Plant Growth & Development

13 Chapter

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

Ans: The definitions are as follows:

- Growth: - A permanent and irreversible increase in the size of an organ or its parts, or even a single cell, is defined as growth. It is usually accompanied by anabolic and catabolic processes (metabolic processes).
- Differentiation: - Differentiation is the process by which cells from the shoot apical meristem, root-apical meristems, and cambium develop and mature to perform specialised functions.
- Development: - All of the changes that an organism goes through during its life cycle is referred to as development. Germination of seeds, growth, differentiation, maturation, flowering, seed formation, and senescence are all the series of events that occur in the life history of a plant that comes under development.
- Dedifferentiation: - Dedifferentiation is the process by which permanent plant cells regain the ability to divide under certain conditions.
- Redifferentiation: - Redifferentiation is the process by which de-differentiated cells mature and lose their ability to divide.
- Determinate growth: - Determinate growth is the type of growth in which growth stops after a certain phase.
- Meristem: - Meristem are the specialised regions in the plants where active cell division takes place.
- Growth rate: - The increased growth rate per unit time is referred to as the growth rate.

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

Ans: Growth, at a cellular level, is primarily associated with an increase in the amount of protoplasm. Many parameters are involved in measuring protoplasm growth, including the differences in length, area, volume, and cell number, the weight of the fresh tissue sample and the weight of the dry tissue samples measured during the growth period. As a result, no single parameter is good enough to demonstrate the growth throughout the life of a flowering plant.

3. Describe briefly:

a. Arithmetic growth

Ans: Just one daughter cell divides following mitotic cell division in arithmetic growth, whereas the other differentiates and develops. For example, the elongation of roots at a constant rate. A linear curve is obtained by plotting the length of the organ against time. Mathematically, it is written as: -

$$L_t = L_0 + rt$$

Hence, L_t is length at time 't', L_0 is the length at time zero and r is the growth rate or elongation per unit time.

b. Geometric growth

Ans: In most systems, the initial growth is slow and is referred to as the lag phase, and after that, it increases rapidly at an exponential rate and is referred to as the log or exponential phase. In this case, both progeny cells that result from mitotic cell division retain the capacity to divide and continue to do so. However, when nutrition availability is limited, growth slows and eventually stops, resulting in a stationary phase. A sigmoid curve can be seen on the graph of geometric growth.

c. Sigmoid growth curve

Ans: A sigmoid curve is a characteristic property of a living organism growing in its natural habitat. The lag phase, the log phase or exponential phase of rapid growth, and the stationary phase are the three phases of this curve.

Exponential growth can be expressed as:

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

W_1 = Final size (weight, number, height etc.)

W_0 = Initial size at the beginning of the period.

r = Growth rate

t = Time of growth

e = Base of natural logarithms

d. Absolute and relative growth rates

Ans: The measurement and the comparison of total growth per unit time are called the absolute growth rate. The relative growth rate is the rate at which a particular system grows per unit time on a common basis, e.g., per unit initial parameter.

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

Ans: The five main groups of natural plant growth regulators are: -

i. Auxins

ii. Gibberellic acid

iii. Cytokinins

iv. Ethylene

v. Abscisic acid

Discovery, physiological functions and agricultural/horticultural applications of Auxins are summarised as follows: -

Discovery:

Charles Darwin and Francis Darwin made the first observations about the effects of auxins when they noticed that the coleoptiles of canary grass responded to unilateral illumination by growing towards the light source (phototropism). It was determined after a series of experiments that the tip of the coleoptile was the site of transmittable influence which results in the bending of the entire coleoptile. F.W. Went isolated auxin from the tips of the coleoptiles of oat seedlings.

Physiological Functions:

- They control plant cell growth.
- They cause the phenomenon of apical dominance i.e.; the growing apical buds inhibit the growth of the axillary buds.
- They control division in the vascular cambium as well as xylem differentiation.
- They also induce parthenocarpy.
- They prevent the abscission of leaves and fruits.

Horticulture Application:

- They help in the initiation of rooting in stem cuttings, which is a popular method of plant propagation.
- They are used as herbicides. Example: - **2-4 D** is a weedicide used to kill dicotyledonous weeds.
- They induce parthenocarpy. Example: - Tomatoes.
- They also promote flowering. Example: - Pineapples.

5. Why is Abscisic acid also known as a stress hormone?

Ans: Abscisic acid promotes the closure of stomata in the epidermis and increases plant tolerance to a variety of stresses. As a result, it is also known as the stress hormone. It encourages seed dormancy and seed germination under favourable conditions. It makes seeds more resistant to desiccation. It also promotes the abscission of leaves, fruits, and flowers and helps in the activation of dormancy in plants at the end of the growing season.

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

Ans: The higher plants have the ability to grow indefinitely throughout their lives. This ability is due to the presence of meristems at specific locations in the body of plants. These meristems (consisting of meristematic cells) have the capacity to divide and self-replicate. Hence, growth in higher plants is considered to be open. Also, some of these cells always differentiate after a few rounds of cell division. As a result, the differentiation is also open.

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

Ans: Flowering in some plants is influenced by the lengths of light and dark periods. If both the short-day and long-day plants are given an adequate photoperiod, they can flower at the same time.

8. Which one of the plant growth regulators would you use if you are asked to:

a. Induce rooting in a twig

Ans: Auxin is used to induce rooting in a twig.

b. Quickly ripen a fruit

Ans: Ethylene is used to quickly ripen a fruit.

c. Delay leaf senescence

Ans: Cytokinins are used to delay leaf senescence.

d. Induce growth in axillary buds

Ans: Cytokinins are used to induce growth in axillary buds.

e. Bolt a rosette plant

Ans: Gibberellins are used to bolt a rosette plant.

f. Induce immediate stomatal closure in leaves.

Ans: Abscisic acid or ABA is used to induce immediate stomatal closure in leaves.

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

Ans: No, the leaves are the sites of perception of light / dark duration. As a result, a defoliated plant will not respond to the photoperiodic cycle. Hence, the plant would not respond to light in the absence of leaves.

10. What would be expected to happen if:

a. GA_3 **is applied to rice seedlings**

Ans: When GA_3 is applied to rice seedlings, the rice seedlings will show an increase in height and promote elongation of internodes.

b. Dividing cells stop differentiating

Ans: Plant organs such as leaves and stems will not form if dividing cells stop differentiating.

c. A rotten fruit gets mixed with unripe

Ans: When a rotten fruit is mixed with unripe fruits, the ethylene produced by the rotten fruits causes the unripe fruits to ripen faster.

d. You forget to add cytokinin to the culture medium

Ans: Cell division, growth, and differentiation will be slowed if you forget to add cytokinin in the culture medium.