WELCOME

TO

This is an Education Platform

We Provide PDF Notes for Pharmacy Students

Web Site http://www.fdspharmacy.in/

You tube https://www.youtube.com/c/FDSpharmacy

Telegram https://t.me/Fdspharmacy

App https://play.google.com/store/apps/details?id=com.FDSPharmacyMedia.FDSPharmacy

E-mail fdspharmacyinfo@gmail.com

REMEDIAL BIOLOGY

UNIT 5

TOPIC :

- **Plant growth and development**

  Phases and rate of plant growth, Condition of growth, Introduction to plant growth regulators

Plant growth and development

- Plant growth refers to the irreversible increase in size and volume of plant organs or the whole plant over time. Plant development includes growth as well as the differentiation and maturation of cells, tissues, and organs into a fully functional plant.
- Growth is one of the most visible and measurable aspects of development in plants.

Phases of Plant Growth

Plant growth typically occurs in **three phases**:

1. Meristematic Phase

- Found in root and shoot tips (apical meristems).
- Cells are actively dividing.
- Cells have dense cytoplasm, thin walls, and prominent nuclei.

2. Elongation Phase

- Occurs just behind the meristematic zone.
- Cells increase in size by absorbing water and expanding their vacuoles.
- Responsible for increase in length of organs.

3. Maturation Phase

- Cells attain maximum size and thickness.
- Cells undergo differentiation and become specialized for various functions (e.g., xylem, phloem).
- No further cell division occurs in this zone.

Conditions for Growth in Plants

→ Plant growth is influenced by a variety of environmental (external) and physiological (internal) conditions. These factors either promote or inhibit the growth and development of a plant.

1. External Factors (Environmental Conditions)

➢ These are physical and chemical conditions outside the plant body that affect growth:

a. Water

- Essential for cell enlargement, turgidity, and metabolic activities.
- Acts as a solvent and medium for enzymatic reactions.
- Required for photosynthesis and transport of nutrients.
- Water deficiency leads to wilting, reduced growth rate, and cell division.

b. Oxygen

- Required for aerobic respiration, which provides ATP (energy) for growth processes.
- Actively dividing cells, like those in meristems, need a continuous oxygen supply.
- In waterlogged soils, oxygen becomes limited, reducing root growth.

c. Temperature

- Affects the rate of metabolic reactions.
- Optimum temperature for most plant growth: 25°C–35°C.
- Very high or low temperatures can denature enzymes and slow down or stop growth.
- Some seeds require chilling (vernalization) to germinate.

d. Light

- Essential for photosynthesis, which provides energy for growth.

- Affects photoperiodism (flowering response to day length) and photomorphogenesis.
- Influences stem elongation, leaf expansion, and chlorophyll synthesis.

e. Nutrients (Minerals)

- Plants require macronutrients (N, P, K, Ca, Mg, S) and micronutrients (Fe, Zn, Cu, B, Mo, Mn) for growth.
- Nutrients are involved in enzyme activation, cell division, DNA/RNA synthesis, and photosynthesis.
- Deficiency causes growth retardation, chlorosis, and poor yield.

2. Internal Factors (Physiological Conditions)

➢ These are plant-internal components that control and regulate growth:

a. Genetic Factors

- Growth potential is controlled by the plant's genetic makeup (DNA).
- Determines size, shape, growth rate, and life cycle.

b. Enzymes

- Growth processes like cell division, elongation, respiration, and biosynthesis require enzymes.
- Enzyme activity is influenced by temperature, pH, and substrate availability.

c. Plant Growth Regulators (PGRs)

- These are hormone-like chemicals that regulate various aspects of growth.
- Examples:
  - Auxins – Promote cell elongation
  - Gibberellins – Stimulate stem growth
  - Cytokinins – Promote cell division

- Abscisic Acid (ABA) – Inhibits growth, promotes dormancy
- Ethylene – Controls fruit ripening and abscission

Plant Growth Regulators (PGRs)

- Plant Growth Regulators (PGRs) are chemical substances, either natural (produced within the plant) or synthetic, that influence the physiological processes of growth and development in plants, even when present in very low concentrations.

PGRs regulate activities like

- Cell division and elongation
- Flowering and fruiting
- Dormancy and senescence
- Root and shoot growth
- Seed germination

Classification of PGRs

PGRs are broadly classified into **five major types** based on their function:

1. Auxins (Growth Promoters)

- First discovered by Charles Darwin.
- Indole-3-acetic acid (IAA) is the most common natural auxin.

Functions

- ✓ Promotes cell elongation (especially in shoots).
- ✓ Stimulates root initiation in stem cuttings.
- ✓ Controls apical dominance (inhibits lateral bud growth).
- ✓ Induces parthenocarpy (fruit formation without fertilization).
- ✓ Prevents premature fruit and leaf drop.

Examples

- Natural: IAA, IBA (Indole-3-butyric acid)
- Synthetic: NAA (Naphthalene acetic acid), 2,4-D (Herbicide)

2. Gibberellins (GA)

- First observed in a fungus Gibberella fujikuroi.

Functions

- ✓ Promotes stem elongation and bolting in rosette plants.
- ✓ Breaks seed dormancy and promotes germination.
- ✓ Stimulates enzyme production (like α-amylase in germinating seeds).
- ✓ Induces parthenocarpy.
- ✓ Delays fruit and leaf senescence.

Examples

- GA_1, GA_3 (gibberellic acid)

3. Cytokinins

- First discovered in coconut milk and later in tobacco pith cultures.

Functions

- ✓ Promotes cell division and shoot formation.
- ✓ Delays senescence (anti-aging effect on leaves).
- ✓ Overcomes apical dominance (opposite to auxin).
- ✓ Promotes chloroplast development.
- ✓ In tissue culture, high cytokinin:auxin ratio induces shoot formation.

Examples

- Natural: Zeatin

- Synthetic: Kinetin, Benzylaminopurine (BAP)

4. Abscisic Acid (ABA) – **Growth Inhibitor**

- Stress hormone or Dormin

Functions

- ✓ Induces dormancy in seeds and buds.
- ✓ Promotes stomatal closure during water stress.
- ✓ Inhibits seed germination.
- ✓ Promotes leaf senescence and abscission (leaf/fruit fall).
- ✓ Acts as an antagonist to gibberellins.

Found in

- Leaves, seeds, and fruits

5. Ethylene – **Gaseous Hormone**

- Only gaseous plant hormone.

Functions

- ✓ Promotes fruit ripening (especially climacteric fruits like banana, mango).
- ✓ Induces flowering in pineapple.
- ✓ Stimulates epinasty (downward bending of leaves).
- ✓ Helps in breaking dormancy.
- ✓ Promotes senescence and abscission.
- ✓ Stimulates root hair growth.

Applications of PGRs in Agriculture and Horticulture

- ✓ 2,4-D: Used as a weed killer.
- ✓ IAA/NAA: Used in rooting hormone solutions.
- ✓ Gibberellins: Used to induce bolting in beet and cabbage.
- ✓ Cytokinins: Used in tissue culture for shoot regeneration.