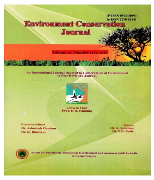
Journal homepage: https://www.environcj.in/

Environment Conservation Journal

ISSN 0972-3099 (Print) 2278-5124 (Online)



Effects of pinching and plant growth regulators on chrysanthemum productivity in the central plain zone of Punjab

Jitendra Kumar Sahu ✉
Department of Horticulture, Lovely Professional University, Phagwara, Punjab

Deepika sahu
Department of Floriculture and Landscaping, Mahatma Gandhi University of Horticulture & Forestry, Sankra, Durg (C.G.)

Gloriya Smita Kispotta
Department of Floriculture and Landscape, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.)

Khiromni Nag
Department of Floriculture and Landscape, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.)

ARTICLE INFO

Received : 13 September 2023
Revised : 31 December 2023
Accepted : 05 January 2024

Available online: 27 February 2024

Key Words:
Crop yield enhancement
Chrysanthemum flower quality
Double pinching

ABSTRACT

The current study was designed in a factorial randomized block with 16 treatment combinations, including four concentrations of GA_3 (G_0-control or water spray, G_1 at 200 ppm, G_2 at 300 ppm, and G_3 at 400 ppm) and four levels of pinching (no pinching, pinching at 25 days after transplanting, pinching at 40 days after transplanting, and double pinching at 25 and 40 days after transplanting), and replicated three times. The results showed that the G2P2 treatment had greater effects on the number of primary branches (46.3), the number of leaves (135.8), the number of flowers (107.5), the Flower diameter (6.93 cm), the Weight of flowers per plant (287.1 g) and the Flower yield per ha. (15.7 t). Pinching and plant growth regulators can either induce or decrease plant height and spread, ultimately affecting yield.

Introduction

Floriculture is a rapidly growing field of study that is considered a profitable business and has become one of the most significant and rapidly expanding commercial trades in agriculture worldwide owing to its appealing flowers and aesthetic value. Chrysanthemum, also known as the "queen of the east" or "atom queen", is a highly sought-after annual flower belonging to the Asteraceae family and is renowned for its attractive, showy and prolific blooms. Recently, Chrysanthemum plants have become increasingly popular due to their diverse applications, including as cut flowers, loose flowers, and landscaping plants. The cultivation of chrysanthemum in the Punjab region has high potential for growth due to the favorable soil and climatic conditions. To achieve optimum growth, high yield and high quality flowers, special horticultural practices are necessary. One example of this technique is known as "pinching," where the tip of the stem is removed to discourage apical dominance. Plant growth and development are regulated by hormones in minute quantities. The use of plant growth regulators at a commercial level can greatly improve the quality of flower production. The application of plant growth regulators plays a crucial role in the growth and flowering of chrysanthemum. Appropriate doses of these regulators are essential for producing high-quality flowers. Insufficient amounts of plant growth regulators can lead to poor growth and flowering. GA_3, a plant growth regulator, is vital for breaking dormancy and increasing the yield of several crop species. Thus, this study aimed to explore the potential of enhancing chrysanthemum production and quality through the use of plant growth regulators.

Corresponding author E-mail: sahujitendra11@gmail.com
Doi:https://doi.org/10.36953/ECJ.25362712

Material and Methods

The current study was conducted at the Horticulture Department, Lovely Professional University, Phagwara, Punjab, during the 2021–22 period. The experimental design employed was a factorial randomized block design. The treatments involved different concentrations of GA3 (gibberellic acid), specifically G0: control (water spray), G1: GA3: 200 ppm, G2: 300 ppm, and G3: 400 ppm GA3, resulting in a total of 16 treatment combinations: P0: no pinching, P1: pinching at 25 days after transplanting, P2: pinching at 40 days after transplanting, and P3: double pinching at 25 and 40 days after transplanting. Each treatment combination was replicated three times. The 2.3 1.85-meter net plots were created after preliminary tillage operations. Healthy and uniformly grown plants of cv. Pusa Aditya, aged 45 days, were transplanted at a spacing of 45 cm × 45 cm. The application of different concentrations of GA3 occurred 30 days after transplanting, while pinching was executed at 25 days and 40 DAT. Observations of various vegetative characteristics, including the height of the plant, spread of the plant, number of branches, number of leaves, leaf area, and yield, were made at 30 DAT.

