Original research article

Performance of South Indian Chrysanthemum (*Dendranthema grandiflora* T.) Varieties Under High-Density Planting in Prayagraj Climatic Conditions

ABSTRACT

A field experiment was conducted to evaluate the response of south Indian chrysanthemum (*Dendranthema grandiflora* T.) varieties under high-density planting in Prayagraj climatic conditions at the Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology And Sciences, Prayagraj, during the month of October, 2022 to January, 2023. The experiment was laid out in Factorial Randomized Block Design (FRBD) comparing two factors with twelve treatment combinations and three replications. Significant improvement in growth and flowering characters was recorded in T_8-variety V_2(Poornima White) with spacing S_4 (30 cm x 10 cm), (47.5 cm) was found to be tallest in plant height, T_5-variety V_2(Poornima White) with spacing S_1 (30 cm x 30 cm) recorded wider in plant spread (42.6 cm^2), more the number of primary branches (15.7), greater the number of flowers per plant (23.9), bigger size of flower diameter (7.6 cm) and more number of days shelf life of the flower (8.5), T_{12}-variety V_3 (Belgium pink) with spacing S_4 (30 cm x 10 cm) found best in parameters i.e., less number of days taken to first bud initiation (43 days), and days taken to 50 percent flowering (73 days).

Keywords: *Belgium Pink, Chrysanthemum, Iceberg, Poornima White, Spacing, Varieties.*

1. INTRODUCTION

"Chrysanthemum is commonly known as Guldaudi, Autumn Queen, or Queen of the East" (Koley and Sarkar, 2013). "It belongs to the family Asteraceae and is native to Northern Hemisphere chiefly Europe and Asia. It has a diverse and beautiful range of color shades, shapes, and sizes. India's total area under floriculture crops is 324.00 thousand hectares with an approximate production of 1962.00 thousand MT of loose flowers and 823.00 thousand MT of cut flowers" (Anonymous. 2018). Its commercial cultivation is being done in states *viz.*, Maharashtra, Rajasthan, Madhya Pradesh, and Bihar and in places *viz*., Delhi, Kolkata, Lucknow, Kanpur, and Allahabad mainly for the sake of decoration and participating in flower shows, with the help of pot grown plants.

“In India, chrysanthemum occupies a place of pride both as a commercial crop and as a popular exhibition flower. The erect and tall growing cultivars are suitable for background planting in borders. The cultivars with the dwarf and compact growing habit, on the other hand, are suitable for a front-row plantation or pot culture” (Uddin *et al.*, 2015). “The decorative and fluffy bloomed small flowered cultivars are ideal for garland making and hair decoration. The extra-large bloomed cultivars are used for exhibition value. Loose flowers are used for garlands, venis, worship, etc. Long-stem or cut flowers are used for bouquets, vases, etc”. (Prakash *et al.*, 2018). “In North India, various hues of red, yellow, white, and purple chrysanthemums are abundant for decorating the landscape in the ground or pots. But, in South India, mostly yellow-colored flowers are preferred and grown as loose flowers for trade” (Thakur *et al*., 2018).

“Since the ultimate aim of any crop is productivity and good quality produce different agro-techniques are followed. Also among different crop management practices, planting density influences plant growth to a major extent. Optimum spacing plays a significant role to increase the higher production of flowers and flower yield” (Aashutosh *et al.*, 2019). Mainly it affects flower numbers by modifying the microclimate of the plants, exerting a considerable influence on the performance of the crop by creating competition between plants for nutrients, water, and light. This makes it necessary to study optimum spacing for maximization of the production of quality flowers.

