



## Growth and flowering response of *Chrysanthemum morifolium* cultivar Anmol to different growth retardants

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### ABSTRACT

An experiment was conducted at the experimental farm of Department of Floriculture and Landscaping, Punjab Agricultural University from 2015 to 2016 with the objective to standardize the optimum concentration of different growth retardants for alteration of plant architecture and improvement of flowering parameters in chrysanthemum (*Chrysanthemum morifolium* Ramat.) cv. Anmol. The experiment was conducted in completely randomized design (CRD) with three replications comprising ten pots per replication. Cycocel (@ 500, 750, 1000, 1250 and 1500 ppm), Daminozide (@ 500, 750 and 1000 ppm) and Ethephon (@ 250, 500 and 1000 ppm) were sprayed on chrysanthemum cv. Anmol (spray type) after one month of transplanting. The effect of growth retardants in reduction of plant height followed the order daminozide > ethephon > cycocel. Internodal length was much reduced by daminozide @ 1000 ppm. Highest plant spread, diameter of main stem and leaf area was obtained under daminozide @ 1000 ppm. Floral characters like days to bud appearance, days to colour break stage and days to full bloom stage was obtained earlier in daminozide @ 1000 ppm and later in ethephon @ 1000 ppm. Flower diameter was much increased by daminozide @ 500 ppm. Highest number of flowers/plant was obtained under daminozide @ 1000 ppm. Highest duration of flowering was obtained under daminozide @ 1000 ppm and minimum under ethephon @ 1000 ppm.

**Key words:** Chrysanthemum, Growth retardants, Height, Vegetative growth

Chrysanthemum (*Chrysanthemum morifolium* Ramat.) is one of the most beautiful and perhaps the oldest flowering plant, commercially grown in different parts of World (Dole and Wilkins 2005). It is a genus of approximately 30 species of perennial flowering plants belonging to family 'Asteraceae', found in Asia and north eastern Europe and commonly known as "Autumn Queen" or "Queen of East" (Bhattacharjee 2006). The Netherland and Columbia are the leading exporters of chrysanthemum and, in India; its cultivation is concentrated mainly in Karnataka, Tamil Nadu, West Bengal, Madhya Pradesh and Himachal Pradesh. Chrysanthemum produces showy flowers with different flower colour, exceptionally hardy nature and relative ease to grow (Bhattacharjee 2006). Flower shape that can be used as pot plants for beautifying indoors and outdoors, as cut flowers for making bouquets and vase decoration, as loose flower for making garlands, worshipping purpose and for garden decoration. Therefore, it is the most important both as cut flower and as potted plant in international market.

Growth retardants are now a days being tried for controlling growth and flowering of chrysanthemum with a view to have compact plants, to stretch-out or retard the rate of plant growth and also to hasten or delay the flowering

period (Anderson 2006). Plant growth retardants can be an economical option for controlling growth, and often these chemicals also improve the quality and overall appearance of many plants including herbaceous perennials. Therefore, to achieve the desired shape, size and form of the plants use of growth retardants is a must. Retardants are commonly used in floriculture for height control (Pasian 1999) but they may also increase the number of lateral shoots or suppress the growth of vegetative shoots developing beneath the flower, resulting in a larger no. of inflorescences (Whealy *et al.* 1988, Keever and Foster 1989). Height control has an important role in avoiding unacceptably tall plants, which require more space, labour and higher transportation costs (Hayashi *et al.* 2001). Besides being more suitable for transport, there is a higher demand for lower plants on the market (Kuehny *et al.* 2001) and they also look better, which is important because the aesthetic impression of the final product determines the market value of the plant (McMahon and Kelly 1999). The effect of CCC and ethephon on chrysanthemum growth and development was investigated by (Haque *et al.* 2007) while (El-Sheibany *et al.* 2007) studied the effect of daminozide on some foliage characters of local cultivar of chrysanthemum and recorded a significant reduction in the height at harvest. The objective of the present study were to standardize the optimum concentration of different growth retardants for commercial applications on chrysanthemum.

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## MATERIALS AND METHODS

The investigation was carried out at the experimental farm of Department of Floriculture and Landscaping, Punjab Agricultural University from 2015 to 2016. The healthy terminal stem cuttings (5-7 cm) free from symptoms of any disease or insect pest were taken in 2<sup>nd</sup> week of July and planted in propagation trays having burnt rice husk as rooting media. Roots were developed after 10 - 15 days and rooted cuttings were transplanted in the pots during 1<sup>st</sup> week of August. The potting media consist of Coco peat + Perlite + Vemiculite (3:1:1 v/v) and only one plant was planted in one pot. To maintain the health and presentability of pots, standard plant protection measures were adopted. Pinching was done to encourage lateral branching in cultivar Anmol (spray type) and Royal Purple (spray type), 4 and 7 week after transplanting. Staking was done by using sticks to keep the plants erect and maintain the proper shape of plant and bloom. The first application of growth retardants were applied after pinching on 30 days after transplanting and another two applications were applied at 15 days interval. Control plants were sprayed with distilled water. The experiment was conducted in completely randomized design (CRD) with three replications comprising ten pots per replication. Various parameters were observed on

growth and flowering, i.e. plant height, internodal length, plant spread, diameter of main stem at flowering, leaf area, leaf colour, days to bud appearance, days to colour break stage, days to full bloom stage, flower diameter, number of flowers per plant and duration of flowering. Leaf area was recorded at full bloom stage with the help of leaf area meter, which is also known as sun scan instrument. The visual observations were recorded on leaf colour, i.e dark green, green, light green in comparison to normal plant. Colour of the leaf was compared with the help of Royal Horticultural Society colour chart, London.

