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Research Journal of Agricultural Sciences
An International Journal

P- ISSN: 0976-1675
E- ISSN: 2249-4538

Volume: 12
Issue: 05

Res Jr of Agril Sci (2021) 12: 1511–1514

CARAS

Res. Jr. of Agril. Sci. (Sep-Oct 2021) 12(5): 1511–1514
www.rjas.org

Full Length Research Article

Effect of Plant Growth Regulators on Growth and Flowering of Chrysanthemum (*Chrysanthemum morifolium* Ramat.) in Coastal Tamil Nadu

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Received: 01 Jun 2021 | Revised accepted: 02 Aug 2021 | Published online: 04 Sep 2021

ABSTRACT

Chrysanthemum (*Chrysanthemum morifolium* Ramat.) is an important commercial flower crop grown in India. It is grown for loose flower, cut flower and potted plant trade throughout the world. Unlike traditional chrysanthemum cultivation, cut chrysanthemum focuses more on the quality of stem and flower. The present investigation was carried out during 2019 at Department of Horticulture, Faculty of Agriculture, Annamalai University, Chidambaram, Tamil Nadu. The study was carried out with seven different treatments involving two growth regulators with three levels (Gibberellic acid @ 50 ppm, 100 ppm, 150 ppm and Paclobutrazol @ 30 ppm, 45 ppm, 60 ppm) sprayed at 30th and 45th DAP, along with control (Water spray). The experiment was laid out in a Completely Randomized Design with three replications. The result revealed that the maximum values for Plant height (70 cm at 120 DAP) Number of leaves (218.2), Flower diameter (8.6cm) and Vase life (4.2days) were recorded in the treatment which was sprayed with Gibberellic acid @ 150 ppm.

Key words: Growth regulator, Gibberellic acid, Paclobutrazol, Growth, Flowering, Chrysanthemum

Chrysanthemum ranks third position in India after jasmine and rose [1]. Traditionally chrysanthemum is grown in India mostly for loose flower trade. However, with recent advances in protected cultivation and introduction of modern cut flower varieties, India started to produce and export cut flowers to international markets. In India it is grown in 20,900 hectares with the production of 1, 85,240 tonnes of loose flowers and 14, 930 tonnes of cut flowers [2]. The natural flowering of florist's chrysanthemum occurs between late summer and late winter depending upon the cultivar and climate. Earlier it was believed that flowering was induced by falling temperature of late summer and autumn, until the classical the theory of photoperiodism was established. Both photoperiod and amount of light are known to have major effects on growth and flowering of chrysanthemum. A preliminary trial of planting a cut flower variety of chrysanthemum at Annamalai Nagar resulted in delayed flowering and the stems were lean and lanky. The quality of cut chrysanthemum is the result of interaction among genotype, environment and cultural management. Controlling plant size is one of the most important aspects in floricultural crops which can be achieved genetically, environmentally, culturally or chemically [3-4]. Growth regulating chemicals are applied when a desirable effect cannot be achieved by manipulation of the plant environment. However, the effective concentration varies with the location and varieties [5]. In addition to GA, Paclobutrazol, one of the new triazol pyrimidine growth regulators was used to improve the compactness [6-7]. The effective dosage again depends on the culture, season, concentration and method of application. Not much work has been done to improve the quality of cut chrysanthemum in coastal tropics. In view of the above facts, the present study was formulated to study the effect of plant growth regulators on growth and flowering of chrysanthemum (*Chrysanthemum morifolium* Ramat.) in coastal Tamil Nadu.

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MATERIALS AND METHODS

The present investigation was carried out in the Floriculture yard, Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalai Nagar, during 2019-20. The experiment was laid out in a completely randomized design (CRD) with three replications. The study was carried out with seven different treatments involving two growth regulators with three levels (Gibberellic acid @ 50 ppm, 100 ppm, and 150 ppm) and Paclobutrazol 30 ppm, 45 ppm, and 60 ppm)). The treatments were imposed as foliar spray on 30th and 45th days after transplanting at respective concentration during early morning. The chrysanthemum variety 'Light yellow' possessing regular incurve type of flowers was used in the experiment. Fifteen pots were maintained per treatment and replication. Pinching was done at 12 days after planting when plant attained a height of 15 cm or six alternate leaves were produced. Observations on the growth parameters viz., plant height number of leaves, flower weight, flower diameter and vase life were recorded and statistically analyzed.

