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Evaluation of chrysanthemum (*Dendranthema grandiflora* Tzelve) varieties for growth, quality and yield under eastern dry zones of Karnataka

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Abstract

The present investigation was carried out at the experimental block of the Department of Floriculture and Landscape Architecture, College of Horticulture, Bengaluru. The experiment was laid out using a Randomised Complete Block Design with three replications to evaluate and identify the best performing chrysanthemum cultivar for commercial cultivation for Eastern Dry Zone of Karnataka. Among the ten chrysanthemum cultivars evaluated, the cv. Cream white recorded a higher plant height of 81.40 cm and the cv. Hemmady local recorded maximum plant spread in both East-West (61.73 cm) and North-South directions (59.20 cm), produced maximum number of primary (19.00) and secondary branches per plant (36.93) at the grand growth stage. Also recorded maximum duration of flowering (40.00 days), more number of flowers per plant (238.20) and higher stomatal frequency (3.53/0.13 mm²) on the upper surface of the leaves. The cv. Chandini recorded maximum yield per hectare (10.40 t/ha) with maximum duration flowering (36.67 days). The cv. Kaveri Orange produced bigger flower having the flower diameter of 5.73 cm and longer shelf life in both ambient (4.33 days) and in refrigerated (3-5 °C) conditions (12.00 days). Days to 50 percent of flowering (88.33 days) was early in cv. Scent Yellow also recorded highest chlorophyll content of 67.95 SPAD values. The cv. Poornima Yellow recorded highest relative water content of 63.98 percent and cv. Red ruby recorded highest stomatal frequency on the lower surface (11.13/0.13 mm²) of the leaf. Thus, out of 10 cultivars screened, cv. Chandini, cv. Hemmady Local and cv. Kaveri Orange were found highly suitable for commercial cultivation under the Eastern dry zones of Karnataka.

Keywords: Chrysanthemum, vegetative growth, quality, yield, flowering

Introduction

Floriculture is a fast-emerging competitive industry in India owing to its varied agro-climatic conditions. Globally, more than 140 countries are involved in the cultivation of floricultural crops. In India, the major cut flower and loose flower growing states are West Bengal, Karnataka, Maharashtra, Tamil Nadu and Andhra Pradesh and the major loose flowers cultivated are Jasmine, Rose, Chrysanthemum, Marigold and Tuberose. Chrysanthemum (*Dendranthema grandiflora* T.) ranks second in the national loose flower market. It is commonly known as Guldaudi, Autumn Queen or Queen of the East and belongs to the family Asteraceae. The wide variation in flower colours, sizes, petal shapes and structures make it more valuable flower crop for different purposes, viz. loose flower, cut flower, pot mums and as garden plant. It is cultivated over a wide range of climatic conditions, but the growth of a definite cultivar varies with environmental factors like temperature and photoperiod. The successful cultivation of chrysanthemums depends on the interaction of the cultivar with the specific environment where it is growing. Every year many numbers of cultivars are introduced in chrysanthemums depending on the preferences of the farmers and consumers. Hence, identifying the suitable cultivars for a particular region for determined purpose is very imperative in chrysanthemums. Evaluation of new genotypes for new environments is always necessary to study the quality traits under varying climatic conditions. In view of the above facts, the present research was conducted to assess the performance of different varieties of chrysanthemum for loose flowers under the Eastern Dry Zone of Karnataka.

Material and Methods

An experiment was conducted to evaluate ten different chrysanthemum cultivars under the Eastern dry zones of the state at the experimental plot of the Floriculture Department of College of Horticulture, Bengaluru, during the rainy season of 2021. The cultivars included for screening are Marigold, Red Ruby, Poornima White, Chandini, Hemmady Local, Poornima Yellow, Kaveri Orange, Scent White, Cream White and Scent Yellow. The crop was grown in the open field condition with an average annual rainfall of 915.60 mm at an altitude of 930 meters above mean sea level at a latitude of 12°58' North and a longitude of 77°35' east. The rooted chrysanthemum cuttings were planted at a distance of 60×45 cm apart after adding well rotten FYM at 20 t ha⁻¹ and a fertiliser dose of 120:150:100 kg NPK per hectare in the form of urea, single super phosphate (SSP), and potash muriate. However, nitrogen was applied in three separate doses, the first as a basal dose and the remaining doses after 30 and 45 days after planting. Pinching was done after the plants became 15-20 cm tall and disbudding was practised for up to 60 days. Irrigation, weeding, hoeing and plant protection measures were followed as per the requirement of the crop following standard package of practices (Anon., 2014) [3]. Data were recorded in terms of different plant parameters viz., plant height (cm), plant spread (North-South and East-West direction) (cm), number of primary and secondary branches per plant, days to 50 percent flowering, duration of flowering, flower diameter (cm), number of flowers per plant, the shelf life of flower under ambient and refrigerated condition (days), yield of flower per hectare (t ha⁻¹), stomatal frequency, relative water content and chlorophyll content. The cultivars were planted in three replications, and five plants were selected in each replication for making observations. The data collected are analysed statistically using Randomised Complete Block Design.

