The Andhra Agric. J 62(4): 909-913, 2015

Flowering and Flower Characters in Garland Chrysanthemum (*Chrysanthemum coronarium* L.) as Influenced by Pinching Time

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ABSTRACT

Pinching at 20 DAS (nursery) recorded the maximum number of flowers per plant on par with pinching at 10 DAT. It was also superior in terms of weight of flowers per plot and number of seeds per flower. Pinching at 20 DAT significantly delayed flowering. This treatment increased the number of days taken for the appearance of first flower bud by 7 days compared to non-pinched plants and by 5 to 6 days compared to early pinched plants *i.e.* at 20 DAS and at 10 DAT. Quality parameters *viz.,* flower weight, flower diameter and 1000-seed weight was maximum in the treatments of pinching at 20 DAS and pinching at 10 DAT, which were at par.

Key words : Flower characters, Garland chrysanthemum, Pinching time and Quality.

Flowering is the most important development phase in any crop. Unfurling into this phase depends on attainment of a minimum level of vegetative growth or control of vegetative growth diverting assimilates into the flowers. Pinching is the act of cutting or nipping off the new growth on a plant in order to force branching so that the eventual number of flowers is increased. A plant generally grows straight up due to apical dominance. If the growing tips are pinched out, assimilates are diverted into lateral buds and branching occurs. Modification of plant architecture by means of pinching has been done in several commercial flower crops. However, such a study has not been conducted so far in garland chrysanthemum which is an annual species under chrysanthemum group of flowers. Since, time of pinching is the first aspect to be standardized with respect to this practice, an attempt has been made to evaluate the effect of pinching time on flowering and flower characters of the crop.

MATERIAL AND METHODS

The experiment comprised six treatments as listed below.

1. Pinching at 20 DAS (pinching in nursery) 4. Pinching at 30 DAT
2. Pinching at 10 DAT 5. Pinching at 40 DAT
3. Pinching at 20 DAT 6. No pinching (control)

The experiment was laid out in randomized block design with three replications. The gross plot size was 3.0 m x 2.1 m and the net plot size was 2.7 m x 1.8 m. The spacing adopted was 30 cm both between rows and plants within a row. A few seedlings from a part of nursery were pinched off the apical buds at 20 days after sowing. Pinching after planting was done at different stages as per the treatments by removing the apical bud along with the crown of juvenile leaves manually.

RESULTS AND DISCUSSION

Days taken for first flower bud appearance

The number of days taken for first flower bud appearance varied significantly among the different treatments during both the seasons (Table 1). The greatest delay in flower bud appearance was noticed in the treatment pinching at 20 DAT during *kharif* and *rabi* (29.50 days and 33.04 days) which was significantly late compared to the rest of the treatments. The number of days taken for first flower bud appearance by other times of pinching was on par with non-pinched control plots.

Days taken for 50 per cent flowering

There were significant differences with respect to number of days taken for 50% flowering among the treatments with various times of pinching during both the seasons (Table 1). The maximum delay in 50% flowering was noticed in the treatment

pinching at 20 DAT during *kharif* and *rabi* (38.35 and 39.65 days) which was significantly late compared to the remaining treatments. The number of days taken for 50% flowering by other times of pinching was on par with non-pinched control plots.

Number of flowers per plant

The number of flowers per plant exhibited significant differences among the different pinching times during both the seasons (Table 2). In *kharif,* pinching at 20 DAS recorded the highest number of flowers per plant (32.04) which was significantly superior to no pinching treatment (24.65) but on par with pinching at 10 DAT (30.71). A minimum of 20.24 flowers per plant was recorded by pinching at 40 DAT. In *rabi,* pinching at 20 DAS resulted in the maximum number of flowers per plant (42.80) significantly superior to non-pinched plants (34.48 flowers per plant) but on par with the plants pinched at 10 DAT (41.29 flowers per plant). Minimum number of flowers per plant was recorded by late pinching at 40 DAT (29.52).

Number of flowers per plot

Flower yield per plot exhibited significant differences among the different times of pinching both the seasons (Table 2). During *kharif,* pinching at 20 DAS recorded the highest number of flowers per plot (1537.9) which was significantly superior to no pinching treatment (1183.2) but on par with pinching at 10 DAT (1474.1). A minimum of 971.5 flowers per plant was recorded by pinching at 40 DAT. In *rabi,* pinching at 20 DAS resulted in the maximum number of flowers per plot (2054.4) significantly superior to non-pinched plants (1655.0 flowers per plot) but on par with the plants pinched at 10 DAT (1981.9 flowers per plot). Minimum number of flowers per plant was recorded by late pinching at 40 DAT (1417).

