***Original Research Article***

# Performance of South Indian Chrysanthemum (*Dendranthema grandiflora* T.) Varieties Under High Density Planting


## ABSTRACT

The experiment was conducted to evaluate the response of south Indian chrysanthemum (*Dendranthema grandiflora* T.) varieties under high density planting in Prayagraj climatic condition at 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 Completely Randomized Block Design (FRBD) comparing two factors with twelve treatment combinations. Factor A consist three varieties of chrysanthemum i.e., (Iceberg Yellow, Poornima White, Belgium Pink). The factor B consist of four spacings i.e., (30cm x 30cm, 30cm x 20cm, 30cm x 15cm and 30cm x 10cm). From present investigation it was recorded that treatment T8-$V_2$(Poornima White) +$S_4$ (30cm × 10cm) found to be best in plant height (47.5 cm), T5-$V_2$(Poornima White) + $S_1$ (30cm × 30cm) recorded best in plant spread (42.6 cm), T5-V2(Poornima White) + 30cm × 30cm was observed better in the parameters like number of primary branches (15.7), number of flowers per plant (23.9), flower diameter (7.6 cm), shelf life of the flower (8.5), T12-V3 (Belgium pink) +30cm×10cm found best in parameters i.e., days taken to first bud initiation (43 days), 50 percent flowering (73 days).



Keywords: *Belgium Pink, Chrysanthemum, Iceberg Yellow, Poornima White, Varieties,*




## INTRODUCTION

Floriculture is a fast emerging industry with higher potential for returns than most of the field and other horticultural crops. Chrysanthemum is commonly known as Guldaudi, Autumn Queen or Queen of the East

(**Koley and Sarkar, 2013**). It belongs to family Asteraceae and is native to Northern Hemisphere chiefly Europe and Asia. It has diverse and beautiful range of colour shades, shapes and size. It is grown as cut flower, loose flower, potted plant, bedding plant and also for exhibitions and garden display purpose. It is mostly used in our country for making garlands, venis, bracelets, flower decoration and religious offerings (**Bohra and Kumar**, **2014**). The total area under floriculture crops in India is 324.00 thousand hectares with 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 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 flowers or cut flowers are used for bouquet, vase etc. **(Prakash *et al.,* 2018)**. In North India various hues of red, yellow, white and purple chrysanthemums are grown in abundance for decorating the landscape either in the ground or in pots. But, in South India mostly the yellow-colored flowers are preferred and grown as loose flowers for trade **(Thakur et al., 2018).**

Since, ultimate aim of any crop is the productivity and good quality produce different agro-techniques are followed. Also among different crop management practices, planting density influences the plant growth to a major extent. Mainly it affects flower number 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 production of quality flowers.

## 2. MATERIALS AND METHODS

This experiment was laid out at Horticulture Research field, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology And Sciences, Prayagraj (U.P.) during the month of October, 2022 to January, 2023. 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 Factorial Completely Randomized Block Design consisting of twelve treatments and replicated thrice. Factor A consist of three varieties of chrysanthemum i.e., (Iceberg Yellow, Poornima White, Belgium Pink). The factor B consist of four spacings i.e., (30cm x 30cm, 30cm x 20cm, 30cm x 15cm and 30cm x 10cm). The biometric observations were recorded at various stages of vegetative parameters on different characteristics *viz.,* plant height in (cm), plant spread in (cm) and number of primary branches.

Floral parameters include days taken to first bud initiation, days taken to 50% flowering, number of flowers per plant, flower diameter (cm) and shelf life of flower (days). The data recorded during the experiment were

subjected to statistical analysis by using analysis of variance (ANOVA). The significant difference among the varieties were compared against the critical difference at 5% level of significance (CD 0.05).

**Chart 1 : Treatment combination**

| Treatment Number | Treatment Details |
|---|---|
| $T_1$ | $V_1S_1$ (Iceberg Yellow + 30cm ×30cm) |
| $T_2$ | $V_1S_2$ (Iceberg Yellow + 30cm× 20cm) |
| $T_3$ | $V_1S_3$ (Iceberg Yellow + 30cm× 15cm) |
| $T_4$ | $V_1S_4$ (Iceberg Yellow + 30cm× 10cm) |
| $T_5$ | $V_2S_1$ (Poornima White + 30cm× 30cm) |
| $T_6$ | $V_2S_2$ (Poornima White + 30cm× 20cm) |
| $T_7$ | $V_2S_3$ (Poornima White + 30cm× 15cm) |
| $T_8$ | $V_2S_4$ (Poornima White + 30cm ×10cm) |
| $T_9$ | $V_3S_1$ (Belgium Pink + 30cm ×30cm) |
| $T_{10}$ | $V_3S_2$ (Belgium Pink + 30cm× 20cm) |
| $T_{11}$ | $V_3S_3$ (Belgium Pink + 30cm ×15cm) |
| $T_{12}$ | $V_3S_4$ (Belgium Pink + 30cm× 10cm) |