## RESULTS AND DISCUSSION

It is evident from the data presented in (Table 1) that the effect of different doses of growth retardants on chrysanthemum cv. Anmol had significant ( $P < 0.005$ ) effect on morphological characters. Among all the treatments, minimum plant height at first bud appearance (24.13cm) was obtained in T<sub>9</sub> (Daminozide @ 1000 ppm) which was at par with T<sub>12</sub> (Ethepon @ 1000 ppm), both these treatments were significantly lower than control (27.09cm). Similar results were obtained by Kim *et al.* (2010) and Haque *et al.* (2007). The reduction in plant height with B-9, Cycocel and Ethepon application might be due to inhibitory role

Table 1 Effect of growth retardants on growth and flowering of *Chrysanthemum morifolium* cv. Anmol

Treatment	Plant height at first bud appearance	Plant spread	Internodal length	Diameter of main stem at flowering (mm)	Leaf area	Leaf colour	Days to bud appearance	Days to colour break stage	Days to full bloom stage	Flower diameter (cm)	Number of flower/plant	Duration of flowering (days)
T1	27.09a	13.07g	5.12a	4.01j	1.03h	Y G GP -145 B	84.26c	106.03d	126.26e	3.76g	25.86e	20.56de
T2	25.46ab	14.22f	4.61b	4.22i	1.36g	Y G GP 146 A	84.76bc	106.20d	126.63d	4.94bcde	25.20ef	20.06efg
T3	25.18ab	14.67e	4.53b	4.44h	1.73f	Y G GP 146 A	84.90abc	106.33d	126.83d	4.80cde	25.03ef	20.46def
T4	25.04ab	14.70de	4.5b	4.64g	1.86e	Y G GP 146 A	85.13abc	106.40d	126.93d	4.73def	24.16fg	23.66b
T5	24.77ab	15.29a	4.35bc	4.76g	2.55b	Y G GP 146 A	85.50ab	106.86c	127.33c	4.62ef	23.80g	21.13d
T6	24.92ab	15.23a	4.21bcde	4.95f	2.60ab	Y G GP 146 A	85.63ab	107.10c	127.50c	4.35f	23.50g	21.16d
T7	25.34ab	14.90cde	3.86cde	5.11e	2.01d	G 137 B	82.86d	104.06e	124.50f	5.69a	27.60d	22.63c
T8	24.81ab	15.20ab	3.73e	5.56b	2.59ab	G 137 B	82.60d	103.80e	124.03g	5.21bc	28.40cd	23.09bc
T9	24.13b	15.36a	3.20f	5.90a	2.66a	G 137 B	80.56e	103.66e	123.56h	5.12bcd	31.06a	25.06a
T10	25.20ab	14.95bcd	4.28bcd	5.22de	2.33c	G 138 B	85.76ab	107.23bc	128.06b	5.38ab	28.63cd	19.70fgh
T11	25.14ab	15.10abc	4.07bcde	5.32cd	2.40c	G 138 B	86.00ab	107.53ab	128.56a	5.12bcd	29.50bc	19.46gh
T12	24.48b	15.25a	3.79de	5.45bc	2.52b	G 138 B	86.06a	107.73a	128.73a	5.06bcde	30ab	19.16h
F test	*	*	*	*	*		*	*	*	*	*	*

Mean values in each column with the same letter are not significantly different at  $P < 0.05$  according to DMRT. \*Significant at  $P < 0.05$