2. MATERIALS AND METHODS

This experiment was laid out at the Horticulture Research field, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology And Sciences, Prayagraj (U.P.) during 2022-23. The research field lies between the parallels of 24º 77” and 25^0 47” North latitudes and 81^0 19” and 82^0 21” East longitudes. The experiment was laid out in a Factorial Randomized Block Design (FRBD) consisting of twelve treatments and replicated thrice. Factor A consist of three varieties of chrysanthemum i.e., (Iceberg, Poornima White, Belgium Pink). Factor B consists of four spacings i.e., (30 cm x 30 cm, 30 cm x 20 cm, 30 cm x 15 cm, and 30 cm x 10 cm). Varieties are procured from K.S.R farms, Chittor district, AP at the 3-4 leaf stage of the plant. To identify suitable variety and planting density of chrysanthemums for improved growth, and flower quality. The data recorded during the experiment were subjected to statistical analysis by using analysis of

variance (ANOVA). The significant difference among the varieties was compared against the critical difference at a 5% level of significance ($CD_{0.05}$).

Treatment combination

NOTATION	TREATMENT DETAILS
T_1	V_1S_1 (Iceberg + 30 cm x 30 cm)
T_2	V_1S_2 (Iceberg + 30 cm x 20 cm)
T_3	V_1S_3 (Iceberg + 30 cm x 15 cm)
T_4	V_1S_4 (Iceberg + 30 cm x 10 cm)
T_5	V_2S_1 (Poornima White + 30 cm x 30 cm)
T_6	V_2S_2 (Poornima White + 30 cm x 20 cm)
T_7	V_2S_3 (Poornima White + 30 cm x 15 cm)
T_8	V_2S_4 (Poornima White + 30 cm x 10 cm)
T_9	V_3S_1 (Belgium Pink + 30 cm x 30 cm)
T_{10}	V_3S_2 (Belgium Pink + 30 cm x 20 cm)
T_{11}	V_3S_3 (Belgium Pink + 30 cm x 15 cm)
T_{12}	V_3S_4 (Belgium Pink + 30 cm x 10 cm)

3. RESULTS AND DISCUSSION

3.1 Vegetative parameters

Plant height – A significant difference was observed among all the treatments taller plant height was recorded in (T_8 –V_2S_4, 47.5 cm) followed by (T_7 – V_2S_3, 43.3 cm) and shorter plant height was recorded in (T_9 –V_3S_1, 21.2 cm). At closer spacing taller plants might be due to heavy competition between plants for light resulting in elongation of the main stem and tend to grow vertically when they are crowded owing to the shadowing effect of the plants on one another. However, the extent of this elongation of the cells in the meristematic region differs from space between the plant population and variety to variety which might be due to the genetic potential or its suitability to the climatic conditions prevailing in the region. Similar findings have been reported by Dorajeerao and Mokashi (2013) and Mali *et al.* (2016) in chrysanthemum.

Plant spread – Among all the treatments significantly wider plant spread was recorded in (T_5– V_2S_1, 42.6 cm^2) followed by (T_1–V_1S_1, 40.4 cm^2), and narrow plant spread was recorded in (T_{12} – V_3S_4, 20.1 cm^2). The favorable effect of wider spacing in promoting plant growth might have helped the individual plant to utilize more soil, water, nutrition, air, and light to put up better growth than those having closer spacing, where the increased plant population

per unit area also competes. Since more branches were available and luxuriant growth of the plant spread more and also the genetic nature of the genotype, and its wide adaptability to the prevailing environmental conditions. These results were in accordance with the findings of Joshi *et al.* (2016) in annual chrysanthemums and Pratibha *et al.* (2018) in French marigold.

Number of primary branches – Among all the treatments significantly more number of primary branches were recorded in (T_5 –V_2S_1, 15.7) followed by (T_1–V_1S_1, 15.2) and a lower number of branches were recorded in (T_{12}–V_3S_4, 7.0). The favorable effect of wider spacing in promoting plant growth might have helped the individual plant to utilize more soil, water, nutrition, air, and light to put up better growth than those having closer spacing, where the increased plant population per unit area also competes. The difference in the number of branches per plant might be attributed to the inherent character of variety whose performance is based on the environmental conditions of the region. Similar results were reported by Aashutosh *et al.* (2019) and Nagdeve *et al.* (2021) in chrysanthemum.

