PHYTOHORMONE (Auxins)

Introduction :- Previously it was known that growth and development in plants happen due to absorption of water and nutrient from soil but now it is clearly understood that some chemicals or organic compounds that promote growth and development of plants. Such compound are called PHYTOHORMONE or PLANT HORMONE or GROWTH REGULATOR. They are known to exists in plants and perform various functions.

Definition → The chemical, controlling and regulating the growth and development to plants have been reffered as PHYTOHORMONES.

The word hormone has originated from a Greak word "HORMAO" which means to stimulate.

The vrord phytohormone was coined by THIMANN (1943), of America.

Characteristics :-

Hormone possess flowing characteristics :—

(i) Effective in minute quantities (in ppm)
(ii) Similar to Enzyme & catalysts.
(iii) Site of origin & action of are different. origin (A) → (B) reaction
(iv) They are dissimilar to enzyme & catalysts.
(v) They show board action spectrum
(vi) Similar to antibiotics.
(vii) They are required in traces.
(viii) All hormone are organic in nature.

They have been divided into five board classes —

I. Auxin or Indole derivetics.
II. Gibberellins
III. Cytokinins
IV. Abscissic acid
V. Ethylene.

I. **Auxine** :- This group of phytohormone promote longitudinal growth is stem in absence of meristematic tissue.

II. **Gibberellins** :- It is also responsible for causing longitudinal growth in stem but in presence of meristematic tissue.

III. **Cytokinins** :- It causes mitotic cell division in vegetative cells.

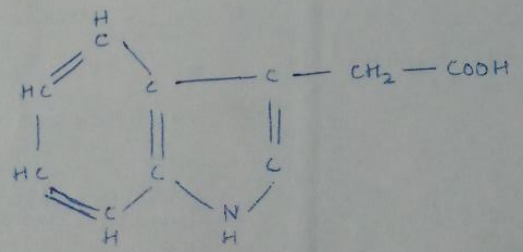
IV. **Abscissic acid** :- It causes fall down the plant parts like leaves, flowers & fruits.

V. **Ethylene** :- It is responsible for fruit ripening.

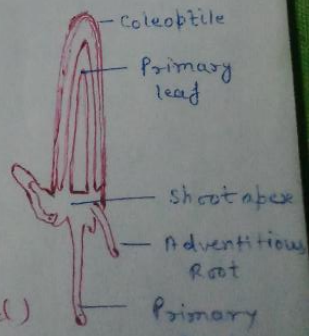
Auxine

Definition → Auxins are phytohormones means which promote longitudinally growth in stem or coleoptile in absence of meristematic tissue.

The term Auxin includes all those chemical substances which promote growth of stem or coleoptile sections and decapitated coleoptiles, but in the same concentrations are incapable of causing growth on intact plant. The principle naturally occuring auxin is indole-3-acetic acid (IAA).



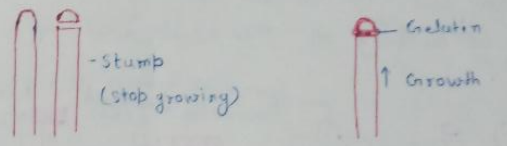
IAA (Indole acetic acid)



Oat Coleoptile

Discovery :- The existence of first plant growth hormone came from the work of DARWIN (1881). Darwin and his son, while working on canary grass (Phalaris canariensis), demonstrated the bending of grass coleoptile towards unilateral source of light. The bending occured only when the tip of coleoptile was also illuminated. Decapitating or covering the tip of cap resulted in loss of sensitivity of the plant towards light. Replacement preceived the light and then exerted some influence on differential growth in the non-illuminated side.

① ⇒ Boysen-Jensen (1910, 13) → Similar observation were made by Boysen-Jensen on oat (Avena Sativa) coleoptile. He decapitated the seedling. Smeared a bit of gelatin on the cut end, replaced the tip on the gelatin, and found that coleoptile bends towards light source. The conclusion was drawn by this simple experiment that some substance has diffused from the tip through the gelation to the cut end where it causes growth.

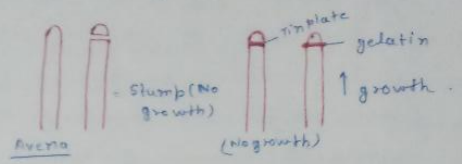


Avena Coleoptile

Conclusion :- He concluded the diffusible chemical that promote growth of the stump occur at the tip.

