Agri Articles
(e-Magazine for Agricultural Articles)
Volume: 03, Issue: 01 (JAN-FEB, 2023)
Available online at http://www.agriarticles.com
©Agri Articles, ISSN: 2582-9882

Physiological and Biological Responses of Plant Growth Regulators in Fruit Crops

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Plant growth regulators include plant hormones (natural & synthetic), but also non-nutrient chemicals not found naturally in plants that when applied to plants, influence their growth and development. All plant hormones are growth plant growth regulators but all plant regulators are not plant hormones. Phytohormones are organic substances produced naturally by plants which in minute/low concentrations.

- increase
- decrease
- modify the growth and development.

AUXINS

Derived from the Greek word "auxein" means- "to grow/increase". Auxins is a growth promoting substance that promotes growth along the vertical axis when applied in low concentration to the shoot of the plant.

Occurs universally in all plants at active growth sites.

- Organs that are expanding and growing meristems both produce auxin.
- More auxin is produced at the shoot apex than at the root apex.
- More auxin is produced by apical buds than lateral ones.
- Developing seeds have a higher auxin content than mature seeds.
- Six times more auxin is produced by apical buds than by growing leaves.

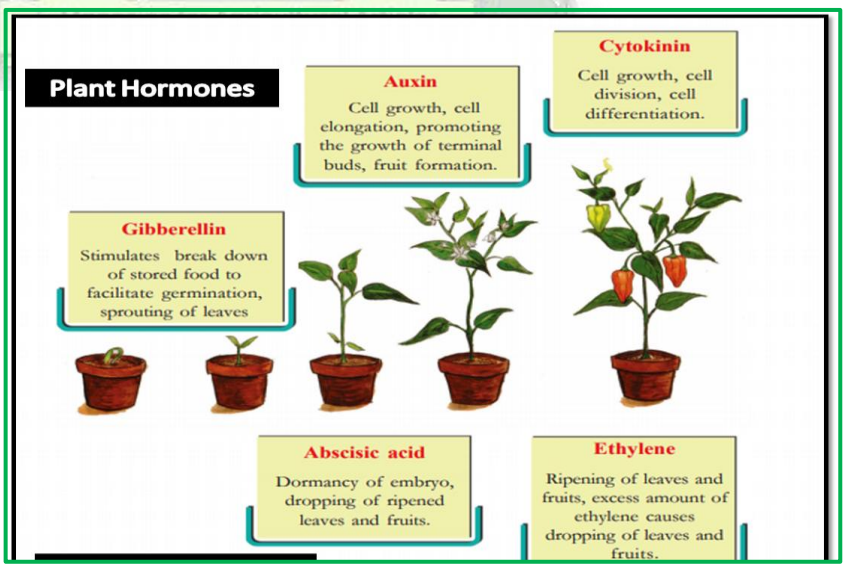
Effects of different Auxin on Plant Growth and Development

