g.

Crop	Phytoalexins produced by diseased plants.
Groundnut	Resvertrol
Soybean	Glyceollins.

10. The family needs of feed, food, fuel, fiber, spices, sugar etc. are fulfilled and also fulfill needs of livestock.
 11. Advantages of raising short duration crops (catch crop / vegetables) when long season crops cannot be raised due to some reasons. (3).

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Q. 8. Define weed and explain damages (losses) caused by weeds.
 Weed: It is a plant growing at a place and time where it is not desired (1).

Damages (losses) caused by weeds

- 1. Reduction in crop yields:** Weeds compete with crop plants for plant nutrients moisture, space and sunlight. They are hardly and vigorous in growth habit. So they grow faster than crop plants, consume large quantities of water, nutrients and also cause shading effect (smother the crop) resulting in considerable reduction in crop yields – some of them (weeds) are parasites either partially or totally on crop plants.
- 2. Weeds harbour Pests and Diseases:** Weeds present in the off season on field bunds, wastelands, irrigation channels etc harbour pests and diseases (act as alternate host for pest & diseases) which attack the crops sown subsequently e.g.

Crop	Pest / Disease	Alternate Host (Weeds)
Red gram	Gram Caterpillar	<i>Amaranthus, Datura</i>
Rice	Stem borer	<i>Echinochloa, Panicum</i>

- 3. Allelopathy or Teletoxy (seeds secretions are harmful) :** The phenomenon of one plant having detrimental (harmful) effect on another plant through the production of chemical compounds (allopathic compounds) is called alleopathy.
- 4. Weeds increase the cost of cultivation of crop:** Generally, it is estimated that about 30% of the total expenditure for crop production is on tillage operations.
- 5. The quality of farm produce is lowered:** When the crop is harvested from weedy field, the weeds seeds get contaminated and lower the quality of grains. Weed seeds present in the produce cause odd odours to flour.
- 6. Weeds lower quality of animal products:** Certain seeds like parthenium, Hulhul (*Cloome viscosa*), wild onion or wild garlic etc. when mixed with forage impart off flavours or bitter taste to the milk. Seeds of gokhru (*Xanthium strumarium*) get attached to the body of sheep and seriously impairs wool quality
- 7. Weeds are harmful to human beings:** Some of the weeds cause health problems and allergic reactions. Parthenium : Skin Irritation and allergy (Dermotitis). Mixture of *Argemone mexicana* in mustard seed cause dropsy disease, water is collected in different body parts.
- 8. Weeds are harmful to animals: (Animal health problems):** Many weeds are poisonous to animals when ingested. *Datura stramonium* (Datura) may cause death of animals if eaten by them. *Sorghum halapense* (Johnson grass) at its tillering stage is poisonous to grazing animals because of its high prussic acid (HCN) Content.
- 9. Weeds lower irrigation efficiency and storage capacity of irrigation tanks:** Weeds check flow of water in canals and field channels and increase seepage losses and overflow of water resulting in lowering irrigation efficiency. Aquatic weeds like water hyacinth *Hydrilla spp, Typha spp.* (cattails) are menace to fisheries and navigation and also lower volumes of water in irrigation tank.
- 10. Weeds lower value of land:** Land infested by the perennial weeds such as *Cyperus rotundus, Cynodon dactylon* etc. makes land unsuitable for economic crop production and such land fetches less price in the market.
- 11. Weed reduces the carrying capacity of grazing lands and pastures**
- 12. Weeds cause wear and tear of farm implements and interference to field operations:** They reduce efficiency of farm implements.
- 13. Some of the noxious perennial weeds limit the choice of crop.**

