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Unveiling the Spectacular Performance of Diverse Chrysanthemum Varieties in Flowering, Quality and Yield

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Authors' contributions

This work was carried out in collaboration among all authors. Author AM conceptualized the research. Authors AM and JS designed the experiments and contributed to experimental materials. Author AG executed field/lab experiments and collected the data, did data analysis and interpretation. Author AG and MKN prepared the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

A comprehensive research initiative conducted in Jhalawar 2019-20 focused on evaluating the genetic diversity and performance of various chrysanthemum varieties. The aim of this study was to evaluate the genetic variability and assess the varietal performance of chrysanthemum

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(*Dendranthema grandiflora* Tzvelev) under the specific agro-climatic conditions of Jhalawar. The study sought to identify high-performing varieties and quantify key genetic traits relevant to yield and quality characteristics, with the goal of supporting selection efforts for enhanced chrysanthemum production in the region. This investigation was conducted at the Floriculture and Landscaping block of the College of Horticulture and Forestry, Jhalawar, Rajasthan. The experimental work was carried out during the winter season of the year 2019-20, capitalizing on the local climate to evaluate varietal responses under Jhalawar conditions. The experiment employed a Randomized Block Design (RBD) with multiple replications to ensure robust data. Different chrysanthemum varieties were planted in designated plots, and observations on traits such as flower yield, flower quality, and growth parameters were recorded periodically. Statistical analysis, including ANOVA, was performed to detect significant differences among the varieties. This analysis helped in identifying high-performing varieties suited for Jhalawar conditions and provided insights into genetic variability for potential selection and breeding programs. Ten different genotypes were carefully chosen for the study, including Marigold, Poornima Pink, Dall White, Calcutta Shantini, Karnool, Poornima Red, Dall Yellow, Poornima White, Poornima Yellow and Dundi for in-depth analysis.A randomised block design with three replications was used in the experiment. Cultivar 'Calcutta Shantini' exhibited the maximum days taken to first flower bud emergence of plant (51.50 days) and the maximum number of flowers per plant (269.90). Conversely, cv. 'Dall Yellow' showed the shortest duration to fifty percent flowering (67.64 days). Notably, cv. 'Dundi' displayed the maximum flower diameter (7.47 cm), while cv. 'Poornima Pink' had the longest flower stalk (13.09 cm). Remarkably, cv. 'Marigold' demonstrated the highest flower fresh weight (63.67 gm), dry weight (14.41 gm), and shelf life (4.67 day).

Keywords: Evaluation; genetic variability; varietal performance; chrysanthemum; genotypes.

1. INTRODUCTION

Chrysanthemums, belonging to the Asteraceae family, originated primarily in Europe and Asia in the northern hemisphere. They possess a basic chromosome number of n=9 and their diverse cultivars showcase a broad spectrum of ploidy levels, ranging from 2n=36, 45, 47, 71, to 75. These plants, which can be annual or perennial herbs with occasional woody characteristics, feature inflorescences known as "capitulum." Within these capitulums, perfect disc florets stand out alongside pistillate ray florets, all supported by a naked, flat or convex receptacle adorned with imbricate, angled or terete involucre scales. Chrysanthemum, a versatile floral marvel, is enjoying a surge in popularity as a cherished choice for adorning interior spaces and embellishing exquisite bouquets. In India, the result of extensive genetic enhancement research across diverse institutions has led to the development of approximately one thousand captivating varieties. Despite the vast spectrum of possibilities, there remains an untapped potential for further elevating this floral gem through focused attention and innovative improvement initiatives. Identifying chrysanthemum varieties tailored to diverse agro-climatic conditions and specific purposes is imperative. A thorough understanding of the existing material's variability and the relationships between different traits is essential groundwork for any breeding program striving for superior yield and quality. This foundational knowledge paves the way for targeted innovation, ensuring that each bloom thrives in its unique environment, delivering excellence in both quantity and caliber.In order to appraise the performance of each cultivar, genetic diversity must be assessed.Present investigation’s main objective was to study performance of diverse chrysanthemum varieties in flowering, quality and yield parameters.

