FREE NOTES · NCERT + NEET LEVEL

Plant Growth & Development

Growth aur uska maap, phases aur rates (arithmetic aur geometric), differentiation, plasticity, plant growth regulators (auxin, gibberellin, cytokinin, ethylene, ABA) aur unke upyog.

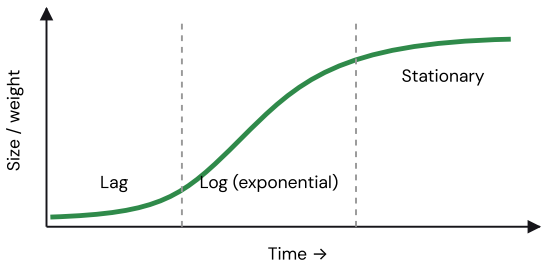
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01 Growth aur uska maap

- Growth = size me sthayi, ulat na sakne wali badhat; paudhon me **open** kyunki meristems cells jodte rehte.
- Primary growth: apical meristems (lambai). Secondary growth: lateral meristems (motai).
- Maap: fresh/dry weight, lambai, area, volume, cell number. Makke ki root apical meristem ghante me 17,500 se zyada cells; tarbooz ke cells 3.5 lakh guna tak.
- Phases: meristematic (divide, ghana protoplasm, bade nuclei), elongation (vacuoles, nayi wall), maturation (poora size).

02 Growth rates

- **Arithmetic**: ek daughter divide, doosra differentiate; $L_t = L_0 + rt$; seedhi line (constant rate se badhti root).
- **Geometric**: dono daughters divide; $W_1 = W_0 e^{rt}$ (r = relative growth rate, efficiency index); limited nutrients me **sigmoid** curve.
- Absolute growth rate: kul growth per time. Relative growth rate: per time per shuruati size.
- Growth ki shartein: paani (turgidity), O_2, nutrients, sahi temperature, roshni, gravity.

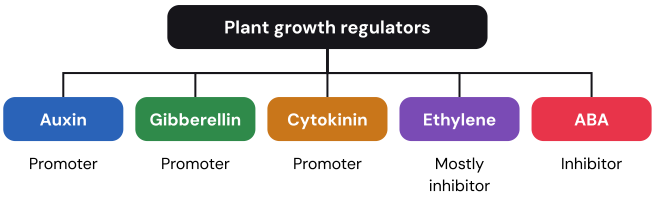


Sigmoid growth curve

03 Differentiation aur plasticity

- **Differentiation**: cells khaas kaam ke liye pakte (tracheary elements protoplasm kho dete, lignified walls).
- **Dedifferentiation**: differentiated cells phir divide karne lagte (interfascicular cambium, cork cambium). **Redifferentiation**: unke products phir pakte.
- Development = growth + differentiation; andar ke (genes, PGRs) aur bahar ke (roshni, temperature, paani, O_2, poshan) factors se.
- **Plasticity**: mahaul ya umar ke hisaab se alag structures: kapas, dhaniya, larkspur me **heterophylly** (bachpan vs badi pattiyan) aur buttercup (hawa vs paani).

04 PGRs: khoj



PGRs ke paanch group

PGR	Khoj
Auxin	Charles & Francis Darwin (canary grass coleoptile ka phototropism); F.W. Went ne oat coleoptile tips se nikala
Gibberellin	E. Kurosawa: chawal ki "bakanae" (foolish seedling) bimari, fungus *Gibberella fujikuroi*
Cytokinin	F. Skoog: autoclaved herring sperm DNA se kinetin; makke ke daane aur nariyal paani se zeatin
ABA	Inhibitor-B, abscission II, dormin teeno ek hi nikle
Ethylene	Cousins: paki naarangi ki gas se kele jaldi pake

