

MSC SEMESTER II

Important notes on Auxin and Gibberline, Cytokinines

Natural auxins:

Indole 3-acetic acid (IAA) are naturally occurring auxins in plants and therefore; regarded as phytohormones. is the best known and universal auxin. It is found in all plants and fungi. Besides IAA, indole-3-acetaldehyde, indole -3-spyruvic acid, indole ethanol, 4-chloro-idole aerie acid (4-chloro--IAA) etc., are some other natural auxins.

The first naturally occurring auxin was isolated by Kogl and Haagen-Smit (1931) from human urine.

Physiological Effects and Applications of Auxin

1. **Apical Dominance** (Characteristic function of auxin): The phenomenon in which apical bud dominates over the growth of lateral buds is called Apical Dominance. Prunning in gardens promotes densing of hedge.
2. **Cell Division & Cell Enlargement/Callus formation** Auxin is important in Tissue culture & Grafting. It stimulates division of intrafascicular cambium. Also in healing of wounds.
3. **Shortening of Internodes:** a-NAA induces the formation of dwarf shoot or spurs in apple, pear etc., thus number of fruits increases.
4. **Prevention of lodging:** Auxin spray prevents lodging of crops, immature leaves & fruits.
5. **Root initiation:** Rooting on stem cuttings is promoted by IEA & NAA (Root growth inhibited by auxin).
6. **Potato dormancy:** MH (Maleic-Hvdrazide). a--NAA., induces dormancy of lateral buds in potato tubers & potato can stored for long duration.
7. **Prevention of Abscission:** IAA, NAA prevents premature abscission of plant organs.
8. **Flower initiation:** Auxin is inhibitor of flowering but it promotes uniform flowering in Pine apple & Litchi plants.
9. **Parthenocarpy:** Seed less fruits can produced by spray of IAA. (By Gusteffson)
10. **Selective weed killer:** Dicot broad leave weeds can be eradicated by 2, 4-D & 2, 4, 5-T.
11. **Agent orange** is used in biowar. It was used by USA against Vietnam (1966-60).
12. **Femaleness:** Feminising effect in some plants.
13. Flower & Fruit thinning: Certain trees like mango form less number of fruits in alternate years. But auxins can produced normal fruit crops every year. This is known as fruit thinning.
14. When Antiauxin (TIBA-Tri-Iodo-Benzoic acid) are sprayed on mature cotton field then cotton balls can picked easily.

Bio-Assay test:

Bioassay means the testing of substance for its activity in causing a growth response in a living plant or its parts.

(i) **Avena curvature test:** Avena curvature test carried out by F.W. Went (1928), demonstrated the effect of auxins on plant growth by performing some experiments with the oat (*Avena sativa*) coleoptile.

(ii) **Root growth inhibition test:** are bioassays for examining auxin activity.

Gibberellic Acid/ Gibberline

First of all Japanese farmers observed peculiar symptoms in rice seedlings & called the bakanae disease (Foolish seedling disease). In this disease, rice plants become thin, tall & pale due to infection of *Gibberella* (Ascomycetes) or *Fusarium* (Deuteromycetes) confirmed by **Kurosawa & Swada**.

Yabuta and Sumiki 1938 were first to extract a crystalline substance from the *Gibberella* fungus, which they named as Gibberellin.

Gibberellin is acidic, 100 type of Gibberellins (GA1, GA2, GA3, GA100) are known. GA3 [C₁₉H₂₆O₆] is representative of all Gibberellins. First discovered Gibberellins from higher plants was GA1 (GA1 & GA20 are common GA's of higher plants)

GA found in all group of plants (algae to angiosperms) but as a flowering hormone acts only in angiosperms., Biosynthesis of gibberellin takes place by Mevalonic acid pathway (Kaurene → GA)

Physiology Effects and Applications

Stem/internode elongation: It is the characteristic function of gibberellins. GA induces internode elongation, leaf expansion & used in sugarcane cultivation. (Gibberellins induce stem elongation in Rosette plants (Cabbage). This phenomenon known as Bolting effect. (Elimination of rosette habit in some plants by gibberellins action is called bolting)

Elongation of genetic dwarf plants When gibberellin are applied to dwarf *Maize*, *Pisum* & *Vicia faba*, then they become tall. Extreme dwarfism in rosette plant/ dwarfism can be eliminated by GA.

