PG Internal Assessment Test-I

M. Sc. Botany II Year, Semester-IV

Paper-II: Phytohormones and Plant Development

Multiple choice questions

1. The hormone which promote apical dominance is [B]
   A. Gibberellins B. Auxins C. Ethene D. Cytokinins
2. Abscission is prevented by [B]
   A. Gibberellins B. Auxins C. Ethene D. Cytokinins
3. Gibberellins were first obtained from [C]
   A. Plants B. Algae C. Fungi D. Bacteria
4. Seed of dormancy can be broken by [A]
   A. Gibberellins B. Auxins C. ethene D. Cytokinins
5. Leaf senescence is delayed by [D]
   A. Gibberellins B. Auxins C. ethene D. Cytokin ins
6. Weed killing is done by [A]
   A. 2, 4 D B. NAA C. IAA D. Ethane
7. Bud initiation in shoots in promoted by [A]
   A. Auxin B. Gibberellins C. Cytokinins D. Ethane
8. Bolting of some rosette plants is promoted by [B]
   A. Ethane B. Gibberellins C. auxin D. Cytokinins
9. Indole acetic acid (IAA) stands for [C]
   A. Iodine acetic acid B. acetic acid C. Indole acetic acid D. Iron acetic acid
10 Sprouting of potatoes is inhibited by [B]
   A. Ethane B. 2,4 D C. NAA D. Cytokinins
11. Which plant hormone is responsible for saving the crops from falling. [C]
   A. Cytokinin B. Gybberellin C. Auxin D. Ethylene
12. Which of the following hormone is found in gaseous form [C]
   A. Florigens B. Abscisic Acid C. Ethylene D. Auxin
13. Name the plant hormone which is responsible for the ripening of fruits? [A]
   A. Ethylene B. Auxin C. Traumatic D. Cytokinins
14. Which plant hormone is helpful in making RNA and protein [C]
   A. Gibberellins B. Auxin C. Cytokinins D. Ethylene
15. Which of the following statement is incorrect [B]
   A. Auxins are the most important plant hormone. B. Auxins are produced at the region of elongation.
   C. Indoleacetic Acid (IAA) is a principal auxin. D. Auxins are important in regulating the fall of leaves, fruits.
16. Which plant hormone helps in breaking the dormancy of plant? [B]
   A. Auxin B. Gibberellin C. Cytokinin D. Ethylene
17. Which hormone is formed in leaves and helps in the blooming of the flowers [C]
   A. Traumatic B. Auxin C. Florigens D. None of the above
18. Which plant hormone is formed in injured cells by which the injury of plant is healed [B]
   A. Florigens B. Traumatic C. Abscisic Acid D. None of the above
19. Which of the following hormone help in the cell division and development in the presence of auxins [B]
   A. Ethylene B. Cytokinins C. Auxins D. Florigens
20. Name the plant hormone which increases the activity of cambium in the wooden plants [A]
   A. Gibberellins B. Cytokinins C. Auxins D. Ethylene
21. An excised leaf does not turn yellow if it is induced to root. This is attributed to the synthesis in root of [B]
   A. Ethylene B. Cytokinins C. Gibberellins D. Auxins.
22. A natural growth regulator is [D]
   A. NAA B. 2,4-D C. Benzaldehyde D. Ethylene

23. The maximum growth phase is [C]
A. Lag phase B. Steady phase C. Log Phase D. Senescent phase
24. The growth of clans dishes from growth of animals in being [A]
A. Localised B. Diffused C. Localized and diffused D. None of the above
25. Ethylene is mainly responsible for [C]
A. Formation of flower B. Formation of root hair C. Ripening of fruits D. Formation of fruit
26. The rosette habit of cabbage can be changed drastically by the application of [A]
A. GA B. IAA C. ABA D. CK
27. Growth is a [C]
A. Reversible increase in size B. Reversible increase in shape
C. Irreversible increase in size D. None of the above
28. Bakanae disease is caused by [A]
A. Fungus B. Algae C. Bacteria D. Virus
29. Gibberellins were first extracted from [C]
A. Coleoptile tip B. Root tip C. Fungus D. Bacteria
30. The short day is [D]
A. Tomato B. Sunflower C. Cotton D. Potato
31. The long day plant is [D]
A. Tomato B. Potato C. Cotton D. Spinach
32. The day neutral plant is [B]
A. Tobacco B. Tomato C. Wheat D. Oat
33. The synthesis of amlyase in certain serials is simulated by [A]
A. GA B. IAA C. CK D. ABA
34. Plant growth is [D]
A. Irreversible B. Increase in size C. Localised D. All the above
35. Plant response to environment is mainly through [D]
A. Induction of dormancy B. Abscission of parts C. Synthesis of pigments D. Growth
36. Darwin and Darwin discovered that canary grass coleoptile bends towards light only when [C]
A. It is 5 cm long B. The Seedling is growing in blue light
C. Coleoptile tip is intact and exposed to light D. Nights are cooler

