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

A V D Dorajeerao, M Sattiraju and A N Mokashi
Department of Horticulture, Horticultural College and Research Institute, V.R.Gudem, W.G Dist. Dr. Y.S.R. Horticultural University-534 101, A.P

ABSTRACT

Flowering delayed significantly by increasing the spacing level from $S_{30 \times 30}$ to $S_{60 \times 60}$. The flower yield per ha was found to be highest at $S_{30 \times 30}$ level which is at par with $S_{30 \times 40}$ level in both *kharif* and *rabi* seasons. The number of flowers per plant was increasing as the plants were widely spaced, highest being recorded at $S_{60 \times 60}$ level. The increase in mean flower weight was not significant, though it was observed 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 $S_{30 \times 30}$ to $S_{60 \times 60}$, but the differences were found to be statistically non-significant.

Key words : Flower yield, Garland chrysanthemum, Planting geometry and Quality.

Search for new species is increasing in floriculture, which has emerged as a field of great commercial importance both nationally and internationally. In India, there is a total of 1,60,720 ha under commercial floriculture with a loose flower production of 8,70,000 tonnes during the year 2007-2008 (Mistry *et al.,* 2008). There was a 230 per cent increase in loose flower and 480 per cent increase in total flower production between the years 1993-94 and 2001-02 (Singh and Upadhyaya, 2007). Garland chrysanthemum, botanically known as *Chrysanthemum coronarium* L., is an annual under the chrysanthemum group of flowers. It is more hardy, vigorous and grows taller. Its flowers are in various shades of yellow, white, having single or double forms (Desai, 1962). They are hermaphrodite. The plant is self-fertile and seed propagated. In India, the crop has been naturalized and locally called 'Bijli' in Nagpur (Meshram *et al.,* 2008), 'Baboona' in Haryana (Mishra *et al.,* 2002) 'Guldhak' in Punjab, 'Market' in Delhi and 'Gendi' in Uttar Pradesh area (Arora, 1990).

In the present investigation an attempt was made to increase the productivity of garland chrysanthemum by manipulating plant population per unit area. The results on various aspects and their impact on growth, yield and quality of garland chrysanthemum are presented in this paper.

MATERIAL AND METHODS

The present study was carried out at Floriculture unit of Main Agricultural Research Station, Department of Horticulture, University of Agricultural Sciences, Dharwad, during the years 2007-2009. The objective of study was to evaluate the effect of planting geometry on growth parameters of garland chrysanthemum (*C. coronarium* L.). The experiment was conducted with five treatments corresponding to different populations as mentioned below.

Treatment	Planting geometry	Population per plot	Population per ha
$S_{30 \times 30}$	30 cm x 30 cm	120	111111
$S_{40 \times 30}$	40 cm x 30 cm	90	83333
$S_{45 \times 45}$	45 cm x 45 cm	45	49383
$S_{60 \times 45}$	60 cm x 45 cm	35	37037
$S_{60 \times 60}$	60 cm x 60 cm	30	27778

The experiment was laid out in randomized block design with four replications, having a gross plot size of 3.9 m x 3.3 m which allowed a net plot size of 3.6 m x 3.0 m. Healthy seedlings were transplanted in these plots at 30 days age. Growth parameters, *viz.* plant height, plant spread, number

of leaves per plant, number of branches per plant, dry matter production, leaf area per plant were recorded at 20 days interval starting from 25th day after transplanting (DAT). A total of three observations at 25, 45 and 65 DAT were recorded during *kharif* whereas, during *rabi* the prolonged life span allowed four observations at 25, 45, 65 and 85 DAT. The data recorded on each character were analyzed by the ANOVA technique as described by Panse and Sukhatme (1967). The treatment means were compared using the critical difference values calculated at 5 per cent level of significance.

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 levels of planting geometry during both the seasons(Table 1). In *kharif,* $S_{30 \times 30}$ level took the least number of days for first flower bud appearance (21.59) which was significantly earlier to $S_{45 \times 45}$ (23.58 days) whereas, maximum number of days (24.74) was taken by $S_{60 \times 60}$. In *rabi,* $S_{30 \times 30}$ level was the earliest for first flower bud appearance (26.99 days) which was followed by $S_{45 \times 45}$ (29.48 days) whereas, maximum number of days (30.93) for first flower bud appearance was taken by $S_{60 \times 60}$.

