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DP Kedar
Ph.D., Scholar, Department of Floriculture and Landscape Architecture, Dr. Pdkv, Akola, Maharashtra, India

Dr. DM Panchbhai
Associate Dean, College of Agriculture, Nagpur, Maharashtra, India

DB Chatse
Ph.D. Scholar, Department of Floriculture and Landscape Architecture, Dr. PDKV, Akola, Maharashtra, India

Corresponding Author:
DP Kedar
Ph.D. Scholar, Department of Floriculture and Landscape Architecture, Dr. Pdkv, Akola, Maharashtra, India

Effect of different methods for increasing growth, flowering and yield of annual chrysanthemum

DP Kedar, Dr. DM Panchbhai and DB Chatse

1. Introduction

Improvement Chrysanthemum is a member of family *Asteraceae*. There are 160 species of chrysanthemum. Annual chrysanthemum is propagated through seeds. *Annual chrysanthemum* comprise of three species *viz*. *Chrysanthemum segtum* (Corn marigold), *Chrysanthemum carinatum* (tricoloured chrysanthemum) and *Chrysanthemum coronarium* (Crown daisy or garland chrysanthemum). The crown daisy or garland chrysanthemum is a native to southern Europe, is a branching, annual with a finely cut foliage reaching a height up to a meter, size of flower varies from 2.2 to 4 cm and colour is usually is shades yellow and white with cream zone at the centre. Among annual chrysanthemum (*Chrysanthemum coronarium*) has its own importance. It is one of the most important flower crop grown in India. Maharashtra is one of the leading states in flower production. It has a great demand during various functions, festivals, marriages for floral decorations in Maharashtra, Annual chrysanthemum is more popular among the farmers because of easy cultivation for cut as well as loose flowers. The growers get attracted towards annual chrysanthemum due to its short duration to produce marketable attractive yellow and white colour flowers with good keeping quality. In Vidarbha region, the demand of chrysanthemum flowers is for various purposes and increasing tremendously. Growers in this region facing problem in scientific cultivation of chrysanthemum due to lack of technical information and improved agro-technique like use growth regulator, fertilizer dose and different spacing etc.

2. Effect of pinching

Shivankar *et al.* (2010) [19] conducted an experiment on annual chrysanthemum and reported that, minimum plant height was noticed in double pinching done 30 and 45 days after transplanting. Whereas, maximum plant height was recorded in control treatment i.e. no pinching. Regarding the number of primary branches per plant, 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.

Dorajeerao *et al.* (2011) conducted an experiment which reveals that the highest crop growth rate, plant height (106.97cm), leaf area (1050.3cm2) during all growth stages was recorded by pinching at 20 days after transplanting, which was significantly superior at initial stage and at par during later growth stages when compared top inch in treatment, plant height (99.42 cm), leaf area (895.1cm2) at 10 days after transplanting in garland chrysanthemum (*Chrysanthemum coronarium* L.). Dorageerao and Mokashi (2012) observed that, number of flower per plant, yield of flower per plot, seed yield per plant, seed yield per plot, 1000 seed weight, germination percentage maximum when plant pinched at 20 DAS and 10 DAT in annual chrysanthemum.

Sharma *et al.* (2014) on the basis of present investigation, it may be concluded that, among triple pinching treatments 20, 30 and 40 DAT treatment resulted maximum number of flower per plant (145.03) whereas, maximum yield of flower per hectare (193.32 q/ha) was observed in double pinching 20 and 30 DAT treatment.

Badge *et al*. (2017) [1] were studied and, flower yield maximum was found to be maximum in pinching at 30 days after transplanting. Taksande *et al*. (2017) [21] were studied and found among the pinching treatment, significantly more days to first flower bud initiation, days to as recordedin treatment in pinching at 45 DAT.where as Pinching 15 DAT was found to be best for diameter of fully opened flower. And more length of flower stalk was found in no pinched. Hawa *et al*. (2018) [6] were studied and found and in single pinching at 30 days after