Flower yield per ha

The flower yield per ha exhibited significant differences among the various pinching times during both the seasons (Table 2). During *kharif,* pinching at 20 DAS recorded the highest weight of flowers per ha (6.51 t) which was on par with pinching at 10 DAT (6.13 t) whereas, a minimum flower yield of 2.88 t ha^{-1} was recorded by pinching at 40 DAT. In *rabi,* pinching at 20 DAS was the most productive with 9.61 t ha^{-1} flower yield which was on par with pinching at 10 DAT (9.19 t ha^{-1}) whereas, a minimum flower yield of 4.99 t ha^{-1} was recorded by late pinching at 40 DAT.

Seed yield per flower

The seed yield per flower exhibited significant differences among the pinching treatments during both the seasons. The maximum seed yield per flower (230.9 mg and 334.8 mg) was recorded by pinching at 20 DAS during *kharif* and *rabi* respectively and it was on par with pinching at 10 DAT which recorded seed yield per flower as 211.6 mg and 306.8 mg (Table 1). The seed yield per flower was minimum (153.1 mg and 222.0 mg) by pinching at 40 DAT.

Flower diameter

The flower diameter did not exhibit significant differences among the various pinching treatments during both the seasons (Table 3). During *kharif,* pinching at 20 DAS recorded the highest size of flowers having a diameter of 4.91 cm whereas, a minimum flower diameter of 3.45 cm was recorded by late pinching at 40 DAT. During *rabi,* pinching at 20 DAS produced the largest flowers with 5.16 cm diameter while minimum diameter of flowers (3.83 cm) was recorded by pinching at 40 DAT.

Hundred flower weight

Significant differences were recorded in hundred flower weights among the different pinching treatments during both the seasons (Table 3). During *kharif,* the heavier flowers were obtained by the nursery pinched (20 DAS) flowers with a hundred flower weight of 205.69 g, which was significantly superior to pinching at 30 DAT (165.69 g) whereas minimum value of hundred flower weight (143.76 g) was recorded by pinching at 40 DAT. During *rabi* the highest value of hundred flower weight (227.47 g) was recorded by the plants pinched at 20 DAS, significantly superior to pinching at 30 DAT (193.33 g) whereas minimum value of hundred flower weight (171.28 g) was recorded by pinching at 40 DAT.

Thousand seed weight

Table 1. Days taken for first flower bud appearance and days taken for 50% flowering as influenced by pinching time in garland chrysanthemum during *kharif* and *rabi.*

Treatment	Days taken for first flower bud appearance		Days taken for 50% flowering	
	Kharif	*Rabi*	*Kharif*	*Rabi*
Pinching at 20 DAS	23.58	26.41	30.65	33.01
Pinching at 10 DAT	24.56	27.51	31.93	33.56
Pinching at 20 DAT	29.50	33.04	38.35	39.65
Pinching at 30 DAT	23.50	26.32	30.55	32.58
Pinching at 40 DAT	22.50	25.20	29.25	32.24
No pinching	22.05	24.70	28.67	29.64
Mean	24.28	27.20	31.57	33.45
S Em	1.08	1.01	1.46	0.98
CD at 5%	3.24	3.03	4.39	2.93

Table 2. Flower yield parameters as influenced by pinching time in garland chrysanthemum during *kharif* and *rabi*.

Treatment	Number of flowers per plant			Flower yield per hectare (tonnes)			Seed yield per flower (mg)		
	Kharif	*Rabi*	Mean	*Kharif*	*Rabi*	Mean	*Kharif*	*Rabi*	Mean
Pinching at 20 DAS	32.0	42.8	37.4	6.51	9.61	8.06	230.9	334.8	282.8
Pinching at 10 DAT	30.7	41.3	36.0	6.13	9.19	7.66	211.6	306.8	259.2
Pinching at 20 DAT	22.8	32.4	27.6	3.91	6.44	5.18	175.6	254.6	215.1
Pinching at 30 DAT	20.6	29.9	25.2	3.37	5.71	4.54	165.4	239.9	202.7
Pinching at 40 DAT	20.2	29.5	24.9	2.88	4.99	3.94	153.1	222.0	187.5
No pinching	24.7	34.5	29.6	4.09	6.26	5.18	192.5	279.1	235.8
Mean	25.2	35.1	30.1	4.48	7.03	5.76	188.2	272.9	230.5
S Em	1.45	1.63	1.54	0.26	0.32	0.29	8.37	12.14	10.26
CD at 5%	4.24	4.77	4.505	0.75	0.94	0.845	24.44	35.44	29.94

Table 3. Flower and seed quality parameters as influenced by pinching time in garland chrysanthemum during *kharif* and *rabi*.