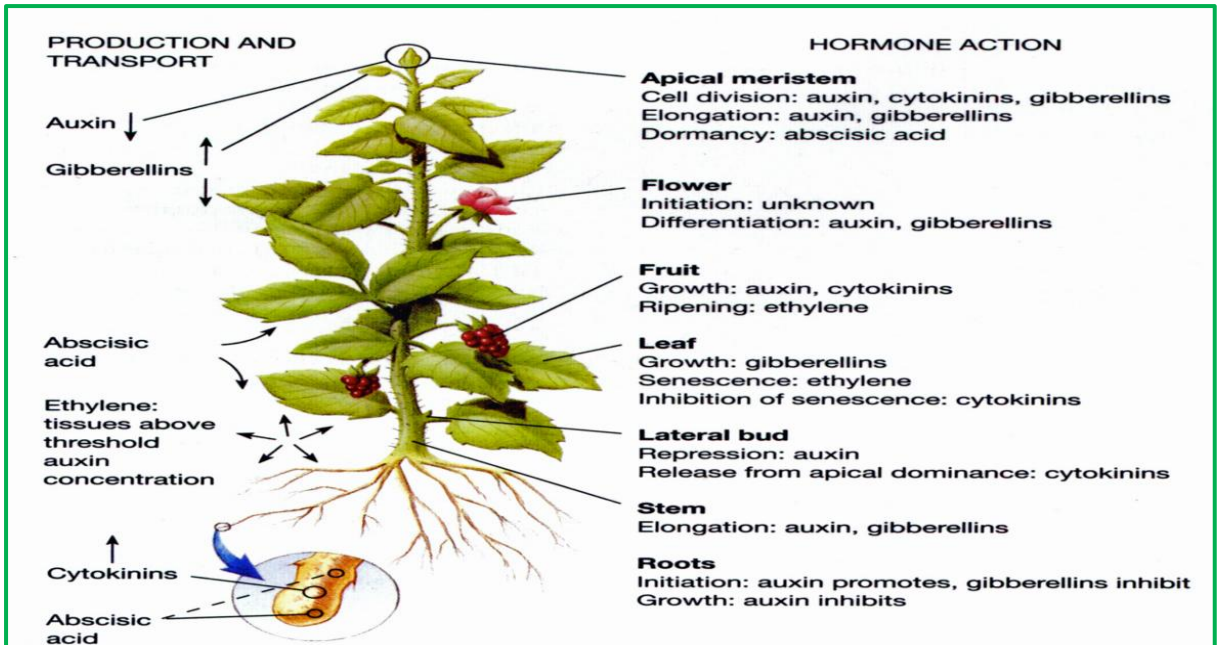
Cell Elongation and Cell Division

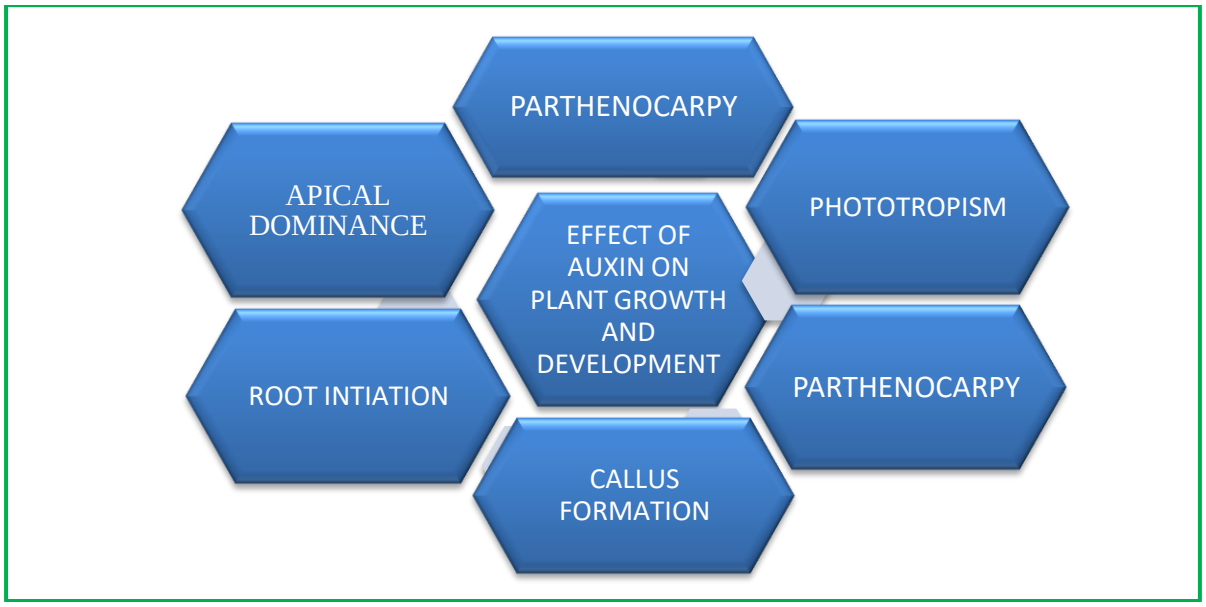
- Causes growth in coleoptiles and stems due to elongation of already existing cells.

The main causes of cell elongation

- By increasing the osmotic content, permeability of the cell to water and wall synthesis.
- By reducing wall pressure.
- By inducing the synthesis of RNA & protein which in turn lead to an increase in cell wall plasticity & extension.







