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# Plant Growth Regulators: A Review

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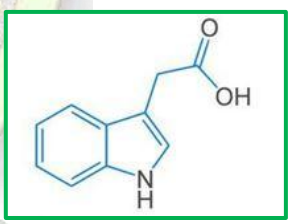
Plant Growth Regulators are defined as small, simple chemicals produced naturally by plants to regulate their growth and development. Plant growth regulators (PGR s) are molecules that influence the development of plants and are generally active at very low concentrations. There are natural regulators, which are produced by the plant itself, and also synthetic regulators; those found naturally in plants are called phytohormones or plant hormones.

Plant Growth Regulators can be of a diverse chemical composition such as gases (ethylene), terpenes (gibberellic acid) or carotenoid derivates (abscisic acid). Different hormones can be sorted into different classes, depending on their chemical structures. Within each class of hormone the exact structures vary, but they have similar physiological effects. Initial research into plant hormones identified five major classes: abscisic acid, auxin, cytokinins, ethylene and gibberellins. 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 growth and promote dormancy and abscission in plants. An example is an abscisic acid.

**Plant Growth Promoters**:

1. **Auxins:** The first phytohormone to be discovered is the Auxin and it was discovered by the biologist Charles Darwin. Auxins are one of the most important plant hormones. The chief naturally occurring auxin is indole-3 acetic acid – IAA and other related compounds. The term Auxin is derived from the Greek language meaning to grow.



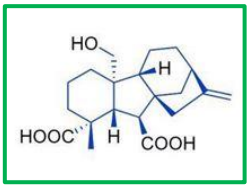

These plant growth regulators are generally produced at the points of stems and roots from where they are transported to other parts of the plants. These plant hormones include both natural and synthetic sources. Indole-3-acetic acid and indole butyric acid are obtained from natural plant sources, whereas naphthalene acetic acid and 2, 4-dichlorophenoxyacetic acid are obtained from synthetic sources.

**Functions of Auxins**

A. Facilitate flowering in plants
B. Used in the process of plant propagation.
C. Used by gardeners to keep lawns free from weeds.
D. Involved in the initiation of roots in stem cuttings.
E. Prevention of dropping of leaves and fruits at early stages.
F. Regulate xylem differentiation and assists in cell division.
G. Auxins are widely used as herbicides to kill dicot weeds.

H. Used to produce fruit without preceding fertilization.
I. Promote natural detachment (abscission) of older leaves and fruits.
J. Apical dominance may occur in which the growth of lateral buds is inhibited by the growth of apical buds. In such cases, the shoot caps may be removed.
K. These are produced by the apex of root and shoot.

2. **Gibberellins:** The first gibberellin to be discovered was gibberellic acid. Now there are more than 100 types of gibberellins and are mainly gathered from a variety of organisms from fungi to higher plants.

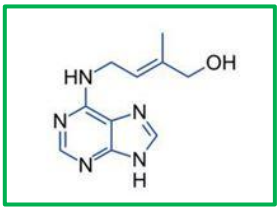



They are acidic and are denoted as follows – $GA_1$, $GA_2$, $GA_3$ etc.

**Functions of Gibberellins**

A. Delay senescence in fruits.
B. Involved in leaf expansion.
C. Break bud and seed dormancy.
D. Promote bolting in cabbages and beet.
E. Facilitate elongation of fruits such as apples and enhance their shape.
F. Used by the brewing industry to accelerate the malting process.
G. Used as the spraying agent to increase the yield of sugarcane by elongation of the stem.
H. In young conifers, utilized to fasten the maturity period and facilitate early seed production
I. Helps in increasing the crop yield by increasing the height in plants such as sugarcane and increase the axis length in plants such as grape stalks.
J. Gibberellins are acidic in nature.
K. It also delays senescence.

3. **Cytokinins:** These are produced in the regions where cell division occurs; mostly in the roots and shoots. They help in the production of new leaves, lateral shoot growth, chloroplasts in leaves etc. They help in overcoming apical dominance and delay ageing of leaves.

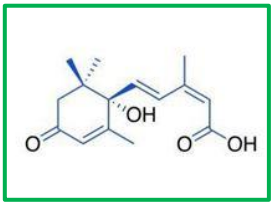



**Functions of Cytokinins**

A. Break bud and seed dormancy.
B. Promotes the growth of the lateral bud.
C. Promotes cell division and apical dominance.
D. They are used to keep flowers fresh for a longer time.
E. Used in tissue culture to induce cell division in mature tissues.
F. Facilitate adventitious shoot formation and lateral shoot growth.
G. Promotes nutrient mobilization that in turn assists delaying leaf senescence.
H. Helps in delaying the process of ageing (senescence) in fresh leaf crops like cabbage and lettuce.
I. Involved in the formation of new leaves and chloroplast organelles within the plant cell.
J. Used to induce the development of shoot and roots along with auxin, depending on the ratio.

**Plant Growth Inhibitors**

4. **Abscisic acid:** It is a growth inhibitor, which was discovered in the 1960s. It was initially called dormant. Later, another compound abscisin-II was discovered and are commonly called as abscisic acid. This growth inhibitor is synthesized within the stem, leaves, fruits, and seeds of the plant. Mostly, abscisic acid serves as an

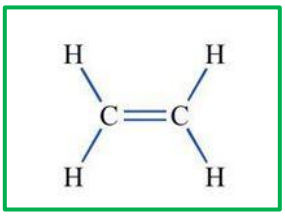


antagonist to Gibberellic acid. It is also known as the stress hormone as it helps by increasing the plant-tolerance to various types of stress.

**Functions of Abscisic acid**

A. Stimulates closing of stomata in the epidermis.
B. Helps in the maturation and development of seeds.
C. Inhibits plant metabolism and seed germination.
D. It is involved in regulating abscission and dormancy.
E. It is widely used as a spraying agent on trees to regulate dropping of fruits.
F. Induces seed-dormancy and aids in withstanding desiccation and various undesired growth factors.

5. **Ethylene:** Ethylene is a simple, gaseous plant growth regulator, synthesised by most of the plant organs includes ripening fruits and ageing tissues. It is an unsaturated hydrocarbon having double covalent bonds between and adjacent to carbon atoms.




Ethylene is used as both plant growth promoters and plant growth inhibitors. Ethylene is synthesized by the ripening fruits and ageing tissues.

**Functions of Ethylene**

Ethylene is the most widely used plant growth regulator as it helps in regulating many physiological processes.

A. Induce flowering in the mango tree.
B. Promotes sprouting of potato tubers.
C. Breaks the dormancy of seeds and buds.
D. Enhances respiration rate during ripening of fruits.
E. Applied to rubber trees to stimulate the flow of latex.
F. Facilitates senescence and abscission of both flowers and leaves.
G. Used to stimulate the ripening of fruits. For example, tomatoes and citrus fruits.
H. Affects horizontal growth of seedlings and swelling of the axis in dicot seedlings.

Increases root hair formation and growth, thus aids plant to expand their surface area for absorption.

## Conclusion

Plant growth regulators provide a quick effect on plants and can be used for quality improvement of seeds. It can be used for hybrid seed production and also can be used for long storage of produce.