Fill in the Blanks

1. The meristems present at the tips of roots and shoot are called **apical** meristems.
2. The meristenc situated at the bases of **internodes** is ‘called intercalary meristem.
3. The cylinders of dividing cells present in the vascular and **cork** tissue of the plants are called lateral meristems.
4. The special substances produced by the plants which influence the growth and plant responses are called **Hormones**
5. The phenomenon in which ovary changes into fruit without fertilization is called **parthenocarpy**
6. The production of **auxin** increases iii ovary after pollination.
7. The rapid stem elongation of rosette plant is called **bolting**
8. The rate of respiration of the fruit increases. It is called **climacteric** respiration.
9. The term” vernalisation” was coined by **Lysenko**
10. Substances which originate at the tip of stem and control growth elsewhere are Hormones
11. The discovery that light induced bending of stem The Apex produces a diffusible chemical was made by **Boysen Jensen and Paal**
12. In 1905, the British physician **E. H. Starling** introduced the term hormone
13. Amyloplasts that function as gravity sensors are called **statoliths**, and the specialized gravity-sensing cells in which they occur are called **statocytes**.
14. K. V. Thimann first observed the synthesis of IAA in the mold ***Rhizopus suinus***, which had been fed the amino acid **tryptophan**
15. Abscisic acid (ABA) is a 15-carbon **sesquiterpene** that is synthesized by cleavage of the 40-carbon carotene

Violaxanthin

16. **Della** proteins are a class of nuclear proteins that appear to function as repressors in **gibberellin** signaling.
17. Cytokinins (CK) are derivatives of the **nitrogenous base adenine** and are noted primarily for their capacity to stimulate cell division in tissue culture
18. The effect of ethylene on plants was originally described by **Dimitry Nikolayevich Neljubow**, a graduate student in Russia in 1886.
19. Ethylene stimulates the swelling of stem tissues and the downward curvature of leaves is called **epinasty**.
20. The primary leaves of seedlings are enclosed in a hollow, sheath-like structure, called the **coleoptile**

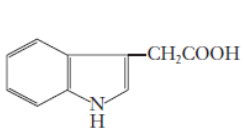
Short Questions

1. What is growth? Discuss its different aspects.
2. Acid-growth hypothesis
3. Give roles of Auxins in plant growth.
4. Give role of gibberellins in growth.
5. Give role of cytokinins in growth.
6. Hydathodes
7. Root cap
8. Batatasins
9. Brassinosteroids
10. Abscisic acid

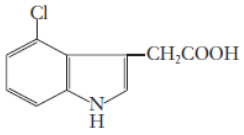
Sem -4 Paper -2; Study material

- 1905, the British physician E. H. Starling introduced the term **hormone** (Gr., to *excite* or *arouse*) to describe these chemical messengers. Hormones are numerous naturally occurring chemical substances that profoundly influence, at micromolar concentrations, the growth and differentiation of plant cells and organs.
- **Phototropism**, or growth with respect to light, is expressed in all shoots and some roots; it ensures that leaves will receive optimal sunlight for photosynthesis.
- **Gravitropism**, growth in response to gravity, enables roots to grow downward into the soil and shoots to grow upward away from the soil, which is especially critical during the early stages of germination.
- **Thigmotropism**, or growth with respect to touch, enables roots to grow around rocks and is responsible for the ability of the shoots of climbing plants to wrap around other structures for support.
- Amyloplasts that function as gravity sensors are called **statoliths**, and the specialized gravity-sensing cells in which they occur are called **statocytes**. Whether the statocyte is able to detect the downward motion of the statolith as it passes through the cytoskeleton or whether the stimulus is perceived only when the statolith comes to rest at the bottom of the cell
- The primary leaves of seedlings are enclosed in a hollow, sheath-like structure, called the **coleoptile**, which encloses and protects the leaves as they grow up through the soil.

