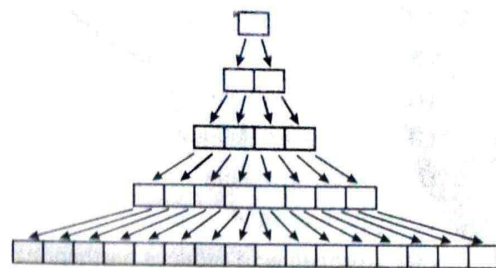


13 Plant Growth and Development



13.1. Growth

- The process of growth is maximum during:
(A) lag phase (B) senescence
(C) dormancy (D) log phase.
[NEET Sept. 2020]
- Typical growth curve in plants is:
(A) sigmoid (B) linear
(C) stair-steps shaped (D) parabolic.
[AIPMT Cancelled 2015]
- Klinostat is employed in the study of:
(A) osmosis (B) growth movements
(C) photosynthesis (D) respiration
[AIPMT 1993]

13.2. Differentiation, Dedifferentiation and Redifferentiation

- Formation of interfascicular cambium from fully developed parenchyma cells is an example for:
(A) redifferentiation (B) dedifferentiation
(C) maturation (D) differentiation
[NEET 2024]
- In tissue culture experiments, leaf mesophyll cells are put in a culture medium to form callus. This phenomenon may be called as:
(A) Development (B) Senescence
(C) Differentiation (D) Dedifferentiation
[NEET 2023]

13.3. Development

- Which one of the following plants does not show plasticity?
(A) Coriander (B) Buttercup
(C) Maize (D) Cotton
[NEET 2022]

- Plants follow different pathways in response to environment or phases of life to form different kinds of structures. This ability is called:
(A) elasticity (B) flexibility
(C) plasticity (D) maturity
[NEET 2021]
- Senescence as an active developmental cellular process in the growth and functioning of a flowering plant, is indicated in:
(A) vessels and tracheid differentiation
(B) leaf abscission
(C) annual plants
(D) floral parts.
[AIPMT Screening 2008]

13.4. Plant Growth Regulators

- Match List-I with List-II:

List-I	List-II
(a) Absciscic acid	(i) Promotes female flowers in cucumber
(b) Ethylene	(ii) Helps seeds to withstand desiccation
(c) Gibberellin	(iii) Helps in nutrient mobilisation
(d) Cytokinin	(iv) Promotes bolting in beet, cabbage, etc.

Choose the correct answer from the options given below:

- | | | | |
|-----------|-------|-------|-------|
| (a) | (b) | (c) | (d) |
| (A) (ii) | (iii) | (iv) | (i) |
| (B) (iii) | (ii) | (i) | (iv) |
| (C) (ii) | (i) | (iv) | (iii) |
| (D) (ii) | (i) | (iii) | (iv) |
- [Re-NEET 2024]
- F. Skoog observed that callus proliferated from the internodal segments of tobacco stem when auxin was supplied with one of the following except.
(A) Extract of Vascular tissues
(B) Coconut milk
(C) Absciscic acid
(D) Yeast Extract
[Re-NEET 2024]

11. Given below are some statements about plant growth regulators.

- (I) All GAs are acidic in nature.
 (II) Auxins are antagonists to GAs.
 (III) Zeatin was isolated from coconut milk.
 (IV) Ethylene induces flowering in Mango.
 (V) Absciscic acid induces parthenocarp.

Choose the correct set of statements from the option given below:

- (A) (I), (III), (IV) (B) (II), (V)
 (C) (I), (II), (III) (D) (II), (IV), (V)

[Re-NEET 2024]

12. Auxin is used by gardeners to prepare weed-free lawns. But no damage is caused to grass as auxin:

- (A) promotes abscission of mature leaves only.
 (B) does not affect mature monocotyledonous plants.
 (C) can help in cell division in grasses, to produce growth.
 (D) promotes apical dominance.

[NEET 2024]

13. Spraying sugarcane crop with which of the following plant growth regulators, increases the length of stem, thus, increasing the yield?

- (A) Gibberellin (B) Cytokinin
 (C) Absciscic acid (D) Auxin

[NEET 2024]

14. Spraying of which of the following phytohormone on juvenile conifers helps hastening the maturity period, that leads early seed production?

- (A) Zeatin
 (B) Absciscic Acid
 (C) Indole-3-butyric Acid
 (D) Gibberellic Acid

[NEET 2023]

15. Which hormone promotes internode/petiole elongation in deep water rice?

- (A) Ethylene (B) 2, 4-D
 (C) GA₃ (D) Kinetin

[NEET 2023]

16. Production of Cucumber has increased manifold in recent years. Application of which of the following phytohormones has resulted in this increased yield as the hormone is known to produce female flowers in the plants:

- (A) Gibberellin (B) Ethylene
 (C) Cytokinin (D) ABA

[NEET 2022]

17. The gaseous plant growth regulator is used in plants to:

- (A) promote root growth and root hair formation to increase the absorption surface.
 (B) help overcome apical dominance.
 (C) kill dicotyledonous weeds in the fields.
 (D) speed up the malting process.

