

## GROWTH AND SEED YIELD OF ANNUAL CHRYSANTHEMUM AS INFLUENCE BY PINCHING AND CYCOCEL

Shrutika Taksande<sup>1</sup>, V. U. Raut<sup>2</sup> and D. M. Panchbhai<sup>3</sup>

### ABSTRACT

A field experiment was conducted at Main garden, Department of Horticulture, Dr. PDKV, Akola to study the effect of pinching and cycocel on seed yield of annual chrysanthemum. Experiment comprising four levels of pinching i.e. no pinching, pinching at 15 DAT, pinching at 30 DAT and pinching at 45 DAT and four levels of cycocel i.e. 500 ppm, 1000 ppm, 1500 ppm and water spray (control) during *rabi* season of the year 2013-14 and 2014-15. Among the pinching treatments, significantly reduced plant height was recorded in pinching at 30 DAT where as pinching at 15 DAT was found to be best for improving other growth parameters viz., number of primary branches and stem diameter. Whereas, pinching at 15 DAT was found to be best for seeds flower<sup>-1</sup>, seed yield plant<sup>-1</sup>, seed yield plot<sup>-1</sup>, seed yield hectare<sup>-1</sup> and seed quality contributing character like test weight. In respect of foliar application of cycocel, reduced plant height was recorded @ cycocel 1500 ppm whereas, significantly more number of primary branches and stem diameter were recorded by the application of cycocel @ 1000 ppm. Significantly maximum seeds flower<sup>-1</sup>, seed yield plant<sup>-1</sup>, seed yield plot<sup>-1</sup>, seed yield hectare<sup>-1</sup> and test weight were recorded cycocel @ 1000 ppm.

(Key words: Pinching, cycocel, growth, seed yield, foliar application)

### INTRODUCTION

Annual Chrysanthemum or garland chrysanthemum, botanically known as *Chrysanthemum coronarium* (L.), is an annual under the chrysanthemum group of flowers. Annual chrysanthemum is a native of Mediterranean and Europe belongs to family Asteraceae. It is different from florist chrysanthemum in many aspects. The crop is relatively short durated and less photosensitive; thus capable of coming up throughout the year.

It is hardier, vigorous and grows taller. Its flowers are in various shades of yellow, white, having single or double forms is one of the popular and commercially important flower crops and occupies a prime position in the domestic and international market. It is a multipurpose flower, which is in a great demand as a cut flower, loose flower and for its use in making garland and flower decoration. The horticulture science is a much enriched with new tools and techniques during recent years. The research workers have reported that flowering of many crops could be improved and enhanced by application of suitable growth retardant such as cycocel and using agro techniques like pinching.

Pinching refers to removal of growing tips of the plants to induce the growth of vegetative laterals. Due to pinching, number of branches and flowering stem may increase in each plant and more yield of flower and seed unit<sup>-1</sup> area can be obtained. Cycocel is an important growth retardant useful in most of the plant. Growth retardants are

also useful to arrest vertical growth as it acts antagonistically to auxin and thus counteracts apical dominance and hence, it may be also useful in increasing number of branches plant<sup>-1</sup>. It is generally accepted that exogenously applied growth substances act through the alteration in the levels of naturally occurring hormones, thus, modifying the growth and development of the plant. Hence, the present study was undertaken to study the effect of pinching and cycocel on flowering and flower quality of annual chrysanthemum.

### MATERIALS AND METHODS

An investigation entitled, "Effect of pinching and foliar application of cycocel on seed yield of annual chrysanthemum" was conducted at Main garden, Department of Horticulture, Dr. PDKV, Akola during *rabi* season of the year 2013-14 and 2014-15. Experiment was laid out in factorial randomized block design with three replications and sixteen treatment combinations. Experiment comprising four levels of pinching i.e. P<sub>1</sub> - no pinching, P<sub>2</sub> - pinching at 15 DAT, P<sub>3</sub> - pinching at 30 DAT and P<sub>4</sub> - pinching at 45 DAT and four levels of cycocel i.e. T<sub>1</sub> - 500 ppm, T<sub>2</sub> - 1000 ppm, T<sub>3</sub> - 1500 ppm and T<sub>4</sub> - water spray (control). Seeds of annual chrysanthemum were sown in the nursery. Farm yard manure was applied at 20 t ha<sup>-1</sup>. A standard dose of NPK at the rate of 100 kg N, 50 kg P and 50 kg K hectare<sup>-1</sup> was applied. Full dose of P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O along with half dose of N was applied at the time of transplanting and remaining half dose of nitrogen was given at 30 DAT. The

1. Ph.D. Student, Horticulture Section, Dr. PDKV, Akola
2. Assoc. Professor, Horticulture Section, College of Agriculture, Nagpur
3. Professor and Head, Horticulture Section, College of Agriculture, Nagpur

uniform and healthy seedlings were selected for the transplanting and one day prior to transplanting irrigation was given to the prepared plot. Seedling transplanted by keeping 30 cm distances between plants and 30 cm between rows.

