Plant growth regulators:

Light, water, oxygen and nutrition is obligate requirement for plants to grow and develop into fully matured plants. Along with these environmental factors, plants also produce intracellular chemicals which help in their growth and development. These factors are called plant growth regulators. They are intrinsic factors. So, Plant Growth Regulators are simple chemicals produced naturally by plants to regulate their growth and development.

Characteristics

These chemicals are having diverse chemical composition. They are also referred to as plant growth substances, phytohormones or plant hormones. Based on their chemical nature and mode of actions important plant growth regulators are ethylene (gaseous form), auxin, gibberellic acid, cytokinin, abscisic acid. .

Based on their action, they are broadly classified as follows:

Plant Growth Promoters – They promote cell division, cell enlargement, flowering, fruiting and seed formation. Examples are auxins, gibberellins and cytokinins.

Plant Growth Inhibitors – These chemicals inhibit plant growth and promote dormancy (temporary inactive phase) and abscission in plants (natural detachment/ falling off of dead leaves and riped fruit. An example is an abscisic acid.

Ethylene helps in fruit ripening. It can be a promoter or an inhibitor, but is largely a Plant Growth Inhibitor.

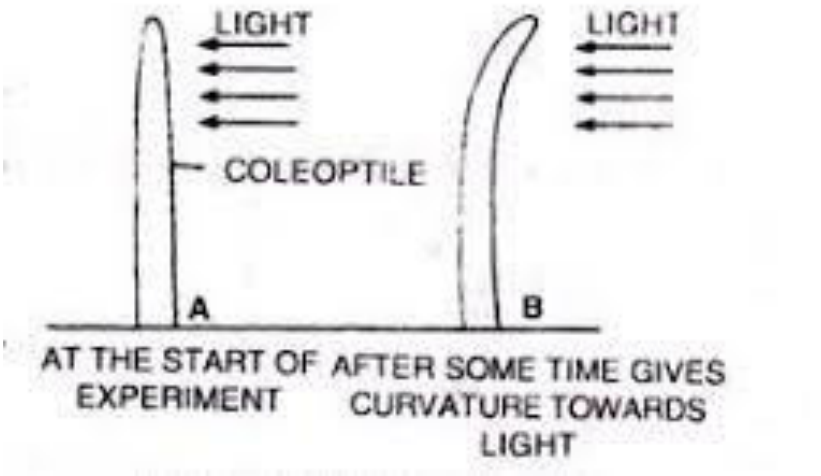
Auxins

Natural auxins produced by plants are Indole-3-acetic acid (IAA) and Indole butyric acid (IBA), phenylacetic acid (PAA), indole-3-propionic acid (IPA). Natural auxins are found in growing stems and roots coleoptile from where they migrate to their site of action.

Naphthalene acetic acid (NAA) and 2, 4-dichlorophenoxyacetic (2, 4-D) are examples of synthetic auxins.

