

PLANT GROWTH AND DEVELOPMENT

① Growth →

- One of the most fundamental characteristics of living beings.
- Irreversible, permanent ↑ in size of an organ or its parts or an individual cell.
- **Intrinsic Growth**.
- Accompanied by anabolic and catabolic processes.

② Open or Indeterminate Growth →

- Cells are always being added to body by meristem.
- plant growth is **open**.
- primary growth by root and shoot apical meristem.
- Lateral meristems cause Secondary growth (growth in girth) Vascular Cambium, Cork Cambium.

③ Growth is Measurable →

- Growth is measured by varieties of parameters. → ↑ in fresh/dry wt.
- ↑ in length, ↑ in area,
- ↑ in Volume, ↑ in Cell number
- (one cell of maize root apical meristem give rise to 17500 new cells/hour).

④ Phases Of Growth →

- ① **Meristematic** → Cells rich in protoplasm, large nucleus, primary cell wall, abundant plasmodesmata
- ② **Elongation** → Cell enlargement, ↑ Vacuolation, new cell wall deposition.
- ③ **Maturation** → Max size in terms of wall thickening and protoplasmic modification.

⑤ Growth Rates → (↑ in growth/time)

Growth

Arithmetic

One cell continues to divide while others mature.

$$L_t = L_0 + xt$$

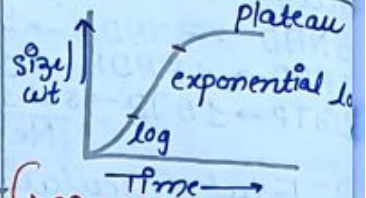
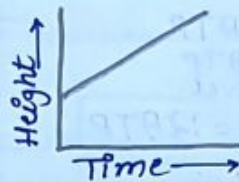
x = growth rate/elongation per unit time.

Geometric

All progeny cells continue to divide.

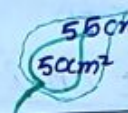
$$W_t = W_0 e^{xt}$$

x = growth rate
 e = base of natural logarithms.



⑥ Growth Rate

Absolute Relative



→ Sigmoid Curve is characteristic to living organisms growing in natural environment.

absolute rate = same
Relative → Very different

⑦ Differentiation →

Maturation of cell leading to loss of ability to divide.

De-differentiation →

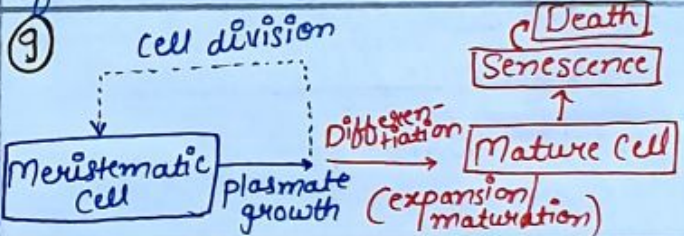
Differentiated cells regaining the capacity to divide.

Re-differentiation →

Cells produced by dedifferentiated cells again lose ability to divide.
e.g. → Cork, Secondary Cortex.

⑧ Development →

All changes that an organism undergoes during its lifecycle from germination of seed to senescence.

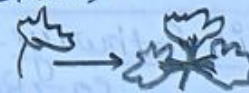


⑩ Plasticity →

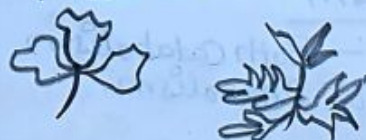
Plants follow different pathways in response to different environments or phases.

Eg. **Heterophylly** in Cotton, Coriander, and Larkspur

(Different leaves in juvenile and mature plant)



Eg. **Buttercup** (Different leaves in air and water)



⑪ Plant Hormones / Phyto Hormones

plant Growth Regulators

Growth promoters

- Auxin
- Gibberellins
- Cytokinins

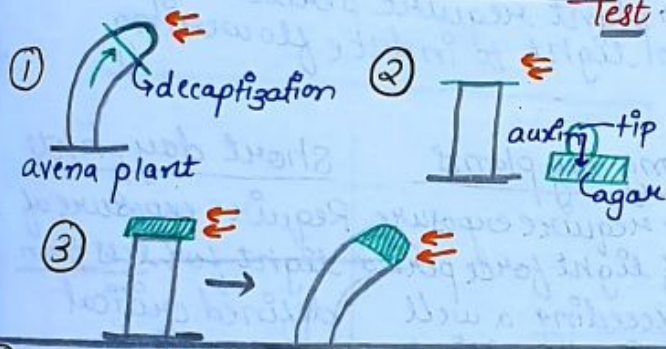
Growth Inhibitors

- (response to wounds and stress)
- ABA (Absciscic acid)
- Ethylene

- apical buds removed in tea plantations, hedge making.
- Induce parthenocarpy (fruit without fertilization) e.g. → In tomatoes.
- Herbicide
- 2-4D kills dicot Weeds, used to prepare weed free lawns.
- Control Xylem differentiation and help in cell division.

