AGRI MAGAZINE
(International E-Magazine for Agricultural Articles)
Volume: 02, Issue: 11 (November, 2025)
Available online at http://www.agrimagazine.in
©Agri Magazine, ISSN: 3048-8656

Plant Growth Regulators and Their Role in Flowers

*Rishabh Shahi, Dr. Himanshu Trivedi and Dr. Abhishek Tiwari
Chhatrapati Sahu ji Maharaj University, Kanpur, Uttar Pradesh, India
*Corresponding Author's email: rishabhshahi9589@gmail.com

Plants, like all living organisms, possess an intricate system of growth and development regulated by both internal and external factors. Among the internal factors, plant hormones or Plant Growth Regulators (PGRs) play a pivotal role. These naturally occurring organic substances, produced in minute quantities, influence physiological processes such as cell division, elongation, flowering, fruiting, and senescence. In floriculture, the manipulation of plant growth regulators has become an essential practice to improve flowering, regulate plant architecture, enhance vase life, and synchronize bloom periods. The commercial flower industry depends heavily on PGRs to ensure uniform flowering, improve flower quality, and extend post-harvest life, which ultimately enhances market value. PGRs are either naturally occurring hormones or synthetic analogues that mimic the effect of natural hormones.

Classification of Plant Growth Regulators

Plant growth regulators are broadly classified into two categories:

1. **Natural plant hormones** (phytohormones): naturally produced within the plant.
2. **Synthetic PGRs**: artificially synthesized compounds that mimic the activity of natural hormones.

Based on their physiological functions, PGRs are divided into five major groups:

1. Auxins
2. Gibberellins (GAs)
3. Cytokinins
4. Ethylene
5. Abscisic Acid (ABA)

Each of these growth regulators has a unique role in plant physiology and flower development.

1. Auxins and Their Role in Flower Development

Auxins are the first group of plant hormones discovered. The most common natural auxin is *indole-3-acetic acid (IAA)*. Synthetic auxins include *indole-3-butyric acid (IBA)*, *naphthalene acetic acid (NAA)*, and *2,4-dichlorophenoxyacetic acid (2,4-D)*.

Functions in Flowering Plants

- **Promotion of Flower Initiation:** Auxins promote flower initiation in some species by enhancing cell elongation and division in the meristematic regions.
- **Control of Apical Dominance:** In ornamental crops like *rose* and *chrysanthemum*, auxins suppress lateral bud growth, maintaining apical dominance and a desirable plant shape.
- **Rooting of Cuttings:** In floriculture, IBA and NAA are commonly used to induce rooting in cuttings of *rose*, *geranium*, *carnation*, and *hibiscus*.
- **Prevention of Flower and Fruit Drop:** Synthetic auxins are sprayed to prevent premature flower and fruit drop in crops like *jasmine* and *rose*.
- **Enhancement of Vase Life:** Auxins help delay senescence and extend the vase life of cut flowers by maintaining cell turgidity.

Examples in Floriculture

- In *chrysanthemum*, application of NAA (25–50 ppm) promotes lateral branching.
- In *carnation*, IBA (1000–2000 ppm) effectively enhances rooting in stem cuttings.
- In *rose*, NAA treatment reduces bud drop and increases flower yield.

2. Gibberellins (GAs) and Flower Development

Gibberellins are diterpenoid acids known for promoting stem elongation and flowering. The most commonly used gibberellins are GA_3, GA_4, and GA_7.

Functions in Flowering Plants

- **Induction of Flowering:** Gibberellins promote flowering in long-day plants such as *chrysanthemum* and *petunia* under non-inductive conditions.
- **Enhancement of Flower Size:** GA_3 increases cell elongation and expansion, resulting in larger flowers in *gerbera*, *marigold*, and *gladiolus*.
- **Regulation of Plant Height:** Low concentrations of GA can promote elongation, while inhibitors like paclobutrazol suppress excessive height, useful in pot plants.
- **Improvement of Flower Quality:** Application of GA_3 increases spike length, floret size, and number of florets per spike in *gladiolus* and *tuberose*.

Examples in Floriculture

- *Gladiolus:* GA_3 (100–150 ppm) enhances spike length and number of florets.
- *Marigold:* GA_3 (100 ppm) improves plant height and flower diameter.
- *Gerbera:* GA_3 (50–100 ppm) increases peduncle length and flower size.
- *Tuberose:* GA_3 application results in earlier flowering and increased spike length.

3. Cytokinins and Their Role in Flowering

Cytokinins are adenine derivatives that promote cell division and delay senescence. Common cytokinins include *kinetin*, *benzylaminopurine (BAP)*, and *zeatin*.

Functions in Flowering Plants

- **Promotion of Cell Division:** Cytokinins promote rapid cell division in meristematic tissues and developing floral buds.
- **Delay of Senescence:** Cytokinins delay leaf and flower senescence, enhancing vase life of cut flowers like *carnation*, *rose*, and *chrysanthemum*.
- **Flower Induction and Differentiation:** In tissue culture, BAP induces flower formation in ornamental crops such as *orchid* and *anthurium*.
- **Enhancement of Bud Break:** Cytokinins overcome apical dominance caused by auxins, encouraging lateral bud development in *rose* and *bougainvillea*.

Examples in Floriculture

- *Chrysanthemum:* BAP (50 ppm) enhances branching and flower number.
- *Rose:* BAP (100 ppm) improves bud opening and delays senescence.
- *Orchid tissue culture:* BAP (1–2 mg/L) induces floral bud formation in vitro.