[NEET 2022]

18. The plant hormone used to destroy weeds in a field is:

- (A) IAA (B) NAA
 (C) 2, 4-D (D) IBA.

[NEET 2021]

19. Match the following concerning the activity or function and the phytohormone involved.

Column I	Column II
(a) Fruit ripener	(i) Absciscic acid
(b) Herbicide	(ii) GA ₃
(c) Bolting agent	(iii) 2, 4-D
(d) Stress hormone	(iv) ethephon

Select the correct option.

- (a) (b) (c) (d)
 (A) (ii) (iii) (iv) (i)
 (B) (iii) (iv) (ii) (i)
 (C) (iv) (iii) (ii) (i)
 (D) (iv) (ii) (i) (iii)

[NEET Oct. 2020]

20. Fruit and leaf drop at early stages can be prevented by the application of:

- (A) cytokinins (B) ethylene
 (C) auxins (D) gibberellic acid.

[NEET 2017]

21. The *Avena* curvature is used for bioassay of:

- (A) GA₃ (B) IAA
 (C) Ethylene (D) ABA

[NEET Phase-I 2016]

22. You are given a tissue with its potential for differentiation in an artificial culture. Which of the following pairs of hormones would you add to the medium to secure shoots as well as roots?

- (A) IAA and gibberellin
 (B) Auxin and cytokinin
 (C) Auxin and absciscic acid
 (D) Gibberellin and absciscic acid

[NEET Phase-II 2016]

23. What causes a green plant exposed to the light on only one side to bend towards the source of light as it grows?

- (A) Green plants need light to perform photosynthesis.
 (B) Green plants seek light because they are phototropic.
 (C) Light stimulates plant cells on the lighted side to grow faster.
 (D) Auxin accumulates on the shaded side, stimulating greater cell elongation there.

[AIPMT Cancelled 2015]

24. Auxin can be bioassayed by:

- (A) *Avena* coleoptile curvature
- (B) hydroponics
- (C) potometer
- (D) lettuce hypocotyl elongation.

[AIPMT Latest July 2015]

25. Dr. F.W. Went noted that if coleoptile tips were removed and placed on agar for one hour, the agar would produce a bending when placed on one side of freshly cut coleoptile stumps. Of what significance is this experiment?

- (A) It made possible the isolation and exact identification of auxin.
- (B) It is the basis for quantitative determination of small amounts of growth-promoting substances.
- (C) It supports the hypothesis that IAA is auxin.
- (D) It demonstrated polar movement of auxins.

[AIPMT 2014]

26. Which one of the following growth regulators is known as 'stress hormone'?

- (A) Absciscic acid
- (B) Ethylene
- (C) GA₃
- (D) Indole acetic acid

[AIPMT 2014]

27. During seed germination its stored food is mobilised by:

- (A) ethylene
- (B) ABA
- (C) cytokinin
- (D) gibberellin. [NEET 2013]

28. The pineapple which under natural condition is difficult to blossom has been made to produce fruits throughout the year by application of:

- (A) NAA, 2, 4-D
- (B) Phenyl acetic acid
- (C) Cytokinin
- (D) IAA, IBA.

[NEET Karnataka 2013]

29. The viability of seeds is tested by:

- (A) 2, 6 dichlorophenol indophenols
- (B) 2, 3, 5 triphenyl tetrazolium chloride
- (C) DMSO
- (D) Safranin.

[NEET Karnataka 2013]

30. Which one of the following generally acts as an antagonist to gibberellins?

- (A) Zeatin
- (B) Ethylene
- (C) ABA
- (D) IAA

[AIPMT Mains 2012]

31. One of the commonly used plant growth hormone in tea plantations is:

- (A) ethylene
- (B) absciscic acid
- (C) zeatin
- (D) indole-3-acetic acid.

[AIPMT Mains 2010]

32. Root development is promoted by:

- (A) absciscic acid
- (B) auxin
- (C) gibberellin
- (D) ethylene.

[AIPMT Mains 2010]

33. One of the synthetic auxin is:

- (A) NAA
- (B) IAA
- (C) GA
- (D) IBA.

[AIPMT Screening 2009]

34. Which one of the following acids is a derivative of carotenoids?

- (A) Indole butyric acid
- (B) Indole-3-acetic acid
- (C) Gibberellic acid
- (D) Absciscic acid

[AIPMT Screening 2009]

35. Which one of the following pairs is not correctly matched?

- (A) Gibberellic acid — Leaf fall
- (B) Cytokinin — Cell division
- (C) IAA — Cell wall elongation
- (D) Absciscic acid — Stomatal closure.