Results and Discussion

The data presented in Table 1 show that, compared with the other treatment combinations, the application of 300 ppm GA3 without pinching had a significant effect on increasing plant height (40.7 cm). Conversely, the combination of pinching at 25 and 40 DAT without GA3 spraying resulted in the shortest plant height (28 cm), as shown in Fig 1. This can be attributed to the fact that GA3 promotes plant growth by enhancing internodal length through increased cell division and enlargement, as previously noted by Reddy and Sulladmath (1983). Additionally, this increase in cell plasticity promotes protein synthesis and contributes to heightened apical dominance. The leaves absorbed GA3 through foliar spray, and it swiftly translocated through the plant's xylem and phloem tissues, a phenomenon observed in studies conducted by various researchers, including Dhanapal *et al.* (2015) and Mishra *et al.* (2017). In addition, Abd El-Ghany and El-Sheikh (2018) attributed the increased branching and spread of chrysanthemum plants to the repetitive removal of the apical portion of the main branch. This practice led to the liberation of axillary buds from the correlative inhibition of apical dominance, prompting them to initiate growth. Consequently, removal of the apical portion facilitated a greater degree of branching, contributing to the overall expansion and proliferation of the chrysanthemum plants. The reduction in plant height could be a result of the removal of apical meristematic tissues that suppressed apical dominance through pinching. Additionally, the manipulation of growth, flowering, and vegetative growth may have contributed to an increase in height by enhancing the osmotic uptake of water and nutrients through GA3, which helps maintain turgor pressure against cell wall softening. The treatment combination that resulted in the highest average plant spread (46.7 cm) was the application of 300 ppm GA3 in conjunction with the two pinching practices at 25 and 40 days after transplanting. Interestingly, this specific treatment had statistically similar effects on the same concentration of GA3 (300 ppm) applied in combination with a single pinching practice at 40 days after transplanting. Conversely, the lowest average plant spread (22.4 cm) was observed when no GA3 was applied, and no pinching was performed (Figure 1). The expansion of plant spread may be a result of inhibiting apical dominance through the use of higher concentrations of growth regulators or by pinching, which leads to the development of more lateral branches and ultimately an increase in plant spread. In the context of chrysanthemum plants, the significant increase in average plant spread attributed to pinching can be attributed to the inhibition of apical dominance. This phenomenon encourages the growth of both the main stem and lateral branches, ultimately leading to an expanded average plant spread in all directions. Mounika *et al.* (2019) provided evidence supporting the impact of pinching on chrysanthemum plants. Their study revealed that plants subjected to double pinching displayed the highest level of spread. According to the interaction study, the maximum number of branches (46.3) was observed after 40 days of spraying 300 ppm GA3 with a single pinching agent, which was

Table:1 Impact of plant growth regulators and pinching on Chrysanthemum growth and flowering

Treat. Details	Plant height(cm)	Plant spread (cm)	No. of Primary branches	No. of leaves per plant	No. of flower per plant	Flower diameter (cm)	Weight of flower per plant (g)	Flower yield per ha. (t)
G_0P_0	34.5	22.4	25.6	101.6	83.3	4.25	102.5	7.3
G_0P_1	31.2	23.5	27.8	112.5	78.5	4.39	120.9	9.1
G_0P_2	36.0	25.9	27.9	113.5	80.7	4.43	126.1	9.8
G_0P_3	28.0	25.9	26.8	110.1	80.6	4.36	109.1	8.0
G_1P_0	31.4	28.7	29.8	114.4	81.2	4.57	126.1	9.3
G_1P_1	32.9	31.0	32.7	115.6	86.1	4.62	138.4	10.5
G_1P_2	33.5	32.0	31.2	117.8	91.6	4.75	139.3	10.7
G_1P_3	31.5	35.4	28.6	111.3	81.9	4.62	136.0	9.8
G_2P_0	40.7	36.1	33.8	128.7	92.0	5.55	175.7	12.4
G_2P_1	32.4	41.4	43.0	131.1	103.3	6.33	226.7	13.6
G_2P_2	29.7	44.0	46.3	135.8	107.5	6.93	287.1	15.7
G_2P_3	35.8	46.7	39.4	126.1	99.8	5.75	188.4	13.4
G_3P_0	37.7	28.5	31.7	116.8	82.3	4.97	141.2	10.4
G_3P_1	32.1	32.6	35.0	119.0	97.1	5.36	155.8	11.2
G_3P_2	32.1	33.3	36.2	124.8	94.8	5.48	164.3	11.9
G_3P_3	29.0	37.2	32.4	123.5	91.4	5.16	146.4	10.6
SEm ±	**1.00**	**1.36**	**1.34**	**1.73**	**1.39**	**0.16**	**8.42**	**0.72**
CD at 5%	**2.89**	**3.94**	**3.87**	**5.01**	**4.01**	**0.49**	**24.32**	**2.07**