Flowering in Long Day Plant in short light duration

Parthenocarpy: Like Auxin, exogenous use of GA also induces the formation of seedless fruits.

Substitution of cold treatment or Vernalisation

GA induce flowering in biannual plants even in first year form

Breaking of dormancy: GA breaks the dormancy of seeds, buds and tubers.

Seed germination: Gibberellins induce germination via activating the synthesis of hydrolysing enzymes like amylase, Lipases & Proteases, induce pollen tube germination process.

Sex expression: GA induce maleness in Cucumis, Cannabis.

Germination of Photoblastic seeds: Gibberellin treated light sensitive seeds can germinate in dark. Ex. Lettuce, Tobacco.

Fruit & Flower enlargement: Size of grape fruits & bunch & Geranium flowers can be increased by GA. Pomalin & GA (GA4 & GA7) + CK(6- Benzyladenine) - acts as apple enlarger.

Bio assay:

1. α -amylase activity test in Barley endosperm:

Endosperms are detached from embryos, sterilized and allow to remain in 1ml of test solution for 1-2 days. There is build up of reducing sugars which is proportional to GA concentrations. Reducing sugars do not occur in endosperms kept as control.

2. Elongation of Dwarf Pea & Maize test:

Seeds of dwarf pea are allowed to germinate till the just emergence of plumule. GA solution is applied to some seedlings, others are kept as control. After 5 days, epicotyl length is measured. Increase in length of epicotyl over control seedlings' is proportional to GA concentration.

Cytokinins(CK)

Cytokinin was discovered by Miller and prof. Skoog) on tobacco pith culture. They added the contents of an old DNA- bottle (Herring fish sperms DNA) to the culture medium & observed that the-tobacco pith callus could grow for longer period.

Miller isolated an active substance from autoclaved DNA from Herring sperm, stimulated cell division. He named this substance as kinetin

Cytokinin: important points to remember

1. Term cytokinin By Letham and Skoog.
2. The first natural cytokinin was identified & crystallized from immature corn grains by Letham & named as Zeatin.
3. The most common cytokinin in plants are Zeatin and isopantanyl adenine.
4. Cytokinin is a derivative of Adenine base.
5. Root tips are major site of synthesis of CK (by Mevalonic acid pathway).
6. Movement of cytokinin is polar & Basipetal.
7. Coconut milk factor also performed activity like cytokinin, thus used in tissue culture.
8. Zachau obtained cytoknins from serine-t-RNA of yeast.
9. BAP (Benzylamino purine), Diphenylurea and Thidiazuron are synthetic cytokinins.

Physiological Effects and Applications

1. **Cell Division: & Cell Enlargement:** One of the most important characteristic function of cytokinin on plants is induction of cell division. In tissue culture also.
2. **Induction of secondary growth:** Formation of inter fascicular cambium and induce secondary growth.
3. **Morphogenesis:** Morphogenetic changes induce by CK in presence of IAA.
High CK + low auxin - Shoot formation
High auxin + low CK - Root formation
4. **Promotion of lateral growth:** Promotes growth of lateral buds by counteracting/ masking apical dominance:
5. **Breaking the dormancy of seeds:** Like GA the dormancy of certain seeds can be broken by CK.
6. **Delay in senescence (Richmond Lang effect):** The ageing process of leaves usually accompanies with loss of chlorophyll and rapid catabolism. This is called as senescence. Senescence can be postponed by CK (increase short life of plant parts)
7. **Lignin biosynthesis** in some plants

8. **Parthenocarpy** in some fruits
9. **Phloem conduction** : induce acilitation of Nutrients Mobilisation in all parts of plants
10. **Femaleness**: induce femaleness in plants
11. **Flowering in Short Day Plant**: Induce flowering in SDP even in in long days duration)
12. **Induce stomatal opening**

Bio-assay:

1. **Tobacco pith cell division test:** Tobacco pith culture is divided into two weighted lots. One supplied with cytokinin and the other without it. After 3-5 weeks, increase of fresh weight of treated tissue over control is noted. It is a measure of stimulation of cell division and hence cytokinin activity.

2. **Delay in senescence test:** Leaves are cut into equal sized discs with the help of a cutter. They are divided into two lots. One lot is provided with cytokinin. After 48-72 hours, leaf discs are compared for chlorophyll contents. Cytokinin retards chlorophyll degradation. Lower loss of chlorophyll pigmentation under cytokinin treatments results to delay in plant senescence process