RESULTS AND DISCUSSION

The result of the experiments is presented in (Table 1-3). The analysis of variance due to treatments was found to be significant for all the characters except plant height at 30 DAP. Comparisons of the effect of GA_3 on plant height with control showed that GA treated plants were taller than control. With successive increase in levels of GA the plant height also increased. Among the three levels of GA_3, GA @ 150 ppm (T_4) exhibited about 65.5% more plant height than control (T_1). The increase in plant height might be attributed to stimulated gibberellin biosynthesis which induces cell division and cell elongation [8]. Increased plant height due to GA application was also reported by [9]. The results of the present study corroborate the findings of [5] who also reported GA @ 150 ppm gave the highest plant height. Compared to control, GA applied plants exhibited more intermodal length. With successive levels of GA, the intermodal length also increased and the longest internodal length was observed at 150 ppm and it was about 42.8% over control. In the present experiment, the plants were pinched on 12th day after planting and the plants were trained to have four primary branches (sprays). The spread of the plant which is an indirect expression of vigour and branching indicated that GA @ 150 ppm showed 24.5% more spread on East- West direction and 38.6% more spread on North-South direction over control. The highest plant spread with GA application in chrysanthemum also reported by [10].

Table 1 Effect of plant growth regulators on growth characters of chrysanthemum

Treatments	Plant height (cm)				Number of leaves	Stem girth (cm)	Internodal length (cm)
	30 DAP	60 DAP	90 DAP	120 DAP			
T_1: Control	25.6	33.8	37.1	46.0	126.2	1.7	2.8
T_2: Gibberellic Acid50ppm	24.1	50.5	54.1	60.5	182.9	2.2	3.3
T_3: Gibberellic Acid 100ppm	25.3	52.1	57.6	64.9	195.4	2.3	3.5
T_4: Gibberellic Acid 150ppm	27.2	58.9	64.3	70.0	218.2	2.7	4.0
T_5: Paclobutrazol 30ppm	23.9	26.1	27.6	30.2	135.7	2.6	2.5
T_6: Paclobutrazol 45ppm	21.6	24.9	26.3	29.6	145.3	2.7	2.2
T_7: Paclobutrazol 60ppm	20.5	23.2	24.4	26.5	152.7	2.7	2.2
S. Ed.	-	0.1	1.0	0.2	3.3	0.05	0.1
CD (p = 0.05)	NS	0.3	2.2	0.4	7.0	0.1	0.2

Table 2 Effect of plant growth regulators on growth and flowering characters of chrysanthemum

Treatments	Plant spread (cm)		Leaf area (cm^2)	Chlorophyll content (mg g^{-1})	Days required for 1st flower bud initiation	Days required for first flowering
	East-West	North-South				
T_1: Control	43.2	33.6	87.8	17.6	76.0	106.7
T_2: Gibberellic Acid50ppm	46.7	38.3	94.4	22.9	61.5	91.4
T_3: Gibberellic Acid 100ppm	50.9	41.1	103.0	23.4	58.9	87.9
T_4: Gibberellic Acid 150ppm	53.8	46.6	106.9	23.8	57.8	85.9
T_5: Paclobutrazol 30ppm	41.1	31.8	68.9	21.1	68.9	96.9
T_6: Paclobutrazol 45ppm	37.3	30.6	66.4	22.0	68.0	95.7
T_7: Paclobutrazol 60ppm	33.4	24.5	63.4	22.6	66.2	94.7
S. Ed.	0.7	0.9	1.9	0.3	0.4	0.6
CD (p = 0.05)	1.5	2.0	4.2	0.6	1.0	1.4