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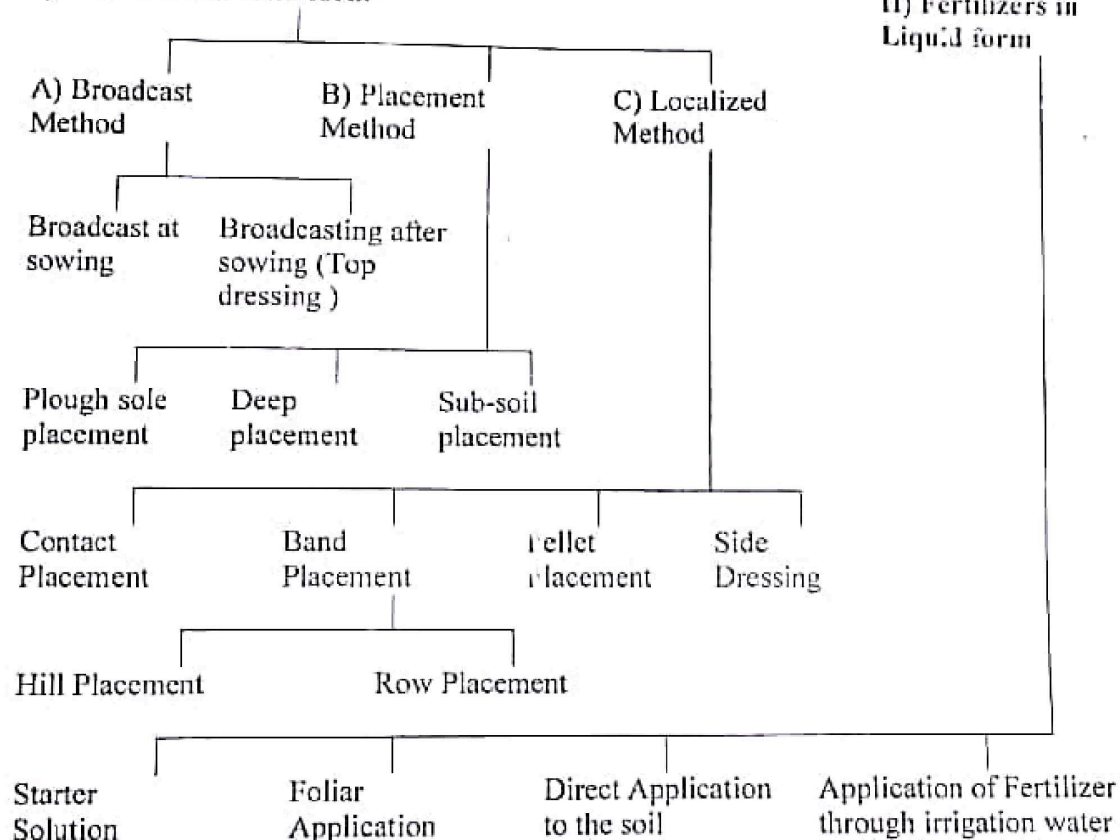
- 14. Mis-utilization of weeds: e.g. *Veratrum spp* for poisoning the drinking water.
- 15. Many weeds lower beauty of public places: Weeds lower aesthetic value of garden e.g. if in a lawn the weeds are present.
- 16. Weeds menace to woodlands and forests: In forests dry weeds offer potential source of fire hazards e.g. *lantana camara* catch fire even when green. Similarly unwanted brush weeds reduce tree growth (3).

Q.9. Enlist different methods of fertilizer application and explain about localized method of fertilizer application.

Methods of application of fertilizers: (1)

I) Fertilizers in solid form

II) Fertilizers in Liquid form



Localized placement: Application of fertilizers in the soil by taking into account the position of seed, seedlings or growing plants. In other words, application of fertilizers in the soil close to the seed or plant. This method is useful, when relatively small quantities of fertilizers are to be applied. Fertilizers are placed in bands or pockets. This method reduces fixation of phosphorus and potassium.

i) **Contact placement:** Drilling of fertilizer and seed together while sowing i.e. placing of seed and fertilizers in the same row. The greatest hazard of this method is that the seed germination may sometimes be affected. This hazard can be avoided by placing the fertilizer below the seed by fertilizer drill. Only small quantity of fertilizer can be combined and drilled along with seeds so that germination may not be adversely affected.

ii) **Band placement:** Fertilizer is placed either continuous or discontinuous bands. Application of fertilizer in discontinuous bands is known as 'hill placement'. It is most useful for widely spaced crops e.g. fruit crops, vegetables etc. Application of fertilizer in continuous bands is known as row placement. It is most useful for crops like – Sugarcane, Potato, Maize, Cotton, Tobacco etc. Hill

placement or ring placement can be followed when plants are widely spaced particularly in square planting. Row placement can be followed for placing fertilizers on one side or both sides of the rows by hand or a seed drill.

ii) Pellet application: In this method, the nitrogenous fertilizer is applied in the form of pellets 3 to 5 cm. deep between two rows of the paddy crop. For this purpose fertilizer is mixed with soil in 1:10 ratio and made into dough. Then small pellets are made and deposited in the mud of paddy field. Application of urea through mud balls and paper packets is convenient for deep placement. Urea Super Granules (USG) is also conveniently placed in rice.

iv) Side dressing: In this method the fertilizers are spread in between the rows or around the plants. 1. Application of nitrogenous fertilizers in between the rows by hand. 2. Wide spaced crops like Maize, Sugarcane, Tobacco etc. 3. Application of mixed or straight fertilizers around the base of fruit trees like Banana, Grape, and Mango. It is also known as **mud application or ring method (3)**.