Table: 1 Effect of spacing and different varieties on vegetative parameters of chrysanthemum

		At 90 days*		
Sl. No.	**Treatment combinations**	**Plant height (cm)**	**Plant spread (cm^2)**	**Number of primary branches**
1.	V_1S_1 (Iceberg + 30 cm x 30 cm)	44.9	40.4	15.2
2.	V_1S_2 (Iceberg + 30 cm x 20 cm)	36.3	37.2	14.2
3.	V_1S_3 (Iceberg + 30 cm x 15 cm)	40.7	26.1	12.0
4.	V_1S_4 (Iceberg + 30 cm x 10 cm)	41.9	24.6	11.0
5.	V_2S_1 (Poornima White + 30 cm x 30 cm)	38.9	42.6	15.7
6.	V_2S_2 (Poornima White + 30 cm x 20 cm)	39.5	37.6	14.8
7.	V_2S_3 (Poornima White + 30 cm x 15 cm)	43.3	26.9	12.6
8.	V_2S_4 (Poornima White + 30 cm x 10 cm)	47.5	25.2	11.3
9.	V_3S_1 (Belgium Pink + 30 cm x 30 cm)	21.2	26.9	10.1
10	V_3S_2 (Belgium Pink + 30 cm x 20 cm)	23.0	24.2	9.5
11	V_3S_3 (Belgium Pink + 30 cm x15 cm)	24.3	23.6	7.4
12	V_3S_4 (Belgium Pink + 30 cm x 10 cm)	25.1	20.1	7.0
	F-test	**S**	**S**	**S**

S.E(d)±	0.837	0.543	0.165
$CD_{0.05}$	1.746	1.133	0.345

Days*- days after planting

3.2 Floral parameters

The Floral parameters after planting varied significantly among different treatments. The data is recorded in Table 3.2.

Days taken to first bud initiation – A significant difference was observed among all the treatments less number of days taken to first bud initiation was recorded in (T_{12}–V_3S_4, 43 days) followed by (T_4–V_1S_4, 44.3 days). Whereas, more number of days was recorded in (T_5–V_2S_1, 51.2 days).

Days taken to 50 percent flowering – A significant difference was observed among all the treatments less number of days taken to 50 percent flowering was recorded in (T_{12}–V_3S_4, 73 days) followed by (T_4–V_1S_4, 75 days). whereas, the more number of days taken to 50 percent flowering was recorded in (T_5–V_2S_1, 86.7 days). Earliness in the days taken to first bud initiation might be ascribed to the fact that individual plants grown at the closer spacing which produced less vegetative growth might have entered their reproductive phase earlier due to more competition among the plants for nutrient absorption, moisture, and sunlight exposure. Therefore, days taken to 50 percent flowering also followed in the same treatment. Variation in the flowering time of different varieties might be due to the genetic makeup of different varieties responsible for plant vigour and environmental effect. The finding is in agreement with the result of Subhramanyam (1991) and Sainath (2009) in chrysanthemum.

Flower diameter – Among all the treatments significantly bigger size flower diameter was recorded in (T_5–V_2S_1, 7.6 cm) followed by (T_6–V_2S_2, 7.5 cm) whereas, a smaller size flower diameter was recorded in (T_{12}–V_3S_4, 6.5 cm). The increase in flower diameter might be in wider spacing plants due to the fact that at the onset of the reproductive phase, the vegetative growth seized, and thereafter manufactured food material was utilized exclusively by the sink resulting in increased flower diameter and this variation among the varieties may be due to genetic traits and prevailing environmental conditions. Similar results were recorded by Kour (2009) in marigolds, Waded (2015), and Taksande *et al.* (2017) in chrysanthemums.

