EXERCISE QUESTIONS

CHAPTER - 15 PLANT GROWTH AND DEVELOPMENT

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

Ans - (1) Growth: Both anabolic and catabolic metabolic processes, which consume energy, are associated with growth. A leaf's extension is an illustration of growth.

(2) Differentiation: To carry out particular roles, cells produced from root and shoot apical meristems and cambium differentiate and mature. Differentiation is the process that causes maturation. They experience minor or significant structural alterations in both their cell walls and protoplasm. As an illustration, the cells would lose their protoplasm to develop a tracheary element.

(3) Development: The term "development" refers to all alterations an organism experiences throughout its life cycle, from seed germination to senescence. The same rule applies to tissues and organs.

(4) Plants have another intriguing process called dedifferentiation. Under some circumstances, differentiated live cells that had previously lost the ability to divide can regain it. Dedifferentiation is the word for this phenomenon. Interfascicular cambium and cork cambium are two examples.

(5) Redifferentiation: As a result, such meristems/tissues have the ability to produce cells that once more lose the ability to divide but develop to carry out particular functions, i.e., they become redifferentiated. Name a few tissues that result from redifferentiation in a woody dicotyledonous plant.

(6) Determinate growth: Plants can grow in an indeterminate or determinate manner. Even in plants, differentiation is not complete because tissues produced by the same meristem at various stages of development. The position of the cell within the tissue also affects its eventual configuration as it reaches maturity. For instance, cells pushed to

the periphery develop as the epidermis while those positioned distant from root apical meristems differentiate into rootcap cells.

(7) Meristem growth: This stage of growth is represented by the cells that are constantly dividing at the root and shoot apexes.

(8) Growth rate: Growth rate is the increased growth per unit of time. As a result, the rate of growth can be mathematically represented. There are numerous ways for an organism or a portion of the organism to multiply its cells. The growth rate exhibits an increase that could be either geometrical or arithmetic.

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

Ans - A blooming plant is made up of several organs, such as roots, stems, leaves, flowers, and fruits, that grow in various ways at various phases of the life cycle. For these plant organs to show growth, various conditions must be satisfied. For assessing the growth of plant parts like fruits, bulbs, corms, etc., fresh weight is utilised.

Increases in volume, diameter, and other factors are also taken into account while measuring the growth of fruits. Increase in surface area is utilised as the metric for flat organs like leaves. Stem and roots typically expand in length, followed by girth, hence growth is gauged by changes in length and diameter. As a result, the flowering plants display a number of indicators that show growth.

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

Ans - (a) Arithmetic growth: When the length of a plant organ is plotted against time, a linear curve is shown; this growth is referred to as arithmetic growth. In this growth, the growth rate is constant and progresses in an arithmetic fashion, for example, a plant's length is measured as 2, 4, 6, 8, 10, and 12 cms at a set interval of 24 hours. It is present in roots or shoots that are extending continuously. The formula for arithmetic growth is Lt = L0 + rt. Here, Lt is the length following time t. L0 is the initial length, and r is the growth rate.

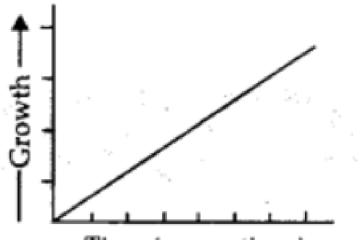

Fig.: Arithmetic growth curve

(b) Geometric growth: This type of growth occurs when both of the progeny cells that result from mitosis are still able to divide. When grown in nutrient-rich medium, it happens in many higher plants as well as in unicellular organisms. Since there are few cells at first, the growth phase that follows is referred to as the lag phase. Later, there is exponentially faster growth. It is also known as the exponential or log phase.

Fig.: Geometric growth curve

(c) Sigmoid growth curve: Long-term geometric growth is not possible. Cells can pass away. Growth is slowed by nutrition availability issues. The stationary phase follows. There could even be a decline. An ordinary sigmoid or S-curve will result from plotting the growth against time.