[AIPMT 2007]

36. "Foolish seedling" disease of rice led to the discovery of:

- (A) ABA
- (B) 2, 4-D
- (C) IAA
- (D) GA.

[AIPMT 2007]

37. An enzyme that can stimulate germination of barley seeds is:

- (A) invertase
- (B) α -amylase
- (C) lipase
- (D) protease. [AIPMT 2006]

38. How does pruning help in making the hedge dense?

- (A) It releases wound hormones.
- (B) It induces the differentiation of new shoots from the rootstock.
- (C) It frees axillary buds from apical dominance.
- (D) The apical shoot grows faster after pruning.

[AIPMT 2006]

39. Cell elongation in internodal regions of the green plants takes place due to:

- (A) indole acetic acid
- (B) cytokinins
- (C) gibberellins
- (D) ethylene. [AIPMT 2004]

40. Differentiation of shoot is controlled by:

- (A) high auxin : cytokinin ratio
- (B) high cytokinin : auxin ratio
- (C) high gibberellin : auxin ratio
- (D) high gibberellin : cytokinin ratio [AIPMT 2003]

41. Plants deficient of element zinc, show its effect on the biosynthesis of plant growth hormone:

- (A) auxin
- (B) cytokinin
- (C) ethylene
- (D) absciscic acid.

[AIPMT 2003]

42. Coconut milk factor is:
 (A) an auxin (B) a gibberellin
 (C) abscisic acid (D) cytokinin. [AIPMT 2003]
43. Seed dormancy is due to:
 (A) ethylene (B) abscisic acid
 (C) IAA (D) starch. [AIPMT 2002]
44. Hormone responsible for senescence is:
 (A) ABA (B) auxin
 (C) GA (D) cytokinin [AIPMT 2001]
45. Which of the following prevents fall of fruits?
 (A) GA_3 (B) NAA
 (C) Ethylene (D) Zeatin [AIPMT 2001]
46. Which combination of gases is suitable for fruit ripening?
 (A) 80% CO_2 and 20% CH_4
 (B) 80% CH_4 and 20% CO_2
 (C) 80% CO_2 and 20% O_2
 (D) 80% C_2H_4 and 20% CO_2 [AIPMT 1998]
47. Gibberellins induce:
 (A) flowering.
 (B) production of hydrolysing enzymes in germinating seeds.
 (C) cell division.
 (D) hasten leaf senescence. [AIPMT 1997]
48. Some of the growth regulators affect stomatal opening. Closure of stomata is brought about by:
 (A) indole butyric acid
 (B) abscisic acid
 (C) kinetin
 (D) gibberellic acid [AIPMT 1994]
49. Bananas can be prevented from over-ripening by:
 (A) maintaining them at room temperature
 (B) refrigeration
 (C) dipping in ascorbic acid solution
 (D) storing in a freezer [AIPMT 1992]
50. Cytokinins:
 (A) promote abscission
 (B) influence water movement
 (C) help retain chlorophyll
 (D) inhibit protoplasmic streaming [AIPMT 1992]
51. Dwarfness can be controlled by treating the plant with:
 (A) cytokinin (B) gibberellic acid
 (C) auxin (D) antigibberellin [AIPMT 1992]
52. A chemical believed to be involved in flowering is:
 (A) gibberellin (B) kinetin
 (C) florigen (D) IBA [AIPMT 1991]
53. The hormone responsible for apical dominance is:
 (A) IAA (B) GA
 (C) ABA (D) florigen [AIPMT 1991]
54. Which of the following movement is not related to auxin level?
 (A) Bending of shoot towards light.
 (B) Movement of root towards soil.
 (C) Nyctinastic leaf movements.
 (D) Movement of sun flower head tracking the sun. [AIPMT 1990]
55. Phytohormones are:
 (A) chemicals regulating flowering.
 (B) chemicals regulating secondary growth.
 (C) hormones regulating growth from seed to adulthood.
 (D) regulators synthesised by plants and influencing physiological processes. [AIPMT 1990]
56. Highest auxin concentration occurs:
 (A) in growing tips
 (B) in leaves
 (C) at base of plant organs
 (D) in xylem and phloem [AIPMT 1990]
57. Mowing grass lawn facilitates better maintenance because:
 (A) wounding stimulates regeneration.
 (B) removal of apical dominance and stimulation of intercalary meristem.
 (C) removal of apical dominance.
 (D) removal of apical dominance and promotion of lateral meristem. [AIPMT 1989]
58. Leaf fall can be prevented with the help of:
 (A) abscisic acid (B) auxins
 (C) florigen (D) cytokinins [AIPMT 1989]
59. Cut or excised leaves remain green for long if induced to root or dipped in:
 (A) gibberellins (B) cytokinins
 (C) auxins (D) ethylene [AIPMT 1988]

SOLUTIONS

1. (D) The process of growth is maximum in log phase or exponential phase. During this phase, the growth rate of cells increases gradually to maximum rate. The initial growth is slow (lag phase), but increases rapidly (in log phase).

