Plant Growth and Development

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CLASS: XI **BIOLOGY**

Very Short Answer Questions (1 Mark)

1. **Define growth.**

   Growth is defined as an irreversible increase in size, weight or volume of an organism or its part.

2. **Where does growth occur in a plant?**

   Growth occurs in the meristematic regions of a plant.

3. **Define seed dormancy.**

   Seed dormancy refers to the inherent block that does not allow a seed to germinate even under favourable conditions.

4. **Name the first step towards plant growth.**

   Seed germination is the first step.

5. **What is seed germination?**

   Seed germination is the process in which the dormant embryo resumes its metabolic activities and growth under favourable conditions, after the dormancy period is over or dormancy is overcome.

6. **What is considered as the symbol of seed germination?**

   Emergence of radicle that gives rise to root system is the symbol of seed germination.

7. **Which part of the embryo of seed comes out first during seed germination?**

   Radicle comes out first during seed germination.

8. **Mention two essential conditions for seed germination.**

   Availability of water and oxygen.

9. **What term is given to the meristematic cells in the vascular bundles of dicot stem?**

   Cambium.

10. **How does water help in growth?**

    Water maintains turgidity of growing cells and provides the medium for enzymatic reactions.

11. **Write the optimum range of temperature for growth.**

    28-30°C is the optimum temperature.

12. **Define growth curve of a plant.**

    Growth curve is the graph plotted with the increase in weight or volume of a plant or plant organ as a function of time.

13. **Name the three kinds of meristems in plants.**

    Apical meristem, intercalary meristem arid lateral meristem.

14. **Which meristem helps in growth in length of plants?**

    Apical meristem

15. **Which meristem helps in the growth of plants in thickness?**

    Lateral meristems.

16. **Name the instrument used for measuring growth in plants.**

    Auxanometer or Auxograph.

17. **Name two organisms where increase in number of cells is an indication of growth.**

    Yeast, bacteria and some algae.

18. **What are phytohormones?**

    Phytohormones are the chemicals secreted by plants in minute quantities, which influence the physiological activities leading to inhibition, promotion or modification of growth.

19. **Name the first plant hormone to be discovered.**

    Auxins were the first plant hormones.

20. **Name the source from where the first auxin was isolated.**

    Human urine.

21. **Where are auxins produced in plants?**

    Auxins are produced in the apices of shoot and roots.

22. **Name two synthetic auxins.**

    2, 4 dichlorophenoxy acetic acid, naphthalene acetic acid.

23. **Expand IAA.**

    Indole-3-acetic acid.

24. **Write the full form of IBA.**

    Indole butyric acid.

25. **Name two naturally occurring auxins in plants.**

    Indole 3-acetic acid and Indole butyric acid.

26. **What are free auxins?**

    The auxins which can be easily isolated are called free auxins.

27. **What are bound auxins?**

    The auxins which cannot be extracted easily and need the use of organic solvents are called bound auxins.

28. **What is apical dominance?**

    It is the phenomenon in which presence of apical bud suppresses the growth of lateral buds into branches.

29. **What was the cause for 'bakane' disease of rice in Japan?**

    Gibberella fujikuroi, a fungus was the cause of the disease.

30. **Name the active principle responsible for bakane disease of rice.**

    Gibberellin.

31. **Which of the gibberellins was the first to be discovered?**

    GA3 was the first gibberellin to be discovered.

32. Name the first cytokinin isolated from plants and its source.

Zeatin, from maize endosperm.

33. Where are cytokinins synthesised in plants?

Cytokinins are synthesised in plants where cell divisions occur like root and shoot apices, developing shoot buds and embryos.

34. Name the only gaseous plant hormone

Ethylene.

35. Write the full form of ABA.

Abscisic Acid.

36. Define photoperiodism.

Photoperiodism is defined as the phenomenon in which plants respond to the relative length of day and night to which they are exposed.

37. What are long day plants?

Those plants which require exposure to light longer than the critical day length for their flowering are called long day plants.