Regarding pinching treatment 4-5 cm terminal portion of growing tip was nipped out as per treatment time i. e. 15, 30 and 45 DAT. Application of cycocel was done at 40 DAT. Observations on growth parameters viz., height of plant, number of primary branches plant<sup>-1</sup>, stem diameter, seeds flower<sup>-1</sup>, seed yield plant<sup>-1</sup>, seed yield plot<sup>-1</sup>, seed yield hectare<sup>-1</sup>, test weight were recorded. The data were statistically analyzed as per method suggested by Gomez and Gomez (1984) for randomized block design.

## RESULTS AND DISCUSSION

The results obtained from present investigation are presented below on the basis of pooled mean of two years of experimentation (2013-2014 and 2014-2015).

### Effect of Pinching

#### Growth parameters

The growth parameters included height of plant, number of primary branches plant<sup>-1</sup>, stem diameter. The observations recorded on growth parameters are given in table 1. Significant differences were recorded among the treatments in respect of height of plant. Significantly minimum height of plant was recorded in pinching at 30 days after transplanting (76.33 cm) whereas, maximum height of plant was registered in control treatment i.e. no pinching (86.21 cm). Plant height was increased as pinching performed at early growth stages of plant. In pinching, removal of the apical growth or topmost of the shoots from plant which arrested the vertical growth of plant and reduced plant height. Shinde *et al.* (2010) observed that plant height of chrysanthemum cv. IIHR-6 was significantly reduced by different pinching treatments. However, more reduction of height was recorded under early pinching. Dorageerao *et al.* (2012) reported that pinching at 20 DAT recorded minimum plant height.

Significant differences were recorded among the treatments, in respect of number of primary branches plant<sup>-1</sup> and stem diameter. Significantly maximum number of primary branches plant<sup>-1</sup> and stem diameter was recorded in pinching at 15 days after transplanting (31.07), (2.807 cm) which were significantly superior over rest of the treatments whereas, minimum number of primary branches plant<sup>-1</sup> and stem diameter were registered in control treatment i.e. no pinching (26.88), (2.732 cm).

In pinching, the apical portion of main stem was removed and therefore, more side branches were formed below pinched portion because the growing tips are pinched out and assimilates are diverted into lateral buds and branching occurs. Maximum stem diameter of plant was due to the fact that, an early pinching reduced the plant height with corresponding increase in branches plant<sup>-1</sup>

tending to more plant spread and automatically accumulated the carbohydrates in branches resulted into thicker stem. Shivankar *et al.* (2014) conducted an experiment on annual chrysanthemum and reported that, maximum number of primary branches plant<sup>-1</sup>, stem diameter of plant, spread of plant at 50% flowering and fresh and dry weight of plant (biomass) were found maximum in early pinching at 30 days after transplanting under Nagpur conditions. Dorageerao *et al.* (2012) reported that pinching at 20 DAT recorded minimum plant height. Highest number of branches, leaf area plant<sup>-1</sup>, number of leaves favoured under early pinching.

### Seed yield parameters

The observations recorded on seed yield parameters are given in table 2. The data on pooled basis revealed that there were significant differences among the treatments in respect of seeds flower<sup>-1</sup>, seed yield plant<sup>-1</sup>, seed yield plot<sup>-1</sup>, seed yield hectare<sup>-1</sup> and test weight. In pinching maximum seeds flower<sup>-1</sup> (94.25 mg), seed yield plant<sup>-1</sup> (7.59 g), seed yield plot<sup>-1</sup> (131.54 g), seed yield hectare<sup>-1</sup> (4.86 q) and test weight (1.92 g) was recorded when pinching done at 15 days after transplanting. Whereas, minimum seeds flower<sup>-1</sup> (82.15mg), seed yield plant<sup>-1</sup> (6.13 g), seed yield plot<sup>-1</sup> (89.01 g), seed yield hectare<sup>-1</sup> (3.32 q), test weight (1.64 g) was registered in control treatment i.e. no pinching. Pinching treatment maintain more number of leaves unit<sup>-1</sup> of ground area for a longer duration and assimilated more dry matter during log phase of growth as well during partitioned a good position into reproductive part catching a better position to record significantly higher seed yield. Early pinching assimilated maximum dry matter in plants and putting up optimum vegetative growth without interrupting floral bud initiation and higher yield plant<sup>-1</sup>. Gyandev *et al.* (2006) found that, pinching at 25 DAT increased number of flower bearing branches and number of flowers plant<sup>-1</sup>, number of seeds flower<sup>-1</sup>, test weight and seed yield ha<sup>-1</sup> with better seed quality parameters in China aster. Dorageerao *et al.* (2012) observed maximum number of flowers plant<sup>-1</sup>, yield of flowers plot<sup>-1</sup>, seed yield plant<sup>-1</sup>, seed yield plot<sup>-1</sup> and 1000 seed weight when plant pinched at 20 DAS and 10 DAT in annual chrysanthemum.