GA sprayed plants not only showed increased plant height but also possessed more number of leaves and larger leaves. The results indicated that GA @ 150 ppm showed 72.9% more number of leaves and 21.7% more leaf area over control. Since leaves play an important role in converting photo energy into chemical energy, the favourable expression of vegetative characters might be attributed to the increased photo assimilation coupled with nutrient absorption and better source – sink partitioning. Increased assimilation, nutrient absorption, mobilization due to GA. The increased number of leaves were observed under GA treatment could be attributed to the action of GA in cell division, cell elongation and tissue differentiation that resulted in the initiation of more number of leaves and leaf area. The results of the present study goes in support of the findings of [10] who also reported that GA when applied at 300 ppm twice on 25th day after transplanting resulted in more number of leaves and leaf area. The results of the present investigation goes in support of the finding of [11] who found the maximum number of leaves and leaf length with GA @ 150 ppm when compared to control in chrysanthemum. In cut chrysanthemum, stem girth is an important character considered in trade. Higher the stem girth more is the quality and best suited for bouquets and flower arrangements. The effect of GA @ 150 ppm on stem girth showed an increase of 58.8% over control. It was statistically on par with Paclobutrazol @ 45 ppm (T_6) and Paclobutrazol @ 60 ppm (T_7). Increase in concentration of endogenous concentration due to exogenous application might have played a major role in increased stem girth of flower stalk. More food reserves may have been converted to only fewer sinks that enhanced to produce bigger flowers and increased stalk length [11].

Comparison of the effect of GA_3 on first flower bud initiation, first flowering and 50% flowering with control showed that GA treated plants showed early bud initiation and flowering than control. With successive increase in levels of GA the plants showed early bud initiation and flowering. Among the three levels of GA_3, GA @ 150 ppm (T_4) exhibited early bud initiation (57.8 days) and first flowering (85.9 days) than control (76.0 and 106.7 days) (T_1). Early flowering observed in GA applied plants might be attributed to the altered balance of Phyto hormones in favour of reproductive phase. Early flowering observed in GA applied plants might be attributed to the altered balance of Phyto hormones in favour of reproductive phase. Exogenous application might have either triggered endogenous synthesis of GA or complimented the endogenous concentration. Further, the action of GA in decreasing the concentration of ABA would have resulted in early reproductive phase [12]. Incidentally, under natural inductive period, the increased vegetative characters especially the number of leaves and leaf area might have favoured earliness as it is well known that altered C: N ratio is one of the factors which is responsible for the conversion of vegetative meristem into flower meristem. Early bud initiation and flowering due to GA application was also reported by [13]. The results of the present study corroborate the findings of [5] who also reported that GA @ 150 ppm resulted in early flower bud initiation and flowering in 61 days.

GA treated plants exhibited more number of flowers and maximum individual fresh flower weight GA_3 @ 150 ppm showed 26% more number of flowers per spray and 53.8% more individual flower weight over control. Among three levels of GA_3 @ 150 ppm (T4) exhibited about 55.2% more spray length and 22.8% more flower diameter over control. Active cell elongation in the flower might be the reason of increase in flower diameter. GA_3 is also known to be the component of florigen which required for flower formation of flowers in plants and rapid mobilization and accumulation of metabolites that resulted in big flower size [14-15]. GA sprayed plants not only showed maximum flower diameter and spray length and also observed in more number of flowers per spray and individual fresh flower weight. Increase in fresh weight might be attributed to increased flower size and better growth thus resulting better source-sink [16]. Among the three levels of GA_3, GA @ 150 ppm (T_4) exhibited about 147% more vase life when compared to control (T_1). Enhancement of the vase life might due to the overall modified effect on the vegetative and reproductive growth of the plant [9].

