

CHAPTER 13

PLANT GROWTH AND DEVELOPMENT

NCERT EXERCISE AND SOLUTIONS - BIOLOGY

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

ANSWER:-

- **Growth:** An irreversible, permanent increase in the size of an organ, its parts, or individual cells, supported by metabolic activities fueled by energy.
- **Differentiation:** The process by which cells from root and shoot apical meristems or cambium mature to perform specific functions.
- **Development:** The sum of all changes an organism undergoes during its lifetime.
- **Dedifferentiation:** The ability of plant cells that have lost their capacity to divide to regain this ability under certain conditions, such as meristem formation.
- **Redifferentiation:** Cells formed through dedifferentiation lose their ability to divide again and mature to perform specialized functions.
- **Determinate growth:** Growth that occurs for a specific period, seen in some plants that grow to a certain size and then stop.
- **Meristem:** Plant tissue composed of undifferentiated, actively dividing cells known as meristematic cells.
- **Growth rate:** The increase in growth measured per unit of time.

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

ANSWER:-

Growth results from an increase in the quantity of protoplasm. Measuring protoplasmic growth involves various parameters, such as an increase in height, weight, cell number, fresh tissue mass, length, area, or volume. Consequently, it is challenging to rely on a single parameter to represent growth throughout the lifespan of a flowering plant.

Q. 3. Describe briefly:

- (a) Arithmetic growth
- (b) Geometric growth



- (c) Sigmoid growth curve
 (d) Absolute and relative growth rates

ANSWER:-

- (a) **Arithmetic Growth:** In arithmetic growth, one daughter cell continues to divide, while the other differentiates and matures. A root elongating at a constant rate illustrates this type of growth. Mathematically, it is expressed as:

$$L_t = L_0 + rt$$

Where:

- L_t : Length at time t
 - L_0 : Initial length at time zero
 - r: Growth rate or elongation per unit time
- (b) **Geometric Growth:** Geometric growth begins with a slow initial phase (lag phase), followed by a rapid exponential phase (log phase) where both progeny cells retain the ability to divide after mitosis. Growth slows during the stationary phase due to nutrient limitations. This type of growth follows a multiplicative pattern, and when plotted against time, it results in a sigmoid (S-shaped) curve.

Exponential growth is represented mathematically as:

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

Where:

- W_1 : Final size
- W_0 : Initial size
- r: Growth rate
- t: Time
- e: Base of natural logarithms

The relative growth rate (r) reflects a plant's efficiency in producing new substances, also called the efficiency index. Thus, the final size (W_1) depends on the initial size (W_0).

- (c) **Sigmoid Growth Curve:** The sigmoid or S-shaped growth curve is obtained by plotting growth against time. It consists of four phases: the slow lag phase, the rapid exponential phase, the phase of diminishing growth, and the stationary phase.
- (d) **Absolute and Relative Growth Rates:**

Absolute Growth Rate: The total growth per unit time.

Relative Growth Rate: The growth rate per unit time relative to the initial size.

- Q. 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.**

ANSWER:-

Plant Growth Regulators (PGRs):

Plant growth regulators are intrinsic chemical substances that regulate the growth and development of plants. The five primary groups of natural PGRs are:



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

These PGRs are produced in various plant parts and play a vital role in controlling differentiation and developmental processes throughout the plant's life cycle.

Gibberellins

Discovery:

- Gibberellins, denoted as GA1, GA2, GA3 (gibberellic acid), were among the first identified and are acidic in nature.
- Over 100 gibberellins have been identified in fungi and higher plants.

Physiological Functions:

- Promote a variety of physiological responses in plants.
- Increase the length of grape stalks by elongating the axis.
- Enhance the elongation and shape of fruits like apples.
- Delay the process of senescence, extending the functional life of plant parts.

Agricultural and Horticultural Applications:

- Delayed senescence allows fruits to remain on trees longer, extending their market availability.
- In the brewing industry, gibberellic acid (GA3) accelerates the malting process.
- In sugarcane, gibberellin application increases stem length, boosting yields by up to 20 tonnes per acre.
- Juvenile conifers can be sprayed with GAs to hasten seed production by reducing their maturity period.
- Gibberellins promote bolting, or rapid internode elongation, in crops like beetroots and cabbages, which occurs just before flowering.

Q. 5. Why is abscisic acid also known as stress hormone?

ANSWER:-

Abscisic acid plays a crucial role in triggering the closure of stomata in the epidermis and enhancing the plant's ability to tolerate various stresses, earning it the title of the "stress hormone." It also promotes seed dormancy, ensuring that seeds germinate only under favourable conditions. This mechanism helps seeds survive desiccation and induces dormancy at the end of the growing season in plants, facilitating the abscission of fruits, leaves, and flowers.



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

ANSWER:-

The capacity of higher plants to sustain indefinite growth throughout their lifespan is attributed to the presence of meristems in specific areas of their body. These meristematic cells have the ability to divide and self-perpetuate, enabling open growth in these plants. Some of these cells undergo differentiation after several rounds of division, making differentiation an open process as well.

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

ANSWER:-

In a few plants, flowering depends on relative durations of dark and light periods. Both the long-day plants and the short-day plants can flower at the same place, with the condition being that they are supplied with sufficient photoperiod.

Q. 8. 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.

ANSWER:-

The following plant growth regulators are associated with the corresponding events:

- (a) Promote rooting in a twig – Auxins
- (b) Accelerate fruit ripening – Ethylene
- (c) Delay leaf senescence – Cytokinin
- (d) Stimulate growth in axillary buds – Cytokinin
- (e) Induce bolting in a rosette plant – Gibberellins
- (f) Trigger rapid stomatal closure in leaves – Abscisic acid

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

ANSWER:-

No, a defoliated plant will not respond to the photoperiodic cycle. This is because the leaves are the sites of perception of dark or light duration. Hence, if leaves were not present, plants would not respond to light.



Q. 10. What would be expected to happen if:

- (a) GA3 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.

ANSWER:-

- (a) When GA3 is applied to rice seedlings, it will result in internode elongation, leading to an observable increase in height.
- (b) If the cells cease differentiating, essential plant parts such as the stem and leaves will not develop.
- (c) When a rotten fruit is mixed with unripe fruits, the plant growth regulator ethylene, produced by the decaying fruit, accelerates the ripening of the unripe fruits.
- (d) If cytokinin is omitted from the culture medium, the processes of cell division, differentiation, and growth will be slowed down or inhibited.