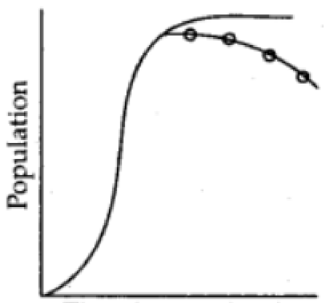

Fig.: Sigmoid growth curve

(d) The measurement of overall growth per unit of time is known as the absolute growth rate. Growth per unit of time per unit of starting growth is relative growth rate.
Measurement at the beginning of the period/Growth across the chosen time period

Let's say two leaves grew by 5 cm2 in a single day. The initial dimensions of leaf A were 5 cm2 and leaf B were 50 cm2. Despite having same absolute growth (5 cm2/day), leaf A's relative growth rate is faster than leaf B's (5/50) due to its smaller initial size.

15.4. 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

Ans - There are five primary categories of naturally occurring plant growth regulators, which are widely acknowledged to function as plant hormones. Which are:
1. Auxins
2. Gibberellins
3. Cytokinins
4. Abscisic acid
(5) Etylene

Auxin discovery: In 1880, Charles Darwin and Francis Darwin studied the coleoptile of canary grass (Phalaris sp.) and discovered that the tip of the coleoptile had a material that could recognise the light stimulus and cause the tip to bend toward the light. Working with Avena seedlings, Boysen and Jensen (1910–1913) revealed that the chemicals produced in the tip are soluble in water (gelatin).
According to Paal (1919), the compounds released at the tip are moved downward and stimulate cell elongation in half of the region of the body that was on the dark side and hence bending was observed in opposite direction.

They are a different variety of promotory PGR, it has been discovered. More than 100 gibberellins have been identified in a variety of species, including fungi and higher plants. Their designations are GA1, GA2, and GA3. When rice seedlings with the infection were treated with fungal filtrates, E. Kurosawa noted the disease's symptoms. The illness known as "bakane" (foolish seedling) in rice seedlings was brought on by Gibberalla fujikuroi. Later tests revealed that the active ingredients were gibberellic acid.

Physiological functions

(i) They make the axis grow longer, which is employed to lengthen the grape stalk.

(ii) Gibberellins lengthen and improve the form of fruit like apples.

(iii) They also delay senescence. As a result, the fruits' shelf life can be increased by leaving them on the tree for longer.

(iv) Auxins increase the size of the carpel, leading to early fruit formation, but they suppress the growth of axillary buds (apical dominance).

(v) Auxin application delays the senescence process, which includes the abscission of leaves, fruits, branches, etc (vi). Auxins cause feminization, or the production of female flowers on male plants.

Auxin use in agriculture and horticulture:

1. Many plants' stem cuttings take root when auxins like IAA, IBA, and NAA are applied. This process is frequently used to propagate a variety of economically beneficial plants.

2. Normally, auxins prevent flowering, but when applied to pineapple and litchi, they encourage flowering, which is why they are utilised in orchards.

3. Some plants, such as tomato, pepper, cucumber, and citrus, are made parthenocarpous by auxin, which results in seedless fruits with higher economic value.

4. Because they are less expensive and have superior chemical stability, auxins like 2, 4-D and 2, 4, 5-T are utilised commercially as weedicides. These herbicides are selective (killing broad-leaved plants, but not grasses).

5. Auxins are used to check for early fruit ripening and stop the formation of an abscission zone in the petiole or beneath the fruit. On apple, orange, and grapefruit trees, auxin controls the maturation of the fruit. Auxins in high doses can make fruit drop. Therefore, extensive synthetic auxin sprays are employed in the food industry to encourage coordinated fruit abscission that will make harvesting easier.

6. The apical bud, which produces auxin, suppresses the growth of lateral buds, resulting in apical dominance. Thus, it is employed practically to extend the period during which potato tubers are dormant.