Use of auxin in fruit crops

- **Rooting of Cuttings:** Application of NAA (in Mango) and IBA (in Guava) in stem cutting causes 100% success in vegetative propagation.
- **Seedless Fruit Production (Parthenocarpy):** In the case of Banana, Grapes and Strawberry – Application of IAA, IBA and NAA show 100% success.
- **Promotion of Flowering:** Application NAA causes uniform flowering in Pineapples leading to the development of uniform sized fruits.
- **Prevention of Premature Dropping of Fruits:** In the case of Apple – NAA, In the case of Citrus fruits – 2,4–D/ 2,4,5-T
- **Germination:** IAA and IBA are widely used in soaking seeds for germination.
- **Fruit Setting:** In berries 2, 4, 5-T is used for improved fruit setting.
- **Thinning of Flower, Fruit and Leaves:** NAA is used for fruit thinning in Apple.
- **Weedicide:** 2, 4-D, MCPA (Methyl Chloro-Phenoxy Acetic Acid) are weed killers.
- **Tissue Culture:** Auxin along with cytokinin exhibits successful callus formation and root-shoot differentiation.

GIBBERLIN

Discovered by Kurosawa, a Japanese Plant Pathologist in1928. Rice plants infected by the fungus Gibberella fujikuroi (Synonym: Fusarium moniliforme) showed excessive stem elongation. The symptom is called 'Bakane' diseases. The chemical was extracted & purified and named Gibberellic Acid (GA). Now 80 different Gibberellins are available- GA1 to GA80 is available. The most commonly occurring gibberellins is GA3**.**

- **Effects of different GA on Plant Growth and Development**
- **Stimulates cell division, cell elongation (or both) and controls enzyme secretions.** Ex: dwarf cultivars can be treated with GA and grow to normal heights which indicates dwarf species lack normal levels of GA.
- **Involved in overcoming dormancy in seeds and buds.**

GA translocated easily in the plant (able to move freely) in both directions – because produced in not only the shoot apex but also in the root structure.

- **Used commercially in:**

- Increasing fruit size of seedless grapes.
- Stimulating seed germination & seedling growth.
- Promoting male flowers in cucumbers for seed production.
- Overcoming cold requirements – for some seeds, application of GA foregoes the cold (some seed require to be frozen or placed in the refrigerator for a period of time before they will germinate).

CYTOKININ

- Promotes cell division
- Found in all tissues with considerable cell division i.e. embryos (seeds) and germinating seeds, young developing fruits. Roots supply cytokinins upward to the shoots.
- Interact with auxins to influence the differentiation of tissues (may be used to stimulate bud formation).
- Auxin and Gibberellins increase growth mainly by increasing cell elongation.
- Growth involves another important process namely Cell division.
- Developing embryo shows active cell division.
- Liquid endosperm of coconut called Coconut Water / Milk contain cell division causing factors (Kinetin).
- Similarly the developing endosperm of maize contains such factors (Zeatin).
- When roots start to grow actively in the spring, they produce a lot of cytokinins, which are then transferred to the shoot and used to activate and enlarge dormant buds.
- Cytokinins are used in tissue cultures to stimulate the growth of shoots.
- Leaf senescence may be slowed or prevented by cytokinins (leaf ageing or leaf fall).

ABSCISIC ACID

- Growth inhibitor
- Stimulation of stomata closure, inhibition of bud and shoot development
- Widespread throughout the plant's body and spreads easily.
- Interacts with other hormones in the plant to inhibit growth while enhancing auxin and gibberellin effects.
- Involved in the commencement of dormancy (a time of rest) in seeds, perennial flowers, and shrubs and leaf and fruit abscission (fall).
- ABA is effective at causing stomata to close in leaves, suggesting a role in plant stress physiology. (For instance, ABA levels rise after plants are stressed by water, heat, and excessive salinity.

ETHYLENE

- Ethylene promotes ripening.
- Gaseous hormone.
- Produced in the actively growing meristems of the plant, in senescing ripening or ageing fruits, in senescing (ageing or dying) flowers, in germinating seeds and in certain plant tissues as a response to bending, wounding or bruising.
- Ethylene diffuses easily as a gas throughout the plant.
- May promote leaf senescence and abscission (leaf fall).
- Increases female flowers in cucumbers (economically- will increase fruit production).
- Degreening of oranges, lemons and grapefruit. Ethylene gas breaks down chlorophyll and lets colors show through.