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Varun Chauhan
Department of Floriculture and Landscaping, College of Horticulture, VCSG, Uttarakhand University of Horticulture and Forestry, Bharsar, Pauri Garhwal, Uttarakhand, India

Mamta Bohra
Department of Floriculture and Landscaping, College of Horticulture, VCSG, Uttarakhand University of Horticulture and Forestry, Bharsar, Pauri Garhwal, Uttarakhand, India

Rohan Tomar
Department of Floriculture and Landscaping, College of Horticulture, VCSG, Uttarakhand University of Horticulture and Forestry, Bharsar, Pauri Garhwal, Uttarakhand, India

Neha Dobhal
Department of Fruit science, College of Horticulture, VCSG, Uttarakhand University of Horticulture and Forestry, Bharsar, Pauri Garhwal, Uttarakhand, India

Corresponding Author:
Varun Chauhan
Department of Floriculture and Landscaping, College of Horticulture, VCSG, Uttarakhand University of Horticulture and Forestry, Bharsar, Pauri Garhwal, Uttarakhand, India

Effect of paclobutrazol and daminozide on vegetative attributes of chrysanthemum (*Dendranthema grandiflora* Tzvelve)

Varun Chauhan, Mamta Bohra, Rohan Tomar and Neha Dobhal

Abstract
The present investigation was conducted to evaluate the vegetative parameters of chrysanthemum cv. Dolly White in response to different concentrations of paclobutrazol and daminozide at Floriculture and Landscaping Block, College of Horticulture, VCSG Uttarakhand University of Horticulture and Forestry, Bharsar, Pauri Garwal from June to December, 2019. The experiment was laid out on Randomized Complete Block Design with nine treatments. The treatments used were control, paclobutazol (30, 60, 90 and 120 ppm) and daminozide (250, 500, 750 and 500 ppm). Each treatment was replicated thrice. The cuttings were planted in pots of size 15 cm × 15 cm (length and diameter). Paclobutrazol and daminozide were applied at 30 and 60 days after planting of cuttings.
The results of investigation revealed that shortest plant height (18.22 ± 0.35 cm) was recorded from the plant drenched with paclobutrazol @ 120 ppm and found statistically at par with paclobutrazol @ 60 and 90 ppm (19.82 ± 0.64 cm and 18.69 ± 0.57 cm, respectively). The diameter of main stem and plant spread (5.02 ± 0.05 mm and 21.33 ± 0.24 cm, respectively) were recorded maximum in plants sprayed with daminozide @ 1000 ppm and found statistically at par with paclobutrazol @ 90 ppm (4.93 ± 0.01 mm and 20.32 ± 0.38 cm, respectively).
Thus, it can be concluded that drenching of paclobutrazol @ 60 ppm was found effective in getting dwarf plant. For improving maximum plant spread paclbutrazol @ 90 ppm was found best.

Keywords: paclobutrazol, daminozide, dolly white

Introduction
Chrysanthemum is one of the most demanded flower crop in domestic and international markets. The wide range of flower size, colour, shape and form of the flower grab attention of consumers. The flowers are used as both cut as well as loose flower. Beside this the dwarf and compact growth plants are suitable for pot and bedding purpose. Nowadays due to continuous increase in population and urbanization there is shortage of land for cultivation of plants. Therefore, peoples living in urban areas shifting their interest from growing tall and bushy plants to compact and dwarf type one. The small sized plants help in greater space utilization efficiency. Ahmad *et al.* (2015) [1] reported that production of small and compact plants offer an economic benefit to producer. The use of plant growth retardants is an effective technique to restrict stem elongation to achieve aesthetically and commercially pleasing plants (Rezazadeh *et al.,* 2016) [20]. The growth retardants are very useful for manipulating the shape, size and form of plants.
It is herbaceous, perennial plant. The leaves are spirally arranged on erect, branched stems and the flowers are borne in capitula. The distinguishing character of this family is that a large number of tiny flowers are closely mounted on a flattened stem end which given the whole compositae inflorescence a false appearance of a single bloom. The flowering time of the most of cultivars is controlled by modifying the natural day length (Bhattacharjee, 2003) [3]. The national chrysanthemum societies in each country classify the cultivars grown on the basis of bloom characteristics *viz.*, the relative number of two kinds of florets, the physical shape of florets and the direction of growth and arrangement of florets. The chrysanthemum bloom contains two types of florets *i.e.* disc floret and ray floret. Disc floret is situated in centre, tubular in shape with five united petals whereas ray floret surrounds the disc florets and comparatively longer in shape, colour and direction of growth (Kher, 1988) [13].