7. Naphthalene acetamide is used to stop crops from lodging (an excessive lengthening and development of weak plants, particularly in gramineae) or falling.

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

Ans - Photoperiodism is the term used to describe how plants react to the length of light. A plant is categorised as a short-day plant, a long-day plant, or a day-neutral plant based on how it responds to the length of light. The study of flowering behaviour in various crop plants in relation to light exposure time benefits from the use of photoperiodism.

Plants undergo vernalization, or cold-induced flowering. Inducing flowering in some plants requires exposure to cold temperatures. Rye and wheat winter variants are sown in the autumn. Winters are spent in the seeding stage, and summers are spent in the flowering stage. These types, though, are unable to blossom when planted in the spring.

Vernalization is the process of promoting or inducing flowering in plants by exposing them to low temperatures for a period of time. The following are some implications of vernalization:

(i) Crops can be cultivated early

(ii) Plants can be cultivated in such areas where they wouldn't typically grow.

(iii)The plant's yield increases.

(iv)There is an improvement in cold and frost resistance.

(v) There is an increase in resistance to fungal infections.

15.6. Why is abscisic acid also known as stress hormone?

Ans -The leaves of plants growing under stressful situations, such as drought, flooding, damage, mineral deficiency, etc., contain a surprisingly high proportion of abscisic acid (ABA). Stomata close and turgor disappear along with it. When such plants are returned to regular circumstances, their turgor returns to normal, and their ABA concentration falls. It is also known as stress hormone because, when under stress, ABA synthesis is accelerated and, when stress is relieved, it is either destroyed or inactivated.

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

Ans - In general, plant development is unpredictable. Higher plants have special regions known as meristems that participate in the development of new cells. Plant bodies are constructed in a modular method, and because the tips (which contain the apical meristem) "are open ended, continually expanding and creating new organs to replace the older or senescent ones," the construction is never finished. Differentiation is inevitably linked to growth.

Additionally, the precise cause of distinction is unknown. Not only does a plant's growth have no limits, but so does its distinctiveness. When they reach maturity, the same apical meristem cells give rise to other cell types, including xylem, phloem, parenchyma, sclerenchyma fibres, collenchyma, etc. As a result, both processes are deterministic, limitless, and, when they reach maturity, produce diverse structures.

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

Ans - Only a short photoperiod and a long dark period are necessary for a short day plant (SDP) to flower, such as Xanthium, Dahlia, etc. On the other hand, a long day plant (LDP), such as wheat, oat, etc., will only flower when it obtains a lengthy photoperiod and short dark period. Critical photoperiod is the continuous length of light that, while it must never be surpassed in SDP, must always be exceeded in LDP to enable flowering. Henbane needs light for more than 11 hours, but Xanthium needs light for fewer than 15.6 hours. Henbane (DP) and Xanthium (a SDP) will both flower at the same time in the light period between 11 and 15.6 hours.

15.9. 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

Ans - (a) Auxins like IBA, NAA.

(b) Ethylene

(c) Cytokinins

(d) Cytokinins

(e) Gibberellins

(f) Abscisic acid (ABA)

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

Ans - Some plants' ability to blossom is influenced by both the relative durations of light and darkness as well as their combination. This cycle is photoperiodic. Because shoot apices of plants cannot independently sense photoperiods, even when they transform into flowering apices before to flowering.

The leaves are the location where light and dark durations are perceived. The hormone(s) known as florigen have been proposed as the hormone(s) in charge of flowering. Only when the plants are exposed to the required inductive photoperiod does florigen migrate from leaves to shoot apices to induce flowering.

15.11 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

Ans - (a)The coleoptile will lengthen quickly because GA3 promotes cell development.

(b) A callus will form, which is a mass of undifferentiated cells.

(c) Because of the enhanced rate of respiration brought on by the release of ethylene from rotting fruit, the unripe fruits will ripen quickly.

(d) Cell division will slow down, and the callus' shoot won't start growing.