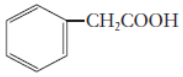
Naturally Occurring Auxins



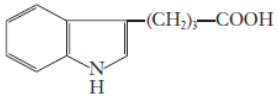
I. Indole-3-acetic acid (IAA)



II. 4-Chloroindole-3-acetic acid

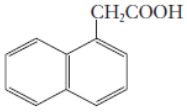


III. Phenylacetic acid

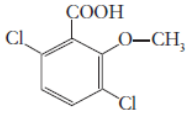


IV. Indole-3-butyric acid (IBA)

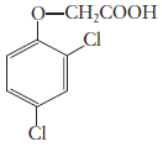
Synthetic Auxins

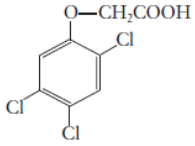


V. Naphthalene acetic acid (NAA)



VI. 2-Methoxy-3,6-dichloro-benzoic acid (dicamba)





- K. V. Thimann first observed the synthesis of IAA in the mold *Rhizopus suinus*, which had been fed the amino acid tryptophan
- In 1970, R. Cleland and D. Rayle proposed a simple theory to explain auxin stimulated increases in cell wall extensibility. They suggested that auxin causes acidification of the cell wall environment by stimulating cells to excrete protons. There the lower pH activates one or more wall-loosening enzymes, which have an acidic pH optimum. At about the same time, A. Hager, working in Germany, published a similar proposal but went further to suggest that auxin stimulated proton excretion by activating a plasma membrane–bound ATPase proton pump. The combined Cleland-Hager proposals are known as the **acid-growth hypothesis**.
- Polar transport of auxin in shoots tends to be predominantly basipetal at a velocity somewhere between 5 and 20mm hr−1.
- Auxins are characterized by their capacity to stimulate elongation in coleoptile and stem segment but are involved in virtually every aspect of plant development, including seed germination, vascular differentiation, lateral bud development, secondary root initiation, the response of roots and shoots to gravity, and flower and fruit development.
- There are three principal sites of gibberellin biosynthesis: (1) developing seeds and fruits, (2) the young leaves of developing apical buds and elongating shoots, and (3) the apical regions of roots.
- Discovery of gibberellins**-**Plants infected with the *bakanae* (‘‘foolish seedling’’) disease exhibited weak, elongated stems and produced little or no grain. Japanese plant pathologists, interested in developing means for controlling the disease, soon established a connection with the presence of a fungus, *Gibberella fujikuroi*. In 1926, E. Kurosawa reported the appearance of symptoms of the disease in uninfected rice plants that had been treated with sterile filtrates from cultures of this fungus. By 1938, Japanese investigators had isolated and crystallized the active material, which they called *gibberellin* after the genus name for the fungus.
- DELLA proteins are a class of nuclear proteins that appear to function as repressors in gibberellin signaling.
- **Cytokinins** (CK) are derivatives of the nitrogenous base adenine and are noted primarily for their capacity to stimulate cell division in tissue culture. Cytokinins also influence a number of other developmental responses, including shoot and root differentiation in tissue culture, the growth of lateral buds and leaf expansion, chloroplast development, and delay of senescence.
- Enzymes that direct the synthesis of cytokinins have been isolated from the slime mold *Dictyostelium discoideum*, tobacco callus tissue, and crown gall tissue
- Abscisic acid (ABA) is a 15-carbon sesquiterpene that is synthesized by cleavage of the 40-carbon carotene violaxanthin. It is synthesized primarily in green leaves and can be stored in the chloroplast,

although there is some evidence that ABA may also be either synthesized or stored in roots and exported to the leaves in times of water stress.

