NCERT Solutions for Class-XI Biology

Chapter-15

1. Define growth, differentiation, development, dedifferentiation, redifferentiation, determinate growth, meristem and growth rate.

1. (a) Growth

It is an irreversible and permanent process, accomplished by an increase in the size of an organ or organ parts or even of an individual cell.

(b) Differentiation

It is a process in which the cells derived from the apical meristem (root and shoot apex) and the cambium undergo structural changes in the cell wall and the protoplasm, becoming mature to perform specific functions.

(c) Development

It refers to the various changes occurring in an organism during its life cycle – from the germination of seeds to senescence.

(d) De-differentiation

It is the process in which permanent plant cells regain the power to divide under certain conditions.

(e) Re-differentiation

It is the process in which de-differentiated cells become mature again and lose their capacity to divide.

(f) Determinate growth

It refers to limited growth. For example, animals and plant leaves stop growing after having reached maturity.

(g) Meristem

In plants, growth is restricted to specialised regions where active cell divisions take place.

Such a region is called meristem. There are three types of meristems – apical meristem, lateral meristem, and intercalary meristem.

(h) Growth rate

It can be defined as the increased growth in plants per unit time.

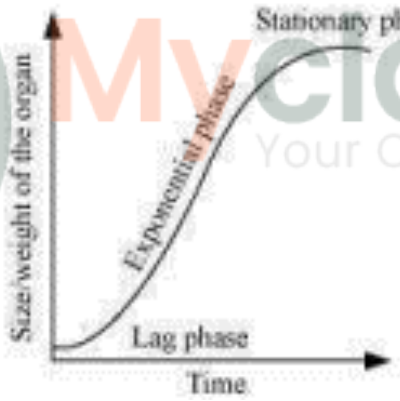
2. Why is not any one parameter good enough to demonstrate growth throughout the life of a flowering plant?

2. A flowering plant consists of a number of organs viz., roots, stem, leaves, flowers, fruits etc. growing differently under different stages of life cycle. These plant organs require different parameters to demonstrate their growth. In plant organs like fruits, bulbs, corms etc. fresh weight is used for measuring their growth. In case of fruits, increase in volume, diameter etc., are also used as other parameters for the measurement of their growth. For flat organs like leaves, increase in surface area is used as the parameter. Stem and roots primarily grow in length and then in girth, thus increase in length and

diameter are used for measuring their growth. Consequently, the flowering plants exhibit several parameters to demonstrate growth.

3. Describe briefly:
(a) Arithmetic growth
(b) Geometric growth
(c) Sigmoid growth curve
(d) Absolute and relative growth rates

3. (a) Arithmetic growth In arithmetic growth, one of the daughter cells continues to divide, while the other differentiates into maturity. The elongation of roots at a constant rate is an example of arithmetic growth.
(b) Geometric growth
Geometric growth is characterised by a slow growth in the initial stages and a rapid growth during the later stages. The daughter cells derived from mitosis retain the ability to divide, but slow down because of a limited nutrient supply.
(c) Sigmoid growth curve
The growth of living organisms in their natural environment is characterised by an S shaped curve called sigmoid growth curve. This curve is divided into three phases – lag phase, log phase or exponential phase of rapid growth, and stationary phase.



Exponential growth can be expressed as:

$W_1 = W_0 e^n$

Where,
W_1 = Final size
W_0 = initial size
r = Growth rate
t = Time of growth
e = Base of natural logarithms
(d) Absolute and relative growth rates Absolute growth rate refers to the measurement and comparison of total growth per unit time.
Relative growth rate refers to the growth of a particular system per unit time, expressed on a common basis.

4. List five main groups of natural plant growth regulators. Write a note on discovery, physiological functions and agricultural/horticultural applications of any one of them.

4. There are five main groups of natural plant growth regulators which are very much recognised as natural hormones in plants. These are:

1. Auxins
2. Gibberellins
3. Cytokinins
4. Abscisic acid
5. Ethylene

Discovery of auxin: In 1880, Charles Darwin and Francis Darwin worked with the coleoptile of canary grass (Phalaris sp.) and found the existence of a substance in coleoptile tip, which was able to recognise the light stimulus and leads to the bending of tip towards light. Boysen and Jensen (1910-1913) worked on Avena seedling and explained that the substances secreted in the tip are soluble in water (gelatin).

Paal (1919) reported that the substances secreted in the tip are translocated downwards and caused cell elongation in half portion which was on the dark side and hence bending was observed in opposite direction.

F.W. Went (1928) further refined this experiment and supported the observations of Paal. He was the first person to isolate and name these substances of tip as auxins (Greek Auxein – means 'to grow').

In 1931, Kogl and Haagen-Smith isolated crystalline compounds from human urine. These were named as auxin-a, auxin-b and heteroauxin.

Physiological functions of auxins:

1. Auxins induce cambial cell divisions, shoot cell elongation and early differentiation of xylem and phloem in tissue culture experiments.
2. In general, auxins initiate rooting but inhibit the growth of roots. IBA is the most potent root initiator.
3. Auxins inhibit the growth of axillary buds (apical dominance) but enhance the size of carpel and hence earlier fruit formation.
4. Application of auxins retards the process of senescence (last degradative phase), the abscission of leaves, fruits, branches, etc.
5. Auxins induce feminisation, i.e., on male plant, female flowers are produced.

