Crop Regulation in Chrysanthemum

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OPEN ACCESS

Keywords

Chrysanthemum, cut flower, Crop regulation, Flower production, Market demand

How to cite this article:

Mangroliya, P. M., Singh, A., Ahir, M. P., Chaudhary, P. K., Patel. G. D. and Mangroliya, R. M. 2026. Crop Regulation in Chrysanthemum. *Vigyan Varta* 7 (11): 70-75.

ABSTRACT

Chrysanthemum (*Chrysanthemum morifolium* Ramat.) is an important commercial ornamental crop widely cultivated for cut flowers, loose flowers, pot plants and garden decoration. Its flowering behaviour is significantly influenced by photoperiod, temperature and environmental conditions, making crop regulation essential for achieving uniform flowering, improved flower quality and year-round production. Crop regulation involves cultural, physical and chemical practices to manipulate plant growth and flowering according to market demand. Important cultural practices include variety selection, appropriate planting time, pinching, disbudding and optimum spacing. Physical methods, such as photoperiod manipulation through artificial lighting and blackout systems, along with temperature management, help regulate flowering time. Plant growth regulators, including chlormequat chloride, daminozide, paclobutrazol and gibberellic acid are used to manage plant height, stem length and flower development. Balanced nutrition and proper irrigation further support healthy growth and flowering. Integrating these techniques enables growers to improve flower yield, quality, uniformity and economic returns while facilitating off-season production and meeting increasing market demand.

INTRODUCTION:

Chrysanthemum (*Chrysanthemum morifolium* Ramat.), popularly known as "Queen of the East" is one of the most important commercial ornamental crops cultivated worldwide for cut flowers, loose flowers, pot plants and garden decoration. In India, chrysanthemum occupies a prominent position among flowering crops due to its wide adaptability, rich diversity in colour and form, long flowering duration and high market demand during festivals, weddings and religious functions. The crop belongs to the family Asteraceae and is a qualitative short-day plant, which means flowering is highly influenced by photoperiod and temperature. Because of its strong response to environmental factors, growers often face challenges in obtaining uniform flowering, desired flower size, synchronized blooming and year-round production.

Crop regulation refers to the scientific manipulation of plant growth, development and flowering through cultural, physical and chemical practices to achieve flowering at a desired time with optimum yield and quality (Bhattacharjee and De, 2005). In chrysanthemum, crop regulation is especially important because market value is highly dependent on timing, flower size, stem length, colour intensity and uniformity. Natural flowering often coincides with a particular season, but market demand exists throughout the year. Hence, regulating vegetative growth and flowering is essential to meet commercial needs. The principle of crop regulation in chrysanthemum is based on understanding the plant's physiological behavior, especially its response to photoperiod, temperature, nutrition and growth regulators (Ara *et al*., 2023). Practices such as pinching, disbudding, photoperiod manipulation, nutrient management, irrigation scheduling and use of plant growth regulators (PGRs) are widely used. By adopting suitable crop regulation techniques, growers can control plant height, branching pattern, flowering time and flower quality.

Objectives of Crop Regulation in Chrysanthemum

The main objectives of crop regulation in chrysanthemum are:

1. To obtain flowering at a desired time to meet market demand during peak seasons.
2. To ensure uniform and synchronized flowering across the crop.
3. To improve flower quality in terms of size, colour, shape and vase life.
4. To regulate plant height and branching for better plant architecture.
5. To increase yield of cut flowers or loose flowers per unit area.
6. To enable year-round or off-season production.
7. To reduce crop losses caused by adverse climatic conditions.
8. To enhance economic returns to growers.

Growth and Flowering Behavior of Chrysanthemum

Chrysanthemum is a short-day plant, requiring day length shorter than a critical photoperiod (generally 13–14 hours) to induce flowering. Under long-day conditions, the plant remains in the vegetative phase, producing leaves and stems. Once exposed to short days, floral initiation occurs, followed by bud development and flowering (Bose and Yadav, 2008). Temperature also plays a crucial role. Optimum temperature for vegetative growth

ranges between 18–25°C, while flowering is favoured by slightly cooler temperatures (15–20°C). High temperatures can delay flowering and reduce flower quality, whereas very low temperatures may cause bud drop or malformed flowers. Chrysanthemum exhibits indeterminate growth, meaning vegetative growth can continue even after floral initiation if environmental conditions permit. Therefore, regulation of vegetative growth is necessary to divert assimilates towards reproductive development (Halevy, 1985).

Principles of Crop Regulation

Crop regulation in chrysanthemum is based on the following principles:

1. Manipulation of photoperiod to control floral initiation.
2. Control of vegetative growth through pinching and growth retardants.
3. Balanced nutrition to support both vegetative and reproductive phases.
4. Regulation of source–sink relationship to enhance flower development.
5. Synchronization of flowering through uniform cultural practices.

Methods of Crop Regulation in Chrysanthemum

Crop regulation can be achieved through cultural, physical and chemical methods.