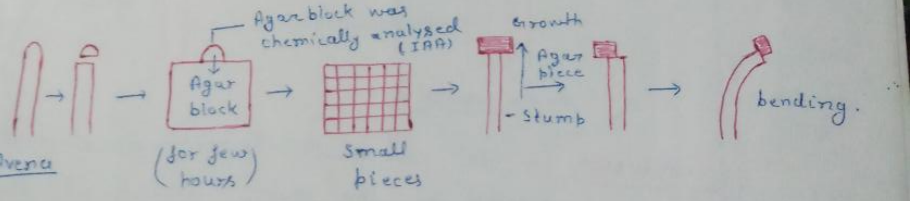
② ⇒ Paal (1919) → Paal demonstrated that if he decapitated tip was replaced on the cut end eccentrically, more growth results on that side which causes bending

even through this is done in complete darkness.



Conclusion → He also came to the same conclusion that tip contains the chemical for growth of the stump but these two workers felt to isolate the chemical from the tip of the coleoptile.

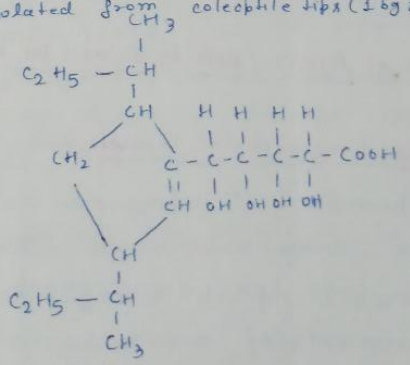
③ ⇒ Went (1928) → Final proof was provided by Went in (1928). He isolated the chemical from tip through this famous experiment. Went provided that some material substances is involved in unilateral growth and that this substance is provided by the apex. He placed several decapitated tips of Avena Coleoptile over a thin block of agar. agar (a polysaccharide that attains a gelatin like consistency when dissolved in hot water and allowed to cool.). The agar block was allowed to stay for some time. The block was then cut to small pieces and each pix. was placed excentrically on the cut end of coleoptile.



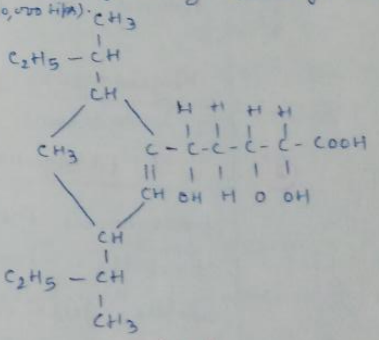
The characteristic bending was observed though the experiment was performed in darkness. This clearly demonstrated that the substance responsible for growth is synthesized in the apex and translocated downwards where it cause growth. The substance has reached

out in the agar block from the coleoptile tips & then migrated downwards in the coleoptiles where it triggered the longitudinal growth on one side. Went named this substance as Auxin and concluded that "no growth can occur without Auxin."

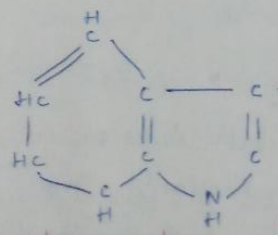
Isolation of Auxine → Chemical characterization of Auxin was done by KOGL (1931) and THIMANN (1935). For the first time Auxine isolated by Salkowski (1885). Kogl is isolated the substance from urine of pathological Dutch patient and named it Auxin-a (auxintriolic acid, $C_{18}H_{32}O_5$). Kogl (further isolated), Haagen Smit, Enxleben (1934) isolated a similar substance from corn germ oil and named it Auxin-b (auxenolonic acid, $C_{18}H_{30}O_4$). Subsequently they isolated another auxin from human urine called heteroauxin which was identified as indole 3-acetic acid (IAA). ~~The molecular str. of IAA is given in fig.~~ Thimann (1935) isolated it from the culture filtrate in which the fungus Rhizopus Suinus had been growing. Recenty it has isolated from coleoptile tips (1 kg from 30,000 tips).



auxin-a



auxin-b



IAA

Structure of Auxins

Distribution of Auxin → Auxin are widely distributed in all plant parts but the maximum concentration has been reported to the meristematic region particularly the stem and root tip. They are of two types —

(a) **Natural auxin** → A number of naturally occuring auxins are called natural auxin. Some of them are indole-3-acetonitrite, indole-3-ethnol etc.

