



Studies on Performance of Chrysanthemum (*Dendranthema grandiflora* T.) Varieties under Prayagraj Agro Climatic Conditions

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The objective of this study was to find out the most suitable variety for plant growth flower yield and quality of chrysanthemum (*Dendranthema grandiflora* T.) under the agro climatic conditions of Prayagraj, India. The present experiment was carried out during October to March, 2021-2022 in Research Field, Department of Horticulture, SHUATS, Prayagraj. The experiment was conducted in Randomized Block Design (RBD), with 15 varieties which have been replicated 3 times. From the performed experimental it was concluded that the 15 chrysanthemum varieties under study showed significant variation in all the parameters observed. The variety Non pinch Non stick expressed significantly better performance in terms of height (35.77 cm), plant spread (22.90 cm²), average flower weight (11.4 g), flower yield per plant (134.15 g), shelf life (11 days). Variety Vijay took earliness for first flower bud initiation (38 days), which followed by Non pinch Non stick (41.47 days), the variety Vijay took less number of days (55 days) for flowering, but variety Non pinch Non stick took more number of days for flowering (59.7 days). The variety Pink Princes also reported significantly better performance in most of the parameters like number of primary branches (13.7), number of leaves (83.44), number of flower buds (44.00), number of flowers per plant (29.00), at par with the variety C₂₆, followed by Scarleteer. Hence, the varieties Non pinch Non stick and Pink Princes performed best varieties for cultivation in Prayagraj.

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1. INTRODUCTION

Chrysanthemum is a well-known ornamental horticultural plant and a commercially important flower crop. chrysanthemum (*Dendranthema grandiflora* T.) of the Asteraceae family is a highly attractive and charming flowering plant with over 2000 varieties in the world [1]. Chrysanthemums are grown in pots or as cut flowers, and their success is primarily due to the wide variety of cultivars available [2]. The word chrysanthemum is derived from the Greek word "chryos" means gold and "anthon" or "anthos" means flower. Chrysanthemum has diploid chromosome no $2n=18$. It is believed to be native to northern hemisphere chiefly Europe and Asia and believed to have been originated from China [3]. It is also known as Guldaudi, the Autumn Queen, or the Queen of the East.

It is commercially grown in various parts of the world. The Netherlands, Italy, Colombia, Spain, Germany, and the United States are the most important countries where it is primarily grown in greenhouses. Japan is the world's leading producer of chrysanthemums. It is the most important commercial flower crop grown in the Netherlands and Germany as a spray or cut flower, and as a potted plant in America. Chrysanthemum is a symbol of 'Royalty' in Japan, and it is also the national flower of Japan. (A glimpse of floriculture and landscaping).The year 1995-1996 was celebrated as "International year of chrysanthemum". In the trade of global flower market, chrysanthemum is the second largest cut flower after rose and holds fifth rank as pot plant [4].

Chrysanthemum is a photosensitive crop, requiring long days for vegetative growth and short days for flowering. Chrysanthemum is a short-day plant that fails to perform flower buds if the day length exceeds 14.5 hours and fails to develop buds if the day length exceeds 13.5 hours; with the exception of certain early flowering cultivars, the plant requires longer days for proper vegetative growth. Chrysanthemums are divided into two types: large flowered (standard) and small flowered (spray type). Large flowered chrysanthemums with long, sturdy stems and excellent keeping quality, making them ideal for flower arrangements, cut flower production, and as a potted flowering plant for exhibition and decoration. Extra-large bloomed

cultivars are grown for exhibition value, bouquets, vases, and so on, whereas small flowered cultivars are grown primarily for loose flower.

The variations among chrysanthemum varieties are large in response to environment particularly temperature and the interaction between temperature and cultivar occur for every developmental trait. [5]. Therefore, varietal evaluation became necessary in order to identify the best variety for the specific region. The performance of any crop or variety is heavily influenced by the interaction of genotype and environment. As result, varieties that thrive in one region may not thrive in other regions with varying climatic conditions. As a result, new genotypes must be evaluated for quality traits under varying climatic conditions.

2. MATERIALS AND METHODS

2.1 Experimental Location, Environmental Conditions (Climate and Weather)

The field experiment entitled "Studies on Performance of chrysanthemum (*Dendranthema grandiflora* T.) Varieties" Under Allahabad agro climatic conditions of Prayagraj" was carried out at Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Allahabad to find out the best performing varieties for this region.