**Plant height (cm):** The plant height was measured by meter scale from ground level to the highest tip of the main stem. The height was measured for all the five plants in each plot which was tagged and later an average was calculated.

**Plant spread ($cm^2$):** The spread of the plant was recorded by measuring the plant canopy in two mutually perpendicular directions with the help of a meter scale. The spread was measured for all the five plants in each plot which was tagged and later an average was calculated.

**Number of primary branches:** Total number of branches coming out from the main stem was counted and recorded. This was done for all tagged plants in each treatment. Later on, their average was calculated.

**Days taken to first flower bud initiation:** To record the first flower bud appearance, the plants were observed critically and after its emergence the flower buds were tagged. Days taken for flower bud appearance were noted from transplanting date to flower bud appearance date.

**Days taken to 50% flowering:** Number of days taken by the half of the plants for flowering in each plot from the date of planting was recorded and average was calculated.

**Number of flowers per plant:** The fully opened flowers picked up from each of five tagged plants were counted during each picking. After last picking the cumulative number of flowers per plant was calculated by summing the values of all pickings, later on average number of flowers per plant for each treatment was calculated.

**Flower diameter (cm)**: Fully opened five flowers were randomly selected on each tagged plant at peak

flowering stage and diameter of flowers was measured with the vernier callipers. Average was calculated later.

**Shelf life of flowers (days):** The shelf life was recorded in days from after harvesting of flowers placing them in ambient temperature to wilting of flowers. Later on, average shelf life of flowers was calculated.

## 3. RESULTS AND DISCUSSION

### 3.1 Vegetative parameters

### 1. Plant height (cm)

At 90 days after transplanting plant height varies from 21.2cm to 47.5cm. Maximum plant height (47.5cm) was recorded in treatment $T_8$ – Poornima White + 30cm×10cm followed by treatment $T_7$ - Poornima White + 30cm×15cm (43.3cm) and minimum plant height (21.2cm) was recorded in $T_9$ – Belgium Pink + 30cm×30cm.

Similar findings have been reported by **Dorajeerao and Mokashi (2013) and Mali *et al.* (2016)** in chrysanthemum. They observed maximum height at the closer spacing which decreased gradually as the spacing increased. Increase in plant height at closer spacing might be due to heavy competition between plants for light, moisture, space and aeration which increases the stem elongation by increasing the cell size and cell number.

### 2. Plant spread (cm)

After 90 days of transplanting plant spread varies from 20.1cm to 42.6cm. Maximum plant spread was recorded in treatment $T_5$- Poornima White + 30cm×30cm (42.6cm) followed by treatment $T_1$ - Iceberg Yellow + 30cm×30cm (40.4cm) and minimum spread of plant was recorded in $T_{12}$ – Belgium Pink + 30cm×10cm (20.1cm). The results with respect to plant spread observed more spread (42.6cm) in wider spacing $S_1$ (30 cm ×30cm) and less (20.1cm) in closer spacing $S_4$ (30cm×10cm).

This indicates that, the plant spread was more under wider spacing which might be due to the favorable growing conditions like more space available for growth of roots and shoots, which ultimately helps in higher uptake of nutrients and water from the soil. Similarly, more amount of sunlight was also available in wider spacing that might have increased the rate of photosynthesis and thereby growth of plants. This increase in plant spread also might be due to increased lateral growth at the expense of apical growth**.** Similar results were obtained by **Joshi *et al.* (2016)** in annual chrysanthemum and **Pratibha *et al.* (2018)** in French marigold.

### 3. Number of primary branches

At 90 days of transplanting higher number of primary branches (21.2cm) was recorded in treatment $T_5$ – Poornima White + 30cm×30cm followed by treatment $T_1$-Iceberg Yellow + 30cm ×30cm (15.2) and lower number of branches (7) was recorded in $T_{12}$- Belgium Pink + 30cm×10cm. The results with respect to number of primary branches observed higher (15.7) in wider spacing $S_1$ (30cm×30cm) and lower (7) in closer spacing $S_4$ (30cm×10cm).