Number of flowers per plant - Data for this attribute revealed that the number of flowers per plant showed significant differences among the treatments. (T_5–V_2S_1, 23.9 flowers) registered the more number of flowers per plant while (T_{12}–V_3S_4, 3 flowers) registered the less number of flowers per plant. Plants grew more luxuriantly under wider spacing due to more availability of nutrients and space and resulting in the production of more vegetative growth which is responsible for the mobilization of biomass from source to sink *i.e.*, flowers. Therefore, having a greater number of branches provides more sites for flower initiation, resulting in an increased number of flowers. Additionally, more branches allow for increased sunlight exposure and nutrient absorption, promoting robust growth and supporting the plants metabolic processes involved in flowering. The findings are enclosed in conformity with the reports of Dorajeerao *et al.* (2012) and Khobragade *et al.* (2012) on garland chrysanthemum and in china aster.

Shelf life of chrysanthemum flowers - Shelf life is one of the qualities attributing characteristics that varied significantly with the planting densities. The more number of days of shelf life was recorded in (T_5–V_2S_1, 8.5 days) followed by (T_1–V_1S_1, 7.7 days) whereas, the less number of days of shelf life was recorded in (T_{12}–V_3S_4, 5 days). Shelf life will be more of wider spacing because greater carbohydrate assimilation has a wider spacing of better vegetative growth so shelf life will be more. The variation in shelf life might be attributed to the loss of weight of flowers and the genetic inherent character of varieties. Similar results were reported by Waded (2015) and Aashutosh *et al.* (2019) in chrysanthemum.

Table: 2 Effect of spacing and different varieties on floral parameters of chrysanthemum

Sl. No.	Treatment combinations	First bud initiation (days)	50% flowering (days)	Number of flowers/ plant	Flower diameter (cm)	Shelf life (days)
1.	V_1S_1 (Iceberg + 30 cm x 30 cm)	49.6	84.8	20.8	7.4	7.7
2.	V_1S_2 (Iceberg + 30 cm x 20 cm)	48.3	82.6	19.3	7.2	6.9
3.	V_1S_3 (Iceberg + 30 cm x 15 cm)	46.2	77.2	17.0	6.8	5.9
4.	V_1S_4 (Iceberg + 30 cm x 10 cm)	44.3	75	14.6	6.6	5.2
5.	V_2S_1 (Poornima White + 30 cm x 30 cm)	51.2	86.7	23.9	7.6	8.5
6.	V_2S_2 (Poornima White + 30 cm x 20 cm)	49.3	84.1	23.2	7.5	7.6

7.	V_2S_3 (Poornima White + 30 cm x 15 cm)	47.5	80.7	20.6	6.9	6.3
8.	V_2S_4 (Poornima White + 30 cm x 10 cm)	45.3	77.5	18.6	6.7	5.6
9.	V_3S_1 (Belgium Pink + 30 cm x 30 cm)	50.3	85.3	5.6	7.1	7.5
10	V_3S_2 (Belgium Pink + 30 cm x 20 cm)	48.4	83.6	5.3	6.9	6.4
11	V_3S_3 (Belgium Pink + 30 cm x 15 cm)	45.0	76.7	3.4	6.7	5.7
12	V_3S_4 (Belgium Pink + 30 cm x 10 cm)	43.0	73.0	3.0	6.5	5.0
	F-test	**S**	**S**	**S**	**S**	**S**
	S.E(d)±	0.255	0.586	0.287	0.060	0.021
	$CD_{0.05}$	0.532	1.224	0.599	0.126	0.044

CONCLUSION

On the basis of the results obtained from the present investigation, it can be concluded that T_8-V_2 (Poornima White) along with a spacing S_4(30 cm x 10 cm) recorded the tallest plant height, T_5-V_2 (Poornima White) with a spacing S_1(30 cm x 30 cm) was found to be wider in plant spread, more number of primary branches, the greater number of flowers per plant, the bigger size of flower diameter and more number of days shelf life of the flower. Treatment T_{12}-V_3 (Belgium pink) with spacing S_4(30 cm x 10 cm) was observed lesser in days taken to first bud initiation and 50 percent flowering.

ACKNOWLEDGEMENT

The authors are thankful to the Department of Horticulture, Naini Agricultural Institute, Prayagraj, Sam Higginbottom University of Agriculture Technology and Sciences, (U.P) India for providing the necessary facilities to undertake the studies.

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