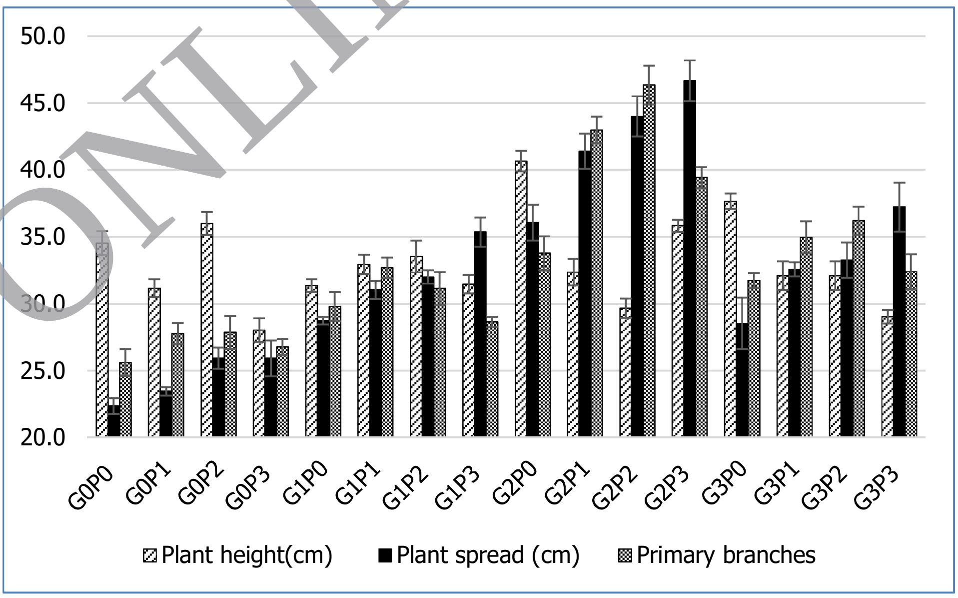


Fig. 1: Impact of plant growth regulators and pinching on Chrysanthemum growth parameters (Vertical bars show standard errors of means)

statistically similar to the number of branches affected by the same dose of GA3 combined with pinching at 25 days after transplanting. The treatment labeled "control" yielded the lowest number of primary branches, with a recorded count of 25.6. Consequently, based on the collected data, it can be deduced that the application of GA3 at a concentration of 300 ppm alone can significantly increase the number of secondary branches. This effect is likely a result of the ability of GA3 to stimulate cell enlargement and division, promote protein synthesis, and encourage branching. The removal of apical dominance through pinching may also contribute to this outcome. The observation that pinching led to the highest number of branches is likely due to its ability to suppress apical dominance, which in turn promotes the development of a greater number of lateral branches. In their study, Nagarjuna *et al.* (1988) observed a greater number of branches in Chrysanthemum plants treated with 200 ppm GA3 than in those in the control group. The outcomes observed in this study are consistent with the findings of Dabas *et al.* (2001), who also reported an increase in the number of branches on marigolds. The number of leaves, another important vegetative parameter, was also significantly influenced by the concentration of GA3 and by pinching. The maximum number of leaves (135.8) was observed with foliar application of GA3 at 300 ppm and single pinching at 40 days after transplanting. Conversely, the minimum number of leaves (102.5) was observed for plants without GA3 application or pinching. An adequate level of pinching results in sufficient light intensity being received by the plants, which likely stimulates food synthesis and increases amylase activity; a primary physiological effect of auxin is to elongate cells. Pinching also reduced apical dominance and promoted lateral growth, while GA3 was observed to improve the ability of regions of actively growing plants to absorb water, leading to the production of more branches and, ultimately, more leaves. The application of GA3 led to an increased number of branches and facilitated the initiation of more leaves on chrysanthemum plants. Extensive research carried out by Sharma and Sati (2018), Jaiswal *et al.* (2018), Deka *et al.* (2017), and Chaudhari *et al.* (2017) collectively emphasized the beneficial effects of GA3 application on chrysanthemum leaf development. These studies offer valuable insights into the molecular and physiological mechanisms responsible for GA3-induced leaf proliferation. By deciphering the complex pathways and signals involved, researchers are advancing our understanding of plant hormone interactions, providing crucial knowledge about the intricate processes governing chrysanthemum growth.