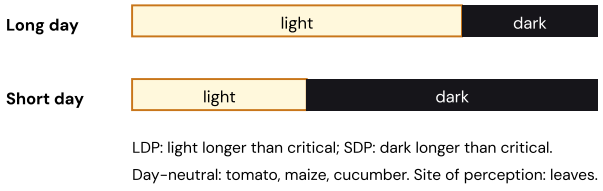
05 PGRs: asar aur upyog

PGR	Main effects / uses
Auxin (IAA, IBA; NAA, 2,4-D synthetic)	Rooting of stem cuttings; prevent fruit and leaf drop; **apical dominance**; parthenocarpy (tomato); 2,4-D weedicide (kills dicot weeds); xylem differentiation
Gibberellin (GA_3, 100+ types)	Stem elongation (grapes stalk, apple shape); delay senescence; sugarcane yield up to 20 tonnes/acre more; malting in brewing; bolting in beet, cabbage
Cytokinin	Cell division; new leaves, chloroplasts, lateral shoots; overcome apical dominance; delay leaf senescence (nutrient mobilisation)
Ethylene (gas)	Fruit ripening (increases respiration: respiratory climacteric), senescence, abscission; horizontal growth of seedlings, apical hook; flowering in pineapple, mango; ethephon most used source; promotes female flowers in cucumber
ABA (stress hormone)	Stomatal closure, seed and bud dormancy, inhibits growth, helps seed withstand desiccation; antagonist of GA

06 Interactions aur summary

- PGRs akele kam kaam karte: auxin ka apical dominance cytokinin se kam hota; GA aur ABA dormancy pe ulta asar.
- Bahar ke factors (temperature, roshni) PGRs ke zariye kaam karte.
- Practical: chai bagaan aur hedge me shoot tip katne (decapitation) se side branches zyada.

07 Extra: photoperiodism, vernalisation, seed dormancy



Photoperiodism

- **Photoperiodism** (Garner aur Allard): din ki lambai pe phool aana. Long-day plants: gehun, mooli, chukandar. Short-day plants: soybean, tambaku, chawal, guldaudi. Day-neutral: tamatar, makka, kheera.
- **Vernalisation**: kuch samay thand se phool jaldi; mausam ke ant me jaldi prajanan rokta. Biennials (gajar, patta gobhi, chukandar) aur gehun, jau, rye ki winter kismein.
- **Seed dormancy**: zinda beej sahi halat me bhi nahi ugta; kaaran: sakht seed coat, ABA, phenolics, kachcha embryo. Todne ke tareeke: scarification, gibberellins, thand, roshni.
- **Richmond–Lang effect**: cytokinin patti ka budhapa rokta. **Ethephon** = ethylene ka srot; **malting** me GA (brewing).
- Beej ugna: imbibition → enzymes active (aleurone me GA → α-amylase) → pehle radicle bahar.

08 Important Q&A

Q1. Apical dominance kya? Chai bagaan me kaise upyog?

Badhti apical bud side buds ko rokti (auxin). Chai me shoot tip katne se side buds badhti, ghane paudhe, zyada pattiyan.

Q2. ABA ko stress hormone kyun kehte?

Stress (sookha) me badhta; stomata band karta aur sehne ki shakti badhata.

Q3. Bolting kaunsa PGR? Ganne me kaise upyog?

Gibberellin; spray se internodes lambe, 20 tonne/acre tak zyada paidawar.

09 Common mistakes

- 2,4-D ko natural auxin kehna (synthetic hai).
- Ethylene ko sirf inhibitor kehna (ripening, female flowers bhi).
- Heterophylly ke examples mix karna.
- Absolute aur relative growth rate mix karna.

10 Practice (NEET style)

1. Bakanae bimari se kiski khoj?
2. Phal pakane wala hormone?
3. Leaf senescence rokne wala?
4. e^{rt} wali equation?
5. Dicots ko maarne wala weedicide?

ANSWERS

1) Gibberellin · 2) Ethylene · 3) Cytokinin · 4) Geometric growth · 5) 2,4-D

11 Quick revision: exam se 5 minute pehle

GROWTH

- Open growth
- Lag-log-stationary (sigmoid)
- Arithmetic L_o+rt

PROMOTERS

- Auxin: rooting, apical dominance
- GA: bolting, ganna
- CK: cell division

INHIBITORS

- Ethylene: ripening
- ABA: stomata band, dormancy

DISCOVERIES

- Went: oat
- Kurosawa: chawal
- Skoog: kinetin

Koi doubt? padhaiadda.netlify.app pe AI Doubt Solver se poocho, ya is chapter ka mock test do.