Results and Discussion

The data pertaining to plant height, plant spread (North-South and East-West direction) and number of primary and secondary branches at the grand growth stage (90 days after planting) of different chrysanthemum varieties are presented in Table 1.

At the grand growth stage, cv. Cream White recorded significantly highest plant height (81.40 cm), followed by cv. Hemmady local with 53.93 cm and cv. Chandini with 51.73 cm (2021). On the other hand, the cv. Red Ruby produced minimum plant height of 34.87 cm. The cv. Hemmady local had the maximum plant spread (E-W) of 61.67 cm. This was followed by the cultivars Kaveri Orange (53.07 cm) and Chandini (50.20 cm). The Red Ruby cultivar recorded a minimum plant spread (E-W) of 39.33 cm. The maximum plant spread (N-S) of the cv. Hemmady local was 59.20 cm and was followed by cv. Kaveri Orange (51.07 cm) and cv. Poornima Yellow (49.27 cm). In cv. Red Ruby, a minimum plant spread (N-S) of 38.27 cm, was recorded. With respect to number of branches, cv. Hemmady Local produced maximum number of primary branches per plant (19.00) and secondary branches (36.93). This was followed by cv. Chandini (15.40 and 31.93, respectively). While cv. Marigold recorded minimum number of primary branches (7.73) and secondary branches (14.93) per plant.

The variation in vegetative growth among the cultivars was mainly due to genetic variation among the cultivars as well as it could also be attributed to existing environmental conditions of the respective cultivar (Prashant *et al.*, 2020) [10]. An increased number of branches per plant leads to production of more flower bud, which in turn enhancing the yield of flowers (Singh

et al., 2019) [12]. A similar trend of variation in vegetative growth parameters was observed by Thakur *et al.* (2018) [15] and Thiripurasundari *et al.* (2021) [16] in chrysanthemums.

Flowering attributes and quality parameters like days to 50 percent flowering, duration of flowering, flower diameter and shelflife of flowers are presented in Table 2. Number of days taken for 50 percent flowering was recorded minimum in cv. Scent White (84.67 days), which was on par with cv. Scent Yellow (88.33 days) and cv. Cream White (90.00 days) and days to 50 percent flowering was significantly delayed in cv. Hemmady local (110.33 days). The maximum duration of flowering was recorded in cv. Hemmady local (40.00 days), which was on par with cv. Chandini (36.67 days). It was followed by cv. Marigold (31.33 days) and cv. Poornima White (31.00 days). However, flowering duration was very short in cv. Cream White (28.00 days).

The variation in flowering attributes among the varieties was attributed to the genetic makeup of the cultivar, prevailing environmental condition with an average temperature of 18°C during night and 26°C during day condition, average relative humidity of 75 percent and long day during planting and other management factors (Thakur *et al.*, 2018) [15]. Similar results were also reported by Srilatha *et al.* (2015) [13]; Suvija *et al.* (2016) [14]; Madhumati *et al.* (2018) [9] and Thiripurasundari *et al.* (2021) [16] in chrysanthemum.

Flower quality and yield parameters like 100 flower weight, flower diameter, shelf life under ambient and refrigerated (3-5°C) conditions and yield per hectare are presented in Table 3. Significantly maximum flower diameter was recorded in cv. Kaveri Orange (5.73 cm), which was on par with cv. Poornima White (5.46 cm), cv. Poornima Yellow (5.29 cm) and cv. Cream White (5.27 cm). Variations in the weight of flowers might also be due to the diameter of the flowers and number of florets present in flower (Beeralingappa., 2016) [4]. The variation in flower size and weight in these cultivars might be attributed to the inherent genetic characteristics of the individual cultivars and environmental factors (Suvija *et al.*, 2016) [14]. A similar type of variations was observed by Madhumati *et al.* (2018) [9] and Thakur *et al.* (2018) [15] in chrysanthemum.