Days taken for 50 per cent flowering

There were significant differences with respect to number of days taken for 50% flowering among the different levels of planting geometry during both the seasons (Table 1). In *kharif,* the treatment $S_{30 \times 30}$ took the least number of days for 50% flowering (28.07) which was significantly earlier to $S_{45 \times 45}$ (30.32 days) whereas, maximum (32.16) days for 50% flowering was recorded by $S_{60 \times 60}$. In *rabi,* $S_{30 \times 30}$ level was the earliest for 50% flowering (35.08 days) which was followed by $S_{45 \times 45}$ (38.32 days) whereas, maximum number of days (40.20) for 50% flowering was recorded by $S_{60 \times 60}$.

Number of flowers per plant

The number of flowers per plant exhibited significant differences among the different levels of planting geometry during both the seasons (Table 2). In *kharif,* $S_{60 \times 60}$ level recorded the highest number of flowers per plant (58.59) which was significantly superior to closer levels $S_{45 \times 45}$ (47.18) whereas, a minimum of 34.65 flowers per plant was recorded by $S_{30 \times 30}$. In *rabi,* $S_{60 \times 60}$ level had the most productive plants with 71.66 flowers per plant on par with closer levels of $S_{60 \times 45}$ and $S_{45 \times 45}$ (65.65 and 58.82 flowers per plant) but significantly superior to $S_{40 \times 30}$ (49.74).

Flower yield per ha

The flower yield per ha exhibited significant differences among the different levels of planting geometry during both the seasons (Table 2). During *kharif,* $S_{30 \times 30}$ level recorded the highest weight of flowers per ha (6.50 t) which was significantly superior to wider levels $S_{45 \times 45}$ (4.84 t) whereas, a minimum flower yield of 4.79 t ha^{-1} was recorded by $S_{60 \times 60}$. In *rabi,* $S_{30 \times 30}$ level was the most productive with 10.32 t ha^{-1} flower yield which was on par with $S_{40 \times 30}$ (9.16 t ha^{-1}) but significantly superior to $S_{45 \times 45}$ (8.00 t ha^{-1}) while minimum weight of flowers (7.92 t ha^{-1}) was recorded by $S_{60 \times 60}$.

Seed yield per flower

The seed yield per flower did not exhibit significant differences among the different levels of planting geometry levels during both the seasons (Table 3). However, the maximum numerical value of mean seed yield of 227.3 mg and 329.5 mg per flower was recorded by the plant spacing of 60 x 45 cm during *kharif* and *rabi* seasons, respectively.

Quality parameters

The results on flower and seed quality parameters *i.e.* flower diameter, hundred flower weight and thousand seed weight are tabulated in table 3.

Flower diameter

During *kharif* and *rabi* seasons, the largest flowers were obtained by the treatments $S_{60 \times 45}$ with a flower diameter of 5.39 cm and 6.04 cm respectively (Table 3). However, the differences in the flower diameter recorded by various levels of planting geometry were not significant.

Hundred flower weight

Significant differences were recorded in hundred flower weights among the different levels of planting geometry during both the seasons

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

Treatment	Days taken for first flower bud appearance		Days taken for 50% flowering	
	Kharif	*Rabi*	*Kharif*	*Rabi*
30 x 30 cm	21.59	26.99	28.07	35.08
40 x 30 cm	22.91	28.64	29.78	37.23
45 x 45 cm	23.58	29.48	30.65	38.32
60 x 45 cm	23.68	29.60	30.78	38.48
60 x 60 cm	24.74	30.93	32.16	40.20
Mean	23.30	29.13	30.29	37.86
S Em	0.5795	0.7243	0.7533	0.9416
CD at 5%	1.7373	2.1716	2.2584	2.8230

Table 2. Flower yield parameters as influenced by planting geometry 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
30 x 30 cm	34.65	44.73	39.7	6.50	10.32	8.41	224.7	325.8	275.3
40 x 30 cm	39.11	49.74	44.4	5.67	9.16	7.42	211.7	306.9	259.3
45 x 45 cm	47.18	58.82	53.0	4.84	8.00	6.42	218.8	317.3	268.1
60 x 45 cm	53.25	65.65	59.5	4.83	7.98	6.41	227.3	329.5	278.4
60 x 60 cm	58.59	71.66	65.1	4.79	7.92	6.36	213.1	309.0	261.1
Mean	46.56	58.12	52.3	5.33	8.68	7.01	219.1	317.7	268.4
S Em	4.92	5.53	5.23	0.36	0.51	0.44	5.98	8.67	7.33
CD at 5%	14.36	16.15	15.26	1.06	1.48	1.27	NS	NS	NS