Treatment	Flower diameter (cm)		Hundred flower weight (g)		Thousand seed weight (g)	
	Kharif	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*
Pinching at 20 DAS	4.91	5.16	205.69	227.47	1.78	1.99
Pinching at 10 DAT	4.57	4.81	202.23	225.33	1.77	1.98
Pinching at 20 DAT	3.98	4.18	173.48	201.22	1.59	1.78
Pinching at 30 DAT	3.75	3.94	165.69	193.33	1.55	1.74
Pinching at 40 DAT	3.45	3.83	143.76	171.28	1.48	1.66
No pinching	4.42	4.65	168.21	183.79	1.73	1.94
Mean	4.18	4.24	176.51	200.40	1.65	1.85
S Em	0.49	0.45	12.42	11.10	0.04	0.04
CD at 5%	NS	NS	36.26	32.38	0.11	0.12

The differences recorded in thousand seed weights among the different pinching treatments were found significant during both the seasons. The maximum thousand seed weight (1.78 g and 1.99 g) was recorded by pinching at 20 DAS which was on par with no pinching (1.73 g and 1.94 g) and pinching at 10 DAT (1.77 g and 1.98 g) during *kharif* and *rabi* seasons respectively. Pinching at 40 DAT recorded the lowest value of thousand seed weight (1.48 g and 1.66 g) during both the seasons (Table 3).

Effect of season

It is interesting to note that the flower production was more in *rabi* than *kharif* irrespective of treatment. When compared to *kharif,* the crop during *rabi*, the duration was extended by 20 days giving additional flower pickings. The data on quality parameters indicated that *rabi* flowers were more qualitative *i.e.* heavier, larger and shelf life was longer. These differences may be due to the meterological variables like radiation, low temperature, relative humidity, rainy days are more favourable to garland chrysanthemum in *rabi* than *kharif.*

The highest yield in terms of number of flowers per plant was recorded by pinching at 20 days after sowing (nursery) which was on par with those plants pinched at 10 days after transplanting. Pinching at 20 DAT registered a performance at par with non-pinched plants. Delay in pinching beyond 20 DAT, decreased the number of flowers per plant compared to non-pinched plants. Similar trend was also recorded in the weight of flowers per unit area, since the plant population is kept constant in all the treatments. Pinching in nursery increased the number of flowers per plant in china aster (Malleshappa, 1984) and in marigold (Basavaraj, 1984). Significant differences in number of flowers per plant due to time of pinching in chrysanthemum were also observed by Singh and Baboo (2003) and Beniwal *et al.* (2005). The enhanced yield due to pinching was attributed to increased number of branches per plant that could increase flowering points in china aster (Malleshappa, 1984). Arora and Khanna (1986) and Sehrawat *et al.* (2003) also observed more number of branches associated with more number of flowers per plant in marigold. Similar to the number of flowers per plant, the highest seed yield per plant was recorded by pinching in nursery at 20 DAS, which was at par with pinching at 10 DAT, indicating the dependence of seed yield on flower yield.

Pinching at 20 DAT was on par with non-pinched plants with regard to seed yield per flower, other treatments being significantly inferior in seed count per flower. Bhat and Shepherd (2007) and Sunitha *et al.* (2007) observed significant differences in seed yield due to pinching in marigold, which were attributed to growth and flowering characters. The superiority of early pinching treatments in garland chrysanthemum can be attributed to the efficient photosynthetic area, better assimilation into reproductive parts and putting up optimum vegetative growth without interrupting floral bud initiation. This will be clearer upon examining the data on various growth and quality parameters.

Pinching at 20 DAT significantly delayed flowering. This treatment increased the number of days taken for the appearance of first flower bud by 7 days compared to non-pinched plants and by 5 to 6 days compared to early pinched plants *i.e.* at 20 DAS and at 10 DAT. This indicated that the effort to suppress the apical dominance by means of pinching had a delaying effect on flower initiation. When non-pinched plants were able to initiate flower buds as early as 22 days after transplanting, early pinched plants up to 10 DAT showed a meager delay of only 2 to 3 days on account of a quick restructuring of their architecture. Whereas, pinching at 20 DAT suppressed the plant height, number of branches, leaf area as well as dry matter assimilation to a substantial extent so that such plants needed a longer time in restructuring themselves and to maintain a reasonable growth rate at least on par with non-pinched plants. Finally such plants beared a significantly lesser number of flowers compared to early pinched plants. However, pinching at 20 DAT is found to be useful in delaying the initiation of flowering by seven days without significant difference in the number of flowers per plant compared to non-pinched plants. Later pinching performed after the initiation of flowering resulted in significant reduction in the number of flowers per plant on account of diverting the assimilates into vegetative parts, which would have otherwise sinked into reproductive parts. Srivastava *et al.* (2005) and Sehrawat *et al.* (2003)

also observed significant differences in the time taken for flower initiation due to pinching in marigold.

Flower quality in terms of mean flower weight and flower diameter, and seed quality in terms of 1000-seed weight was maximum in the treatments of pinching at 20 DAS and pinching at 10 DAT, which were at par. Pinching at 20 DAT resulted in the production of flowers and seeds having a quality on par with non-pinched plants. Since the number of flowers has been increased by this treatment without significant increase in dry matter accumulation into flower, significant increase in size or weight of individual flowers or seeds might be unlikely. However, the differences are not statistically significant among the plants pinched later.

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(Received on 30.11.2013 and revised on 29.10.2014)