Among the cultivars, cv. Hemmady local registered a maximum number of flowers per plant (238.20) followed by cv. Chandini (135.40). While minimum number of flowers per plant was obtained in cv. Marigold (16.60). The number of flowers produced per plant ultimately determines the vigour of the genotype for the flower production (Suvija *et al.*, 2016) [14]. Similar results were also observed by Thakur *et al.* (2018) [15]; Roopa *et al.* (2018) [11]; Singh *et al.* (2019) [12] and Prasanth *et al.* (2020) [10] in chrysanthemum.

Chrysanthemum cultivars differed significantly with respect to flower yield per hectare. The cv. Chandini recorded the highest flower yield per hectare (10.40 t/ha), followed by cv. Hemmady local (8.72, t/ha), whereas cv. Marigold registered the lowest flower yield of 2.56 t/ha. Variation in flower yield might be due to the genetic makeup of the variety and their interaction with prevailing genotypes and environmental factors (Srilatha *et al.*, 2015) [13]. It is clearly visible that the existence of a relationship between the number of flower production per plant and the number of primary and secondary branches produced per plant is directly related to increasing the flower yield per plant (Singh *et al.*, 2019) [12]. These results conform with the results reported earlier by Suvija *et al.* (2016) [14] and Thiripurasundari *et al.* (2021) [16] in chrysanthemum.

The shelf life of flowers kept under ambient conditions was maximum in cv. Kaveri Orange (4.33 days), which was on par

with cv. Marigold (4.17 days), cv. Red Ruby (4.00 days), cv. Poornima White (4.00 days), cv. Chandini (3.83 days) and cv. Poornima Yellow (3.83 days). While it was minimum in cv. Cream White (3.17 days) and cv. Scent Yellow (3.17 days). Shelf life under refrigerated conditions recorded highest in cv. Kaveri Orange (12.00 days), which was on par with cv. Marigold (11.67 days) followed by cv. Chandini (11.33 days). While minimum shelf life under refrigerated conditions was recorded in cv. Scent Yellow (9.83 days). This variation might be due to differences in the genetic makeup of cultivars, petal arrangement of the flower and also due to influenced by prevailing environmental conditions which affect the physiological processes of flowers like cell turgidity, water loss through evapotranspiration and breakdown of the reserve food, which governs the shelf life of the flower (Beeralingappa *et al.*, 2016) [4]. The most extended shelf life was mainly due to a reduced rate of evaporation and transpiration, prevailing low temperature and low wind velocity. (Suvija *et al.*, 2016) [14]. These variations in the shelf life of flowers might also be due to the difference in the varieties' senescence behaviour by producing higher amounts of ethylene-forming enzymes. (Thiripurasundari *et al.*, 2021) [16]. Similar results were noted by Roopa *et al.* (2018) [11] and Thakur *et al.* (2018) [15] in chrysanthemum.

Physiological parameters like stomatal frequency recorded on upper surface of the leaf varied significantly (Table 3.) and the cv. Hemmady local registered a highest stomatal frequency

(3.53/0.13 mm²) which was on par with cv. Marigold (3.27/0.13 mm²) and it was followed by cv. Red Ruby (2.13/0.13mm²) and cv. Cream White (2.13/0.13 mm²). However, in cv. Poornima White (0.93/0.13 mm²) recorded least stomatal frequency. This variation was due to varietal characteristics, which attributed to their genetic makeup of the genotypes (Zheng and Labeke, 2018) [17]. Similar results were recorded by Fanourakis *et al.* (2022) [6] and (Bhattarai *et al.*, 2021) [5] in chrysanthemums.

Chrysanthemum cultivars varied significantly for relative water content (Table 3). Maximum relative water content in leaf was recorded in cv. Poornima Yellow (63.98%), which was on par with cv. Marigold (63.07%), cv. Kaveri Orange (62.07%), cv. Scent White (60.21%), cv. Red Ruby (59.65%), cv. Hemmady local (58.65%) and cv. Chandini (58.03%). While minimum relative water content was recorded in cv. Poornima White (52.22%). The variation for RWC was also noticed by various workers Fanourakis *et al.* (2021) [7] and Fanourakis *et al.* (2022) [6] in chrysanthemum.