Caution

Students usually get confused between the terms 'lag' and 'log'. Remember in term 'lag', letter 'a' being first of alphabet series, represent low numbers, while letter 'o' in term 'log' represent higher numbers.

2. (A) In plants, typical growth curve is sigmoidal. The rate of growth of a plant or a plant part is not always the same during its life span. Sometimes it is slow and at other times, it is rapid. If we plot the increase in cell number (growth rate) against time, a typical S-shaped curve is obtained. This is called growth curve or sigmoid growth curve.
3. (B) A klinostat is a device that, by gradually spinning, can counteract the effects of gravity and allow a plant to grow horizontally. As all sides of the rotating organs are affected equally by the gravitational stimuli, rotating klinostats do not exhibit any bending; in contrast, plants grown in fixed or unrotated klinostats bend downward with a positive geotropism.
4. (B) Formation of meristems, i.e., interfascicular cambium and cork cambium from fully developed parenchyma cells is an example of dedifferentiation, where the living differentiated cells, that have lost the capacity to divide can regain the capacity of division under certain conditions.
5. (D) The phenomenon of putting the leaf mesophyll cells in a culture medium to form callus in tissue culture experiments is called dedifferentiation or cellular reprogramming.
- Dedifferentiation refers to the process by which mature cells, such as leaf mesophyll cells, lose their specialised functions and revert to a more primitive, undifferentiated state. In tissue culture, this process is often induced by the addition of hormones to the culture medium.

Related Theory

- Senescence is a process in which the entire cell division process stops, causing cells to permanently stop growing without dying. Senescence of the entire organism can take place or it can happen at the cellular level.
- In differentiation, cells gain specialised roles and switch from one cell type to another in an entity through a biological process.

6. (C) Maize does not exhibit plasticity because the leaf shape remains the same throughout the developmental phase.

Cotton and coriander exhibit plasticity because their leaves differ in shape from juvenile to mature plants. Buttercup also exhibits plasticity, as the shape of their leaves produced in air and those produced in water differ.

Related Theory

Plants take different paths to produce different types of structures depending on their surroundings or stage of development. This is referred to as plasticity.

7. (C) Plasticity is the ability of the plant to adjust to a particular environment by altering the rate of growth, development, and metabolism. It allows the initiation of the cell division from any tissue of the plant, the ability to regenerate the lost organs and to undergo several developmental pathways for its survival.

Related Theory

Leaves are the most plastic plant organ and their growth may be altered by light intensity levels. Leaves grown in the light tend to be thicker, which maximises photosynthesis in direct light; and have a smaller area, which cools down the leaf more rapidly due to a thinner boundary layer (plasticity).

8. (B) Senescence is not confined only to whole plant; it may be limited to a particular organ, such as leaf and flower or cells, such as phloem and xylem. Abscission is natural shedding of leaves, foliage branches, fruits, floral parts, etc. Thus, abscission is a senescence phenomenon.
9. (C) Absciscic acid helps seeds to withstand desiccation. Ethylene promotes female flowers in cucumber. Gibberellin promotes bolting in beet, cabbage, etc. Cytokinin helps in nutrient mobilisation.
10. (C) F. Skoog and his co-workers while working on the inter nodal segments of tobacco stems and observed that the proliferation of mass of undifferentiated cells called callus is occur only in addition to auxins the nutrients medium was supplemented with extracts of vascular tissues, yeast extract, coconut milk or DNA, but not the absciscic acid.
11. (A) Auxins are antagonists to gibberellin and auxins and gibberellin induces parthenocarpy.
12. (B) Auxin is widely used to kill dicotyledonous weeds, and does not affect mature monocotyledonous plants, like gram. It is used to prepare weed-free lawns by gardeners.

13. (A) Sugarcane stores carbohydrate as sugar in their stems. Spraying sugarcane crop with gibberellins increase the length of the stem, thus increasing the yield.
14. (D) Spraying of gibberellic acid on juvenile conifers helps hasten the maturity period, leading to early seed production. Gibberellic acid is a plant growth regulator that stimulates stem elongation, germination, flowering, and fruit maturation. It also plays a crucial role in breaking seed dormancy, promoting seed germination, and increasing seedling growth.
15. (A) The hormone that promotes internode/petiole elongation in deep water rice is ethylene. Ethylene is a gaseous plant hormone that is produced in response to flooding or submergence. In deep water rice, the elongation of internodes and petioles helps to keep the leaves above water and enable the plant to survive under flooded conditions. Ethylene stimulates the elongation of cells in the stem by promoting the activity of enzymes that break down cell wall components, allowing the cells to expand and elongate.
16. (B) A simple gaseous plant growth regulator (PGR) is ethylene. In cucumber, it has a feminising effect that encourages femaleness. Ethylene application causes cucumber plants to produce more female flowers, boosting the overall yield. In order to boost the quantity of female flowers on cucumber plants, ethylene might be used.
17. (A) Ethylene is a simple gaseous plant growth regulator (PGR). It promotes the formation of adventitious roots on various types of cuttings. It also encourages the growth of lateral roots and root hairs, allowing plants to increase their absorption surface.