Table 3 Effect of plant growth regulators on flowering characters of chrysanthemum

Treatments	Days required for 50% flowering	Spray length (cm)	Number of flowers per spray	Flower diameter (cm)	Flower weight (g)	Vase life (days)
T_1: Control	118.1	36.2	5.0	7.0	3.9	1.7
T_2: Gibberellic Acid50ppm	98.4	46.4	5.8	8.0	5.3	3.8
T_3: Gibberellic Acid 100ppm	96.9	49.2	6.1	8.2	5.6	3.9
T_4: Gibberellic Acid 150ppm	94.8	56.2	6.3	8.6	6.0	4.2
T_5: Paclobutrazol 30ppm	106.8	20.9	5.4	7.6	4.3	3.6
T_6: Paclobutrazol 45ppm	104.7	19.8	5.3	7.2	4.1	3.6
T_7: Paclobutrazol 60ppm	102.3	17.6	5.2	7.1	4.1	3.5
S. Ed.	0.5	0.3	0.1	0.1	0.1	0.1
CD (p = 0.05)	1.2	0.6	0.2	0.2	0.2	0.2

Among the three levels of PBZ @ 60 ppm (T_7) exhibited about 39% shorter plant height when compared to control (T_1). The shortest internodal length was observed at the highest concentration of PBZ @ 60 ppm and it was 21.4% shorter over control. It was statistically on par with T_6 – PBZ @ 45 ppm. Application of PBZ @ 60ppm gave 28.4% more chlorophyll content when compared to control. It was on par with GA_3 @ 50 ppm (T_2). The same treatment gave 22.6% reduced plant spread on East-West direction and 27% reduced on North- West direction over control. The reduction of vegetative characters observed under PBZ treatment, might be attributed to the role of PBZ, an anti-gibberellin, to inhibit the gibberellins bio-synthesis. Reduced plant height, internodal distance with thicker and darker leaves due to application of PBZ [17].

Comparison of the effect of PBZ, on first flower bud initiation, first flowering and 50% flowering with control showed that plants showed early flower bud initiation and flowering than control. With successive increase in levels of PBZ the early bud initiation and flowering occurred. Among the three levels of PBZ, PBZ @ 60 ppm (T_7) exhibited early bud initiation (66.2 days) and first flowering (94.7) over control (76.0 and 106.7 days). Among the three levels of PBZ, the effect of number of flowers per spray were non-significant for this trait but when compared to control paclobutrazol @ 30 ppm (T_5) exhibited about 5.9% more number of flowers per spray [18].

Among the PBZ treatments, PBZ @ 30 ppm gave 8.5% more flower diameter when compared to control. PBZ @ 30 ppm not only showed more number of flowers, flower diameter but also showed individual flower weight over control. PBZ @ 30 ppm (T_5) gave 10.2% more flower weight than control. PBZ @ 45 ppm (T_6) and PBZ @ 60 ppm (T_7) were statistically on par with control (T_1) for flower weight. Increased flower diameter and flower weight recorded at PBZ @30 ppm might be attributed to the more number of leaves with higher chlorophyll content. The differences due to the concentration of PBZ on vase life was non-significant. However, PBZ treatment increased the vase life but when compared to control, PBZ @ 30 ppm and PBZ @ 45 ppm gave 117.7% more vase life. The delayed senescence observed under PBZ treatment could be attributed to the inhibitory action of PBZ on ethylene [19].

CONCLUSION

Based on the above facts it may be concluded that application of gibberellic acid @ 150 ppm will give you the best results for quality chrysanthemum production in coastal Tamil Nadu.