38. What are short day plants?

Those plants which require exposure to light shorter than the critical day length for their flowering are called short day plants.

39. What are intermediate day plants or day neutral plants?

Those plants which flower irrespective of day length are called day neutral plants.

40. What is florigen?

Florigen is a hypothetical hormonal substance that initiates flowering.

41. Where is florigen synthesised in a plant?

Florigen is synthesised in leaves.

42. Define vernalisation.

Vernalisation is defined as the cold temperature treatment given to seeds of certain plants to induce early flowering.

43. Name two plants where vernalisation results in early flowering.

Millets, wheat, cotton. (Any two)

44. Define senescence.

Senescence is defined as the period between complete maturity and death of an organ or organism, during which deteriorative or degenerative changes take place in its structure and function.

45. What is whole plant senescence?

When the whole plant dies after producing fruits and seeds, the phenomenon is called whole plant senescence. Eg, Bean, tomato, rice, wheat. (Any two)

46. What is organ senescence?

When only those organs of the plant above the ground dies and the underground put remains alive, the phenomenon is organ senescence. Eg, Alfalfa.

47. What is abscission?

Abscission refers to shedding of leaves, flowers or fruits by a plant.

48. Name the plant hormone that plays an important role in abscission.

Abscisic acid.

Short Answer Questions (2 Marks)

1. What are long day plants? Name any four long-day plants.

Those plants which require exposure to light longer than the critical day length for their flowering are called long day plants. Eg, Wheat, Barley, Sugar beet, Larkspur.

2. What are short day plants? Name any four short day plants

Those plants which require exposure to light shorter than the critical day length for their flowering are called short day plants. Eg, Chrysanthemum, Cosmos, Rice, Dahlia.

3. Why is the term short-day plant a misnomer? Explain.

Short day plants require a light period shorter than the critical light period.

a. But flowering is actually dependent on a long, uninterrupted dark period, which must be longer than the critical dark period.

b. So they can more appropriately be called as long-night plants.

4. What will you do to prevent the leaf fall and fruit drop in plants? Support your answer with reason.

a. Localised auxin spray will prevent the leaf fall and fruit drop.

b. Auxin prevents the formation of abscission layer and the other degenerative changes that lead to abscission.

5. List any two inhibitory functions of auxins.

a. Auxins prevent the formation of abscission layer and other degenerative changes leading to abscission.

b. Auxins prevent the growth of lateral buds into branches, a phenomenon called apical dominance.

6. Write the full form of 2, 4-D. What is its use in agriculture?

- 2, 4-D is 2, 4-dichlorophenoxy acetic acid.
- It is used as a weedicide.

7. Which among the following is a long day plant? Why is it called so?

Sugar beet, sugarcane and tomato.

- Sugar beet is a long day plant.
- It is called a long day plant because it initiates flowering only when the day length/light period is longer than the critical photoperiod.

8. Differentiate between senescence and abscission.

	Senescence	Abscission
1	Senescence refers to the period between complete/reproductive maturity and death of an organ or organism.	Abscission refers to shedding of plant parts like leaves, flowers or fruits.
2	It is characterised by more catabolism, accumulation of wastes and decrease in dry weight.	This is characterised by the formation of abscission layer and digestion of middle-lamella of some cells by pectinase and cellulase enzymes.
3	It occurs due to imbalances in hormones.	Abscissic acid plays a vital role in this process.

9. How are free auxins different from bound auxins?

	Free auxins	Bound auxins
	The auxins which can be easily extracted are called free auxins.	The auxins which are difficult to be extracted, are called bound auxins
	These auxins are more active in growth.	These are inactive in growth.

10. Mention any four causes of seed dormancy.

Seed dormancy can be due to:

- Rudimentary embryos
- Impermeable seed coat.
- Mechanically resistant seed coat.
- Presence of germination inhibitors.

11. Mention any four functions of gibberellins.

Gibberellins induce the production of hydrolytic enzymes, amylases, proteases and lipases for mobilizing the reserve food materials to the embryo during germination.