Caution

- Students need to focus on the keyword 'gaseous'. Out of auxin, cytokinin, ethylene, ABA and gibberellin, only ethylene is found in gaseous form.

18. (C) 2, 4-D, also called 2, 4-Dichlorophenoxyacetic acid is a synthetic auxin that is widely used as a weedicide in plants.

Related Theory

- Auxins are growth hormone found in shoot and root tips and promote cell division, stem and root growth. They also drastically affect plant orientation by promoting cell division to one side of the plant in response to sunlight and gravity.

Caution

- Students must remember that auxin is also known as the weedicide hormone.



Mnemonics

- The five major groups of plant growth regulators are represented as:

Always Get Coffee After Eight

Always – Auxins

Get – Gibberellins

Coffee – Cytokinins

After – Absciscic acid (ABA)

Eight – Ethylene

19. (C) Ethephon is a commercial derivative of ethylene and is used to ripen fruits. 2, 4-D is a synthetic auxin derivative, used as a herbicide against dicotyledonous weeds. Gibberellic acid (GA_3) induces bolting in plants, i.e., the promotion of internodal elongation just prior to their reproductive phase. Absciscic acid is a stress hormone, as it helps the plants to overcome unfavourable conditions by inhibiting growth.
20. (C) Auxins delay leaf senescence at early stages, but promote mature leaf and fruit abscission, promote flowering and growth of flower parts, induce fruit setting and growth, and delay fruit ripening. Cytokinins promote cell division during developmental processes in plants.
- Ethylene promotes or inhibits growth and senescence processes and is involved in fruit ripening.
- Gibberellins stimulate the growth of main stems, bolting (elongation) of rosette plants, etc.
21. (B) *Avena* curvature is a bioassay used for auxin (Indole-3-Acetic Acid).



Related Theory

- Auxin is a phytohormone that promotes stem elongation, inhibit growth of lateral buds (maintains apical dominance). They are produced in the stem, buds, and root tips. This hormone induces a curving of the plant stem tip towards the light (phototropism). The auxins are divided into two basic categories, i.e., natural auxins (e.g., IAA and IBA) and synthetic auxins (e.g., NAA and 2, 4-D).
22. (B) The specific ratio of auxin and cytokinin promotes cells differentiation and growth of roots and shoots. High auxin levels initiate root formation, while high cytokinin levels initiate shoot formation.
23. (D) Auxin moves to the darker side of the plant, when the plant is exposed to sunlight causing the cells there to grow larger than corresponding cells on the lighter side of the plant. This produces a curving/bending of the plant stem tip towards the light.



Related Theory

- Charles Darwin and his son Francis Darwin noted the phototropism in the tip of canary grass, which led to the discovery of auxin, the first hormone found in plants. Initially auxin was isolated from human urine samples.

⚠ Caution

Students should remember that phototropism is due to the action of auxin in the plants, causing the bending of plant towards light.

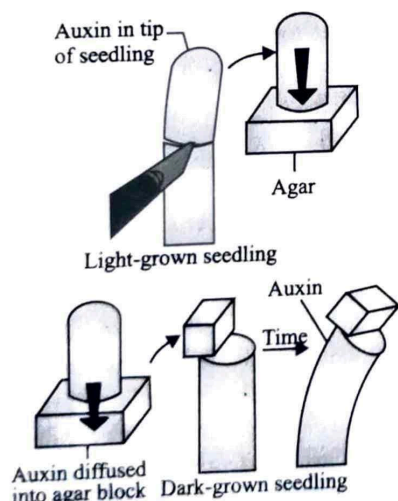
24. (A) Auxin is a phytohormone, which is bioassayed by *Avena* coleoptile curvature test.

Hydroponics involves growing plants (usually crops) without soil, by using mineral nutrient solutions in an aqueous solvent.

A potometer is used to measure water uptake in a leafy shoots.

Lettuce hypocotyl elongation is used to study the relationship between calcium ions and gibberellic acid. Gibberellin controls extension growth in lettuce hypocotyl sections by regulating the uptake of Ca^{2+} by the hypocotyl cells.

25. (D) F.W. Went cut off the tips of oat seedlings that had been illuminated normally and set them on blocks of agar agar. The agar blocks containing the tips were placed on an inert material like glass. Simultaneously, he took oat seedlings, grown in the dark and cut off their tips in a similar way. Later, he discarded the tips and placed the agar cubes eccentrically on the tops of the decapitated dark-grown seedlings. Even though these seedlings had not been exposed to the light themselves, they bent away from the side on which the agar blocks were placed. The side of the coleoptile that received the growth substance elongated faster and caused the curvature towards the opposite side. Went identified the substance as auxin and concluded that phototropism in the tips of coleoptile is due to the polar movement of auxins in the stem.