### Effect of cycocel

#### Growth parameters

The observations recorded on growth parameters are given in table 1. The growth parameters included height of plant, number of primary branches plant<sup>-1</sup> and stem diameter. The observations recorded on growth parameters are given in table 1. The data revealed that significant differences were recorded among the treatments in respect of height of plant. Significantly minimum height of plant was recorded by the application of cycocel 1500 ppm (79.87 cm) and it was found at par with cycocel 1000 ppm (80.16 cm) whereas, maximum height of plant was registered in control (85.84 cm). Plant height was reduced as concentration of cycocel increased. The higher concentration of cycocel 1500 ppm recorded lowest height of plant at 90 days after transplanting. This was due to the fact that, cycocel acts as

Table 1. Growth parameters of annual chrysanthemum as influenced by pinching and cycocel

Treatments	Plant Height (cm)			Number of branches			Diameter of main stem (mm)		
	2013-2014	2014-2015	Pooled Mean	2013-2014	2014-2015	Pooled Mean	2013-2014	2014-2015	Pooled Mean
<b>Factor A. Pinching (P)</b>									
P <sub>1</sub> – No pinching	88.29	84.13	86.21	26.68	27.09	26.88	2.724	2.740	2.732
P <sub>2</sub> – 15 DAT	83.05	78.47	80.77	30.80	31.33	31.07	2.796	2.818	2.807
P <sub>3</sub> – 30 DAT	77.99	74.65	76.33	29.53	29.95	29.75	2.785	2.803	2.794
P <sub>4</sub> – 45 DAT	86.71	82.19	84.95	28.45	29.37	28.91	2.776	2.785	2.781
SE (m) ±	0.30	0.32	0.21	0.20	0.18	0.17	0.006	0.005	0.005
C D at 5 %	0.89	0.93	0.59	0.59	0.53	0.51	0.020	0.015	0.014
<b>Factor B. Cycocel (T)</b>									
T <sub>1</sub> – 500ppm	84.54	80.22	82.38	28.67	29.31	28.99	2.783	2.795	2.789
T <sub>2</sub> – 1000ppm	82.17	78.25	80.16	30.29	30.85	30.57	2.79	2.802	2.796
T <sub>3</sub> – 1500ppm	81.49	78.16	79.87	29.54	30.26	29.90	2.97	2.813	2.805
T <sub>4</sub> – Water spray	87.85	83.83	85.84	26.95	27.32	27.14	2.711	2.736	2.724
SE (m) ±	0.30	0.32	0.20	0.20	0.18	0.17	0.006	0.005	0.005
C D at 5 %	0.89	0.93	0.59	0.59	0.53	0.51	0.020	0.015	0.014
<b>C. Interaction (PxT)</b>									
SE(m) ±	1.94	1.87	1.69	0.41	0.37	1.13	0.013	0.013	0.029
C D at 5 %	--	--	--	--	--	--	--	--	--