2. MATERIALS AND METHODS

The current experiment was conducted in 2019-2020 at the College of Horticulture & Forestry, Jhalrapatan City, Jhalawar, in the Department of Floriculture and Landscaping. The experiment had ten genotypes and three replications and it laid out in a randomised block design. In each sub-block, a genotype was assigned at random. The crop was effectively raised by adhering to advised agronomic measures as per Agricultural University, Kota, (Agriculture University, 2017). The sample for the observations consisted of five randomly chosen plants per variety in every replication that were tagged to avoid border plants. Jhalawar's climate is usually sub-humid, with heavy summertime rainfall, dramatic winter temperature swings and moderate relative

humidity. Rooted cuttings of chrysanthemum varieties from KRCCH, Arabhavi (University of Horticultural Sciences, Bagalkot, Karnataka) were prepared. Field preparation included two rounds of ploughing with a mouldboard plough, followed by harrowing to break clods. Farmyard manure (FYM) was incorporated, and the field leveled and weeded manually. The experiment layout was marked using a measuring tape, rope, and bamboo pegs. Before planting, cuttings were dipped in 0.2% Bavistin and transplanted at 40 × 40 cm spacing on October 7, 2019, with 25 plants per plot. Experiment data was recorded during investigation for various characters under study was analyzed statistically as per the technique suggested by Panse and Sukhatme, (Panse and Sukhatme 1995).

3. RESULTS AND DISCUSSION

3.1 Floral Parameters

3.1.1 Days taken to first flower bud emergence

Variations in the time taken for the first bud emergence were notable across various chrysanthemum genotypes. The appearance of the first flower bud was recorded earlier in cv. 'Dall White' (36.92 days), closely trailed by 'Dall yellow' (37.13 days). The divergence in the time frame for flower bud initiation across distinct cultivars could be attributed to the presence of ample genetic variability (Jamal Uddin et al, 2015). Concurrent results in chrysanthemum were reported by Kumar *et al*. (2015) and Siddique *et al*., (2018).

3.1.2 Days taken for fifty per-cent flowering

The minimum duration for fifty percent flowering was noted in cv. 'Dall Yellow' (67.64 days), succeeded closely by cv. 'Dall White' (67.90 days). Conversely, the maximum duration for achieving fifty percent flowering was observed in cv.'Poornima Red', taking 80.44 days. This variance in flowering time among the cultivars highlights their distinct growth patterns. Variation in days taken to fifty percent flowering may be due to genetic trait or makeup (Byadwal et al, 2018). This result is consistent with related results made in chrysanthemum by Talukdar *et al.*, (2006), Kishan*et al*., (2007), Naik *et al*., (2019) in chrysanthemum. Diverse floral splendor unfolded among various chrysanthemum varieties, each boasting its own distinct diameter.

3.1.3 Flower Diameter (cm)

Among the chrysanthemum varieties observed, cv. 'Dundi' boasted the maximum flower diameter (7.47 cm), closely pursued by cv. 'Poornima White' (7.40 cm). Conversely, cv. 'Calcutta Shantini' exhibited the minimum flower diameter, (4.23 cm). The inherent characteristics of different cultivars may be the cause of the variance in genotypes for blossom diameter (Jamal Uddin, 2015). This variance might result from genotypic variations in the phenotypic manifestation of blossom diameter as well as variations in the genetic composition of the cultivars (Singh et al, 2017). Similar finding in chrysanthemum was reported by Prabhu*et al*., (2018), Mishra *et al*., (2006), Rao and Pratap (2006) and Kavita *et al*., (2003).

3.1.4 Flower Stalk Length (cm)

Cultivar 'Poornima Pink' achieved the longest flower stalk length (13.09 cm), while cv. 'Dall White' followed closely behind at 11.96 cm. Conversely, cv. 'Marigold' recorded the shortest flower stalk length (8.26 cm). Differences in stalk length among different chrysanthemum varieties may arise from genetic variations influencing the expression of this phenotypic trait, as suggested by Ona *et al*., (2015). According to Jamal *et al*., 2015, it was shown that cultivars with larger plants generated longer flower stalks than cultivars with smaller plants. The concurrent results in in gaillardia and China aster were found by Tamut and Kulkarni, (2013) and Zosiamliana *et al*., (2012) respectively.

3.1.5 Number of ray florets

Variations in the number of ray florets per flower were notable across different chrysanthemum varieties. Notably, the cv. 'Marigold' exhibited the maximum ray florets (237.50), followed by cv. 'Poornima White' (233.66). Conversely, the cv. 'Calcutta Shanthini' displayed the minimum ray florets per flower (133.66). Dewan *et al*., (2016) stated that changes in the morphological qualities among the floral attributes in chrysanthemum might possibly be the cause of differences in the number of ray florets. Talukdar *et al*., (2003) and Suvija*et al*., (2016), discovered similar outcomes in chrysanthemum.

