Plant Growth and Development

SHORT NOTES

Growth

- Growth is a characteristic of living beings in which an irreversible permanent increase in size of an organ or its parts occur or an increase in the size of a cell.
- **Plant growth is generally indeterminate** due to capacity of unlimited growth throughout the life.
- 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.

Growth is Measurable

- It is increase in fresh weight, dry weight, length, area, and volume and cell number.

Phases of Growth

- Formative phase - the phase of cell formation or cell division. It occurs at root apex, shoot apex and other meristematic region. The rate of respiration is very in formative phase.
- Phase of Enlargement- cells produced in formative phase undergo enlargement. Enlarging cells develops vacuoles, increase the volume of cell.
- Phase of maturation- the enlarged cells undergoing structural and physiological differentiation.

Growth Rates

- Growth rate can be defined as the increase in growth per unit time.

Plants Show Two Types of Growth

- **Arithmetic growth-** Only one daughter cell continues to divide while others differentiate or mature. It is found in root and shoot elongation.
- **Geometric Growth-** Initial growth is slow (lag phase), followed by a rapid increase in growth (log/exponential phase), and followed by a phase where growth slows down (stationary phase). Example − all cells, tissues and organs show this type of growth.
- **Conditions for Growth Include**- water, oxygen, nutrients and temperature.
- **Differentiation**- In this process, cells derived from root apical and shoot apical meristems and cambium differentiate and mature to perform specific functions.
- **Dedifferentiation**- Process in which living differentiated cells regain their capacity to divide
- **Redifferentiation**- Process in which differentiated cells that have lost their ability to divide are reformed from dedifferentiated cells and have the ability to perform specific functions.

Development – changes in the life cycle.

- Plasticity – different kinds of structure in response to environment or phases of life. E.g. Heteropylly in cotton and coriander. In these plants, leaves have different shapes based on the phase of life cycle as well as the habitat.
- Development = growth + differentiation
- Development is controlled by Intrinsic (Genetic factors and plant growth regulators) and Extrinsic (light, temperature, water, oxygen).

Plant Growth Regulators/Phytohormones

- **Characteristics-** PGRs are small, simple molecules of diverse chemical composition.They could be indole compounds IAA, adenine derivatives (kinetin), derivatives of carotenoids (abscisic acid), terpenes (gibberellic acid) or gases (ethylene)

The Discovery of Plant Growth Regulators

- Auxin was isolated by F.W. Went from tips of coleoptiles of oat seedlings.
- E. Kurosawa identified gibberellins present in a fungal pathogen *Gibberella fujikuroi*
- During mid-1960s, three researches reported the purification and chemical characterisation of inhibitor-B, abscission II and dormin. Later all were proved to be chemically identical. It was named ABA.
- Cytokinins - Skoog and Miller Crystallized it promoting active substance named it kinetin from coconut milk, corn – kernels.
- Cousins confirmed the release of a volatile substance from ripened oranges and was identified as ethylene.

Physiological Effects of Plant Growth Regulators

- **Auxins**- Initiate rooting in stem cuttings, plant propagation, promote flowering, prevent fruit and leaf drop, promote abscission of older mature leaves, Induce parthenocarpy, widely used as herbicides (2,4 – D), kill weeds, Controls xylem differentiation and helps in cell division, used in tea plantations, hedge-making
- **Gibberellins**- Increase in length, cause fruits to elongate and improve its shape, Delay senescence, extend the market period, GA_3 used to speed up malting process in brewing, Increases length of stem, Fastens maturity period, Promotes bolting.
- **Cytokinins**- Produce new leaves, chloroplasts in leaves, lateral shoot growth and adventitious shoot formation, Help overcome apical dominance, Promote nutrient mobilization which helps in the delay of leaf senescence.
- **Ethylene**- Promotes senescence and abscission, Highly effective in fruit ripening, Enhances the respiration rate, Breaks seed and bud dormancy, Initiates germination in peanut seeds, Sprouting potato tubers, induces flowering, regulates physiological processes, Hastens fruit ripening.
- **Abscisic Acid (ABA)**- Regulates abscission dormancy, stimulates the closure of stomata, Increases tolerance, seed development, withstand desiccation