Chapter 13- Plant Growth & Development

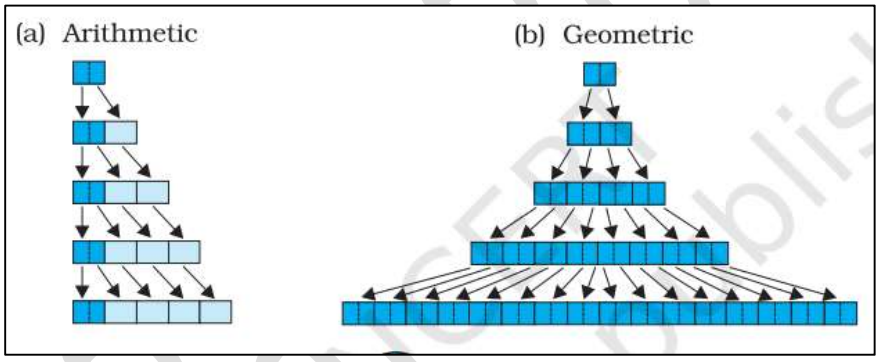
Growth:

It is a characteristic of living beings in which an irreversible permanent increase in size of an organ or its parts occur.

Types of Growth Rate

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

- Plants show two types of growth—Arithmetic and Geometric—according to the increase shown by the growth rate.
- Arithmetic growth - Only one daughter cell continues to divide while others differentiate or mature. Example: root elongating at constant rate.
- 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, Dedifferentiation and Redifferentiation:

Differentiation

- In this process, cells derived from root apical or 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:

- Development – changes in the life cycle.
- Plasticity – different kinds of structure in response to environment or phases of life. Eg. 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 can also be termed as- Growth + Differentiation
- Development is controlled by intrinsic as well as extrinsic factors.
    - Intrinsic-Genetic Factors & PGRs (Plant growth Regulators).
    - Extrinsic − light, temperature, water, oxygen, etc.

Plant Growth Regulators / Phytohormones:

Classification based on their nature of action:

- Plant growth promoters. – **Auxins, Gibberellins** and **Cytokinins**.
- Plant growth inhibitors - **Absissic acid (ABA).**
- **Ethylene** may fit in either of the two groups, but is largely an inhibitor.

Types of phytohormones:

- Auxins, Gibberellins, Cytokinins, Ethylene and Abscisic acid.

Auxins

Discovery :– Auxins were discovered by Charles Darwin and Francis Darwin.

Isolation :– they were isolated from tips of coleoptiles of oat seedlings by F.W.Went as IAA and IBA.

Effects: –

- Initiate rooting in stem cuttings, plant propagation.
- Promote flowering, prevent fruit and leaf drop.
- Promote abscission of older mature leaves.

Uses:-

- Induce parthenocarpy
- Widely used as herbicides (2,4 – D)
- To kill dicotyledonous weeds
- Prepare weed free lawns.
- Controls xylem differentiation and helps in cell division.

Gibberellins

Discovery : E. Kurosawa identified Gibbereilins present in a fungal pathogen *Gibberella fujikuroi*

Isolation: Infected rice seedlings when treated with sterile filtrates of fungus.

Effects:

- GA'S are acidic.
- Increase in length, cause fruits to elongate and improve its shape.
- Delay senescence, extend the market period.
- GA3 used to speed up malting process in brewing

Uses:

- Spraying sugarcane crop with this
- Increases length of stem
- Fastens maturity period.
- Promotes bolting

Cytokinins

Discovery : Skoog and Miller

Isolation: Crystallized it promoting active substance named it kinetin from coconut milk, corn – kernels.

Effects:

- They are synthesized where rapid cell division takes place
- Produce new leaves, chloroplasts in leaves, lateral shoot growth and adventitious shoot formation.

Uses:

- Help overcome apical dominance
- Promote nutrient mobilization which helps in the delay of leaf senescence

Ethylene (gaseous hormone):

Discovery : Cousins confirmed the release of a volatile substance from ripened oranges that hastened the ripening of stored unripened bananas.

Effects:

- 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, promotes root growth root hair formation

Uses:

- Used to initiate flowering, for synchronizing fruit, induces flowering, regulates physiological processes.
- Hastens fruit ripening, accelerates abscission and Promotes female flowers.

Abscisic Acid (ABA):

Discovery: Researchers.

Isolation: 3 kinds of inhibitors - Inhibitor – B, abscission ll & dormin.

Effects:

- Regulates abscission dormancy
- ABA stimulates the closure of stomata
- Increases tolerance, seed development
- Maturation, dormancy, withstand desiccation

Uses:

- There are no. of events in a plant
- Where more than one PGR interact to affect that event, example - Dormancy in seeds / buds abscission, senescence, apical dominance.

Photoperiodism

- It is the response of plants to periods of day/night
- Some plants require periodic exposure to light to induce flowering. Duration of dark period is equally important for flowering.

Long Day Plants − Plants that require exposure to light for a period exceeding critical duration to induce flowering. E.g. Radish, spinach, Hibiscus, sugarcane.

Short Day Plants − Plants that require exposure to light for a period less than this critical period to induce flowering. E.g. Tobacco, Green grams, marijuana, cotton, soyabean, jowar, and rice.

Day Neutral Plants- Plants where there is no correlation between exposure to light and duration and induction of flowering. E.g. cucumber, sunflower, tomato, some varieties of pea, etc.

Vernalization

- It is the phenomenon of dependence of flowering on exposure to low temperature.

- Example − Biennial plants

These are monocarpic plants that flower and then die in second season.

Some examples are **sugar beet, cabbage, carrot**, etc.