This increase in number of branches per plant at wider spacing might be attributed to more space available for each of the plants to grow vigorously as they could receive sufficient amount of sunlight, air and nutrients. Similar results were also 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 DAT | | |
|---|---|---|---|---|
| **S.No.** | **Treatment combinations** | **Plant height (cm)** | **Plant spread (cm)** | **Number of primary branches** |
| 1. | $V_1S_1$ (Iceberg Yellow + 30cm ×30cm) | 44.9 | 40.4 | 15.2 |
| 2. | $V_1S_2$ (Iceberg Yellow + 30cm× 20cm) | 36.3 | 37.2 | 14.2 |
| 3. | $V_1S_3$ (Iceberg Yellow + 30cm× 15cm) | 40.7 | 26.1 | 12 |
| 4. | $V_1S_4$ (Iceberg Yellow + 30cm× 10cm) | 41.9 | 24.6 | 11 |
| 5. | $V_2S_1$ (Poornima White + 30cm× 30cm) | 38.9 | 42.6 | 15.7 |
| 6. | $V_2S_2$ (Poornima White + 30cm× 20cm) | 39.5 | 37.6 | 14.8 |
| 7. | $V_2S_3$ (Poornima White + 30cm× 15cm) | 43.3 | 26.9 | 12.6 |
| 8. | $V_2S_4$ (Poornima White + 30cm ×10cm) | 47.5 | 25.2 | 11.3 |
| 9. | $V_3S_1$ (Belgium Pink + 30cm ×30cm) | 21.2 | 26.9 | 10.1 |
| 10 | $V_3S_2$ (Belgium Pink + 30cm× 20cm) | 23 | 24.2 | 9.5 |
| 11 | $V_3S_3$ (Belgium Pink + 30cm ×15cm) | 24.3 | 23.6 | 7.4 |
| 12 | $V_3S_4$ (Belgium Pink + 30cm× 10cm) | 25.1 | 20.1 | 7 |
| | F-test | S | S | S |
| | S.E.(d) | 0.837 | 0.543 | 0.165 |
| | CD (p=0.05) | 1.746 | 1.133 | 0.345 |

**3.2 Floral parameters**

The Floral parameters after transplanting varies significantly among different treatments. The data recorded in table 2.

**1.Days taken to first bud initiation after planting**

Minimum days taken to first bud initiation was recorded in treatment $T_{12}$- Belgium Pink + 30cm×10cm (43 days) followed by treatment $T_4$- Iceberg Yellow + 30cm×10cm (44.3 days). Whereas, maximum was recorded in $T_5$- Poornima White + 30cm×30cm (51.2 days).

### 2.Days taken to 50 percent flowering after planting

A significant difference was observed among treatments in days taken to 50 percent flowering after planting. Minimum days taken to 50 percent flowering was recorded in treatment $T_{12}$- Belgium Pink + 30cm×10cm (73 days) followed by treatment $T_4$- Iceberg Yellow + 30cm×10cm (75 days) whereas, maximum was recorded in $T_5$- Poornima White + 30cm×30cm (86.7 days).

The recorded data show earliness in 50 percent flowering (73 days) in $S_4$ (30cm×10cm) while wider spacing $S_1$ (30cm×30cm) experienced delayed 50 percent flowering (86.7 days).

The days for commencement of flowering directly affects the days to 50 percent flowering. Earlier flowering commencement in closer spacing might be the reason for minimum days to 50 percent flowering in the same treatment. These results are in closer association with the findings of **Subhramanyam (1991) and Sainath (2009)** in chrysanthemum.

### 3.Flower diameter

Maximum flower diameter was recorded in treatment $T_5$- Poornima White + 30cm×30cm (7.6) followed by treatment $T_6$- Poornima white + 30cm×20cm (7.5) whereas, minimum flower diameter was recorded in $T_{12}$- Belgium Pink + 30cm×10cm (6.5).

The data showed that wider spacing $S_1$ (30cm×30cm) recorded maximum flower diameter (7.6) which was followed by (7.5) with $S_2$ (30cm×20cm) and minimum flower diameter (6.5) in closer spacing $S_4$ (30cm×10cm).

Plants spaced widely, flower diameter is more as compared to closely spaced plants on account of lesser competition of the nutrients, space and light. This increased the flower diameter with increasing the plant spacing which was also reported by **Kour (2009)** in marigold, **Waded (2015) and Taksande *et al.* (2017)** in chrysanthemum.