(b) **Synthetic auxin** → Some auxin have been also synthesize they are called synthetic auxin. These are indole butyric acid (IBA), 2,4-dichlorophenoxy acetic acid (2-4-D), α- and β- nephthalene acetic acid, phenyl acetic acid etc.

Translocation of Auxine → Auxin are transported with the steam one of H_2O through xylem. It happens from base to apex. Vice versa such transported has been named as polar translocation.

Physiological effects of Auxin / Role of Auxin in high plant →

(1) **Cell Elongation and Longitudinal Growth** →

Endogenous Auxin promote cell elongation in stem and coleoptile. However, exogenous auxin solution to intact plants fail to promote much elongation. Probably it is the required amount of auxin is already present in plants.

(2) **Cell division** → Auxin is responsible for initiation and promotion of cell division in cambium. This effect of Auxin is praticularly imp. in secondary growth of stem elongation ~~and the~~ and differentiation of xylem & phalem tissues

Initiation and promotion of cell division by auxins is very useful in tissue culture experiments and formation of callus. Healthy growth of callus (undifferentiated mass of cells) depends on the auxin added in the culture.

(3) Root Formation → The cell div. leading to the formation of adventitious and Lateral roots is stimulated by auxin. For this reason, Auxin, ~~fraeti~~ particularly IBA, is used by plant growers to induce root formation in cuttings. Though the auxin stimulates formation of new roots, it inhibits the root growth.

(4) Apical dominance → It is a common observation in vascular plants. If the apical bud is intact and growing the lateral buds remains suppressed. The influence of apical bud in suppressing the growth of lateral buds is termed as apical dominance.

(5) Parthenocarpy → Auxin is well known to induce parthenocarpy (ie. the formation of seedless fruits without fertilization) in a number of plants. External application of Auxin on flowers causes development of seedless fruit, tomatoes, apples, cucumbers etc.

(6) Eradication of weeds → Some of the synthetic auxin, especially 2,4-D, are used in eradication of weeds. Spraying of these substance causes overstimulated root growth of certain, unwanted dicotyledonous plant which ultimately are destroyed.

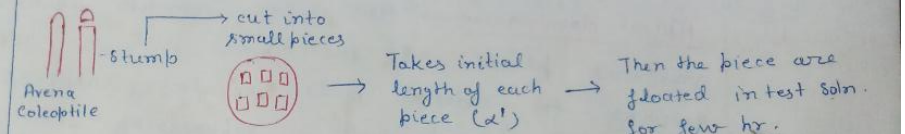
(7) Enzymatic activity → Auxin generally inhibits flowering but in pineapple spraying of certain auxin causes uniform flowering in the whole crop. The auxin helps in

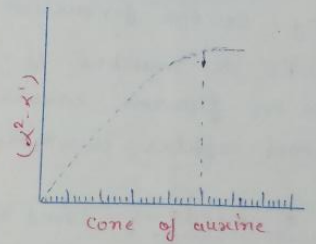
delaying the flower formation in lettuce.

(5) Respiration → Auxin stimulates the respiration in plants.

Bioassays of Auxine →

I. Avena Straight Growth Test → The physiological basis for straight growth test is the simple stimulation of straight growth by auxins. Pea internodes of standard length are floated on test solutions for 6-24 hr. The increase in length is measured and is plotted against auxin concentration

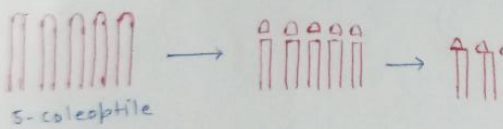


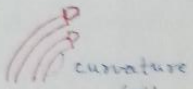


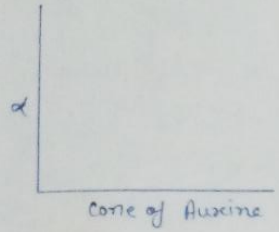
II. Avena curvature test → The agar block containing the auxine is placed on one side of the coleoptile tip against the protruding primary leaf. After 90 min. Shadowgraphs of the curvature are taken with the help of a protractor. The angle of curvature from the straight lower region to the tip of the coleoptile measured. The angle of curvatu is plotted against concentration.

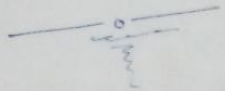
अल्बेंडाज़ोल की गोली

आँगनबाड़ी सेविका का हस्ताक्षर









The word hormone has originated from a