3.1.6 Fresh flower weight (g)

Significant difference of fresh weight of flower was observed in different varieties of

chrysanthemum. Maximum fresh weight of flower (63.67 gm) recorded in cultivar 'Marigold' followed by cv. 'Poornima Yellow' (46.00 gm). In cv. 'Poornima Red' minimum fresh weight of flower was observed (21.00 gm). The variance can be attributed to larger flower sizes characterized by prominent central disc florets and an increased number of well-developed ray florets, as outlined by Keerthi *et al.,* (2017). There might be a correlation between the size and weight of flowers. According to Byadwal*et al*., (2018), the fresh weight of flowers increases with their size. Kumar *et al*., (2017) and Kishan*et al*., (2007), showed similar findings in variance owing to blossom size in chrysanthemum.

Cultivar 'Marigold' recorded maximum dry weight of flower (14.41gm) followed by cv. 'Poornima Pink' (13.67 gm). Minimum dry weight of flower was observed in cv. 'Calcutta Shantini' (5.90 gm). Then variation in weight of dry flower was may be due to reduced flower diameter, number of ray florets in dry matter content (Wasternack, 2006) and (Ataei et al, 2013).

3.2 Yield Parameters

3.2.1 Number of flower plucking

Distinct variations in the number of flower pluckings were observed among different chrysanthemum varieties. 'Karnool' cultivar yielded the highest number of plucking (3.93), statistically equivalent to cv. 'Poornima Pink' (3.87). There might be a number of reasons for the increase in flower plucking, including genetic variety variation, increased main branching, and environmental factors acting in concert. Similar results in gaillardia were reported by Girange*et al*., (2016) and Byadwal*et al*., (2018).

3.2.2 Yield per hectare (q/ha)

Poornima Yellow' (326.78 q/ha) recorded maximum while cv.'Poornima Pink' (90.10 q/ha) recorded minimum flower yield per hectare. Differences in yield of flower among different varieties may be attributed to the cumulative effect of additive genes, as suggested by Behera *et al.,* (2002). Increased floral weight and size, as well as more number of flowers per plant, contributed to the increased flower yield. According to Munikrishnappa*et al*., (2013), varieties with higher dry matter buildup probably contributed to the higher bloom production. Srilatha *et al*., (2015) noted that greater yields may be a result of both a higher number of flowers and increased flower weight. The increased number of leaves may contribute to the creation and accumulation of photosynthetic material, which in turn produces more flowers with larger sizes, as noted by Kumar *et al*., (2017). This might explain the rise in yield of flower. Concurrent findings reported in carnation and marigold by Patil, (2001) and Naik *et al.,* (2019), respectively.

3.2.3 Flower yield per plant (g)

Significant variation was recorded in the treatments with respect to flower yield per plant. Among all the varieties 'Poornima Yellow' (522.86 gm) was recorded maximum flower yield per plant while cv. 'Poornima Pink' (144.17gm) recorded minimum flower yield was recorded in. According to Baskaran *et al*., (2009), a greater rate of water absorption relative to the transpiration rate may also be responsible for the variations in flower output that have been found across the types. The weight of flowers on a plant is closely connected with the quantity of flowers on a plant, which might account for variation in flower production per plant (2014). Increases in morphological characteristics such as plant height, leaf count, and leaf area may have led to the generation of additional photosynthates, which in turn increased the amount of dry matter that accumulated in the rose plant and explained the yield variation (2014).

3.2.4 Number of flowers per plant

Calcutta Shantini' (269.90) followed by cv. 'Poornima Red' (213.20) showed maximum number of flowers, and in cv. 'Poornima Pink' (51.02) minimum number of flowers per plant was observed. The maximum yield was obtained by varying the number of flowers per plant, mainly because more flower buds were produced overall when more branches were started per plant (Prabhu et al, 2018). Differences in the number of flowers per plant among varieties may arise from variations in the number of floret spikes. Genetic variables that control physiological processes and affect the synthesis of proteins and amino acids necessary for growth and development may be connected to this variance (Bajaraya et al, 2018). Similar finding by Nagaraju and Parthasarathy, (2001), in gladiolus and found varietal differences for floret size have been reported.