Flower yield parameters

GA_3 and Pinching significantly affected flowering attributes, *i.e., the* number of flowers plant^{-1}, weight of flower plant^{-1}, flower diameter and flower yield ha^{-1}. The maximum number of flowers (107.5), weight of flower plant^{-1} (287.1 gm), flower diameter (6.93 cm) and flower yield ha^{-1} (15.7 q ha^{-1}) were recorded after foliar application of GA_3 at 300 ppm and pinching after 40 days of transplanting. However, the minimum number of observations was recorded for all flowering parameters without the application of GA_3 and without pinching (Table 1 and Fig 2). Apical dominance can be reduced by pinching and greater concentrations of growth regulators, which divert additional metabolites toward the production of a greater number of flowers. Moreover, auxin levels are significantly decreased by pinching, which helps to eliminate apical dominance and allows the growth of side buds. In Chrysanthemum, an increase in flower yield may be attributed to the average leaf area. The suppression of apical dominance not only increased the number of primary branches but also led to a greater flower count and, consequently, elevated yields. This effect was attributed to enhanced plant growth, boosted production, and increased accumulation of photosynthates, resulting in a greater number of productive shoots per plant. These findings were consistent across various studies, including those conducted by Sahu *et al.* (2021), who reported that the application of GA3 had a greater effect on flowering characteristics in chrysanthemum. Treatment with 300 ppm GA3 resulted in the most remarkable increase in flower yield per plant, plot, and hectare. This was mainly attributed to an increase in the number of branches, which subsequently led to an increase in the number of flowers. The plant needed to successfully complete its vegetative phase before entering the

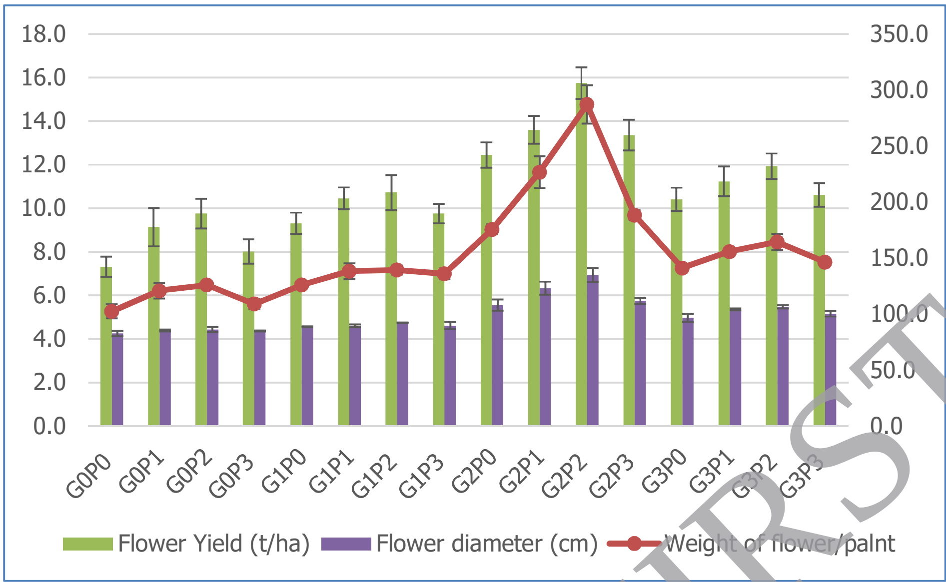


Fig. 2: Impact of plant growth regulators and pinching on Chrysanthemum growth and flowering (vertical bars show standard errors of means)

reproductive phase, which ultimately led to a better yield. The augmented reproductive efficiency and photosynthesis of the restructured plant type, which resulted in a greater number of flowers per plant, were the key reasons behind the increased yield and yield parameters observed with the GA_3 treatment at 300 ppm.

