Long Answer Type Questions

Q. 1. Define growth. Explain the phases of growth.

Ans. Growth is defined as 'a permanent or irreversible increase in dry weight, mass or volume of a cell, organ or organism'.
Plant growth takes place in three steps or phases cell division (meristematic), cell elongation and cell maturation.

(i) Cell division (Meristematic) phase: (i) It is also called formative phase. (ii) New cells are produced by mitotic divisions of the pre-existing cells. (iii) The meristematic cells have thin cellulose walls with abundant plasmodesmetal connections, dense protoplasm and conspicuous nuclei. (iv) In higher plants, cell division occurs in meristems or growing points. (v) As the formation of new cells requires intense biosynthetic activity, the rate of respiration in the cells of formation phase is very high.

(ii) Cell enlargement phase: (i) This phase lies just behind the growing points and is mainly responsible for growth of plant parts. (ii) The newly formed cells, produced in formative phase ergo enlargement. (iii) The enlarging cell also develops a central vacuole. Rate of respiration is but less than that of the cells in the formative phase. (iv) Thus, this phase is characterised by cell enlargement, new cell wall deposition and increased vacuolation.

(iii) Cell maturation phase: (i) This phase occurs just behind the phase of elongation. (ii) The enlarged cells develop into particular type of cells by undergoing structural and physiological differentiation. (iii) Hence, at this phase all the diverse tissue types observed in root or stem viz., epidermis, cortex, vascular tissues etc., and cell are differentiated.

Q. 2. What is growth rate? How will you measure the rate of growth ?

Ans. (i) Growth rate refers to the expression of increased growth per unit time.

(ii) It can be arithmetic or geometric increase.

(iii) In arithmetic growth, following mitotic cell division only one daughter cell continues to divide while the other differentiates and mature.

(iv) The simplest expression of arithmetic growth is exemplified by a root elongating at a constant rate.

(v) On plotting length of the organ at different times a linear curve is obtained.

It is expressed as:

$$L_t = L_0 + rt$$

Here, L_t = Length at time 't'

L_0 = Length at time Zero'

r = growth rate per unit time.

(vi) In geometrical growth, the initial growth is slow (lag phase) and rapidly at an exponential rate (log or exponential phase).

(vii) In this growth, both the progeny cells formed by mitotic cell division retain the ability to divide and continue to do so.

(viii) However, with limited nutrient supply, the growth slows down (stationary phase).

(ix) If we plot a parameter of growth against time, we get a typical S-shaped or sigmoid curve.

(x) The exponential growth can be expressed as:

$$W_1 = W_0 e^{rt}$$

Here,

W_1 = final size (Weight, height, number etc.)

W_0 = initial size

r = growth rate

t = time of growth

e = base of natural logarithms.

Q. 3. Discuss the role of growth regulators in agriculture.

Ans. Role of growth regulators in agriculture:

(i) Parthenocarpy: The knowledge of the fact that application of auxins and gibberellins on unpollinated flowers results in the production of seedless fruits has been a great horticultural importance. It has been of great significance in such fruits where the number of seeds is very high and the seeds are of light food value (e.g., tomato, brinjal, guava, papaya, watermelon, orange) or the seeds are large in size (e.g., Litchi and Mango).

(ii) Flower thinning: This problem refers to fall of unpollinated or unfertilized flowers from certain fruit trees e.g., in pineapple and litchi. This problem has been solved to a great extent by spraying the plants with 2, 4-D and Naphthalene Acetic Acid (NAA) both of which are synthetic auxins.

(iii) Fruit ripening: Ethylene plays an important role in ripening of various fruits like oranges, lemons, grapes, banana etc.

(iv) Root inducing or Root induction: NAA and Indole Butyric Acid (IBA) are very important in inducing roots on stem cuttings. Many plants are known which propagate by their stem cuttings such as *Bougainvillea*, roses, grapes, apples, coleus etc.

(v) Seed germination: Seeds having long periods of dormancy can be made to germinate early by the application of auxins

Q. 4. Mention elaborately the functions of Auxins.

Ans. Functions of Auxins:

(i) Cell enlargement: Auxins promote elongation and growth of stems and roots enlargement of many fruits by stimulating cell enlargement.

The auxins cause cell enlargement by solubilization of carbohydrates, loosening of microfibrils synthesis of more wall materials, increased membrane permeability and respiration.

(ii) Cell division in cambium: Auxin is responsible for initiation and promotion of cell division in cambium. The reactivation of cambium in the growing season is apparently triggered by IAA moving from the developing shoot buds.

(iii) Cell division and tissue culture: In tissue culture auxins initiate and promote cell division, and result in the formation of callus.

(iv) Root growth and root initiation: Auxins promote root growth only at extremely low concentration. At higher concentration, auxin is suitable for shoot elongation.

Q. 5. Give the natural and artificial overcoming of seed dormancy.

Ans. Natural overcoming of seed dormancy:

(i) Weakening of tough and impermeable seed coats by microbial action.

(ii) Rupturing or weakening of seed coats by mechanical abrasions.

(iii) Action of digestive enzymes present in alimentary canals of birds and other animals which happen to feed on their fruits.

(iv) Leaching of inhibitors present in the seed coat.

(v) Inactivation or oxidation of inhibitors by heat, cold and light.