The experiment was carried out at the Department of Research Field, Department of Horticulture, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology, and Science, Prayagraj (2021-22), which is located in the agro-climatic zone of Uttar Pradesh (sub-tropical belt) Prayagraj is a city in the Indian state of Uttar Pradesh. Prayagraj is located in agro-climate zone IV, which is known as the "middle Gangetic plains." The site of the experiment is located at 98 metres above sea level at 25.57° N latitude 81.51° E longitude and has a typical subtropical climate with summer and winter extremes. The maximum temperature of the location reaches up to 46°C - 48°C and rarely falls as low as 4°C-5°C during winter. The average rainfall in this area is around 1027 mm annually with maximum concentration during July to September with few showers and drizzles in winter.

2.2 Biologic Material

The experiment was conducted with 15 chrysanthemum varieties viz. Non pinch Non stick, Loyalty, C₅₂, Dark Eyes, Autumn, C₂₆, Brisa, Scarleteer, Pink Princess, Yellow Lilliput, Peet, Vijay, Swetha Singar, White Bonsai, Wall Street.

2.3 The Experimental Design and Parameters Determined

2.3.1 Experimental design

The trail was laid out in Randomized block design (RBD) with 15 treatments which have been replicated 3 times. 15 chrysanthemum varieties were used. They were Non pinch Non stick(V₁); Loyalty(V₂); C₅₂(V₃); Dark Eyes(V₄); Autumn, (V₅); C₂₆(V₆); Brisa(V₇); Scarleteer(V₈); Pink Princess(V₉); Yellow Lilliput(V₁₀); Peet (V₁₁); Vijay (V₁₂); Swetha Singar (V₁₃); White Bonsai (V₁₄); Wall Street (V₁₅).

2.3.2 Growth parameters

The rooted terminal cuttings at 4th leaf stage were transplanted at spacing 30x30 cm. Growth parameters measured in term plant height(cm), plant spread(cm²), number of branches per plant, number of leaves per plant at 30,60 and 90 days after transplanting.

2.3.3 Flowering parameters

Days to first flower bud appearance, number of flower buds, number of days to first flowering, number of flowers per plant, average single flower weight, flower yield per plant, shelf life.

2.4 Statistical Analysis

The results and data were subjected to statistical analysis separately by using analysis of variance technique (ANOVA). The difference among treatments means was compared by using least significant difference test at 5% probability levels.

3. RESULTS AND DISCUSSION

3.1 Growth Parameter

Growth parameters data are shown in Table 1. The range of plant height was from 35.77 to 13.44 cm. The tallest plant was found from V₁ Non pinch Non stick (35.77 cm), followed by V₈ Scarleteer (28.67 cm), where as the lowest plant

height was recorded in V₁₀ Yellow Lilliput (13.44 cm). The difference in plant height may be due to the varietal character and vigour of the genotypes under study. Similar results were recorded in chrysanthemum by Singh et al. [6].

The number of branches per plant was high in Pink Princess (13.77), followed by V₁₁ Peet (10.55), whereas the lowest number of branches was found in V₂ Loyalty (5). Variation in growth parameters among the cultivars of chrysanthemum might be due to the genetic makeup of the cultivars having different capacity of storing reserved food materials resulting in plant vigour. Similar results were reported by Peddi Laxmi et al. [7].

The range of plant spread was from 25.67 cm² to 13.41 cm². The highest plant spread was found in Pink Princess (25.67 cm²), followed by V₈ Scarleteer (23.83cm²), whereas the lowest was found in V₁₀ Yellow Lilliput (13.41 cm²). Plant spread differed significantly among all the cultivars which might be due to genetic makeup of the varieties and development of more secondary branches in the cultivars thereby increasing the plant spread. Similar results were reported by Poonam and Kumar (2007).

The number of leaves per plant was high in Pink Princess (83.44), followed by V₄ Dark Eyes (34.11), and whereas the lowest number of leaves was found in the variety V₁₀ Yellow Lilliput (27.11). The variation in the number of leaves per plant among cultivars could be attributed to the rate of vegetative growth, which could be attributed to genetic makeup and could be further influenced by agro-climatic conditions. Ona et al. [8] reported similar varietal evaluation results for the number of leaves in chrysanthemum.

3.2 Flowering Parameters

Significant variation was found (visual observation) among 15 chrysanthemum cultivars for the number of days to the emergence of flower bud (from days after transplantation of chrysanthemum suckers). Late flower bud initiation was found in V₆ C₂₆ (64.6 days), while earlier was found in V₁₂ (38 days) in Table 2. This findings referred that V₁₂ Vijay (38 days) was early flower bud cultivar followed by Scarleteer V₈ (40.4 days). Number of days required to first bud emergence differed significantly among all the cultivar under study. The cultivar being an early bloomer or late bloomer seems to be the inherent varietal character and genetic nature of

Table 1. Growth performance parameters of different varieties of chrysanthemum, at different days after transplanting (DAT)