1. Cultural Practices

1.1 Selection of Variety

Different chrysanthemum varieties respond differently to photoperiod and temperature. Early, mid and late flowering varieties are available. Selection of suitable varieties according to season and market demand is the first step in crop regulation.

1. Himanshu: April- July
2. Jwala: May- June
3. Jyoti: June- July
4. Maghi: Feb- March
5. Rainy: Rim jhim
6. Sept- Oct: Sharad Mala, Sharada
7. Oct- Nov: Haldighati, Sharad Mala
8. Jan: Jaya
9. July- Aug: Meghdoot

1.2 Time of Planting

Planting time greatly influences flowering time. By staggering planting dates, flowering can be spread over a longer period. In general, planting during June–July results in flowering during October–November under natural conditions.

1.3 Pinching

Pinching is the removal of the terminal growing point to encourage lateral branching. It is one of the most important crop regulation practices in chrysanthemum.

- Single pinching: Done 3–4 weeks after planting to promote branching.
- Double pinching: Second pinching is done after 2–3 weeks of first pinching to obtain more uniform branches.

1.4 Disbudding

Disbudding involves removal of lateral buds to allow development of a single large terminal flower. This practice is common in standard chrysanthemum grown for cut flowers.

1.5 Spacing and Plant Density

Optimum spacing ensures proper light interception, air circulation and nutrient availability. Closer spacing promotes taller plants, while wider spacing encourages branching.

2 Physical Methods

2.1 Photoperiod Manipulation

Since chrysanthemum is a short-day plant, photoperiod manipulation is a key technique in crop regulation. Long-day treatment: Artificial lighting is provided to extend day length and delay flowering. Short-day treatment: Black cloth or shading is used to reduce day length and induce early flowering (Li *et al*., 2024).

Phytochrome

- It is a biological, proteinaceous pigment that absorbs light.
- It is a non-photosynthetic, photoreceptor pigment.
- Mature leaves are the site of production of this stimulus.
- Two types:

i. Red light absorbing form which is designated as **PR**

ii. Far-red absorbing form which is designated as **PFR**

2.2 Temperature Control

In protected cultivation (greenhouses or polyhouses), temperature can be regulated to optimize growth and flowering. Cooling systems are used during high temperatures, while heating may be required in colder regions (Cho and Kim, 2021).

Photoperiod regulation techniques to create short day

- Black out for SD plants:
- Since the SDP flower when the light period is less than critical day length.
- This can be done by artificially creating darkness or as called as black out method or black out cloth method.
- The plants are grown in a structure, where darkness is created for a part of the day using dark coloured cloth (Yang *et al*., 2025).

3. Chemical Methods (Use of Plant Growth Regulators)

Plant growth regulators play a significant role in crop regulation of chrysanthemum (Nirmalkar *et al*., 2024).

3.1 Growth Retardants

Growth retardants are used to control excessive vegetative growth and plant height.

- CCC (Chlormequat chloride)
- B-Nine (Daminozide)
- Paclobutrazol

These chemicals reduce internodal elongation, resulting in compact plants with strong stems.

3.2 Growth Promoters

Growth promoters such as gibberellic acid (GA_3) are used to increase stem length and flower size, especially in cut flower production (Liu *et al.,* 2025).

3.3 Flowering Regulators

Certain chemicals influence flowering by affecting hormonal balance. Application of appropriate PGRs can either promote or delay flowering depending on requirement.

Role of Nutrition in Crop Regulation

Balanced nutrition is essential for successful crop regulation. Excess nitrogen promotes vegetative growth and delays flowering, while adequate phosphorus and potassium enhance flower initiation and quality.

- Nitrogen: Required during early vegetative growth.
- Phosphorus: Promotes root development and flower initiation.

- Potassium: Improves flower size, colour and vase life.

Micronutrients such as boron, zinc and iron also play an important role in flower development.

Irrigation Management

Proper irrigation scheduling is necessary to avoid stress conditions. Water stress during vegetative phase can reduce plant growth, while stress during bud formation may cause bud drop. Regulated irrigation helps maintain uniform growth and flowering.

Crop Regulation for Off-Season Flowering

Off-season production of chrysanthemum fetches higher prices. This can be achieved by:

1. Controlled photoperiod using artificial lighting or black-out systems.
2. Use of growth regulators to synchronize flowering.
3. Protected cultivation to manage temperature and humidity.

CONCLUSION

Crop regulation in chrysanthemum is a vital horticultural practice aimed at manipulating plant growth and flowering to meet market requirements. By understanding the physiological behaviour of chrysanthemum and adopting appropriate cultural, physical and chemical methods, growers can achieve uniform, high-quality flowers at desired times. Integration of pinching, photoperiod manipulation, balanced nutrition, irrigation management and judicious use of plant growth regulators forms the backbone of successful crop regulation. With increasing demand for ornamental flowers and the expansion of protected cultivation, crop regulation techniques will continue to play a key role in sustainable and profitable chrysanthemum production.

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