- Gibberellins enhance stem elongation and overcome dwarfism.
- They enhance leaf expansion.
- They break dormancy of seeds and buds.
- They promote flowering in certain species.

12. Mention the functions of cytokinins.

- They induce cell division, even in non-meristematic tissues.
- They delay senescence.
- They reduce apical dominance and promote the growth of lateral buds.
- They also influence cell enlargement and differentiation.

13. Enumerate the functions of ethylene in plants.

- Ethylene induces horizontal growth of seedlings.
- They induce fruit ripening.

- They promote senescence and abscission.
- They cause drooping of leaves and flowers.

14. Enlist the functions of abscissic acid in plants.

- Abscissic acid promotes formation of abscission layer and abscission of parts like leaves, flowers,

  fruits, etc.
- Abscissic acid stimulates the closure of stomata under water deficit conditions.
- It induces seed dormancy and enables them to withstand desiccation.
- It increases tolerance of plants to various kinds of stresses.

15. Write a short notes on vernalisation.

Vernalisation is the method of treatment of seeds with specific low temperature to induce early flowering.

The plants of temperate regions require a period of exposure to low temperatures before flowering.

The application of temperatures as low as 1-10^{0}C to certain varieties of plants like millets, wheat, rice, etc. accelerates the growth of seedling and their early flowering.

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

Abscisic acid is called stress hormones as it induces various responses in plants against stress conditions.

It increases the tolerance of plants toward various stresses. It induces the closure of the stomata during water stress.

It promotes seed dormancy and ensures seed germination during favourable conditions.

It helps seeds withstand desiccation.

It also helps in inducing dormancy in plants at the end of the growing season and promotes abscission of leaves, fruits, and flowers.

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

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.

18. Differentiate between primary growth and secondary growth.

Primary growth	Secondary growth
It occurs due to apical shoot and root meristems.	It occurs due to lateral meristem in vascular cambium and cork cambium.
It begins from the initial stages of the plant growth.	It begins at the later stage in the plant growth.

<u>Short Answer Questions</u> (3 Marks)

1. Describe abscission in plants.

Abscission is shedding of leaves, fruits or flowers by a plant, usually due to a change in the hormonal balance.

An abscission layer is developed within the region of attachment.

The middle lamella of some cells in this layer is digested by enzymes like pectinase and cellulose.

Other degenerative changes start taking place and the region becomes soft and weak and is easily detached.

Abscissic acid plays an important role in this process.

2. Describe in detail the conditions necessary for growth.

The conditions necessary for growth are similar to that of synthesis of protoplasm and cell division.

The supply of nutrients, water, oxygen and suitable temperature are necessary for proper growth.

Nutrients provide the materials necessary for synthesis of protoplasm and also act as a source of energy.

Water maintains turgidity of growing cells and provides a medium for enzymatic reactions.

Oxygen is necessary for respiration, i.e., for oxidation of food materials and produce energy.

The optimum temperature for growth is 28 to 30^0C whereas high temperatures above 45^0C coagulate and damage the protoplasm and hinder growth.

Light is not needed in the initial stages, but is necessary for photosynthesis later.

Conditions for Growth	
Factor	**Function**
Water	Cell enlargement
	Turgidity of cells
	Provides the medium for enzymatic activities needed for growth.
Oxygen	Releasing metabolic energy essential for growth activities.
Macro and Micro Nutrients	Required for the synthesis of protoplasm and act as source of energy.
Optimum temperature	Required for proper enzymatic activity
Light and gravity	Affect certain stages of growth.

3. Enumerate the uses of auxins.

- Auxins enhance the formation of roots.
- They cause thinning of flowers and fruits for healthy growth of remaining ones.
- They control preharvest drop of fruit.
- They induce the development of parthenocarpic fruits.
- They control apical dominance, i.e., suppression of growth of lateral buds into branches.
- Auxins are used in weed control.
- They are used to improve the quality of fruits during storage.

