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Assessing Chrysanthemum Varietal Performance and Genetic Variability under Jhalawar, Rajasthan Condition

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Authors' contributions

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

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ABSTRACT

In the backdrop of Jhalawar's unique climate, a comprehensive experiment was undertaken in 2019-20 to scrutinize the genetic variability and performance of ten distinct chrysanthemum varieties. The selected genotypes include Marigold, Poornima Pink, Dall White, Calcutta Shantini, Karnool, Poornima Red, Dall Yellow, Poornima White, Poornima Yellow and Dundi, each offering a unique perspective on varietal performance under the Jhalawar condition. The investigation carefully investigated ten chrysanthemum genotypes using a randomised block design with three replications. Different features were noted for each variety among them. Notably, Poornima Pink soared to the highest plant height at 37.70 cm, while Dall White exhibited the maximum main stem diameter at 1.39 cm. Calcutta Shantini stood out with highest no of leaves 331.80 and 269.90 flowers per plant. Karnool displayed maximum leaf width (7.37 cm) and flower plucking frequency (3.93), while the maximum plant spread in both E-W and N-S directions (40.83 cm and 40.20 cm, respectively) showed by Poornima White boasted, along with the highest count of primary branches per plant (7.50). Poornima Yellow demonstrated exceptional flower yield (522.86 gm) and estimated yield per hectare (326.78 q/ha). Furthermore, a maximum leaf length of 9.42 cm was recorded, showcasing the diverse attributes of these chrysanthemum varieties under the Jhalawar condition.

Keywords: Evaluation; genetic variability; varietal performance; genotype.

1. INTRODUCTION

As a prominent commercial flower crop, chrysanthemum is grown for potted mums, loose blooms, and cut flowers and belongs to the Asteraceae family. This floral species holds significance both as an ornamental delight and a medicinal resource. Originating in East Asia, it has graced gardens for over 2500 years. Chrysanthemum, scientifically known as *Dendranthema grandiflora* Tzvelve, is a member of the Asteraceae family. It is thought to originate from the northern hemisphere, predominantly Europe and Asia. The species possesses a basic chromosome number of n=9. Interestingly, various cultivars exhibit a wide range of ploidy levels, with chromosome counts observed at 2n=36, 45, 47, 71, and 75. Chrysanthemum species encompass both annual and perennial herbs, occasionally exhibiting woody characteristics. The distinctive inflorescence of the chrysanthemum is referred to as a capitulum, characterized by a multitude of minute florets densely clustered on a flattened stem end, creating the illusion of a single bloom. Disc florets within the capitulum are bisexual, whilst ray flowers are pistillate. The involucre scales can be arranged in an overlapping or cylindrical pattern, and the bare receptacle can have a flat or convex form. Globally, chrysanthemum stands as the second most economically important flower crop after the rose, holding immense significance as an ornamental species. In Karnataka, Tamil Nadu, Maharashtra, Rajasthan, Madhya Pradesh, and Bihar. Kolkata, Lucknow, Delhi, Chennai, and Bengaluru are among the cities where it is well-liked and is grown commercially, chrysanthemums are cultivated in Karnataka, across an expanse of 24,660 hectares, yielding a total production of 185,370 metric tons (Anonymous, 2020). Kumar, 2014 stated that utilizing genetic diversity serves as a vital reservoir of genes in enhancing crop yields and developing high-performing varieties and hybrids. For effectively integrating new traits into commercial ornamental crops, accessing to a broad germplasm pool is essential (Anderson, 2006). Panwar et al*.,* 2013 stated that for the success of any hybridization program understanding the extent of variability within a crop species holds significant importance.

2. MATERIALS AND METHODS

The study was conducted in 2019-20 at College of Horticulture & Forestry, Jhalrapatan City, Jhalawar. The experiment involved ten treatments and was conducted under open field conditions. The statistical design used for the experiment was a randomized block design, with three replications. Evaluation of several chrysanthemum cultivars in the unique environmental circumstances of Jhalawar was the main objective. Jhalawar has varied climatic condition which includes a sub-humid climate that is characterised by high summer and winter temperatures, heavy rainfall, and moderate relative humidity.