Conclusion

Based on the results of the present study, it can be concluded that the joint impact of growth regulation and pinching had a notable influence on both vegetative and yield-related characteristics. The most effective treatment combination was GA_3 at 300 ppm in combination with pinching at 40 days posttransplantation. This treatment resulted in superior outcomes in terms of the number of leaves, plant spread, number of flowers per plant, flower diameter, yield per plant and yield per hectare in Chrysanthemum cv. Pusa Aditya. However, the treatment combining GA_3 at 300 ppm with no pinching led to an increase in plant height.

Conflict of interest

The authors declare that they have no conflicts of interest.

References

Abd El-Ghany, M. A., & El-Sheikh, M. A. (2018). Effect of Pinching and Foliar Spray with Plant Growth Regulators on Growth and Flowering of Chrysanthemum cv. "Dorado". Bulletin of Faculty of Agriculture, Cairo University, 69 (2), 189-202.

Chaudhari, K. N., Chavan, P. D., & Kalyankar, A. D. (2017). Effect of plant growth regulators and pinching on growth and flowering of chrysanthemum (*Chrysanthemum morifolium* L.). *The Pharma Innovation Journal*, 6 (10), 8-11.

Dabas, H. K., Mitra, L. I. L. Y., & Dabas, S. (2001). Effect of different concentrations of GA_3 MH and NAA on primary branches of marigold (*Tagetes erecta* L.). *Indian Agric*, 45 (3-4), 265-267.

Deka, J., Das, B., & Deka, M. (2017). Effect of GA3 and NAA on growth, flowering and yield of chrysanthemum (*Chrysanthemum morifolium* Ramat.). *International Journal of Pure and Applied Bioscience*, 5(1), 20-25.

Dhanapal, G. N., Jayanthi, M., & Velu, R. (2015). Effect of foliar spray of GA3 and NAA on growth and flowering of chrysanthemum (*Chrysanthemum morifolium* L.). *Journal of Pharmacognosy and Phytochemistry*, 3(3), 07-10.

Jaiswal, P., Tiwari, R. K., & Tripathi, P. (2018). Effect of plant growth regulators on growth, flowering and yield of chrysanthemum (*Chrysanthemum morifolium* Ramat.) cv.

Pusa Shubhra. *International Journal of Chemical Studies*, 6(2), 3450-3453.

Mishra, S., Singh, S., & Singh, S. (2017). Effect of Plant Growth Regulators on Growth, Flowering and Yield Attributes of Chrysanthemum (*Chrysanthemum morifolium* Ramat.) cv. Snowball. *International Journal of Current Microbiology and Applied Sciences*, 6(5), 955-964.

Mounika, C. H., Suseela, T., Subbaramamma, P., Sujatha, R. V., & Dorajeerao, A. V. D. (2019). Effect of pinching and growth regulators on vegetative and floral parameters Chrysanthemum cv. Pusa Kesari. *Journal of Pharmacognosy and Phytochemistry*, 8(5), 1035-1041.

Nagarjuna, B., Reddy, V. P., & Rao, M. R. (1988). Effect of growth regulators and inorganic fertilizers on growth, flowering and yield of chrysanthemum. *South Indian Hort*, 36(3), 136-140.

Reddy, Y. T. N., & Sulladmath, U. V. (1983). Influence of growth regulators on flower characters of China aster. *South Indian Hort*, 31, 252-256.

Sahu, J. K., Tamrakar, S. K., Lakpale, R., & Tirkey, T. (2021). Effect of planting geometry and plant growth regulators on growth and flowering of chrysanthemum. *Progressive Horticulture*, 53(1), 105-108.

Sharma, S., & Sati, S. C. (2018). Plant growth regulators and their role in enhancing the quality and quantity of *Chrysanthemum morifolium* L. production: a review. *International Journal of Chemical Studies*, 6(1), 1769-1774.