**Table 2. Seed yield parameters of annual chrysanthemum as influenced by pinching and cycocel**

Treatments	Seeds flower <sup>-1</sup> (mg)			Seed yield plant <sup>-1</sup> (g)			Seed yield plot <sup>-1</sup> (g)			Seed yield ha <sup>-1</sup> (q)			Test weight (mg)		
	2013-2014	2014-2015	Pooled Mean	2013-2014	2014-2015	Pooled Mean	2013-2014	2014-2015	Pooled Mean	2013-2014	2014-2015	Pooled Mean	2013-2014	2014-2015	Pooled Mean
	2014	2015		2014	2015		2014	2015		2014	2015		2014	2015	
<b>Factor A. Pinching (P)</b>															
P <sub>1</sub> – No pinching	79.99	80.71	80.18	5.99	6.27	6.13	88.17	90.58	89.01	3.27	3.39	3.32	1.63	1.69	1.64
P <sub>2</sub> – 15 DAT	93.88	94.62	94.25	7.37	7.82	7.59	130.29	132.78	131.54	4.82	4.91	4.86	1.89	1.95	1.92
P <sub>3</sub> – 30 DAT	84.48	85.17	84.83	6.43	6.79	6.60	102.50	104.86	103.68	3.79	3.88	3.83	1.75	1.81	1.78
P <sub>4</sub> – 45 DAT	81.80	82.50	82.15	6.17	6.54	6.35	95.78	97.81	96.80	3.54	3.62	3.58	1.60	1.66	1.63
SE±(m)	0.70	0.70	0.72	0.04	0.05	0.04	1.35	1.37	1.37	0.05	0.05	0.05	0.02	0.03	0.03
C D at 5 %	2.03	2.04	2.08	0.04	0.05	0.04	3.91	3.97	3.98	0.15	0.15	0.15	0.08	0.08	0.08
<b>Factor B. Cycocel (T)</b>															
T <sub>1</sub> – 500 ppm	80.38	81.06	80.56	6.32	6.60	6.47	97.46	99.69	98.21	3.60	3.69	3.63	1.68	1.73	1.69
T <sub>2</sub> – 1000 ppm	95.88	96.58	96.23	7.08	7.49	7.28	121.53	123.66	122.60	4.49	4.57	4.53	1.89	1.96	1.93
T <sub>3</sub> – 1500 ppm	85.05	85.79	85.42	6.55	6.95	6.74	105.79	108.31	107.05	3.95	4.04	4.00	1.72	1.79	1.76
T <sub>4</sub> – Water spray	78.84	79.56	79.20	6.01	6.37	6.19	91.96	94.37	93.17	3.37	3.49	3.43	1.57	1.63	1.60
SE (m) ±	0.70	0.70	0.72	0.04	0.05	0.04	1.35	1.37	1.37	0.05	0.05	0.05	0.02	0.03	0.03
C D at 5 %	2.03	2.04	2.08	0.04	0.05	0.04	3.91	3.97	3.98	0.15	0.15	0.15	0.08	0.08	0.08
<b>C. Interaction (PxT)</b>															
SE(m) ±	1.41	1.41	1.44	0.48	0.47	0.47	2.71	2.75	2.75	0.11	0.10	0.10	0.05	0.05	0.06
C D at 5 %	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

a growth retardant. In cycocel treated plants, it might have reacted with gibberellic acid or IAA oxidase to lower down the level of diffusible auxin thereby suppressing the vegetative growth. Kadam *et al.* (2009) noticed that spraying of cycocel 1500 ppm resulted less height, less number of branches in China aster. Korde (2012) reported that foliar application of cycocel 1500 ppm recorded minimum plant height in annual chrysanthemum.

In respect of number of primary branches plant<sup>-1</sup>, significantly maximum number of primary branches plant<sup>-1</sup> was recorded in cycocel 1000 ppm (30.57). Whereas, minimum number of primary branches plant<sup>-1</sup> was registered in control treatment (27.14), it indicates that number of primary branches plant<sup>-1</sup> were reduced as concentration of cycocel was increased. This might be due to the fact that, cycocel act as a growth retardant. Cycocel arrest the vertical growth as it acts as antagonistic effect on auxin and thus counteracts apical dominance resulted into increased number of primary branches. In cycocel treated plants, suppression of apical dominance may be attributed to increase in number of primary branches plant<sup>-1</sup>. Sainath and Uppar (2009) observed that foliar application of cycocel at 1000 and uppar 1500 ppm decreased plant height and significantly increased number of leaves, number of branches as compared to control in chrysanthemum. Shivankar *et al.* (2014) observed increase in number of branches plant<sup>-1</sup> and plant spread at 1000 ppm cycocel in annual chrysanthemum.

The data revealed significant differences in respect of diameter of main stem. Significantly maximum diameter of main stem was recorded in cycocel @ 1500 ppm (2.805 cm) which was found at par with the treatment cycocel @ 1000 ppm (2.796 cm). Whereas, lowest diameter of main stem was recorded in control (2.724 cm). The higher concentration of cycocel @ 1500 ppm recorded maximum stem diameter of plant. The greater stem diameter in cycocel treatment was due to its effect in reducing the size of vessels and sieve tube and delayed lignifications led towards increase in stem thickness. Shivankar *et al.* (2014) observed that, foliar application of cycocel at 2000 ppm reduced plant height and increased stem diameter in annual chrysanthemum.