The variability for SPAD values was noticed (Table 3). Among the cultivars, the cv. Scent Yellow recorded maximum chlorophyll content (67.95 SPAD value), followed by cv. Marigold (64.74), and cv. Kaveri Orange (62.86), whereas cv. Red Ruby recorded the lowest chlorophyll content of 49.77 SPAD value. This might be due to genetic differences among the cultivars and the effect of environment on it (Hong *et al.*, 2015) [8] and these results were also supported by the work of Amarin *et al.* (2021) [2] and Aind *et al.* (2021) [1].

Table 1: Vegetative parameters in different cultivars of chrysanthemum as influenced by the environment

Cultivars	Plant height (cm)	Plant spread (East-West direction) (cm)	Plant spread (North-South direction) (cm)	Number of primary branches	Number of secondary branches
Marigold	37.27	44.87	42.87	7.73	14.93
Red Ruby	34.87	39.33	38.27	8.60	19.87
Poornima White	40.80	49.67	48.13	13.33	25.53
Chandini	51.73	50.20	48.07	15.40	31.93
Hemmady Local	53.93	61.67	59.20	19.00	36.93
Poornima Yellow	39.80	50.47	49.27	12.60	28.53
Kaveri Orange	43.00	53.07	51.07	10.00	25.13
Scent White	39.27	46.27	45.67	10.47	21.93
Cream White	81.40	48.20	47.27	9.07	20.20
Scent Yellow	39.13	46.33	44.47	10.00	23.67
S. Em. ±	1.79	1.98	1.49	0.95	1.16
CD@5%	5.33	5.89	4.42	2.83	3.44

Table 2: Flowering attributes in different cultivars of chrysanthemum as influenced by the environment

Cultivars	Days to 50% flowering	Duration of flowering (days)	Flower diameter (cm)	Shelf life (days)	
				Ambient condition (days)	Refrigerated condition (3-5 °C) (days)
Marigold	104.67	31.33	4.35	4.17	11.67
Red Ruby	102.67	30.00	4.31	4.00	11.00
Poornima White	98.33	31.00	5.46	4.00	10.67
Chandini	109.00	36.67	5.11	3.83	11.33
Hemmady Local	110.33	40.00	3.67	3.50	11.17
Poornima Yellow	96.00	30.67	5.29	3.83	10.50
Kaveri Orange	95.67	30.33	5.73	4.33	12.00
Scent White	84.67	28.33	4.60	3.33	10.33
Cream White	90.00	28.00	5.27	3.17	11.17
Scent Yellow	88.33	29.67	4.95	3.17	9.83
S. Em. ±	3.13	1.81	0.17	0.22	0.21
CD@5%	9.29	5.39	0.50	0.65	0.62

Table 3: Flower quality and yield attributes in different cultivars of chrysanthemum

Cultivars	Number of flowers per plant	Yield/ha (ton)	Stomatal frequency (No./0.13 mm ²)		Relative water content (%)	Chlorophyll content (SPAD)
			Upper surface	Lower surface		
Marigold	16.60	2.56	3.27	10.00	63.07 (52.65) *	64.74
Red Ruby	87.53	4.19	2.13	11.13	59.65 (50.56)	49.77
Poornima White	47.40	3.36	0.93	8.60	52.22 (46.26)	54.46
Chandini	135.40	10.40	1.80	9.07	58.03 (49.61)	52.61
Hemmady Local	238.20	8.72	3.53	10.27	58.65 (49.97)	49.98
Poornima Yellow	47.00	3.90	1.13	6.87	63.98 (53.10)	51.96
Kaveri Orange	56.27	5.58	2.00	8.20	62.07 (51.99)	62.86
Scent White	55.27	5.95	1.67	8.87	60.21 (50.88)	58.98
Cream White	50.80	4.17	2.13	8.40	54.72 (47.70)	62.47
Scent Yellow	38.87	4.01	1.93	8.47	52.93 (46.66)	67.95
S. Em. ±	7.24	0.42	0.21	0.52	2.59	0.54
CD@5%	21.50	1.24	0.62	1.54	7.68	1.62

*Values in parenthesis are arc sin transformed values

Conclusion

Among chrysanthemum cultivars screened, cvs. Chandini, Hemmady Local and Kaveri Orange were found highly suitable for commercial cultivation for the Eastern dry zones of Karnataka due high yield and quality of flowers.

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