- The primary functions of ABA are (1) prohibiting precocious germination and promoting dormancy in seeds and (2) inducing stomatal closure and the production of molecules that protect cells against desiccation in times of water stress
- The discovery of abscisic acid:In 1953, Bennet-Clark and Kefford reported that plant extracts contained, in addition to IAA, a substance that inhibited growth of coleoptile sections, which they called inhibitor β. The observation that large amounts of inhibitor β could be isolated from axillary buds and the outer layer of dormant potato tuber led Kefford to suggest that it was involved in apical dominance and maintaining dormancy in potatoes. In 1964, P. F. Waring proposed the term ''dormin'' for these endogenous, dormancy-inducing substances. The name *abscisic acid* and abbreviation *ABA* were recommended by this panel to the 1967 International Conference on Plant Growth Substances, which met in Ottawa.
- Discovery of ethylene: The effect of ethylene on plants was originally described by Dimitry Nikolayevich Neljubow, a graduate student in Russia in 1886, who found that abnormal growth of dark-grown pea seedlings could be traced to ethylene emanating from illuminating gas.
- Ethylene occurs in all plant organs—roots, stems, leaves, bulbs, tubers, fruits, seeds
- M. Lieberman and L. W. Mapson first demonstrated in 1964 that methionine was rapidly converted to ethylene in a cell-free, nonenzymatic model system.
- 1977 when D. Adams and F. Yang demonstrated that **S-adenosylmethionine (SAM)** was an intermediate in the conversion of methionine to ethylene by apple tissue. In 1979, Adams and Yang further demonstrated the accumulation of **1-aminocyclopropane-1-carboxylic acid (ACC)** in apple tissue fed [13C]-methionine under anaerobic conditions—conditions that inhibit the production of ethylene.
- Ethylene production is promoted by a number of factors including IAA, wounding, and water stress, principally by the induction of the synthesis of ACC synthase.
- The important aspect of ethylene biosynthesis is the limited amount of free methionine available in plants. In order to sustain normal rates of ethylene production, the sulfur released during ethylene formation must be recycled back to methionine. This is accomplished by commonly referred to as the methionine cycle. This cycle is also known as the Yang cycle, after S. F. Yang, who carried out much of the pioneering work on ethylene biosynthesis.
- Ethylene stimulates many inhibitory and abnormal growth responses such as the swelling of stem tissues and the downward curvature of leaves, or **epinasty**.
  Triple response of etiolated dicot seedling, characterized by inhibition of hypocotyl and root cell elongation, a pronounced radial swelling of the hypocotyl, and exaggerated curvature of the plumular or epicotyl hook.
- Brassinosteroids elicit an impressive array of developmental responses, including an increased rate of stem and pollen tube elongation, increased rates of cell division (in the presence of auxin and cytokinin), seed germination, leaf morphogenesis, apical dominance, inhibition of root elongation, vascular differentiation, accelerated senescence, and cell death.
- Brassinosteroids are polyhydroxylated plant **sterols**-lipoidal substances related biosynthetically to the gibberellins and abscisic acid
- Sterols are triterpenoids, C30 molecules that are derived from acetate through the mevalonic acid pathway

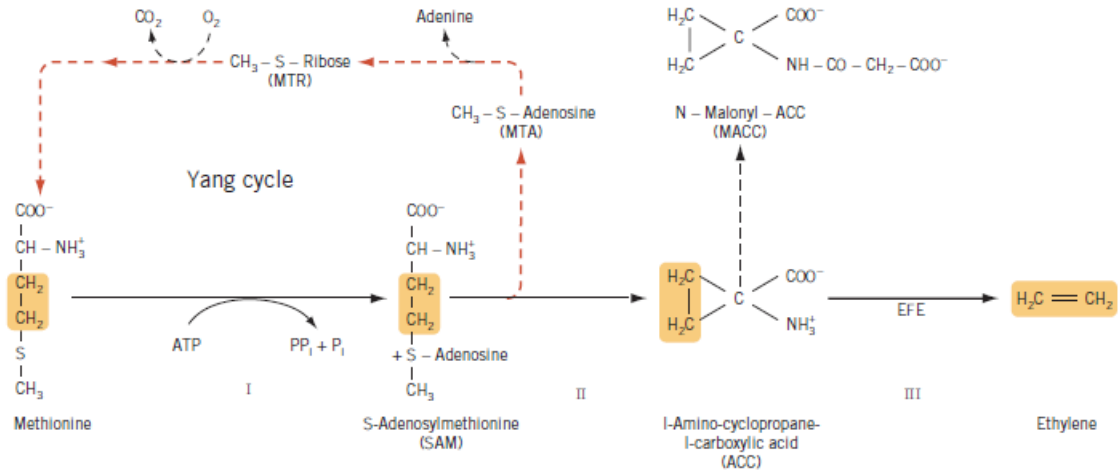


FIGURE 21.8 **A scheme for ethylene biosynthesis in higher plants. The enzymes are I: SAM synthetase; II: ACC synthase; and III: ACC oxidase. The ethylene group is highlighted in yellow. The Yang cycle for sulfur recovery is highlighted in orange.**

Brassinosteroid sensing involves a serine/threonine kinase that regulates the phosphorylation and dephosphorylation of transcription factors.

