

CHAPTER:13 PLANT GROWTH AND DEVELOPMENT

What is Plant Hormones?

Plants need sunlight, water, oxygen, minerals for their growth and development. These are external factors. Apart from these, there are some intrinsic factors that regulate the growth and development of plants. These are called plant hormones or "Phytohormones".

Plant hormones are chemical compounds present in very low concentration in plants. They are derivatives of indole (**auxins**), terpenes (**Gibberellins**), adenine (**Cytokinins**), carotenoids (**Absciscic acid**) and gases (**Ethylene**).

These hormones are produced in almost all parts of the plant and are transmitted to various parts of the plant.

They may act synergistically or individually. Roles of different hormones can be complementary or antagonistic.

Hormones play an important role in the processes like vernalisation, phototropism, seed germination, dormancy etc. along with extrinsic factors.

Synthetic plant hormones are exogenously applied for controlled crop production

Charles Darwin first observed the phototropism in the coleoptiles of canary grass and F.W. Went first isolated auxin from the coleoptiles of oat seedlings.

- Growth is a permanent or irreversible increase in dry weight, size, mass or volume of cell, organ or organism. It is internal or intrinsic in living beings.
- Root apical meristem and shoot apical meristem are responsible for primary growth and elongation of plant body along the axis.

- Intercalary meristem located at nodes produce buds and new branches in plants

- Formative phase is also called as the phase of cell formation or cell division. It occurs at root apex, shoot apex and other region having meristematic tissue. The rate of respiration is very high in the cells under going mitosis division informative phase.

- Phase of Enlargement - newly formed cells produced informative phase undergo enlargement. Enlarging cells also develop vacuoles that further increase the volume of cell.

- Cell enlargement occurs in all direction with maximum elongation in conducting tissues and fibres.

- Phase of maturation - the enlarged cells develop into special or particular type of cells by undergoing structural and physiological difference.

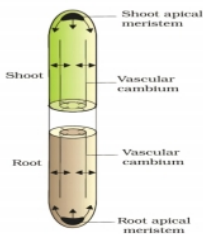


Figure 13.2 Diagrammatic representation of locations of root apical meristem, shoot apical meristem and vascular cambium. Arrows exhibit the direction of growth of cells and organ

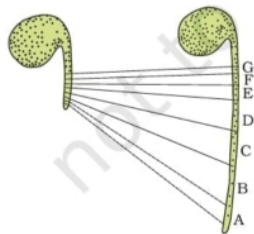


Figure 13.3 Detection of zones of elongation by the parallel line technique. Zones A, B, C, D immediately behind the apex have elongated most.

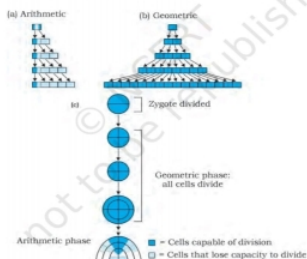
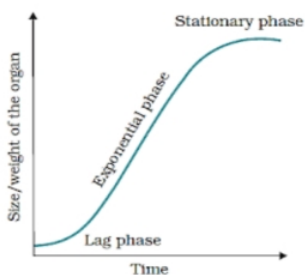


Figure 13.4 Diagrammatic representation of : (a) Arithmetic (b) Geometric growth and (c) Stages during embryo development showing geometric and arithmetic phases



An idealized sigmoid growth curve typical of cells in culture and many higher plants and plant organs

Sigmoid growth curve consists of fast dividing **exponential phase** and **stationary phase**. It is typical of most living organisms in their natural environment.

Plant Growth Regulators are simple molecules of diverse chemical composition which may be **indole compounds**, **adenine derivatives** or **derivatives of carotenoids**.

Auxin

Auxin was first isolated from **human urine**. It is commonly **indole-3-acetic acid (IAA)**. It is generally produced at **stem and root apex** and migrate to site of action.

Functions

1. Cell elongation of stems and roots
2. Apical dominance, IAA in apical bud suppresses the growth of lateral buds
3. Induces parthenocarpy i.e. development of fruit without fertilisation e.g. in tomatoes
4. Prevents premature fall of leaves, flowers, fruits
5. Useful in stem cuttings and grafting where it initiates rooting
6. Promotes flowering e.g. in pineapple

7. 2,4-D is widely used as a herbicide to kill undesirable weeds of dicot plants without affecting monocot plants
8. Helps in cell division and xylem differentiation

Gibberellins

Gibberellins are promoter PGR found in more than 100 forms named as GA₁, GA₂, GA₃ GA₁₀₀. The most common is GA₃ (Gibberellic Acid).

Functions

1. Promotes bolting, i.e. sudden elongation of internodes just before flowering in rosette plants like cabbage, beet
2. Delays senescence
3. Induces parthenocarpy
4. Elongation of the stem and reverses dwarfism
5. Induces maleness in certain plants like cannabis
6. Induces the formation of hydrolytic enzymes such as lipase, amylase in the endosperm of germinating cereal grains and barley seeds
7. Breaks seed dormancy

Cytokinins

Cytokinins the plant growth hormone is basic in nature. Most common forms include kinetin, zeatin, etc. They are mainly synthesized in roots

Functions

1. It promotes lateral and adventitious shoot growth and used to initiate shoot growth in culture
2. Helps in overcoming apical dominance induced by auxins
3. Stimulate the formation of chloroplast in leaves
4. Promotes nutrient mobilisation and delay leaf senescence

Ethylene

Ethylene it is a gaseous hormone which stimulates transverse or isodiametric growth but retards the longitudinal one.

Functions

1. It hastens the ripening of fruits
2. Controls epinasty of leaves
3. Breaks seed and bud dormancy
4. Stimulates rapid elongation of petioles and internodes
5. Promotes senescence and abscission of leaves and flowers
6. Induces root growth and root hair formation thereby increasing the absorption surface
7. Stimulates femaleness in monoecious plants
8. Apical hook formation in dicot seedlings