T<sub>1</sub>: Control

T<sub>4</sub>: CCC@ 1000ppm

T<sub>7</sub>: Daminozide@ 500ppm

T<sub>10</sub>: Ethepon@ 250ppm

T<sub>2</sub>: CCC@ 500ppm

T<sub>5</sub>: CCC@ 1250ppm

T<sub>8</sub>: Daminozide@ 750ppm

T<sub>11</sub>: Ethepon@ 500ppm

T<sub>3</sub>: CCC@ 750ppm

T<sub>6</sub>: CCC@ 1500ppm

T<sub>9</sub>: Daminozide@ 1000ppm

T<sub>12</sub>: Ethepon@ 1000ppm

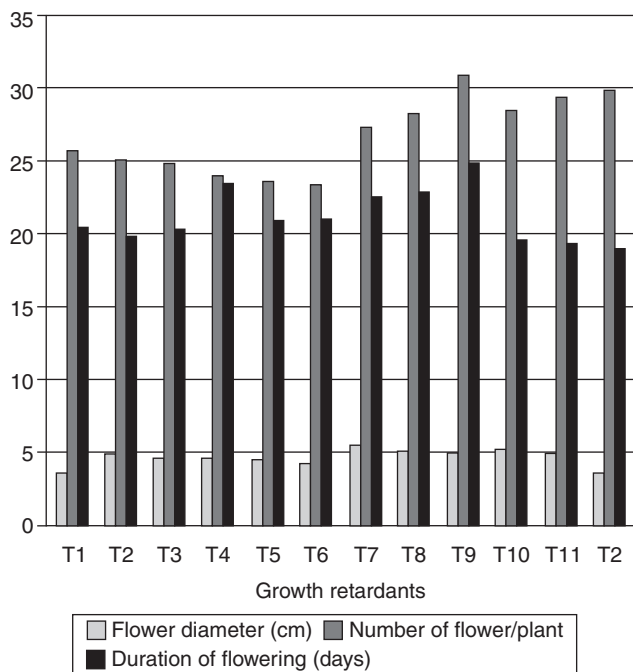


Fig 1 Effect of different growth retardants on flower diameter, number of flowers/plant and duration of flowering

of growth retardants on cell division and cell elongation of apical meristematic cells and also on the GA<sub>3</sub> bio-synthesis (Cathey 1964, 1965). Maximum plant spread (15.36 cm) was obtained in T<sub>9</sub> (Daminozide @ 1000 ppm) which was at par with T<sub>5</sub> (CCC @ 1250 ppm) and T<sub>12</sub> (Ethephon @ 1000 ppm), both these treatments were significantly higher than control (13.07 cm). The significant increase in plant spread is in close conformity with the findings of Karlovic *et al.* (2004).

Internodal length (3.20cm) was recorded minimum in T<sub>9</sub> (Daminozide @ 1000 ppm) while maximum (5.12 cm) was recorded in control. The significant reduction in internodal length is in close conformity with the findings of El-Sheibany *et al.* (2007). Application of triazole plant growth regulators commonly produces plants with darker green leaves than untreated plants and this greening effect of triazole is the result of increased chlorophyll concentration (Wang and Gregg 1994). Colour of leaves in all the treatments where CCC (cycocel), B-9 (daminozide) and ethephon were sprayed was darker green as compared to control. Maximum diameter of main stem at flowering (5.90 mm) was recorded in treatment comprising T<sub>9</sub> (daminozide@ 1000 ppm) followed by T<sub>8</sub> (daminozide @ 750 ppm) and T<sub>12</sub> (Ethephon @ 1000 ppm) while minimum (4.01 mm) was recorded in control. Maximum leaf area (2.66) was recorded in treatment comprising T<sub>9</sub> (daminozide@ 1000 ppm) while minimum (1.03) was recorded in control.

It was observed that days to bud appearance (80.56 days), days to colour break stage (103.66 days) and days to full bloom stage (123.56 days) were significant lower in T<sub>9</sub> (Daminozide @ 1000 ppm) followed by T<sub>8</sub> (Daminozide @ 750 ppm) and T<sub>7</sub> (Daminozide @ 500 ppm) while maximum in T<sub>12</sub> (Ethephon @ 1000 ppm).



Fig 2 Influence of daminozide @ 500, 750 and 1000 ppm (T<sub>7</sub>, T<sub>8</sub>, T<sub>9</sub>, respectively) on plant height at first bud appearance in comparison to control plant (T<sub>1</sub>)

The significant results were in close conformity with the findings of Asrar *et al.* (2014). Maximum flower diameter (5.69 cm) was recorded in T<sub>7</sub> (Daminozide @ 500 ppm) followed by T<sub>8</sub> (Daminozide @ 750 ppm) while minimum (3.76 cm) was recorded in control. By the applications of growth retardants, metabolic changes takes place in the cells. Metabolites are accumulated or conserved in the flowers as the flowers act as a reservoir for metabolites which resulted in increased flower size. Number of flowers/plant were obtained maximum (31.06) in T<sub>9</sub> (Daminozide @ 1000 ppm) followed by T<sub>12</sub> (Ethephon @ 1000 ppm) while minimum (23.50) was recorded in T<sub>6</sub> (CCC @ 1500 ppm). Duration of flowering were obtained maximum (25.06 days) in T<sub>9</sub> (Daminozide @ 1000 ppm) while minimum (19.16 days) in T<sub>12</sub> (Ethephon @ 1000 ppm). The decreased duration of flowering as in case of other retardants might be due to increased respiration which leads to senescence at higher concentration. So, it can be concluded that the best results were obtained when daminozide was used @ 1000 ppm. Thus, 1000 ppm of daminozide can be sprayed for commercial applications on chrysanthemum.

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