Variety symbol	Variety	Plant height			Branches			Plant spread			Leaves		
		30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT
V ₁	Non pinch	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT
	Non stick	25.55	37.55	35.77	3.77	8.88	9.44	21.44	20.55	22.90	22.96	43.82	57
V ₂	Loyalty	10	24.33	20.33	2.22	3.66	5	14.00	16.5	20.48	12.66	34.88	38.44
V ₃	C52	11.88	24.07	21.77	1.33	2.66	3.55	16.33	17.22	20.05	16.11	29.66	35.33
V ₄	Dark Eyes	14.16	21	18.88	3.66	7.77	8.77	13.27	22.88	19.72	20.55	46.88	54.11
V ₅	Autumn	8.72	13.77	17.55	2	3.55	4.44	10.96	13.22	16.94	11.88	23.99	28.2
V ₆	C26	11.55	25.11	20.11	1.88	4.55	5.88	14.66	20.22	20.22	15.44	31.22	33.33
V ₇	Brisa	8	7.33	15.66	1.44	1.77	6.55	11.28	14.22	18.94	22.55	36.77	41.5
V ₈	Scarleter	24.22	28.55	28.67	4.66	7.44	8.22	12.77	13.44	23.83	19.7	32.77	33
V ₉	Pink Princess	14.38	25.22	21.11	4.77	12.66	13.77	16.47	26.11	25.67	25.2	79.66	83.44
V ₁₀	Yellow Lilliput	8.777	11.77	13.44	5.11	5.66	6.11	8	10.88	13.41	16.7	22.88	27.11
V ₁₁	Peet	8.88	16	16.11	3	9.88	10.55	12.04	15	16.16	16	37.66	39.55
V ₁₂	Vijay	10.44	12.33	14.22	2.88	5.11	5.22	7.22	14.44	15.94	17.00	22.66	32.7
V ₁₃	Swetha Singar	9.44	15.66	16.44	4.88	8.66	9.44	10.5	17.55	15.38	16.55	41.11	45
V ₁₄	White Bonsai	8.05	12.22	13.55	3.11	8.55	10.33	10.33	17.66	18.61	19.33	36.22	39.7
V ₁₅	Wall Street	8.61	11.88	13.77	4.55	8.11	9	11.11	16.33	20.06	24.33	31.44	35.55
	F-Test	S	S	S	S	S	S	S	S	S	S	S	S
	SED(≠)	0.75	1.53	5.25	1.04	2.29	2.27	2.38	1.80	2.31	3.91	8.95	8.50
	CD@5%	1.55	3.14	10.74	2.12	4.69	4.65	4.86	3.69	4.73	8.00	18.2	17.38
	CV	0.47	0.63	2.24	2.59	2.84	2.39	1.53	12.9	0.98	1.73	1.98	1.66

Table 2. Flowering parameters performance of different varieties of chrysanthemum

Variety symbol	Varieties	Days taken to first flower bud appearance	Number of flower buds	Number of days taken to 1st flowering
V ₁	Non pinch Non stick	41.47	22.27	59.77
V ₂	Loyalty	38.2	16.56	89.00
V ₃	C52	46.5	18.66	92.66
V ₄	Dark Eyes	41.7	23.56	78.22
V ₅	Autumn	47.00	15.00	56.44
V ₆	C26	64.6	23.55	94.22
V ₇	Brisa	50.00	8.33	93.00
V ₈	Scarleter	40.4	23.14	59.77
V ₉	Pink Princess	51.4	44.3	60.11
V ₁₀	Yellow Lilliput	44.5	11.02	60.88
V ₁₁	Peet	45.5	22.46	77.77
V ₁₂	Vijay	38.00	16.05	55.55
V ₁₃	Swetha Singar	43.1	26.33	64.88
V ₁₄	White Bonsai	43.53	20.27	59.66
V ₁₅	Wall Street	42.00	27.11	62.22
	F-Test	S	S	S
	SED(≠)	6.33	2.73	3.71
	CD@5%	11.91	5.57	7.59
	C.V	13.47	1.04	1.42

Table 3. Performance of different varieties of chrysanthemum as regard as flower yield attributes and quality parameters