⑫ Auxin

- Darwin and his son Francis observed the coleoptiles of Canary grass grew towards light
- (+ve) Phototropism
- Y.F.W. Went isolated auxin from tips of Oat (*Avena* spp) seedlings
- F.W. Went did Avena-Curvature Test



⑬ Functions of Auxin

- 1st isolated from human urine.
- Indole Acetic acid } natural auxins
- Indole Butyric acid }
- Naphthalene Acetic acid } synthetic auxins
- 2,4-Dichlorophenoxy acid }
- Extensive use in agriculture and horticultural practices
- Initiate rooting in stem cuttings
- promote flowering, eg → in pineapples
- prevent fruit and leaf drop at early stages but promote abscission of older leaves and fruits.
- Apical dominance (growing apical buds, inhibits growth of lateral buds)

⑭ Gibberellins

- antagonist to ABA
- Discovery → Bakane (foolish seedling) disease of rice, caused by Fungus.
- Gibberella fujikuroi*
- Active substance was Gibberellin
- Reported by E. Kurosawa
- More than 100 gibberellins forms plants and fungi (GA1, GA2, ...)
- GA3 → First discovered
- Cause increase in length of Grape Stalks.
- Cause apples to elongate.
- Delay senescence (So, fruit can be left on tree)
- Speed up malting in brewing industry.
- ↑ length of sugarcane stem.
- ↑ yield by 20 ton/acre.
- Growth Hormone of plants, Elongation.
- Spraying on Juvenile conifers hasten maturity - leading to early seed production.
- promote Bolting (Internode elongation prior to flowering)

⑮ Cytokinins

- Skoog and Miller crystallised Kinetin, a cytokinin's promoting substance.
- Cytokinesis help in cell division and shoot formation
- Kinetin → modified Adenine, first discovered from autoclaved herring sperm DNA.

→ Kinetin → doesn't occur naturally in plants.

→ Cytokinin → naturally occur in Corn Kernels and Coconut milk.

→ Synthesised in areas of rapid cell division, eg → root apex, shoot buds, Young fruits.

→ produce new leaves, chloroplasts, lateral shoot growth, adventitious shoot formation.

→ Overcome Apical Dominance.

→ promote nutrient mobilisation, helps in delay of leaf senescence.

(16) Ethylene (Gaseous hormone)

→ Cousins confirmed release of Volatile substance from ripened Oranges that hastened the ripening of Bananas.

→ Synthesised in large amount by tissues undergoing senescence and ripening fruits.

→ Triple Response → ① Horizontal Growth
② Swelling of axis.
③ Apical hook formation.

→ promote Senescence and abscission in plant Organs.

→ Respiratory Climatic

→ Rise in rate of respiration during ripening of fruits.

→ Breaks bud and Seed dormancy.

→ Initiate germination in peanut seeds, sprouting of potato tubers.

→ Rapid internode/petiole elongation in deep water ~~water~~ rice plants.

→ Root growth and root hair formation.

→ Initiate flowering and synchronising fruit set in pineapple.

→ Induces flowering in Mango.

→ Ethephon (aqueous solution)

→ Hastens fruit ripening.

→ accelerates abscission in flowers and fruits (thinning of Cotton, Cherry, Walnut)

→ promotes female flowers in Cucumbers.

(17) Abscissic Acid (released in stressful condition).

→ Inhibitor B, Abscission II and Dormin are all abscissic a.

→ Role in regulating abscission and dormancy.

→ Inhibitor of growth and metabolism.

→ Inhibits seed germination.

→ Stimulates closure of Stomata

→ Stress Hormone.

→ Seed development, maturation and dormancy.

(18) Photoperiodism

→ site of perception of light is leaves

→ plant require periodic exposure to light to induce flowering

long day plants

→ require exposure of light for a period exceeding a well defined critical duration.



short day plants

Require exposure of light for less than defined critical period.



Day neutral plants → No correlation b/w exposure to light and flowering

(19) Vernalisation → Winter

→ Some plants require exposure to low temp (quantitatively or qualitatively) for flowering.

eg → Biennial plants → Sugarbeet, Cabbage, Carrot. (2 year)

→ Winter varieties of wheat, barley, rye.

Q20) Seed Dormancy

- Certain seeds fail to germinate, even when external conditions are favourable.
- due to presence of Chemical Inhibitors like ABA, phenolic \bar{a} , para-ascorbic \bar{a} .
- Hard Seed Coats.
- Dormancy can be Overcome by →
 - Seed coat broken by mechanical abrasions.
 - Chilling the seeds.
 - application of gibberellic \bar{a} and nitrates.
 - Changing light and temp.

**NEET
SLAYER**

Tomato → like white Coloured albinos..
(dark room) Kese hua..?
↳ Etiolated.