Materials and Methods
A field experiment was conducted at College of Horticulture, VCSG, UUHF, Bharsar, Pauri Garhwal, Uttarakhand, India during June- December, 2019. The experiment consist of ten treatments *viz.*, T_1 Control (Water spray); T_2 Paclobutrazol @ 30 ppm (Soil drenching); T_3

Paclobutrazol @ 60 ppm (Soil drenching); T_4 Paclobutrazol @ 90 ppm (Soil drenching); T_5 Paclobutrazol @ 120 ppm (Soil drenching); T_6 Daminozide @ 250 ppm (Foliar spray); T_7 Daminozide @ 500 ppm (Foliar spray); T_8 Daminozide@ 750 ppm (Foliar spray); T_9 Daminozide @ 1000 ppm (Foliar spray); The treatments were replicated thrice in Randomized Complete Block Design. The farmyard manure and vermicompost were applied as per treatment allocation to the plots uniformly. Inorganic fertilizers were applied in the form of calcium ammonium nitrate, single super phosphate and muriate of potash. Half dose of nitrogen and full dose of phosphorous and potash were applied as a basal dose and remaining half dose of nitrogen was applied 30 days after transplanting. The terminal cuttings of chrysanthemum for experimental purpose were taken from a healthy stock plants maintained at Floriculture and Landscaping Block, Bharsar, Uttarakhand in the month of June. The length of cutting was about 5-7 cm. The cuttings were prepared by removing basal leaves and reducing the leaf area of remaining leaves to half. The basal portion of cuttings was dipped in IBA solution @ 1000 ppm and planted in a raised nursery bed in shady conditions and then transplanted in plastic pots (length 15 cm and diameter15 cm) under shade condition. The pots were filled with growing media containing sand + soil +FYM + Vermicompost (1:1:1:1). In each pot a single cutting was planted at the centre. Paclobutrazol and Daminozide were applied 30 and 60 days after transplanting of cuttings. They were applied in early morning hours.

Results and Discussion

The shortest plant height (18.21 ± 0.35cm) was recorded from the plants drenched with T_5 (paclobutrazol @ 120 ppm) and found statistically at par with T_4 (18.69 ± 0.57cm) and T_3 (19.82 ± 0.64 cm). Similarly, minimum internodal length (2.92 ± 0.22 cm) was observed in T_4 (paclobutrazol @ 90 ppm) and found statistically at par with T_5 (2.96 ± 0.09 cm) and T_3 (3.22 ± 0.08 cm). The results also revealed that all the applied treatments significantly reduced plant height and internodal length as compared to control. The reduction in plant height and internodal length by the application of different concentrations of paclobutrazol might be due to their inhibitory role on cell division and cell elongation of apical meristematic cells. Similar findings have been reported by Karlovic *et al.* (2004) [10] and Dorajeerao *et al*. (2012) [5] in chrysanthemum. Rademacher (2000) [19] reported that paclobutrazol has an inhibitory effect on gibbberllin biosynthesis, which block cytochrome P-450 dependent monooxygenases there by leads to inhibition oxidation of ent-kaurene in to ent- kaurenoic acid. Thus, blocks the biosynthesis of the active gibberellin which results to reduction in internodal length and plant height (Mahgoub *et al*., 2006) [15]. Similarly, suppression of plant height and internodal length under different concentrations of daminozide might be due to it reduce the conversion of GA to active forms of GA and reducing translocation of GA to actively growing tissues. The above result is corroborated with the finding of Singh (2016) [23] in chrysanthemum. The suppression in plant height under paclobutrazol and daminozide could be attributed due to less internodal elongation registered under these treatments. The results also revealed that increase in concentration of these chemicals there was significant reduction in plant height when compared to control. The results are in close conformity with the findings of Pinto *et al.* (2005) [18] in zinnia and Dorajeerao *et al*. (2012) [5] in chrysanthemum. Both the growth retardants reduce the level of endogenous GA_3, that ultimately leads to the shortening of internodes. Similar findings of shortening of internodal length were also reported by Moond and Rakesh (2006) [16] in chrysanthemum crop, Zalewaska (1989) [25] in chrysanthemum cultivars and Gad *et al*. (1997) [7] in *Fuchsia magellanica*.

The maximum diameter of main stem (5.02 ± 0.05 mm) was noticed in treatment T_9 (Daminozide @ 1000 ppm) and found statistically at par with T_4 (4.93 ± 0.01 mm). In case of plant spread, maximum spread (21.33 ± 0.24 cm) was observed in T_9 (daminozide @ 1000 ppm) and found statistically at par T_4 (20.32 ± 0.38 cm). Application of plant growth retardant play a vital role in anti-auxin activity, disturb carbohydrate metabolism, inhibition of cell division and elongation of apical meristem (Jagdale *et al.*, 2017) [9]. This might be due to the action of growth retardants suppress the formation of apical buds that causes reduction in terminal growth. Therefore, more auxin would have been available for the lateral buds of the plants which ultimately results in improving stem diameter and increasing plant spread. Similar findings were reported by Kim *et al*. (2010) [12] in chrysanthemum, El-Sheibany *et al*. (2007) [6] in local cultivar of chrysanthemum, Singh (2016) [23] in chrysanthemum and Kumar *et al.* (2007) [14] in marigold, Sen and Maharana (1971) [22] in chrysanthemum and Gowda and Jayanhi (1991) [8] in marigold.