transplanting (227.62 and 210.69 g). Single pinching at 30 days after transplanting (8.18 and 7.56 kg) found superior.
Salve *et al*. (2018) were studied and found, plant pinched at 30 after planting was found to be best for improving vegetative growth parameters and flower yield.
Hawa *et al*. (2018) [6] studied and found that Single pinching at 30 days after transplanting improved weight of flower, diameter of fully opened flower, diameter of flower disc and longevity of intact flower, whereas more length of pedicel was registered in no pinching. Double pinching 30 and 45 days after transplanting registered more vase life
Thakre *et al*. (2020) [22] research was conducted and the results obtained the present investigation indicated that, the growth parameters in terms of height of plant was recorded maximum in no pinching, whereas, the maximum stem diameter, number of branches, spread of plant and leaf area were recorded with pinching at 20 DAT. As regards yield parameters, the As regards yield parameters, the maximum flower yield plant^{-1} and hectare^{-1} were recorded in pinching at 20 DAT.

3. Effect of growth retardant

Lokhande *et al*. (2008) reported that, the foliar application of CCC 1000ppm increase the number of branches, leaves, and weight of dry and green matter per plant and plant spread in annual chrysanthemum.
Shivankar *et al.* (2010) [19] observed that, foliar application of Cycocel at 2000 ppm reduced plant height and increased stem diameter, whereas increased in number of branches per plant and plant spread at 1000 ppm Cycocel in annual chrysanthemum.
Shivankar *et al*. (2010) [19] found that, maximum days to 50% flowering, days to first harvesting observed in CCC 2000 ppm compared to control. Whereas maximum duration of flowering was recorded in cycocel 1000 ppm in annual chrysanthemum.
Sainath *et al*. (2010) A field experiment was conducted and found Results revealed that spraying of Gibberellic acid @200 ppm induced early flowering followed by Gibberellic acid @ 100 ppm and similar trend was observed with tricontanol@ 1000 and 500 ppm. On the contrary, among the growth retardants, mepiquat chloride @ 1000 and 2000 ppm and cycocel@ 1000 and 2000 ppm delayed flowering as compared to the Gibberellic acid and tricontanol.
Korde *et al*. (2012) [12] noticed that, foliar application of Cycocel 1000 ppm recorded maximum flowering span in annual chrysanthemum and delay in first bud initiation, fully opened flower from bud initiation and 50% flowering.
Badge *et al*. (2017) [1] were studied and, flower yield maximum was found in foliar application of cycocel 1000 ppm.
Taksande *et al*. (2017) [21] were studied and found foliar application of cycocel @1500 ppm was recorded significantly more days to first flower bud initiation, opening of flower bud initiation, days 50% flowering period, significantly max. diameter of fully opened flower was recorded in 1000 ppm of cycocel and more length of flower stalk was found in control.
Jagdale *et al*. (2017) [8] observed that, maximum branches per plant (34.26), plant spread (46.76cm),stem diameter, maximum flowers per plant (106.0) were recorded treatment of cycocel at 2500ppm