Variety	Varieties	Number of flowers per plant	Average single flower weight (g)	Flower yield per plant (g)	Shelf life (Days)
V ₁	Non pinch Non stick	21	11.4	258.96	11.66
V ₂	Loyalty	15	3.15	71.22	10.00
V ₃	C52	13	3.03	81.92	11.00
V ₄	Dark Eyes	19	3.28	91.7	8.00
V ₅	Autumn	12	3.47	74.694	4.00
V ₆	C26	23	3.63	121.33	9.33
V ₇	Brisa	12	1.3	48.67	5.00
V ₈	Scarleter	22	2.78	122.73	10.33
V ₉	Pink Princess	29	2.2	183.47	8.00
V ₁₀	Yellow Lilliput	11	2.14	70.86	3.33
V ₁₁	Peet	20	2.2	82.93	11.33
V ₁₂	Vijay	18	1.82	44.23	4.33
V ₁₃	Swetha Singar	19	1.3	56.11	9.33
V ₁₄	White Bonsai	22	1.55	67.95	6.33
V ₁₅	Wall Street	25	1.29	81.32	3.33
	F-TEST	S	S	S	S
	SED	4.69	0.66	27.81	1.17
	C.D@5%	8.35	1.36	56.83	2.4
	C.V	25.11	1.75	2.33	1.25

the plant. Similar results were reported by Mikato Shohe et al. [9] in chrysanthemum.

Significant difference was observed for cumulative number of flower buds per plant in chrysanthemum cultivars at 30, 60 and 90 DAT (Table 2). Maximum cumulative number of flower bud was found from V₉ Pink Princess (44.3 buds) whereas minimum was found from V₇ Brisa (8.33 buds).

Significant variation was found among the cultivars of chrysanthemum required maximum 55.55 days for flower initiation and minimum 94.2 days (Table 2). This findings referred that V₁₂ Vijay (55.5 days) was early flowering followed by V₅ Autumn (56.44 days). Late flowering was found in V₃ C26 (94 days), V₇ Brisa (93 days).

Significant variation was recorded among chrysanthemum cultivars performance in respect to the number of flowers per plant. Maximum number of flower was found from V₉ Pink Princess (34), followed by V₁₅ Wall Street (25), V₈ Scarleteer (22), whereas minimum was recorded in V₁₀ Yellow Lilliput (11), Brisa V₇ (12), V₅ Autumn (12) (Table 3). There was significant difference in number of flowers per plant. Higher yield may be due to an increase in morphological parameters such as plant height, number of leaves, and leaf area, which may have contributed to the production of more photosynthesis, resulting in greater accumulation of dry matter, which leads to the production of more flowers per plant. This difference may be due to the difference in the genetic makeup. Similar results were recorded in chrysanthemum by Thiripurasundari et al. [10].

Significant variation was found among the cultivars performance in respect to the average flower weight. The highest was recorded in V₁ Non pinch Non stick (11.4 g), followed by variety V₆ C₂₆ (3.63 g), V₃ C₅₂ (3.47 g), whereas the lowest was recorded in V₇ Brisa (1.3g), V₁₃ (1.3 g) (Table 3). The difference in the flower weight may be due to the varietal character, habitat type and genetic makeup of the varieties. Similar results were recorded in chrysanthemum by Kishan et al. [11].

From the results significant variation among the cultivars performance in respect to the flower yield per plant. The highest was recorded in V₁ Non pinch Non stick (258.96 g), followed by the variety V₉ Pink Princess (183.47 g), variety Scarleteer (122.73 g). Whereas, the variety that

gave minimum flower yield per plant was Vijay (44.23 g), followed by the variety Brisa (48.67 g) (Table 3). The difference in the flower yield per plant may be due to the varietal character, habitat type and genetic makeup of the varieties. Similar results were recorded in chrysanthemum by Siddiqua et al. [12].

Shelf life and vase life varied significantly among the cultivars of chrysanthemum. From the results significant variation among the cultivars performance in respect to the shelf life among all the varieties, the variety with maximum shelf life was Non pinch Non stick (11.66 days), which is found to be par with the variety Peet (11.33 days), followed by the variety Loyalty (10.0 days). Whereas, the variety with minimum shelf life was Wall Street (3.33 days), followed by the variety Autumn (4.0 days) (Table 3). The difference in the shelf life of flowers may be due to the evaporation rate, transpiration rate of the varieties and also may be due to the varietal character, habitat type and genetic makeup of the varieties. Similar results were recorded in chrysanthemum by Joshi et al., [13], Beeralingappa, [14] in chrysanthemum.

4. CONCLUSION

Chrysanthemum cultivars showed wide range of variation in their growth and flowering characteristics. The varieties under study showed significant variation in all the parameters observed. The variety Pink Princes also reported significantly better performance in most of the parameters like number of primary branches (13.7), number of leaves (83.44 leaves), number of flower bud per plant (44.00 buds), number of flowers per plant (29.00). The variety Non pinch Non stick reported significantly better performance in term of height (35.77 cm), plant spread (22.90 cm²), average flower weight (11.4 g), flower yield per plant (134.15 g), shelf life (11.00 days), followed by the variety C₂₆, Scarleteer. Hence, the varieties Non pinch Non stick and Pink Princess performed best and I would recommend these varieties for cultivation in Prayagraj, India [15].

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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