Effect of Auxin in Oat Seedling

26. (A) Abscissic acid is known as stress hormone, as it functions in response to the stress conditions. It causes the seed dormancy and the closing of stomata in case of drought. Ethylene regulates both growth and senescence and causes fruit ripening.

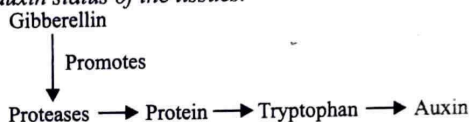
Gibberellins facilitate cell elongation in stem, germination, fruit ripening and flowering. IAA is the main auxin in plants that regulates apical dominance, and responses to light, gravity, and pathogens.

27. (D) Gibberellin induces aleurone cells to secrete enzyme to break down the stored food in seed and mobilise its stored food, which might be used to feed the seed embryos. Cytokinins promote nutrient mobilisation, which helps in the delay of leaf senescence. ABA plays an important role in seed development, maturation and dormancy. Ethylene induces fruit ripening, breaks seed dormancy, etc.



Related Theory

Gibberellins are related to steroids with respect to their action. They exhibit ecdysone like effects. Ecdysone is a molting hormone. Gibberellins can either suppress or activate certain genes. Another effect of gibberellin treatment is the production of enzymes like amylase and protease. Many workers consider that gibberellins exhibit their physiological effects by altering the auxin status of the tissues.



28. (A) NAA (1-Naphthalene acetic Acid) and 2, 4-Dichlorophenoxy acetic acid are synthetic auxins. Generally, auxins inhibit flowering, but in litchi and pineapple, it promotes flowering.



Related Theory

Anti-auxins are a group of chemicals that prevents auxin-action in plants. Transcinnamic acid, ascorbic acid, 7-phenyl butyric acid are some of these anti-auxins. Probably, an antiauxin competes with an auxin for the same site of reaction and thus, inhibits auxin-action.

29. (B) Viability of seeds can be tested by two methods: (1) ability to germinate, (2) testing their ability to respire.

All viable seeds respire. This can be tested by immersing a section of seed containing the embryo in 0.1% solution of 2,3,5 triphenyl tetrazolium chloride (TTC). The viable embryo turns pink due to the conversion of colourless 2,3,5 triphenyl tetrazolium chloride into insoluble coloured dye called triphenyl formazone due to reduction. Tetrazolium chloride (TZ) test is also called as quick germination test.



Related Theory

Seed or plant viability is the measure of how many seeds or how much plant material in a lot are alive and could develop into plants that will reproduce under appropriate field conditions. It is very important that seeds or plant material stored in the gene bank are capable of producing plants when sown in the field.

30. (C) Gibberellins and ABA are antagonistic to each other. Absciscic acid (ABA) and gibberellins (GA) antagonistically mediate several plant developmental processes, like seed maturation, seed dormancy and germination, primary root growth, and flowering time control.
31. (D) Auxins are commonly used in stem cutting. They induce apical dominance, where the apical bud suppresses the growth of lateral buds. When the apical bud is removed, the lateral buds can develop into new shoots and produces dense bushy growth. Indole-3-acetic acid (IAA) is an auxin.



Related Theory

During the process of mowing or trimming, the apical buds of the carpet grass or the tea plants are removed. Thus, the apical dominance is suppressed. This promotes the growth of the lateral buds and thus, the plants become bushier.



Caution

Students should remember that one of the fundamental plant growth substances, indole-3-acetic acid (IAA), belongs to a class of phytohormones known as auxins.

32. (B) Auxin helps to promote root initiation. It also inhibits the growth of lateral bud and maintains apical dominance in plants, also plays an important role in abscission of leaves and fruits.
33. (A) NAA (Naphthaleneacetic Acid) and 2, 4-D (2, 4-Dichlorophenoxy acetic acid) are synthetic auxins. IAA (Indole-3-acetic Acid) and IBA (Indole Butyric Acid) have been isolated from plants. GA is gibberellic acid.



Related Theory

Auxin helps in regulating growth and developmental processes, such as cell division and elongation, tissue differentiation, apical dominance, and responses to light, gravity, and pathogens. The shoot apical meristem generates all the above ground organs of the plant, including leaves and flowers.

34. (D) Absciscic acid is a carotenoid derivative, which belongs to the category of tetra-terpenoid. Indole butyric acid (IBA) and indole-3-acetic acid (IAA) are auxins, which are weak organic acids. Gibberellic acid (gibberellin) is a terpene.