Discovery

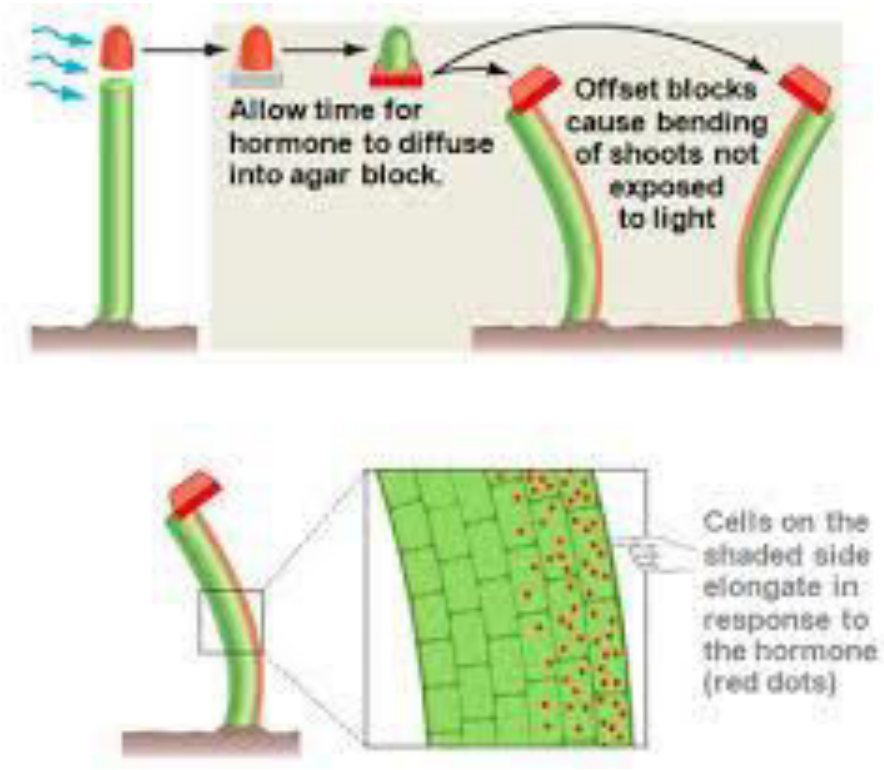
Auxins were the first growth hormone to be discovered. They were discovered by observations of Charles Darwin and his son, Francis Darwin. The Darwins observed that the apical coleoptile (protective sheath) in canary grass grows and bends towards the source of light. This phenomenon is 'phototropism'. In addition, their experiments showed that the coleoptile tip was the site responsible for the bending. Finally, this led to the isolation of the first auxin by **F.W. Went** from the coleoptile tip of oat seedlings. He work on oat (*Avena sativa*), he reported that If the growing tip of oat coleoptile is removed, the remaining portion of coleoptile will show a marked decrease in growth which will ultimately stop. That showed that chemical present in growing tip of oat coleoptile help in plant elongation. This substance is t/a IAA (indole-3-acetic acid), natural auxin.. Went (1928) performed Avena-curvature test.



Avena Curvature Test:

Went showed that a growth promoting chemical diffuses from coleoptile tips, and causes a coleoptile to grow towards the light. Went cut the tips of the coleoptiles and placed them in the dark, putting a few tips on agar blocks then he predicted that agar would absorb the

growth-promoting chemical. On control coleoptiles, he placed a block that lacked the chemical. On others, he placed blocks containing the chemical, either centered on top of the coleoptile to distribute the chemical evenly or offset to increase the concentration on one side. When the growth-promoting chemical was distributed evenly the coleoptile grew straight. If the chemical was distributed unevenly, the coleoptile curved away from the side with the cube, as if growing towards the light, even though it was grown in the dark. Went later proposed that the messenger substance is a growth-promoting hormone, which he named auxin, that becomes asymmetrically distributed in the bending region. Went concluded that auxin is at a higher concentration on the shaded side, promoting cell elongation, which results in coleoptiles bending towards the light



Avena curvature test

Physiological role of Auxin

1) Apical dominance: The growing apical bud inhibits the growth of the lateral buds

2) Root initiation: Auxin helps to initiate rooting in stem cuttings

3) Flowering: Auxins promotes flowering in plants

4) Abscission: Auxins promote the abscission (natural detachment) of older leaves and fruits, but prevent dropping of fruits and leaves too early.

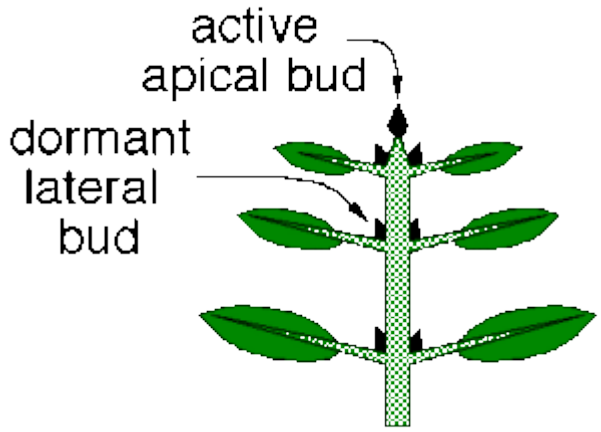
5) Control xylem differentiation

6) Cell division: Auxins help in cell division

7) Induce parthenocarpy i.e. the production of fruit without prior fertilization.

8) 2, 4-D (synthetic auxin) is widely used as a herbicide to kill dicotyledonous weeds.

Apical Dominance (definition): The growing apical bud in higher plants due to auxin at apical region inhibits the growth of the lateral buds. This phenomenon is 'Apical Dominance'. Removal of the apical bud allows the lateral buds to grow. This technique is commonly used in tea plantations and hedge-making.



Apical dominance