Table 3. Flower and seed quality parameters as influenced by planting geometry 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*
30 x 30 cm	4.39	4.92	228.58	248.56	1.78	1.82
40 x 30 cm	4.70	5.26	231.56	252.23	1.70	1.86
45 x 45 cm	4.84	5.42	238.56	259.25	1.80	1.89
60 x 45 cm	5.39	6.04	245.56	266.52	1.85	1.92
60 x 60 cm	5.29	5.92	254.25	276.58	1.88	1.95
Mean	4.92	5.51	239.70	260.63	1.80	1.89
S Em	0.42	0.47	6.67	7.83	0.06	0.05
CD at 5%	NS	NS	19.53	22.86	NS	NS

(Table 3). During *kharif,* the heavier flowers were obtained by the treatments $S_{60 \times 60}$ with a hundred flower weight of 254.25 g, which was on par with closer planting geometry levels up to $S_{60 \times 45}$ (245.56 g) followed by $S_{45 \times 45}$ (238.56 g). During *rabi* the highest value of hundred flower weight (276.58 g) was recorded by the treatment $S_{60 \times 60}$ on par with closer geometry levels up to $S_{60 \times 45}$ (245.56 g) followed by $S_{45 \times 45}$ (254.25 g).

Thousand seed weight

The differences recorded in thousand seed weights among the different levels of planting geometry were not significant during both the seasons (Table 3). However, maximum numerical value of 1.88 g and 1.95 g was recorded by the treatment $S_{60 \times 60}$ during *kharif* and *rabi,* respectively.

The number of days taken to first flower bud appearance and days taken to fifty per cent flowering was also significantly varying among different spacing levels (Table 1). Flowering delayed significantly by increasing the spacing level from $S_{30 \times 30}$ to $S_{60 \times 60}$. Plants, spaced widely, remained in vegetative phase on account of lesser competition from the adjacent plants for space and light, thus delaying flowering. The number of days taken to first flower bud appearance increased with increase in spacing also in marigold (Dongre, 1984 and Jaswinder Singh and Arora, 1990).

The flower yield per ha was found to be highest at $S_{30 \times 30}$ level which is at par with $S_{40 \times 30}$ level in both *kharif* and *rabi* seasons (Table 2). Flower yield in terms of number of flowers per plot also showed the same trend. With wider spacing levels, such yield parameters were found to decrease significantly. The higher yield in terms of flowers as well as seeds per unit area can be attributed to the higher population per unit area with closer spacing levels. Arora and Saini (1976) and Narayanagowda (1985) found that the flower production increases with the increase in plant density per square meter in case of china aster. Plants at high density might have fully exploited space, efficiently utilized the available resources as expressed by Rajanna (2001), Vijayakumar *et al.* (1988) in china aster and Venugopal (1991) in helichrysum.

However, the number of flowers per plant was increasing as the plants were spaced widely. The increase was non- significant from $S_{30 \times 30}$ to $S_{45 \times 45}$ levels. The highest number of flowers per plant is recorded at $S_{60 \times 60}$ level, which was significantly superior to plant spacing levels from $S_{30 \times 30}$ to $S_{45 \times 45}$. On the other hand the increase in mean flower weight was not significant, though it had increased in widely spaced plants (Table 3). The individual plant yield was more at wider spacings, but the loss in yield due to lower plant populations had not been compensated. Similar observations were also recorded by Jaswinder Singh and Arora (1990) in marigold, Vijayakumar *et al.* (1988) in china aster. The enhanced production in widely spaced plants was attributed to increase number of branches, number of leaves, leaf area and total dry matter production per plant (Rajanna, 2001).

Effect of season

Garland chrysanthemum was more productive in *rabi* season compared to *kharif.* As evident from the data on plant height, number of branches, leaves and leaf area per plant, there was progress in crop growth beyond 65 DAT during *rabi* whereas, during *kharif* the crop was flowering only up to 65 DAT. Thus, the crop duration was extended by 20 days giving additional flower pickings during *rabi.* It can be inferred that garland chrysanthemum is more suitable to *rabi* season under Dharwad conditions, though it can be taken up during *kharif* also.

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