Related Theory

Absciscic acid stimulates the closure of stomata in the epidermis and increases the tolerance of plants to various kinds of stresses. So, it is called the stress hormone.

35. (A) Gibberellic acid stimulates the cell growth of leaves and stem causing their expansion and elongation. Whereas, leaf fall is associated with ABA.
36. (D) Gibberellins (GA) were first isolated from the fungus *Gibberella fujikuroi*, the causative organism of foolish seedling disease of rice plants, by Kurosawa in Japan in 1926. Absciscic acid was first identified and isolated chemically from cotton

plants. Auxin was discovered during the study of bending of the coleoptile of canary grass (*Phalaris canariensis*) towards light. 2, 4-D is an herbicide that kills plants by changing the way certain cells grow.

37. (B) Barley seeds are rich in carbohydrate (starch). The starch is hydrolysed by α -amylase to monosaccharides at the time of germination of seeds.
38. (C) The hedge plants are pruned at regular intervals to remove the dominant apical buds and to promote the growth of the lateral buds. This leads to the dense growth of the hedges.
39. (C) Gibberellins are essential for many developmental processes in plants, including seed germination, stem elongation, leaf expansion, trichome development, pollen maturation and the induction of flowering. They are well known to cause cell elongation of intact plants in general and increase the internodal length of genetically dwarfed plants (e.g., Pea, Corn), in particular.



Caution

If auxins, such as NAA are applied, it retards the growth of internode, and thus, increases the number of dwarf shoots and thus the number of fruits.

40. (B) A high cytokinin to auxin ratio triggers shoot formation but inhibits root induction, whereas, a low ratio produces the opposite effect. Plant growth regulators (cytokinin, auxin) are widely used to control differentiation in cultured plant cells and tissues.



Related Theory

In the root meristem, auxin induces the meristematic cell division, whereas cytokinin promotes the cell to switch from the meristematic to differentiated state through inhibiting auxin signalling. Auxin at low concentrations limits the action of cytokinin. An increase in cytokinin level counteracts this inhibitory effect and leads to an inhibition of auxin signalling. At higher concentrations of both hormones, these antagonistic interactions between cytokinin and auxin are absent.


41. (A) Chemically, auxins are weakly acidic growth hormones that have an unsaturated ring structure. They are capable of promoting cell elongation, especially of shoots, but are inhibitory to the roots. Zinc is involved in the synthesis of indole-3-acetic acid in plants and act as an activator in the enzyme tryptophan synthetase. Tryptophan is the precursor of indole-3-acetic acid.
42. (D) Skoog and colleagues found out that the callus from the internodal segments of tobacco stems proliferated only when a certain chemical compound is supplied along with auxin into the nutrient

medium. This chemical compound was later termed kinetic. It was the first synthetic cytokinin to be discovered.

Cytokinins are a class of plant hormones that promote cell division, or cytokinesis, in plant roots and shoots. They are involved primarily in cell growth and differentiation, but also affect apical dominance, axillary bud growth, and leaf senescence.

43. (B) Absciscic acid induces dormancy of buds towards the approach of winter. Absciscic acid accumulates in many seeds during maturation and apparently contributes to seed dormancy. As ABA triggers dormancy, this hormone is also known as dormin. The buds and seeds sprout only when the effect of ABA is overcome by gibberellins.

Related Theory

- ABA acts as a general inducer of senescence. The onset of senescence is correlated with stomatal closure and destruction of chlorophyll. This hormone inhibits the protein and RNA synthesis. The ABA content of aging leaves increases markedly as senescence is initiated.
44. (A) Senescence is a genetically controlled developmental process in which the cellular structure and macromolecules of the senescing organ (often leaves) are broken down and transferred to actively growing regions that act as nutrient sinks. Environmental signals trigger senescence, which is then controlled by hormones like ABA (Absciscic acid).
-  **Caution**
- Students must remember that ethylene hormone is also associated with senescence. It is a multipurpose phytohormone that controls both senescence and growth. Depending on the concentration, timing, and species of the plant, it either promotes or inhibits the processes of growth and senescence.
45. (B) NAA (Naphthalene acetic Acid) is a synthetic auxin. It is produced artificially. It prevents abscission. It prevents the formation of an abscission layer, which forms between organs, such as fruits and flowers and the stem. Fruit fall is caused by a layer of dead cells. As NAA prevents the formation of this layer, it also prevents the fruit from falling.
46. (D) Ethylene is a gaseous hormone, which is also considered as the ripening hormone. To induce the fruit ripening externally, the ethylene hormone is used. The increased concentration of ethylene (80%) and reduced concentration of carbon dioxide (20%) triggers fruit ripening and metabolism.
47. (B) Gibberellin is a hormone found in plants. It breaks seed dormancy. It also promotes seed germination by producing hydrolysing enzymes, such as amylases, lipases, and ribonucleases in seeds. These enzymes solubilise the seed's reserve food. It also aids in stem elongation.