4. Describe the phases and regions of growth in plants. Mention the characteristics of cells of each phase.

Phases of growth		
Phase of Growth	**Region**	**Characteristics of cells**
Phase of meristematic growth	The root apex and the shoot apex	The cells are rich in protoplasm.
		Possess large conspicuous nuclei.
		Their cell walls are primary in nature, thin and cellulosic with abundant plasmodesmatal connections.
Phase of elongation	Just above the tip	Increased vacuolation,
		cell enlargement
		new cell wall deposition
Phase of maturation	Just above the phase of elongation	The cells of this zone, attain their maximal size in terms of wall thickening and protoplasmic modifications.

5. What is senescence? Describe the different types of them.

Senescence is the period between complete maturity and death of an organ or organism, when degenerative changes take place in the structure and function.

It is characterised by accumulation of metabolic wastes and higher rate of catabolism and decrease in dry weight; these are controlled by the activities of phytohormones.

Senescence may be whole plant senescence as in cereals like rice, maize, wheat, beans and tomato, where the entire plant dies after flowering.

When only the above ground part dies each year, and the underground parts live, senescence is called organ senescence, e.g., alfalfa.

6. Give the mathematical representation of arithmetic and geometric growth.

Arithmetic growth is represented as

$Lt = L0 + rt$

Where, Lt = Length at time't'

$L0$ = Length at time '0'

r = Growth rate

Geometric growth is represented as:

$W1 = W0\ e^{rt}$

Where, $W1$ = Final size

$W0$ = Initial size

r = Growth rate

t = Time of growth

e = Base of natural logarithms.

7. Distinguish between arithmetic growth and geometric growth.

	Arithmetic growth	Geometric growth
1	In this, after the mitotic division of a cell, only one daughter cell continues to divide and other differentiates to form a mature cell.	. In this, after the mitotic division of the cell, both the daughter cells have the ability to divide and hence undergo division.
2	It gives a linear curve when length of the organ is plotted against the time.	It gives sigmoid curve when increase in size is plotted against time.
3	Elongation of root at a constant rate is an example of arithmetic growth.	It is found in most of the organs or tissues of living organisms.

Long Answer Questions (5 Marks)

1. What are the important characteristics of growth in plants? Explain in brief.

- Growth in plant involves cell division, cell enlargement and cell maturation/differentiation.
- The cell division in plants occurs in the meristematic regions.
- Meristems at the apical regions, i.e., shoot and root apices and intercalary meristems are responsible for growth in length of plants.
- The lateral meristem occurs in the form of cambium inside the vascular bundles of dicot stem and cork cambium just below the epidermis in the outer layers of cortex.
- Lateral meristems help in increasing thickness of stem and root by secondary growth.
- The rate of plant growth is slow in the initial stages, which corresponds to phase of cell division lag phase.
- Then the growth increase rapidly and corresponds to phase of cell enlargement (exponential phase).
- Then there is a decrease in the rate of growth due to limitation of nutrients (stationary phase).
- The rate of growth can be measured by an increase in size or area if an organ of the plant in a unit time which is called efficiency index.

2. What is photoperiodism? How do you categorize the angiosperms on the basis of their flowering response to photoperiods? Give an example each. Which part of the plant perceives the light stimulus for the process?

Photoperiodism is the phenomenon in which plants respond to relative length of light period and dark period to which they are exposed.

Plants are grouped into three categories, based on their photoperiodic response, which are as follows:

Long day plants:

Long day plants flower only when the day length is longer than the critical photoperiod, e.g., wheat, barley, larkspur, etc.

Short day plants:

Short day plants flower only when the day length is shorter than the critical photoperiod, they are more influenced by the dark period, i.e., if they are exposed to continuous dark period that is longer than critical dark period, they flower, e.g., Chrysanthemum, Cosmos.

Day neutral plants:

Day neutral plants flower irrespective of the day length, i.e., they are influenced by length of light period or dark period, e.g., tomato, cucumber and tobacco.