4. Effect of Different spacing

Belgaonkar *et al*. (1997) [2] conducted an experiment on annual chrysanthemum and observed more diameter of flowers with 45 cm x 45 cm spacing as compared to 30 cm x 45 cm and 60 cm x 45 cm spacing
Sharma and Rawat (2007) observed (*Chrysanthemum coronarium* L.) cv. Marry Mix" The maximum number of flowers per plant (134.87) was recorded in (45 x 60 cm).
Sharma and Rawat (2007) studied (*Chrysanthemum coronarium* L.) cv. Marry Mix". 30 x 30 cm treatment gave the highest net returns (Rs. 163675.66 ha^{-1}) and B: C ratio (5.94:1).
Dorajeerao *et al.* (2012) [3] conducted to evaluate the effect of plant spacing on yield and quality of garland chrysanthemum, The flower weight was not as well as thousand seed weight increase with increasing level of spacing 30 x 30 to 60 x 60 but the difference were found to be statistically non significant.
Dorajeerao and Mokashi (2012) [3] conducted to evaluate of planting geometry on growth and yield of garland chrysanthemum, The flower yield per ha. was found to be highest at 30 x 30 level which is at par with 30 x 40 cm level in both kharif and rabi seson
Dorajeerao *et al.* (2013) [5] conducted to evaluate, the number of flower per plant was increasing as the plant were widely spaced, higher being recorded at S 60 x 60 level Maximum valuein respect of leaf area index, crop growth rate and net assimilation rate were recorded by closer spacing level of 30 x 30 cm. Plant spaced closely at 30 x30 cm recorded more plant height however, significantly lesser leaf area and above ground dry matter accumulation per plant compared to widely spaced plant at 60 x 60 cm.
Dorajeerao *et al.* (2013) [5] was conducted and found that the flower yield per ha was highest at 30 cm x 30 cm spacing level (S 30 x 30). The number of flowers per plant was increasing as the plants were widely spaced, highest being recorded at S60 x 60 level. The increase in mean flower weight was not significant, though it occurred in widely spaced plants. Quality parameters, *viz.* mean flower diameter, hundred flower weight as well as thousand seed weight increased with increasing levels of spacing from S 30 x 30 to S 60 x 60, but the differences were found to be statistically non-significant.
Sharma *et al.* (2014) conducted that, The experiment was conducted with Sixteen combination (Treatment) of Four levels of spacing i.e. 30x30 cm (S1), 30x45 cm (S2), 45x45 cm (S3) 45x60cm (S4) and On the basis of present investigation it may be concluded that, among spacing treatments the maximum number of flower per plant (134.87) was observed in 45 x 60 treatment while, maximum yield of flower per hectare (201.06 q/ha) was observed in 30 x 30 treatment.
Mali *et al.* (2016) [13] conducted a trial on planting Geometry (*Chrysanthemum coronarium* L.) The treatment 45 x 60 cm spacing recorded the maximum plant spread (2643.24 cm^2), number of primary branches per plant (41.90), number of leaves per plant, leaf width (3.85 cm),leaf lengh (6.34 cm) and duration of flowering (64.33 cm), while the treatment 30 x 30 cm had maximum plant height (92.58 cm).
Mali *et al.* (2016) [13] conducted a trial on planting Geometry (*Chrysanthemum coronarium* L.) the number of days taken for first flower bud initiation and 50 percent flowering with earliest first flower bud at (30 x 30 cm) spacing.
Mali *et al.* (2016) [13] conducted a trial on planting Geometry (*Chrysanthemum coronarium* L.) The treatment 45 x 60 cm

spacing recorded the treatment 30 x 30 cm had maximum flower yield per plot (11.85 kg) flower yield per ha (182.87q). Joshi *et al.* (2016) [10] observed the number of flower per plant, average wt. of flower and yield per plant was recorded in maximum in the spacing of 45 x 60 cm, but maximum yield per acre was recorded at the closest spacing of 30 x 30 cm which decresed with increase in spacing.

Joshi *et al.* (2016) [10] observed the minimum days to bud appearance, first flowering and 50% flowering were recorded in 45 x 60 cm spacing and the duration of flowering and size of flower was also recorded maximum in the of 45 x 60 cm

5. Effect of planting time

An experiment was conducted on *Chrysanthemum coronarium* in which planting was done on four dates from 10th September to 15th October and reported that maximum plant height (115.8 cm) and spread (76.8 cm) was observed in October plantings (Yang *et al*., 1989) [24]

Jane *et al*. (2001) [9] conducted a field experiment on annual chrysanthemum and reported that maximum plant height (110.20 cm) and spread (76.19 cm) was observed in the plants transplanted between 5th and 15th October.

A field experiment was conducted on *chrysanthemum coronarium* (Jane *et al*. 2001) [9] and revealed that minimum number of days were taken to bud appearance, first flowering and 50% flowering when the transplanting was done between 5th and 15th October.

Hawa *et al*. (2018) [7] studied and found that among different planting time maximum number of flowers per plant was recorded in 15th October planting (95.28 and 89.90). Regarding yield of flower per plant maximum flower yield was noticed in 15th October planting (208.87 and 195.73). Maximum flower yield per plot was recorded in 15th October planting (7.51and 7.04 kg) Maximum flower yield per hectare was recorded in 15th October planting (15.45 and 14.49 t)

Hawa *et al*. (2018) [7] studied and found that 15th October planting resulted in significantly maximum weight of flower, diameter of fully opened flower, diameter of flower disc, length of pedicel, longevity of intact flower and vase life.