LITERATURE CITED

1. Chawla SL, Mohammed S, Mahawer LN, Jain MC. 2007. Effect of nitrogen and phosphorus on vegetative growth and flower yield of chrysanthemum (*Chrysanthemum morifolium*) cv. Nilima. *Annals of Agricultural Research* 28(1): 25-28.
2. Anonymous. 2020. Indiastat. https://www.indiastat.com/table/agriculture/2/chrysanthemum/962503/1181291/data.aspx.
3. Gopichand YMNVS, Padmalatha T, Pratap M, Sivasankar A. 2014. Effect of bioregulators and stage harvesting on seed maturity and quality in African marigold (*Tagetes erecta*L.). *Indian Journal of Agricultural Research* 48(5): 342-351.
4. Kumar KP, Padmalatha T, Pratap M. 2015. Effect of spacing and pinching on vegetative growth in China aster (*Callistephus chinensis* L. Nees.) cv. Kamini. *Plant Archives* 14(2): 961-966.
5. Choudhari R, Kulkarni BS, Shiragur M. 2018. Growth, flowering and quality of cut chrysanthemum (*Dendranthema grandiflora* Tzevelev.) cv. Yellow Gold, as influenced by different growth regulators. *International Journal of Chemical Studies* 6(1): 1458-1460.
6. Karlovic K, Vrsek I, Sindrak Z, Zidovec V. 2004. Influence of growth regulators on the height and number of inflorescence shoots in the chrysanthemum cultivar 'Revert'. *Agriculturae Conspectus Scientificus* 69(2/3): 63-66.
7. Zhou ZK. 2008. Effects of B-9 and CCC on the growth, flowering and physiological characteristics of *Chrysanthemum morifolium. Journal of Agriculture Science* 8: 21-26.
8. Taiz L, Zeiger E. 2004. *Fisiologia Vegetal*. pp 720.
9. Singh J, Nigam R. 2015. Effect of PGRs and inorganic fertilizers on vegetative growth and flowering behavior of chrysanthemum. *HortFlora Research Spectrum* 4(3): 273-276.
10. Alhajhoj MR. 2017. Effects of foliar application of plant growth regulators on growth and flowering characteristics of chrysanthemum cv. Paintball. *Pakistan Journal of Life and Social Sciences* 15(2): 114-119.
11. Sharifuzzaman SM, Ara KA, Rahman MH, Kabir K, Talukdar MB. 2011. Effect of GA_3, CCC and MH on vegetative growth, flower yield and quality of chrysanthemum. *International Journal of Experimental Agriculture* 2(1): 17-20.
12. Phengphachanh B, Naphrom D, Bundithya W, Potapohn N. 2012. Effects of day-length and gibberellic acid on flowering and endogenous hormone levels in *Rhynchostylis gigantean. Journal of Agriculture Science* 4(4): 217-222.
13. Sajid M, Amin N, Ahmad H, Khan K. 2016. Effect of gibberellic acid on enhancing flowering time in *Chrysanthemum morifolium. Pakistan Journal of Botany* 48(2): 477-483.
14. Kumar P, Raghava SPS, Misra RL, Singh KP. 2003. Effect of GA_3 on growth and yield of China aster. *Journal of Ornamental Horticulture* 6(2): 110-112.
15. Doddagoudar SR, Vyakaranhal BS, Shekhargouda MA, Nalini Prabhakar S, Patil VS. 2002. Effect of mother plant nutrition and chemical spray on growth and seed yield of China aster cv. Kamini. *Seed Research* 30(2): 269-274.
16. Sainath DSU, Meena MK. 2012. Effect of different plant growth regulators on growth, quality, yield and yield components in chrysanthemum (*Chrysanthemum coronorium*). *International Journal of Plant Sciences* 7: 10-17.
17. Dilipkumar M, Yadava LP. 2011. Influence of paclobutrazol application on the flower size and yield of China aster (*Callistephus chinensis* (L.) Nees). *Journal of Applied Horticulture* 13(2): 147-149.
18. Dorajeerao AVD, Mokashi AN. 2012. Yield and quality parameters of garland chrysanthemum (*Chrysanthemum coronarium* L.) as influenced by growth regulators/chemicals. *Indian Journal of Plant Sciences* 1(1): 16-21.
19. Navale MU, Aklade SA, Desai JR, Nannavare PV. 2010. Influence of plant regulators on growth flowering and yield of chrysanthemum (*Dendranthema grandiflora* Tzvelev.) cv. 'IIHR-6'. *International Journal of Pharma and Biosciences* 1(2): 1-4.