The minimum leaf area (11.74 ± 0.45 cm^2) was recorded in T_5 and found statistically at par with T_2 (12.74 ± 0.42 cm^2), T_3 (12.56 ± 0.59 cm^2), and T_4 (12.00 ± 0.32 cm^2). It might be due to because it blocks the GA_3 biosynthesis which causes reduction in speed of cell division and extension so that leaf area was retard. These findings are in conformity with Dani *et al.*, (2010) [4] in marigold and Saiyad *et al.* (2010) [21] in gaillardia and Nasrullah *et al.* (2012) [17] in bougainvillea. Tanimoto (1987) [24] reported that paclobutrazol has the greatest effects on expanding or elongating cells, where inhibition of gibberellin synthesis rapidly causes reductions in stem elongation and leaf expansion so the leaf area was found minimum in paclobutrazol. The maximum leaf area (15.15± 0.39 cm^2) was recorded in T_9 (daminozide @ 1000 ppm) and found statistically at par with T_1 (14.05 ± 0.32 cm^2), T_6 (14.12 ± 0.75 cm^2), T_7 (14.48 ± 0.19 cm^2) and T_8 (14.73 ± 0.15 cm^2). The non significant effect of daminozide application on leaf area have been reported by Pinto *et al.* (2005) [18] in zinnia an Bhat *et al.* (2011) [2] in *Erysimum marshallii.*

Conclusion

The results indicated that all the applied concentration of paclobutrazol and daminozide was found significantly effective in reducing plant height as compared to control. The shortest plant height was recorded in plants drenched with paclobutrazol @ 120 ppm and found statistically at par with paclobutrazol @ 90 ppm and @ 60 ppm. The plants spread was found maximum in plants sprayed with daminozide @ 1000 ppm and found statistically at par with daminozide @ 750 ppm and paclobutrazol @ 90 ppm.

Therefore, from the above findings it can be concluded that drenching of paclobutrazol @ 60 ppm was found effective in getting dwarf plant of chrysanthemum cv. Dolly White. To get maximum plant spread drenching of paclobutrazol @ 90 ppm can be recommended.

Table 1: Effect of different concentrations of paclobutrazol and daminozide on vegetative attributes of chrysanthemum cv. Dolly White

Treatments	Plant height (cm) ± S.E(m)	Internodal length (cm) ± S.E(m)	Diameter of main stem (mm) ± S.E(m)	Plant spread (cm) ± S.E(m)	Leaf area (cm^2) ± S.E(m)
T_1 (Control)	25.77 ± 0.59	3.87 ± 0.02	4.50 ± 0.07	15.40 ± 0.31	14.05 ± 0.32
T_2 (Paclobutrazol @ 30 ppm)	20.63* ± 0.52	3.32* ± 0.08	4.67* ± 0.05	16.66* ± 0.48	12.74* ± 0.42
T_3 (Paclobutrazol @ 60 ppm)	19.82* ± 0.64	3.22*± 0.08	4.84* ± 0.02	18.93* ± 0.29	12.56* ± 0.59
T_4 (Paclobutrazol @ 90 ppm)	18.69* ± 0.57	2.92* ± 0.22	4.93* ± 0.01	20.32* ± 0.38	12.00* ± 0.32
T_5 (Paclobutrazol @ 120 ppm)	18.21* ± 0.35	2.96* ± 0.09	4.74* ± 0.04	16.76* ± 0.45	11.74* ± 0.45
T_6 (Daminozide @ 250 ppm)	22.85* ± 0.46	3.53* ± 0.05	4.63* ± 0.02	17.04* ± 0.46	14.12 ± 0.75
T_7 (Daminozide @ 500 ppm)	22.65* ± 0.56	3.47* ± 0.13	4.79* ± 0.03	18.23* ± 0.40	14.48 ± 0.19
T_8 (Daminozide@ 750 ppm)	21.33* ± 0.52	3.42* ± 0.07	4.87* ± 0.02	20.20* ± 0.33	14.73 ± 0.15
T_9 (Daminozide @ 1000 ppm)	20.66* ± 0.52	3.35* ± 0.12	5.02* ± 0.05	21.33* ± 0.24	15.15 ± 0.39
S.E.(d)	0.77	0.14	0.05	0.52	0.54
C.D. $_{(0.05)}$	1.66	0.31	0.10	1.12	1.16

*significant at 0.05 level of significance

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