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

The data for growth parameters are presented in Table 1. The evaluated data showed that the

plant height was highest in 'Poornima Pink,' measuring 37.70 cm followed by cv. 'Dundi' (36.73 cm). Conversely, shortest plants were observed in the cv. 'Poornima Red' (30.37 cm). The genetic heterogeneity among the various genotypes is mostly responsible for the variations in plant height (Behera et al., 2002). The observed differences in plant height may arise from a combination of factors, including the genetic characteristics of the genotypes, variations in pot mixtures and environmental variables such as, maximum and minimum temperatures, light intensity as well as the nutritional composition of the growing media. *etc.* (Prabhu et al., 2018). The number of primary branches/plant was varied notably, cv. 'Poornima White' (7.50), followed closely by cv. 'Poornima Yellow' (7.20) and cv. 'Marigold' (7.17) recorded highest count. Conversely, the in cv. 'Karnool' (4.27) documented less number of primary branches. The local soil and climate, which may have impacted the many dahlia cultivars, may also be connected to the variance in number of branches (Bajaraya et al., 2018). Significant variations were noted in the main stem diameters observed. Cultivar 'Dall White' exhibited the highest main stem diameter (1.39 cm), with cv. 'Karnool' following closely at 1.20 cm. Conversely, in the cv. 'Dall Yellow' (0.81 cm) main stem diameter was observed to be lowest. The genetic makeup of the types, which may have been further modified by environmental variables, may be responsible for the strength and robustness of stem development as well as the thinness and fragility of stems (Rajivrt et al 2007). The maximum number of leaves per plant was recorded in Calcutta Shantini (331.83), which was followed by the cultivars "Poornima Red" (273.52), "Poornima Yellow" (253.33), and "Poornima White" (251.67). The minimum number of leaves recorded is 95.33 in cv. 'Marigold'. The augmentation of number of leaves/plant could be a result of the coordinated uptake of nutrients and photosynthetic assimilation, facilitated by temperature and optimal relative humidity conditions during the phase of vegetative growth (Bajaraya et al., 2018). These outcomes are concurrent to studies of Ali et al., (2015). The average leaf length recorded was 7.42 cm. Among the genotypes, longest leaf length (9.42 cm), exhibited by cv. 'Dundi' which were statistically at par to cv. 'Marigold' (9.13 cm), followed by cv. 'Karnool' (8.44 cm). Conversely, in cv. 'Poornima Red' the leaf length was minimum (5.62 cm). The maximum leaf width (7.54 cm) exhibited byCultivar 'Karnool' which was statistically at par (7.25 cm) with cv. 'Marigold' while cv. 'Calcutta Shantini' showed minimum leaf width (3.77 cm). Variation in leaf length and width could arise from both an increased leaf count and variations in individual leaf size, as noted in chrysanthemum by Punetha et al. (2011). As stated by Nair and Shiva (2003), the influence of additive gene effects was responsible for variations in leaf area may signify, as demonstrated in gerbera. From the data recorded for plant spread showed the significant variation in the different treatments. Cultivar 'Poornima White' recorded highest plant spread (40.83 cm and 40.20 cm) in east-west and north south direction correspondingly. Minimum spreading of plant observed in cv. Dall Yellow' (30.63 cm) in the east-west direction and in cv. 'Poornima Pink' (33.33 cm) in the north-south direction. According to Singh et al. (2017), a wider plant spread indicates improved vegetative growth. Innate genetic features of the plant and an increase in the number of branches per plant may both contribute to this enhanced dispersion. Prabhu et al., 2018). Niki et al. (2016) also observed similar findings.

3.2 Yield Parameters

Table 2 presented yield parameter data. Maximum number of flowers per plant was observed in cultivar 'Calcutta Shantini' (269.90) followed by cv. 'Poornima Red' (213.20) and conversely, lowest in cv. 'Poornima Pink' (51.02). Behera et al. (2002) and Balaji et al. (2004) reported that additive gene effects were responsible for the genotype-to-genotype differences in yield potential. Regarding the number of flowers per plant, the greater count in some varieties may be explained by the initiation of more branches per plant, consequently leading to the production of a high amount of flower buds per plant and ultimately increasing yield, as suggested by Prabhu et al. (2018). Number of flower plucking recorded the maximum in cv. 'Karnool' (3.93) which was statistically comparable with cv. 'Poornima Pink' and cv. 'Dundi' (3.87, 3.73 respectively). In cv. 'Calcutta Shantini' number of flower plucking was found minimum (2.10). The genetic composition of the kinds, in conjunction with a greater quantity of main branches, as well as the influence of environmental conditions and their interplay, might all be contributing causes to the rise in the frequency of flower plucking. Concurrent results were observed in gaillardia by Girahge et al., (2016) and Byadwal et al., (2018). The cultivar "Poornima Yellow" (522.86 gm) produced the most flowers, followed by cv.