Table 1. Analysis of chrysanthemum genotypes for floral and yield and quality parameters

Genotypes	First flower bud emergence (days)	Fifty per-cent flowering (days)	Flower diameter (cm)	Flower stalk length (cm)	No of ray florets	Fresh flower weight (gm)	Dry flower weight (gm)	No. of flowers/ plant	Flower yield/ plant (gm)	No. of flower plucking	Yield/ hectare (q/ha)	Shelf life of flowers (days)	Vase life of flowers
Marigold	40.33	74.39	6.38	8.26	237.50	63.67	14.41	52.20	205.30	3.32	128.31	4.67	12.13
Poornima Pink	41.33	75.39	6.36	13.09	187.66	43.00	13.67	51.02	144.17	3.87	90.10	4.07	11.50
Dall White	36.92	67.90	6.34	11.96	194.50	36.00	1023	98.05	324.59	3.07	202.87	3.17	9.43
Calcutta Shantini	51.50	78.76	4.23	9.80	133.66	26.00	5.90	269.90	419.88	2.10	262.42	3.42	9.90
Karnool	40.58	71.26	7.12	11.45	137	27.33	6.27	101.50	232.16	3.93	145.09	2.58	7.80
Poornima Red	48.58	80.44	4.68	8.46	197.5	21.00	6.97	213.20	264.38	3.17	165.24	2.72	10.50
Dall Yellow	37.13	67.64	6.22	11.03	201.50	35.00	8.27	120.02	291.48	3.27	182.17	1.97	9.03
Poornima White	47.20	75.64	7.40	11.33	233.66	43.33	11.12	117.58	444.40	2.99	277.75	2.87	8.93
Poornima Yellow	46.38	77.02	6.75	10.72	199.00	46.00	11.73	141.47	522.86	2.95	326.78	2.88	9.50
Dundi	38.42	71.75	7.47	11.44	167.50	32.67	6.27	139.63	372.31	3.73	232.69	2.56	8.03
Mean	42.83	74.00	6.29	10.75	188.95	37.40	9.48	130.45	322.15	3.23	201.34	3.08	9.67
SEm±	0.32	0.68	0.08	0.17	1.18	0.63	0.15	8.74	16.84	0.15	10.53	0.18	0.21
CD 5%	0.95	2.04	0.26	0.52	3.52	1.89	0.45	25.97	50.05	0.45	31.28	0.54	0.63

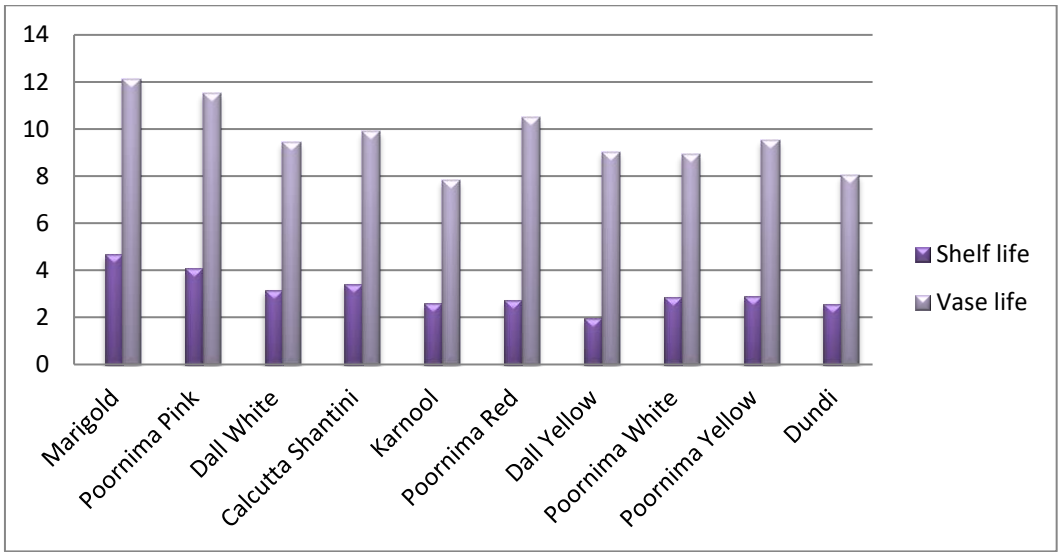

Fig. 1. Performance of Chrysanthemum varieties with respect to shelf life and vase life (days)