Mnemonics

- Major functions of gibberellins can be learnt by:
Girls Influence Parents By Promoting Girl Power
Girls – Gibberellins
Influence Parents – Induce Parthenocarpy
By Promoting – Bolting Promoter
Girl Power – Growth Promoter

48. (B) Absciscic acid promotes interchange of H^+ and K^+ ions through hydrogen-potassium pump and increasing availability of H^+ inside the cytoplasm of guard cells. Loss of K^+ ion decreases osmotic concentration of guard cells, as compared to adjacent epidermal cells. Due to the exosmosis, the turgidity of guard cells decreases and it closes the stomatal pore.

Related Theory

- Absciscic acid (ABA) is known as stress hormone that accumulates under different abiotic and biotic stresses. A typical effect of ABA on leaves is to reduce transpirational water loss by closing stomata and parallelly defend against microbes by restricting their entry through stomatal pores.
49. (C) Ascorbic acid or vitamin C prevents over ripening of banana and other fruits as it is an antioxidant. On the other hand, keeping the bananas at room temperature causes them to rot faster, and keeping them in the refrigerator causes their skin to turn black.
- Storing the banana in a deep freezer can stop the activity of ethylene and prevent the fruit from ripening upto a limited extent.

Caution

- Students often often get confused between two options- storing the banana in a freezer and dipping them in ascorbic acid solution. They must remember that the freezing process reduces the rate of the degradation reactions and inhibits the microbiological and enzymatic activity only up to a limited extent and has only a slight effect on the initial vitamin C content of fruit. Whereas, dipping them in ascorbic acid adds vitamin C to the fruit, which is lost during ripening.
50. (C) Cytokinins are well-known to have an effect on the retention of chlorophyll from higher plants. This hormone causes the yellowing leaves to re-green. On the other hand, ethylene promotes abscission in plants. Auxins help in water movement and promote protoplasmic streaming in plants.
51. (B) Gibberellic acid is a plant hormone that promotes stem and root elongation, internode lengthening, and floral development. It also promotes cell elongation in the stem, which prevents plant dwarfism.
52. (C) Mikhail Khristoforovich Chailakhyan proposed in 1936 that florigen, a flower hormone, is synthesised in the leaves under favourable photoperiodic

conditions. This hormone is delivered to the growing points where flowering occurs, where it generates a systemic signal and initiates flowering.



Related Theory

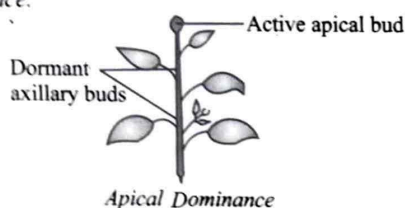
Chailakhyan proposed that florigen could be made up of two parts: one involving the hormone gibberellin (which also causes stems to grow) and another involving an unknown hormone.

53. (A) A phenomenon known as apical dominance occurs when the central stem predominates and the lateral branches are suppressed. It is caused by plant hormones that are produced at the shoot's tip. A kind of auxin hormone called IAA is responsible for apical dominance.



Related Theory

Always remember that cytokinins help overcome the apical dominance.



54. (C) The level of auxin has no relation with nyctinastic leaf motions. In response to the darkness, the leaves move in a rhythmic nastic pattern. The biological (circadian) clock governs it. For instance, the leaves of the *Acacia tortuosa* move vertically at night and horizontally during the day. On the other side, the amounts of auxin control how plants move their parts, such as how their roots move toward the soil, sunflower heads track the sun, and how their shoots bend towards the light.

55. (D) Phytohormones (auxins, gibberellins, cytokinins, ethylene, and abscisic acid) are plant produced growth regulators that influence physiological processes.

Plants produce them, and they control or regulate germination, growth, metabolism, and other physiological activities.

56. (A) Auxin is a plant hormone. This hormone is generally produced in higher concentration in the growing apices of the stems and roots, from where they migrate to the regions of their action. The highest concentration of it induces apical dominance and low concentration of it inhibits the growth in stem.

57. (B) Apical dominance is observed due to the secretion of auxin. Due to mowing, of grass lawn, removal of apical buds causes sprouting of lateral buds with stimulation of intercalary meristem. This is the reason why mowing grass lawns facilitates better maintenance.

58. (D) Cytokinins cause the 'Richmond Lang effect,' which delays plant ageing (senescence). This hormone works by slowing down the rate of chlorophyll destruction and leaf yellowing. As a result, it aids in the reduction of leaf fall.

59. (B) Plant growth hormones known as cytokinins are adenine derivatives. These hormones promote the development of new leaves and chloroplasts, which in turn help the leaves stay green for a longer period of time. Vegetables sold in markets can be kept fresh for several days by applying cytokinins. By using these hormones, cut shoots and flowers can have a longer shelf life.