"Poornima White" (444.40 gm). The cultivar "Poornima Pink" has the lowest documented flower yield (144.17 gm). The differences in flower production across the kinds could possibly be related to a higher rate of water absorption than transpiration (Baskaran et al., 2010). The weight of flowers on each plant, which is directly correlated with the quantity of flowers produced, may have an impact on the variations in flower production per plant (Sharma, 2014). Changes in morphological parameters including plant height, number of leaves, and leaf area might be the cause of the production fluctuations. These elements may increase photosynthate synthesis, which in turn may cause rose bushes to accumulate more dry matter (Ramzan et al., 2014). The cultivars "Poornima Yellow" (326.78 q/ha) followed by "Poornima White" (277.75 q/ha), "Calcutta Shantini" (277.75 q/ha), and "Dundi" (232.00 q/ha) had the highest estimated flower production per hectare. The variety "Poornima Pink" had the lowest flower output per hectare (90.10 q/ha). Greater flower size and weight, as well as more flowers per plant, are associated with better flower yields. Varieties with higher accumulation of dry matter most likely played a major role in improving flower yield (Munikrishnappa et al., 2013). A larger number of leaves may have contributed to the increase in flower yield by enabling the creation and accumulation of the most photosynthetic material possible. As a result, more flowers with bigger sizes were produced in greater quantities (Kumar et al., 2017).

Table 1. Analysis of chrysanthemum genotypes for vegetative parameters

Genotypes	PH	NPB	NLPP	MSD	LL	LW	PS (E-W)	PS (N-S)
Marigold	30.63	7.17	93.53	1.13	9.13	7.25	35.07	35.90
Poornima Pink	37.70	4.77	115.17	0.81	6.08	3.95	34.07	33.33
Dall White	30.76	4.97	243.53	1.39	7.58	5.79	36.23	34.83
Calcutta Shantini	33.30	5.57	331.83	0.92	5.87	3.77	36.50	35.70
Karnool	35.70	4.27	186.45	1.20	8.44	7.54	40.23	38.67
Poornima Red	30.37	6.03	273.52	0.92	5.62	4.13	36.75	38.90
Dall Yellow	34.57	6.30	197.17	0.94	7.13	5.33	30.63	35.30
Poornima White	35.43	7.50	251.67	1.01	7.25	5.55	40.83	40.20
Poornima Yellow	33.97	7.20	253.53	1.01	7.68	5.87	33.10	39.80
Dundi	36.73	6.30	182.50	1.16	9.42	7.18	34.92	39.30
Mean	33.61	6.00	212.89	1.04	7.42	5.63	35.83	37.19
SEm±	0.43	0.50	3.56	0.48	0.16	0.53	0.61	0.50
CD 5%	1.30	1.46	10.58	0.21	1.43	0.49	1.54	1.75

PH- Plant Height (cm) *NPB- Number of primary branches*
NLPP- Number of leaves per plant *MSD- Main stem diameter (cm)*
LL-Leaf length (cm) *LW- Leaf width (cm)*
PS (E-W)- Plant spread (East- West) in cm *PS (N-S)- Plant spread (North- South) in cm*

Table 2. Analysis of chrysanthemum genotypes for yield parameters

Treatments	Number of flowers/plant	Flower yield/ plant(gm)	Number of flower plucking	Flower yield/ ha (q/ha)
Marigold	52.20	205.30	3.32	128.31
Poornima Pink	51.02	144.17	3.87	90.10
Dall White	98.05	324.59	3.07	202.87
Calcutta Shantini	269.90	419.88	2.10	262.42
Karnool	101.50	232.16	3.93	145.09
Poornima Red	213.20	264.38	3.17	165.24
Dall Yellow	120.02	291.48	3.27	182.17
Poornima White	117.58	444.40	2.99	277.75
Poornima Yellow	141.47	522.86	2.95	326.78
Dundi	139.63	372.31	3.73	232.69
Mean	130.45	322.15	3.23	201.34
SEm±	8.74	16.84	0.153	10.53
CD 5%	25.97	50.058	0.456	31.28

4. CONCLUSION

The study found that cv. 'Poornima Yellow' had the maximum anticipated flower production per hectare as well as the maximum yield per plant. However, due to attractive colors and appealing flower appearance in the local market cv. 'Poornima White', cv. 'Dall White', and cv. 'Marigold' became more popular. This study assists farmers and floriculturists in choosing high-yielding, high-quality chrysanthemum cultivars that are appropriate for the local climate by identifying those that thrive in Jhalawar. Breeders can create superior varieties that increase productivity, floral quality, and economic potential by using insights into genetic features. In the end, the results increase the economic feasibility of chrysanthemum cultivation in the area and support sustainable floriculture.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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