Agricultural/horticultural application of auxins:

1. Application of auxins like IAA, IBA, NAA induce rooting in stem cuttings of many plants. This method is widely used to multiply several economically useful plants.
2. Normally, auxins inhibit flowering however in litchi and pineapple, application of auxin promotes flowering thus used in orchards.
3. Auxin induces parthenocarpy in some plants including tomato, pepper, cucumber and Citrus, thus, produces seedless fruits of more economic value.
4. Auxins like 2, 4-D and 2, 4, 5-T are commercially used as weedicides, due to their low cost and greater chemical stability. They are selective herbicides (killing broad-leaved plants, but not grasses).
5. For checking premature fruit drop, auxins are applied which prevent the formation of abscission zone in the petiole or just below the fruit. Auxin regulates maturing fruit on the

trees of apples, oranges and grape fruit. High doses of auxins can cause fruit drop. Thus, heavy applications of synthetic auxins are used commercially to promote a coordinated abscission of various fruits to facilitate harvesting.

6. Auxin, produced in the apical bud, suppresses the development of lateral buds, i.e., apical dominance. Thus practically used in prolonging the dormancy period of potato tubers.
7. Naphthalene acetamide is used to prevent the lodging (excessive elongation and development of weak plants, specially in gramineae) or falling of crops.
8. Auxin (2,4-D) promotes callus formation in tissue culture. Complete plantlets are regenerated from callus tissue, using auxins and cytokinin which are then transplanted into the soil. Now-a-days, this is a widely practised method of propagation in the field of agriculture and horticulture.

5. What do you understand by photoperiodism and vernalisation? Describe their significance.

5. Photoperiodism refers to the response of plants with respect to the duration of light (i.e., period of day and night). On the basis of its response to the duration of light, a plant is classified as a short-day plant, a long-day plant, or a day-neutral plant. Short-day plants flower when they are exposed to light for a period less than the critical day-length (for example: Chrysanthemum). Long-day plants flower when they are exposed to light for a period more than the critical day-length (for example: radish). When no marked correlation is observed between the duration of exposure to light and the flowering response, plants are termed as day-neutral plants (for example: tomato).

It is hypothesised that the hormonal substance responsible for flowering is formed in the leaves, subsequently migrating to the shoot apices and modifying them into flowering apices. Photoperiodism helps in studying the response of flowering in various crop plants with respect to the duration of exposure to light. Vernalisation is the cold-induced flowering in plants. In some plants (such as the winter varieties of wheat and rye and biennials such as carrot and cabbage), exposure to low temperature is necessary for flowering to be induced. The winter varieties of rye and wheat are planted in autumn. They remain in the seedling stage during winters and flower during summers. However, when these varieties are sown in spring, they fail to flower. Similar response is seen in cabbage and radish.

6. Why is Abscisic acid also known as stress hormone?

6. A fairly high concentration of abscisic acid (ABA) is found in leaves of plants growing under stress conditions, such as drought, flooding, injury, mineral deficiency etc. It is accompanied by loss of turgor and closure of stomata. When such plants are transferred to normal conditions, they regain normal turgor and ABA concentration decreases. Since the synthesis of ABA is accelerated under stress condition and the same is destroyed or inactivated when stress is relieved, it is also known as stress hormone.

7. 'Both growth and differentiation in higher plants are open'. Comment.

7. Growth and development in higher plants is referred to as being open. This is because various meristems, having the capacity for continuously dividing and producing new cells, are present at different locations in these plant bodies.

8. 'Both a short day plant and a long day plant can flower simultaneously in a given place'. Explain.

8. A short day plant (SDP) flowers only when it receives a long dark period and short photoperiod, e.g., Xanthium, Dahlia etc. On the other hand, a long day plant (LDP) will flower only when it receives a long photoperiod and short dark period, e.g., wheat, oat etc. Thus critical photoperiod is that continuous duration of light which must not be exceeded in SDP and should always be exceeded in LDP in order to bring them to flower. Xanthium requires light for less than 15.6 hrs and Henbane requires light for more than 11 hrs. Xanthium (a SDP) and Henbane (DP) will flower simultaneously in light period between 11 to 15.6 hrs.

9. Which one of the plant growth regulators would you use if you are asked to:
(a) Induce rooting in a twig
(b) Quickly ripen a fruit
(c) Delay leaf senescence
(d) Induce growth in axillary buds
(e) 'Bolt' a rosette plant
(f) Induce immediate stomatal closure in leaves.

9. (a) Induce rooting in a twig – Auxins
(b) Quickly ripen a fruit – Ethylene
(c) Delay leaf senescence – Cytokinins
(d) Induce growth in axillary buds – Cytokinins
(e) 'Bolt' a rosette plant – Gibberellic acid
(f) Induce immediate stomatal closure in leaves – Abscisic acid

10. Would a defoliated plant respond to photoperiodic cycle? Why?

10. No, a defoliated plant would not respond to photoperiodic cycle because photoperiodic stimulus is picked up by the leaves only. Even one leaf or a part of it is sufficient for this purpose. For perception of photoperiodic cycle, there must be the presence of leaves under inductive photoperiod, so that, the hormone responsible for flowering can be produced.

11. What would be expected to happen if:
(a) GA_3 is applied to rice seedlings
(b)Dividing cells stop differentiating
(c) A rotten fruit gets mixed with unripe fruits
(d)You forget to add cytokinin to the culture medium.

11. (a) If GA_3 is applied to rice seedlings, then the rice seedlings will exhibit internodeelongation and increase in height.

(b) If dividing cells stop differentiating, then the plant organs such as leaves and stem will not be formed. The mass of undifferentiated cell is called callus.
(c) If a rotten fruit gets mixed with unripe fruits, then the ethylene produced from the rotten fruits will hasten the ripening of the unripe fruits.
(d) If you forget to add cytokinin to the culture medium, then cell division, growth, and differentiation will not be observed.