Q.10. Write short notes on (Any two).

a) Characteristics of good quality seed: (2).

- 1) It should be **genetically pure** and should exhibit or bear true morphological and genetically characters of the particular variety/ hybrid of the crop. It must be true to its type.
- 2) They should be free from any admixtures of seeds of other strains of same crop or other crops, weed seeds, dirt and inert material.
- 3) They should have assured and **high germination capacity** which results into vigorous and healthy seedlings.
- 4) Seed should be mature, well developed and uniform in size. OR It must be uniform, in its texture, structure and look.
- 5) They should be free from disease bearing organisms and pests.
- 6) It should be dry and not mouldy in case of cereals, pulses, oilseeds, forage crops etc. However, in case of crops like sugarcane, turmeric, ginger, potato etc, seed material should have sufficient moisture and not dry. Seed should be truthfully labelled and produced under all due cares and strict supervision so that it does not degenerate quality.

b) Signs of maturity in sugarcane: (2)

- 1) General yellowish colour of whole crop.
- 2) Cessation of growth and emergence of **arrows** in case of flowering varieties.
- 3) Swelling of eye buds.
- 4) Cane gives metallic sound when tapped with fingernail at the internodes.
- 5) Breaking of cane at the nodes.
- 6) Increase in sweetness of juice.
- 7) If the broken cane is observed against the sunlight sugar crystals are seen in it.
- 8) Increase in brix reading. Brix reading should be 19 to 24 at the harvesting depending upon the varieties.

c) Zero tillage: (2).

It is an extreme form of minimum tillage. The primary tillage (ploughing) is completely avoided and secondary tillage is restricted to seedbed preparation in the row zone only. It is also known as no till or no-tillage or plough less farming. It is adopted in areas where soils are subjected to wind and water erosion, and cost of tillage and labour is too high. In this methods the machinery performs four tasks (functions) in one operation viz, clean a narrow strip over the crop row, open the soil for seed insertion, place the seed and cover it properly. In case of fruits crop

only trenches are opened at required distance and other operations are not carried out. In zero tillage, herbicides are used before sowing for destroying vegetation or weeds. Generally, non-selective herbicides with relatively short residual effect (paraquate, glyphosate etc) are used before sowing of the crops. During subsequent stages of crop growth, selective and persistent herbicides are needed; e.g. In rice - wheat cropping system, the field preparation is difficult for wheat sowing. Paraquat 2 litres a.i. / ha is applied to kill rice stubbles and other vegetation. Wheat is drilled in between rice rows (stubbles) and weeds in wheat are controlled by selective post-emergence herbicide application. The seeding establishment in zero tillage is 20 per cent less than conventional methods.

Advantages of zero tillage:

- 1] The zero tilled soil is homogenous in structure with more number of earth worms
- 2] It increases organic matter content of soil due to less mineralization
- 3] Surface runoff is reduced and infiltration of water is increased due to mulching
- 4] It saves cost on preparatory and inter tillage.
- 5] It moderates soil temperature, due to surface mulch.

Disadvantages of Zero tillage: -

- 1] Sometimes germination and crop stand is affected as compared to conventional tillage.
- 2] Sowing operation with ordinary implement is difficult
- 3] Higher dose of nitrogen is required as mineralization of organic matter is slow.
- 4] Large population of perennial weeds becomes serious problem.
- 5] Continuous use of herbicides may cause environmental pollution and pests build up are other problems.

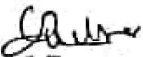
SECTION "B"

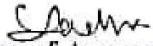
Q11. Define the following terms (4).

1. Seed dormancy: It is an internal condition of viable seed which does not allow its actual germination, although suitable temperature, moisture and aeration etc. are provided.
2. Puddling: Puddling operation consists of ploughing repeatedly in standing water until the soil becomes soft and muddy.
3. Nutrient use efficiency: Nutrient (fertilizer) use efficiency indicates yield of crops (biomass or economic yield) in kg of nutrient applied. Or The extent recovery of applied fertilizer nutrient by crop indicate the nutrient (fertilizer) use efficiency.
4. Top dressing of fertilizers: The application of fertilizers in standing crop is known as top dressing.

Q.12. State true or false and correct the statement if necessary (4).

1. The physical condition of soil resulting from tillage is called as tith (True).
2. Bajra seeds are treated with brine solution for control of rust disease (False).
Ans. Bajra seeds are treated with brine solution for control of ergot disease.
3. The disc plough is used for breaking hard pans in sub soil (False).
Ans. The chisel plough is used for breaking hard pans in sub soil.
4. One crop/variety grown in pure stands at normal density is called solid planting (True).


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