Artificial overcoming of seed dormancy:

(i) Rupturing of seed coats or scarification by abrasion through machine threshing, filing, chipping, vigorous shaking, etc.

(ii) Treatment with hot water or fat solvents for dissolution of surface inhibitors, waxes, etc.

(iii) Treatment with concentrated sulphuric acid for a short period followed by thorough washing to remove all traces of the mineral acid.

(iv) Stratification or subjecting the moist seeds in the presence of oxygen to periods of low or high temperature.

(v) Counteracting the effect of growth inhibitors by soaking the seeds in potassium nitrate, ethylene chlorohydrin, thiourea, gibberellins, etc. Exposure to high concentration of oxygen has similar effect.

Q. 6. What is seed dormancy? How many types of dormancy are there ?

Ans. Seed dormancy or rest is the internal or innate inhibition of germination of otherwise normal or viable seed even when present under most favourable conditions required for its germination.

Dormancy is of several types. The important ones are as follows:

(i) Immature embryo: The embryo is not fully developed at the time of seed shedding. The period of seed dormancy corresponds to the period required by the embryo for its complete development. e.g. *Ginkgo biloba.*

(ii) After ripening: After shedding, the seeds of barley, wheat require an interval of ripening before they attain the power of germination. This period is needed to produce the necessary growth hormones.

(iii) Impermeability of seed coats: The seed coats are impermeable to water, gases or chemical e.g., *Chenopodium*, Apple, *Xanthium* respectively.

(iv) Tough seed coats: The seed coats are hard and growth of provide mechanical resistance to the embryo.

Q. 7. What are the uses of Ethylene and Abscissic acid?

Ans. Uses of Ethylene:

(i) Ethylene is used for colour development and ripening of certain fleshy fruits.

(ii) Application of ethephon in cucumber increases the number of female flowers and hen fruits

(iii) The sprouting of storage organs such as rhizomes, corms, tubers can be enhanced by exposing them to ethylene.

Uses of Abscissic acid:

(i) ABA can be used as anti-transpirant. Application of minute quantity of ABA to leaves reduces transpiration to a great extent through partial closure of stomata.

(ii) Abscissic acid can be used to promote rooting in many stem cuttings.

(iii) The dormancy of buds, seeds and storage organs can be prolonged by the application of ABA.

Q. 8. Mention the examples which prove that phytohormones act synergistically or antagonistically.

Ans. The factors which prove the phytohormones act synergistically or antagonistically are:

(i) Cell division is promoted by both auxins and cytokinins acting synergistically.

(ii) Auxin and cytokinins interact to control morphogenetic differentiation of shoot and root. When auxin is in excess, roots differentiate on the callus, while excess of cytokinins promote bud formation.

(iii) Auxins and cytokinins acts antagonistically in controlling apical dominance. Auxins causes apical dominance, while cytokinins overcome the same

(iv) Senescence is prevented by auxins and cytokinins, while it is stimulated by abscisic acid.

(v) The dormancy of seeds and buds is mostly due to abscissic acid, the same is broken by gibberellins.

(vi) Cytokinins cause opening of stomata, while abscisic acid results in their closure.

Q.9. Explain the role of phytohormones in parthenocarpy and weed control.

Ans. (i) Parthenocarpy: (a) The application of auxins and gibberellins on unpollinated flowers results in the production of seedless fruits.

(b) It has been of great significance in such fruits where the number of seeds is very high and the seeds are of little food value (*e.g.,* tomato, brinjal, guava, papaya, watermelon, orange) or the seeds are large in size (*e.g.,* Litchi and Mango).

(c) Natural parthenocarpy in banana and grapes is because their seedless varieties have higher content of endogenous auxins.

(ii) Weed control:

(a) 2, 4-D and 2, 4, 5-T (Trichlorophenoxy acetic acid) are specific killers of dicot herbs and are known herbicides.

(b) Thus in a field having monocot crop, dicot weeds may be eradicated by spraying either 2, 4-D or 2, 4, 5-T

(c) These weedicides penetrate the meristematic tissues of the plant and inhibit cell division.

Q.10. Explain how is flowering considered a phytochrome mediated process. How can flowering be induced in a short-day plant under long-day conditions?

Ans. Phytochrome: (i) It is the pigment which is responsible for flowering.

(ii) It makes the plant sensitive to light effect.

(iii) It is known as light absorbing pigment and is responsible for photosensitiveness of plants.

(iv) It participates in flowering. In long day plants, the light interruption of dark period does not prevent

(v) If the light is by infra-red, the flowering gets promoted.

(vi) Phytochrome occurs in two forms-one red absorbing (P_R) and the other far red absorbing

(P_{FR}).

(vii) Both the forms are photo-chemically interconvertible.

(viii) The red absorbing form after absorbing the red light is converted into far red form.

(ix) They absorbs the infra-red light and is converted back into red absorbing form of pigment.

(x) Flowering is considered a phytochrome mediated process.

(xi) Photoperiodism controls flowering in plants. Short-day plants like *Xanthium, Chrysanthemum* require a relatively short day high period and a continuous dark period of about 14-16 hours for flowering.

(xii) Dark period is more important to induce flowering than the light period. Flowering can be induced in short day plants by red light treatment followed by far red light treatment.