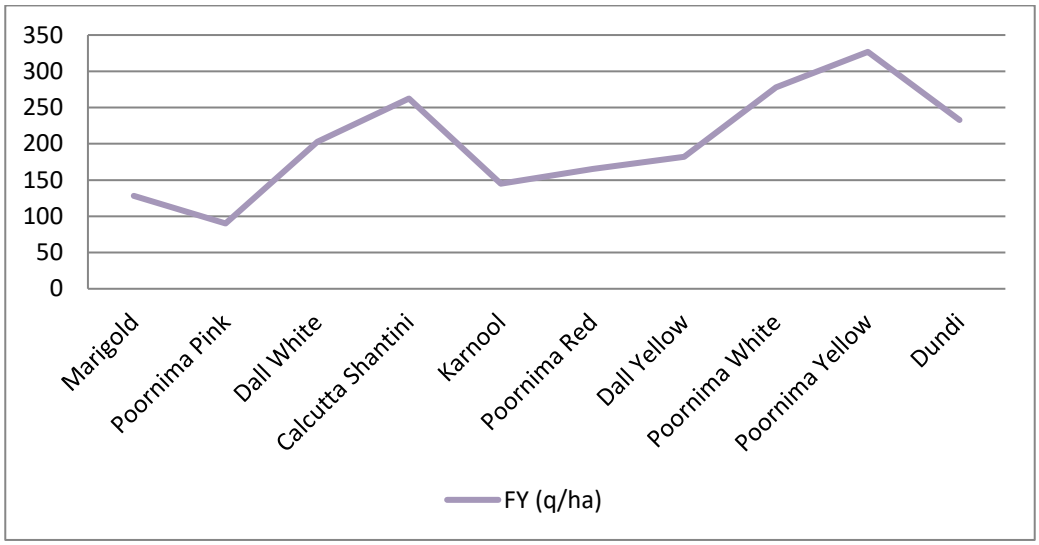

Fig. 2. Performance of Chrysanthemum varieties with respect flower yield per hectare

3.3 Quality Parameters

3.3.1 Shelf life of flowers (days)

A significant difference for shelf life of flower was observed in different varieties of chrysanthemum. Cultivar 'Marigold' recorded maximum shelf life of flower (4.67days) followed by cv. 'Poornima Pink' (4.07 days). Minimum shelf life of flower was observed in cv. 'Dall Yellow' (1.97 days). Differences in the shelf life among varieties could be attributed to varying levels of stored carbohydrates in the plant. This variability might arise from differences in photosynthesis production among the varieties, influenced by variations in their photosynthetic area. Thus, it is possible to draw the conclusion that genetic differences lead to varying levels of carbohydrate buildup, which in turn determines how long flowers last on the shelf (Kumar et al 2007).Increased photosynthetic activity as seen by an increase in dry matter accumulation may have come from having more leaves, which may have contributed to a prolonged shelf life (Dharmendra et al, 2019). Comparable results were noted by Munikrishnappa*et al*., (2013), in China aster and Patil *et al*., (2003), in gladiolus.

3.3.2 Vase life of flowers (days)

Among all the varieties 'Marigold' recorded maximum vase life of flowers (12.13 days).

Changes in cultivar sensitivity to ethylene and changes in these features may be caused by genotype differences in genetic composition. Variations in vase life may also result from differences in the accumulation of carbohydrates as a result of varying leaf development (Vetrivel and Jawaharlal 2014). Concurrent result was also reported by Kavita *et al*., (2003), in gerbera.

4. CONCLUSION

The research findings indicated that the highest yield per plant demonstrated by 'Poornima Yellow' and projected flower yield per hectare, while the 'Marigold' cultivar exhibited the longest shelf and vase life. However, despite these results, 'Poornima White', 'Dall White', and 'Marigold' cultivars gained popularity in the local market owing to their visually appealing color and attractive flower appearance. This study helps identify chrysanthemum varieties that perform well under Jhalawar's conditions, guiding farmers and floriculturists in selecting high-yielding, quality varieties suited to local climate. Insights into genetic traits also support breeders in developing improved varieties, enhancing productivity, flower quality, and income potential. Ultimately, the findings promote sustainable floriculture and boost the economic viability of chrysanthemum cultivation in the region.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

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Details of the AI usage are given below:

1.Quilbot

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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