#### Seed yield parameters

The observations recorded on seed yield parameters are given in table 2. The data revealed that there were significant differences among the treatments in respect of seed yield flower<sup>-1</sup>, seed yield plant<sup>-1</sup>, seed yield plot<sup>-1</sup>, seed yield hectare<sup>-1</sup> and test weight. The maximum seeds flower<sup>-1</sup> (96.23 mg), seed yield plant<sup>-1</sup> (7.28 g), seed yield plot<sup>-1</sup> (122.60 g), seed yield hectare<sup>-1</sup> (4.53 q) and test weight (2.93 g) was recorded in cycocel sprayed @ 1000 ppm. Whereas, minimum seed yield flower<sup>-1</sup> (79.20 mg), seed yield plant<sup>-1</sup> (6.19 g), seed yield plot<sup>-1</sup> (93.17 g), seed yield hectare<sup>-1</sup> (3.43 q), test weight (2.61 g) was registered in

control. Different levels of cycocel increases the soluble carbohydrate accumulation and stream in phloem sap. It verified stem reservoir i. e. excess photoassimilation and its mobilization before seed filling period which have the preponderant role in seed yield. Growth retardant is capable of redistribution of dry matter in plant thereby bringing improvement in seed yield. Similarly foliar application of cycocel resulted into elevated food storage in stem which increases flower size and seed weight, ultimately it increases the seed yield. These might be the reasons for increase in seed yield in the present investigation. Naik *et al.* (2004) observed that, foliar application of cycocel at concentration of 1000 ppm increased the flower yield in African marigold. Sainath and Uppar (2009) observed that foliar application of 1000 ppm CCC increases number of laterals, number of leaves, leaf area plant<sup>-1</sup>, number of capitulum plant<sup>-1</sup>, 1000 seed weight and seed yield in annual chrysanthemum. Similarly same treatment reduced plant height.

## REFERENCES

- Dorajeerao, A.V.D., A.N. Mokashi, V.S. Patil, V.K. Venugopal and R.V. Koti, 2012. Growth analysis as influenced by pinching time in garland chrysanthemum (*Chrysanthemum coronarium* L.) Karnataka Global J. Bioscience and Biotechnology. **1** (2) : 242-247.
- Dorajeerao, A.V.D., A.N. Mokashi, V.S. Patil, V.K. Venugopal and R.V. Koti, 2012, Effect of foliar application of growth regulators on growth, yield and economics in garland chrysanthemum (*Chrysanthemum coronarium* L.) Karnataka J. Agric. Sci. **52**(3): 409-413.
- Gnyadev, B. and M.B. Kurdikeri, 2006. Effect of pinching, plant nutrients, growth retardant sprays on seed, yield, quality and storage studies in china aster (*Callistephus chinensis*) M.Sc. thesis (unpub.) submitted to UAS, Dharwad.
- Gomez, K.A. and A.A. Gomez, 1984. Statistical procedure for Agril Research, 2<sup>nd</sup> Edition Awiley-International Publication Singapore, pp.20-25.
- Korde, D. B. 2012. Effect of plant density and CCC on growth, yield and quality of annual chrysanthemum. M.Sc. Thesis (Unpub.) submitted to Dr. PDKV, Akola, (M. S.).
- Kadam, R.E., G. J. Bankar, A. M. Bhosale, N. G. Rathod and R. P. Dhenge, 2009. Effect of growth regulators on growth and flower of china aster (*Callistephus chinensis* L.) Ann. Plant Physiol. **16** (1):44-47..
- Naik, H. B., A. A. Patil, V. S. Patil, N. Basavaraj and M. Haremath, 2004. Effect of pinching and chemical on xanthophylls yield in African marigold (*Tagetes erecta*) J. Orna. Hort. **7**(314): 182-190.
- Sainath and D. S. Uppar, 2009. Influence of spacing, fertilizer and growth regulators on growth, seed yield and quality in annual Chrysanthemum M.Sc. thesis (unpub.) submitted to UAS, Dharwad.
- Shivankar Sushma, D. M. Panchbhai and Shalini Badge, 2014. Effect of pinching and cycocel on growth and flower yield of Annual chrysanthemum. J. Soils and Crops. **24** (2): 338-340.
- Shinde, K. H., N. S. Parekh, N. V. Upadhyay and H. C. Patel, 2010. Investigation of different GA<sub>3</sub> and pinching on growth, flowering and yield of chrysanthemum. (*Chrysanthemum morifolium* Ramat cv. IIHR-6 under middle Gujrat condition. Asian J. Hort. **5**(2):416-419.

**Rec. on 10.11.2016 & Acc. on 30.11.2016**