6. Effect of Nitrogen

Satar *et al*. (2012) [16] suggested that an application of 200 kg N ha^{-1} significantly produced maximum weight of flower (2.30 g), flower yield plant^{-1} (247.67 g) and flower yield ha^{-1} (183.45 q) in annual chrysanthemum.

Satar *et al*. (2012) [16] nitrogen 200 kg ha^{-1} and phosphorus 100 kg ha^{-1} significantly increased plant height, number of primary branches, diameter of main stem, plant spread, and number of flower per plant per ha.

Teja *et al*. (2017) [23] revealed that Plant height, number of primary branches, number of secondary branches, plant spread and number of leaves of the plant were found significantly maximum with the application of nitrogen at the rate of 200 ha^{-1} in annual chrysanthemum.

Nikam *et al*. (2018) [14] was studied and the results revealed that plant height (112.95 cm and 110.54 cm respectively), stem diameter (2.65 cm and 2.55 cm respectively), number of branches (29.36 and 28.05 respectively), spread of plant (63.13 cm and 59.44 cm respectively) and leaf area (28.10 cm2 and 25.49 cm2 respectively) were recorded significantly maximum with the treatment individual application of 200 kg nitrogen and 75 kg K ha^{-1}. Yield contributing characters like number of flower plant^{-1} (113.26 and 107.43), number of seed flower^{-1} (211.41), seed yield flower^{-1} (30.55 g), plot^{-1} (624.97 g) and ha^{-1} (11.00 qt) were recorded significantly maximum with the treatment individual application of 200 kg nitrogen and 75 kg K ha^{-1}.

Thakre *et al*. (2020) [22] research was conducted and the results obtained in the present investigation indicated that, the growth parameters in terms of height of plant was recorded maximum in 150 kg N ha^{-1} As regards yield parameters, the maximum flower yield plant^{-1} and hectare^{-1} were recorded 150 kg N ha^{-1}.

7. Conclusion

1. Pinching one of the most important operation in annul Chrysanthemum Plant growth retardant are the synthetic compound, Pinching refers to the removal of the growing tip of the plant to induce growth of vegetative laterals. It reduces the plant height and promote axillary branching. In annual Chrysanthemum 30 DAT was found to be superior and best for number of primery branches per plot, stem diameter of plant, spread 50% flowering fresh dry wt. and maximum number of flower and max. yield of flower /ha. Maximum flower yield found in pinching 30 DAT. Pinching 30 DAT transplanting improve weight of flower diameter of flower disc and longevity of intact flower. Maximum yield of flower/ha. was observed in double pinching 20 and 30 DAT.
2. Plant growth retardant are the synthetic compound, which are used to reduce the shoot length of plant in desired way without changing developmental pattern and this is used primarily by reducing cell elongation but also by lowering the rate of cell division. Above the cited foliar application 1000 ppm @CCC are increases number of branches, and flower yield maximum in 1000 ppm and foliar application 2500 ppm @ CCC maximum branches/plant, plant spread, stem diameter and maximum flower/ plant.
3. Effect of spacing on growth and flowering of annual Chrysanthemum. spacing 30 x 30 cm is best for first flower bud initiation, maximum plant height, maximum yield / plot and flower yield / ha. And flower yield /acre and second 45 x 60 cm best for give maximum number of flower / plant, plant spread, increases number of primery branches/plant, leaves/plant, duration of flowering and yield/plant are maximum.
4. Planting time is important factor for growth of annual Chrysanthemum. Above the cited 15th Oct. Planting is best for maximum yield of flower/plant, flower yield / plot, flower yield /ha.
5. Nitrogen is very important and needed for plant growth. It is found healthy soils, and give plant the energy to grow and flowers. Nitrogen is part of the chlorophyll molecule, which gives plant their green colour and is involved in creating food for the plant through photosynthetic. Nitrogen 200 kg ha^{-1} is best for increased per plant, number of pri. Branches, diameter of main stem, plant spread and yield contributing character like number of flower/plant, number of seed /flower. Were significantly maximum with the treatment individual application of 200 kg and 150 kg Nitrogen /ha.

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