- The plant growth regulatory activity of triacontanol (TRIA) was first discovered by Ries et al. (1977) in alfalfa (Medicago sativa L.), natural plant growth regulator found in epicuticular waxes.
- TRIA-mediated improvement in growth, yield, photosynthesis, protein synthesis, uptake of water and nutrients,nitrogen-fixation, enzymes activities and contents of free amino acids, reducing sugars, soluble protein, and activeconstituents of essential oil in various crops.
- **Batatasins** are a class of phenolic compounds which occur in dormant yam bulbils. Five different batatasins (batatasin I, II, III, IV and V) have been isolated. The chemical structures of batatasins are dihydrostilbenes,batatasin I is a phenanthrene (constituent of many species of *Dioscorea* tubers, *Tamus communis* from Dioscoreaceae) and batatasins III, IV and V are substituted diphenylethanes or bibenzyls.
- A**phytomere** is a developmental unit consisting of one or more leaves, the node to which the leaves are attached, the internode below the node, and one or more axillary buds.
- Different regions of the primordium acquire identity as specific parts of the leaf. This differentiation occurs along three axes: **dorsiventral** (abaxial–adaxial), **proximodistal** (apical–basal), and **lateral** (margin–blade–midrib)
- The upper (adaxial) side of the leaf is specialized for light absorption; the lower (abaxial) surface is specialized for gas exchange. Leaf structure and maturation rates also vary along the proximodistal and lateral axes.
- Four developmental zones can be distinguished in a root tip: the root cap, the meristematic zone, the elongation zone, and the maturation zone
- The **root cap** protects the apical meristem from mechanical injury as the root pushes its way through the soil. Root cap cells form by specialized root cap stem cells. As the root cap stem cells produce new cells, older cells are progressively displaced toward the tip, where they are eventually sloughed off. As root cap cells differentiate, they acquire the ability to perceive gravitational stimuli and secrete mucopolysaccharides (slime) that help the root penetrate the soil.
- Meristems are populations of dividing cells, but not all cells in the meristematic region divide at the same rate or with the same frequency. Typically, the central cells divide much more slowly than the surrounding cells. These rarely dividing cells are called the **quiescent center** of the root meristem
- Most cell divisions in the root tip are transverse, or **anticlinal**, with the plane of cytokinesis oriented at right angles to the axis of the root (such divisions tend to increase root length). There are relatively few **periclinal** divisions, in which the plane of division is parallel to the root axis (such divisions tend to increase root diameter).
- The *SHOOTMERISTEMLESS* (*STM*) gene is expressed in the region that gives rise to the shoot apical meristem during the heart stage of embryogenesis, and its continued expression suppresses differentiation of the cells of the shoot apical meristem. The *GNOM* gene is required for the establishment of axial polarity, and the *MONOPTEROS* gene is required for formation of theembryonic primary root as well as vascular development.

- Leaves form in a characteristic pattern, with three stages: (1) organogenesis, (2) development of suborgandomains, (3) cell and tissue differentiation. The number and order in which leaf primordia form is reflected in the subsequent phyllotaxy (alternate, opposite, decussate, whorled, or spiral).
- In many plants, the root and shoot apical meristems are capable of indefinite growth.
- The vegetative shoot apical meristem repetitively generates lateral organs (leaves and lateral buds), as well as segments of the stem. Shoot apical meristems in angiosperms typically are organized into three distinct layers, designated L1, L2, and L3.
- The root and shoot apical meristems are primary meristems formed during embryogenesis. Secondary meristems are initiated during postembryonic development and include the vascular cambium, cork cambium, axillary meristems, and secondary root meristems.
- **Hydathodes** are glandlike modifications of the ground and vascular tissues, typically at the margins of leaves, that allow the release of liquid water (guttation fluid) through pores in the epidermis in the presence of root pressure