4. Ethylene and Its Role in Flowering

Ethylene is a gaseous plant hormone known as the “ripening hormone.” It influences flower senescence, abscission, and sex expression.

Functions in Flowering Plants

- **Regulation of Flower Opening and Senescence:** Ethylene promotes flower opening in some species but accelerates wilting in cut flowers like *carnation* and *orchid*.
- **Sex Expression:** Ethylene induces femaleness in monoecious plants like *cucumber* and *melon*, which is useful for hybrid seed production in ornamentals.
- **Induction of Flowering:** Ethylene-releasing compounds like *ethephon (2-chloroethylphosphonic acid)* induce flowering in *pineapple* and *bromeliads*.
- **Abscission Control:** Ethylene regulates flower and petal drop, which can be beneficial or detrimental depending on the crop.

Examples in Floriculture

- *Pineapple:* Ethephon induces uniform flowering.

- *Carnation:* Ethylene accelerates senescence; anti-ethylene treatments like *silver thiosulfate (STS)* or *1-MCP* are used to extend vase life.
- *Geranium:* Ethephon application controls height and promotes compactness.

5. Abscisic Acid (ABA) and Flowering

Abscisic acid, often termed the "stress hormone," primarily acts as a growth inhibitor. It regulates dormancy, stress tolerance, and senescence.

Functions in Flowering Plants

- **Regulation of Flower Senescence:** ABA accelerates aging and abscission of petals and leaves, often counteracting the effects of cytokinins and gibberellins.
- **Induction of Dormancy:** ABA induces bud dormancy in certain ornamental shrubs, ensuring synchronization with favorable conditions.
- **Stress Response:** ABA enhances tolerance to drought, salinity, and temperature extremes, ensuring flower survival under stress.
- **Regulation of Stomatal Closure:** ABA-induced stomatal closure reduces transpiration, maintaining turgidity in flowers during water stress.

Examples in Floriculture

- In *cut rose*, ABA treatment enhances drought tolerance and reduces wilting.
- In *chrysanthemum*, ABA plays a role in regulating bud dormancy and flowering under stress conditions.

Growth Retardants and Flower Regulation

Besides the classical PGRs, synthetic growth retardants such as chlormequat chloride (CCC), paclobutrazol, and daminozide (Alar) are widely used in floriculture to control plant height and improve aesthetic value.

Functions

- Reduce internodal elongation, producing compact, bushy plants suitable for pot culture.
- Increase chlorophyll content and improve color intensity in flowers.
- Promote earlier flowering and uniform bloom in species like *petunia*, *salvia*, and *marigold*.

Examples

- *Marigold:* CCC (1000 ppm) reduces height and enhances branching.
- *Chrysanthemum:* Paclobutrazol (50 ppm) increases number of flowers and delays senescence.
- *Petunia:* Daminozide promotes compact growth and early flowering.

Post-Harvest Role of PGRs in Flowers

Plant growth regulators are also crucial in post-harvest handling of cut flowers to improve vase life, color retention, and freshness.

Key Roles

1. **Delay of Senescence:** Cytokinins (BAP) and anti-ethylene agents (STS, 1-MCP) delay senescence.
2. **Reduction of Ethylene Sensitivity:** Silver thiosulfate binds to ethylene receptors and prolongs vase life in *carnation* and *orchid*.
3. **Improvement of Water Uptake:** Auxins and cytokinins help maintain turgor and water balance in cut stems.
4. **Color Enhancement:** GA_3 and cytokinins improve pigment synthesis in petals.

Tissue Culture and PGRs in Floriculture

PGRs are indispensable in plant tissue culture for micropropagation of ornamental species. For example, *BAP* and *NAA* are commonly used in *orchid*, *anthurium*, *gerbera*, and *rose* tissue cultures for mass propagation and uniform flower production.

Conclusion

Plant growth regulators have revolutionized the floriculture industry by enabling precise control over flowering, growth, and post-harvest quality. From enhancing root initiation and flower induction to delaying senescence and improving vase life, PGRs have become indispensable tools in ornamental horticulture. The judicious and scientific application of these regulators ensures not only better aesthetic and commercial value but also sustainable flower production systems. Future research should emphasize eco-friendly alternatives and nano-PGR technologies to align with sustainable agricultural practices.

References

1. Davies, P. J. (2010). *Plant Hormones: Biosynthesis, Signal Transduction, Action!* Springer.
2. Taiz, L., Zeiger, E., Møller, I. M., & Murphy, A. (2015). *Plant Physiology and Development.* Sinauer Associates.
3. Kumar, R., & Kumar, V. (2018). Role of plant growth regulators in flower induction and development. *Journal of Applied and Natural Science*, 10(2), 658–666.
4. Singh, A. K., & Sisodia, A. (2019). *Floriculture: Principles and Practices.* Kalyani Publishers, New Delhi.
5. Nair, S. A., Singh, V., & Sharma, T. V. R. S. (2003). Effect of growth regulators on growth and flowering of tuberose (*Polianthes tuberosa*). *Journal of Ornamental Horticulture*, 6(4), 317–322.
6. Rout, G. R., & Mohapatra, A. (2006). Tissue culture of ornamental pot plant: A critical review on present scenario and future prospects. *Biotechnology Advances*, 24(6), 531–560.
7. Dole, J. M., & Wilkins, H. F. (2005). *Floriculture: Principles and Species.* Pearson Education.
8. Singh, K., & Arora, J. S. (2000). *Post-harvest Technology of Flowers and Ornamental Plants.* Kalyani Publishers.