The photoperiodic stimulus is perceived by the leaves.

	Short Day Plant (SDP)	Long Day Plant (LDP)	Day Natural Plant (DNP)
1	These plants require light for a shorter period than their critical period for flowering	The plants require longer exposure to light than their critical period for flowering.	These plants do not require light for flowering.
2	In SDP the length of night is critical so, SDP plants are actually long night plants.	They do not require an uninterrupted dark period. In fact, the period of darkness has an inhibitory effect.	
	E.g., Cosmos, Chrysanthemum	E.g., Wheat and Barley	E.g., Tobacco, Cucumber

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

A defoliated plant will not respond to the photoperiodic cycle.

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.

Therefore, in the absence of leaves, light perception would not occur, i.e., the plant would not respond to light.

4. Describe the sigmoid growth curve in detail with diagram.

When the increase in weight of tissue/organ/organism is plotted as a function of time, an S-shaped curve, called sigmoid growth curve is obtained.

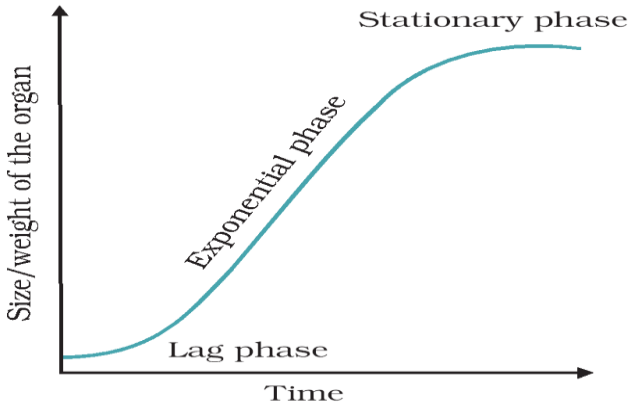
In the initial phase, the curve rises gradually and this phase is called lag phase.

The middle phase where the curve rises steeply is called exponential growth phase.

Then the curve rises slowly and approaches a horizontal line signifying the limit of growth in each particular case.

The difference between the initial and final weight/size of an individual in a given period of time is regarded as the absolute increase.

This type of a growth curve is characteristic of all higher animals, including human being.



5. List five major groups of natural plant growth regulators. Write a short note on discovery of them.

(i) Auxins

(ii) Gibberellic acid

(iii) Cytokinins

(iv) Ethylene

(v) Abscisic acid

(i) Auxins

Discovery:

The first observations regarding the effects of auxins were made by Charles Darwin and Francis Darwin wherein they saw the coleoptiles of canary gross bending toward a unilateral source of light.

It was concluded after a series of experiments that some substance produced at the tip of coleoptiles was responsible for the bending.

Finally, this substance was extracted as auxins from the tips of coleoptiles in oat seedlings.

(ii) Gibberellic acid

Discovery:

Bakane or the "foolish rice seedling" disease was first observed by Japanese farmers.

In this disease, rice seedlings appear to grow taller than natural plants, and become slender and pale green.

Later, after several experiments, it was found that this condition was caused by the infection from a certain fungus *Gibberella fujikuroi.*

The active substance was isolated and identified as gibberellic acid.

(iii) Cytokinins

Discovery:

Through their experimental observations, F. Skoog and his co-workers found that the tobacco callus differentiated when extracts of vascular tissues, yeast extract, coconut milk, or DNA were added to the culture medium. This led to the discovery of cytokinins.

(iv) Ethylene

Discovery:

It was observed that unripe bananas ripened faster when stored with ripe bananas. Later, the substance promoting the ripening was found to be ethylene.

(v) Abscisic acid

Discovery:

During the mid 1960s, inhibitor-B, abscission II, and dormin were discovered by three independent researchers. These were later on found to be chemically similar and were thereafter called ABA (Abscisic acid).

6. 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.

(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

7. 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.

(a) If GA_3 is applied to rice seedlings, then the rice seedlings will exhibit internode-elongation 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.

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