### 4.Number of flowers per plant

Data for this attribute revealed that the number of flowers per plant showed significant differences among the treatments. Treatment $T_5$-Poornima White + 30cm×30cm registered maximum number of flowers per plant (23.9 flowers) while treatment $T_{12}$- Belgium Pink + 30cm×10cm registered minimum number of flowers (3 flowers) per plant.

From result it is concluded that maximum number of flowers per plant (23.9 flowers) found in wider spacing $S_1$ (30cm×30cm) while minimum number of flowers per plant (3 flowers) was recorded in closer spacing $S_4$ (30cm×10cm).

The results of the present study are well supported by **Dorajeerao *et al.* (2012) and Khobragade *et al.* (2012)** who observed increase in number of flowers per plant with increase in planting distance in garland chrysanthemum and china aster respectively. The reason for the same may be ascribed to less plants per unit area. Although number of flowers per plant were more under wider spacing compared to closer spacing.

### 5.Shelf life of chrysanthemum flowers

Shelf life is one of the quality attributing character which varied significantly with the planting densities. Maximum shelf was recorded in treatment $T_5$- Poornima White + 30cm×30cm (8.5 days) followed by treatment

$T_1$- Iceberg Yellow + 30cm×30cm (7.7 days) whereas, minimum shelf life was recorded in the treatment $T_{12}$-Belgium Pink + 30cm×10cm (5 days).

Increasing levels of spacing significantly increase the flower weight and hence the shelf life in chrysanthemum. **Waded (2015) and Aashutosh *et al.* (2019)** recorded maximum shelf life of flowers planted at wider spacing in chrysanthemum.

**Table: 2 Effect of Spacing and Different Varieties on Floral Parameters of Chrysanthemum**

| S.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 Yellow + 30cm ×30cm) | 49.6 | 84.8 | 20.8 | 7.4 | 7.7 |
| 2. | $V_1S_2$ (Iceberg Yellow + 30cm× 20cm) | 48.3 | 82.6 | 19.3 | 7.2 | 6.9 |
| 3. | $V_1S_3$ (Iceberg Yellow + 30cm× 15cm) | 46.2 | 77.2 | 17 | 6.8 | 5.9 |
| 4. | $V_1S_4$ (Iceberg Yellow + 30cm× 10cm) | 44.3 | 75 | 14.6 | 6.6 | 5.2 |
| 5. | $V_2S_1$ (Poornima White + 30cm× 30cm) | 51.2 | 86.7 | 23.9 | 7.6 | 8.5 |
| 6. | $V_2S_2$ (Poornima White + 30cm× 20cm) | 49.3 | 84.1 | 23.2 | 7.5 | 7.6 |
| 7. | $V_2S_3$ (Poornima White + 30cm× 15cm) | 47.5 | 80.7 | 20.6 | 6.9 | 6.3 |
| 8. | $V_2S_4$ (Poornima White + 30cm ×10cm) | 45.3 | 77.5 | 18.6 | 6.7 | 5.6 |
| 9. | $V_3S_1$ (Belgium Pink + 30cm ×30cm) | 50.3 | 85.3 | 5.6 | 7.1 | 7.5 |
| 10 | $V_3S_2$ (Belgium Pink + 30cm× 20cm) | 48.4 | 83.6 | 5.3 | 6.9 | 6.4 |
| 11 | $V_3S_3$ (Belgium Pink + 30cm ×15cm) | 45 | 76.7 | 3.4 | 6.7 | 5.7 |
| 12 | $V_3S_4$ (Belgium Pink + 30cm× 10cm) | 43 | 73 | 3 | 6.5 | 5 |
| | F-test | S | S | S | S | S |
| | S.E.(d) | 0.255 | 0.586 | 0.287 | 0.060 | 0.021 |
| | CD (p=0.05) | 0.532 | 1.224 | 0.599 | 0.126 | 0.044 |



**CONCLUSION**

It is concluded from the present investigation that treatment $T_8$-$V_2$(Poornima White) along with spacing 30cm×10cm recorded highest plant height, treatment $T_5$-$V_2$(Poornima White) with spacing 30cm×30cm found to be best in plant spread, number of primary branches, number of flowers per plant, flower diameter and shelf life of the flower. Treatment $T_{12}$-$V_3$ (Belgium pink) with spacing 30cm×10cm observed better in days taken to first bud initiation and 50 percent flowering.

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