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Evaluation of perennial chrysanthemum cultivars under sub-humid southern plains and Aravali hills of Rajasthan

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ABSTRACT

An investigation was carried out with eleven cultivars of *Dendrenthema grandiflora* L. at Udaipur, Rajasthan to evaluate the cultivars for floral and relative economic parameters. The experiment was laid out in randomized block design with three replications, eleven cultivars by planting 25 plants/ replication and data were recorded on five plants. The data were analyzed by analysis of variance. The maximum plant height (44.21 cm), leaves plant^{-1} (185.87), plant spread from North-South (27.31 cm) and East-West direction (28.34 cm), sprays plant^{-1} (16.73), days to end of flowering (145.33 days), flower duration (63.47 days), freshness of flower on the plant under open field (17.53 days), flowers plant^{-1} (66.86), ten-flower weight (37.30 g), ray floret flower^{-1} (187.60), spray length (34.56 cm), disc floret flower^{-1} (209.27), flower weight plant^{-1} (249.52 g), gross, net returns and B:C ratio were recorded in 'UHF CRY-77'. Minimum days to first bud initiation (71.07 days), first flower bud opening (84.42 days), complete flower opening (92.8 days) were recorded in 'Autumn Joy'. The maximum flower diameter (9.68 cm) recorded in cultivar in cv. Garden Beauty, respectively. On the basis of two years pooled data for vegetative, floral and relative economics parameters cv. UHF CRY-77 for cut flowers followed by 'Jaya' were found best for cut spray purpose and recommended for sub-humid southern plain and Aravalli hills of Rajasthan.

Key words: Cut flower, chrysanthemum, plant spread, flowers plant^{-1}, ray florets.

INTRODUCTION

Chrysanthemum often called mums or this genus (*Chrysanthemum*) contains 30 species a plant belongs to family Asteraceae. *Dendranthema grandiflora* Tzevlrev has basic chromosome number χ = 9 and which is hexaploid in nature, *i.e.* 2n = 54. It is native from Asia and North-Eastern Europe. Chrysanthemum words derived from Greek word '*Chryos*' means golden and '*anthos*' means flower. It is also known as 'Queen of the East' in English, 'Guldaudi' in Hindi and wide variation showed by its large number of cultivars in respect of growth habit, size, colours and shape of bloom make the chrysanthemum suitable for various purposes like cut flower, loose flower, standard and pot mum production. Besides this certain species like *Chrysanthemum cineraiifolium* is grown in temperate regions for making an insecticide called pyrethrum and *C. coccineum* is called 'Painted Daisy' is also grown in temperate countries from seeds. Ryori Giku is a yellow flowering culinary type, which is eaten as delicacy in Japan after frying. However, scanty research works are available on hence, the present investigation was carried out to evaluate perennial chrysanthemum (*D. grandiflora* Tzevelrev) cultivars under sub-humid southern plains and Aravalli hills of Rajasthan.

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MATERIALS AND METHODS

The experiment was conducted at AICRP on Floriculture, Horticulture Farm, RCA Campus, Maharana Pratap University of Agriculture & Technology, Udaipur, Rajasthan during July 2010-April 2012. This is situated at 24º35′ N latitude and 24º42′ E longitude at an altitude of 579.5 m above mean sea level. The region falls under agro-climatic zone IV A-sub humid southern plain and Aravalli hills of Rajasthan. The experiment was conducted on clayey loam soil with pH 8.4 and EC 0.54 dS/m under irrigated conditions. The cultivars used, namely, 'Ajina Purple' (T_1), 'Anmol-F_1' (T_2), 'Autun Joy' (T_3), 'Garden Beauty' (T_4), 'Jaya' (T_5), 'PAU-A-43' (T_6), 'PAU-B-107' (T_7), 'PAU-D-1' (T_8), 'UHFS Chry-83' (T_9), 'UHFS Chry-77' (T_{10}) and 'Winter Queen' (T_{11}). The well-decomposed farm yard manure @ 35 t ha^{-1} was incorporated in all plots 4 week prior to planting. A basal fertilizer dose comprising @ 150 kg N and 150 kg P_2O_5 ha^{-1} at planting time and remaining 150 kg of N was applied at 30 days after planting as suggested by Chawla *et al.* (3). Uniform cultural practices were adopted during the experiment. The terminal rooted cutting was planted at 30 cm row to row and 30 cm from plant to plant on well prepared bed during July, 2010 and 2011 with bed size 1.5 × 1.5 m^2 on flood irrigation system in three replications and 11 varieties used as a treatment in randomized block design. The

observations were recorded on various parameters, *viz*. plant height, number of leaves, plant spread, number of spray, days to first bud initiation, days to first flower bud opening, days to complete flower opening, days to end of flowering, flowering duration, freshness of the flower on the plant under field, flower colour, flower diameter, flowers plant^{-1}, weight of ten flowers, ray floret flower^{-1}, spray length, disc floret flower^{-1}, flower yield plant^{-1}, cost of production, spray yield, suckers, gross returns, net returns ha^{-1} and B:C ratio. The data were recorded on five plants and all the mean value of the recorded data were statistically analyzed as per the method suggested by Gomez and Gomez (7) at 5% level of significance.

RESULTS AND DISCUSSION

Out of eleven cultivars evaluated for their vegetative, floral and economic parameters the pooled data revealed in Table 1 showed significant difference for plant height. The maximum plant height was recorded in cv. UHFS CHRY-77 (44.21 cm), whereas, it was minimum in 'Autumn Joy' (17.87 cm). This variation in plant height among various cultivars may be due to the hereditary traits and prevailing environmental conditions, which resulted in varied growth rate. Similar results were recorded by Rao and Partap (15) who found that plant height ranges from cv. Punjab Gold (25.80 cm) to Neelima (57.33 cm) in chrysanthemum.

Whereas, pooled data revealed that there was a significant difference in number of leaves plant^{-1} among all the cultivars at the stage of the first bud initiation. The maximum leaves plant^{-1}, *i.e.* 185.87 was recorded in cv. UHFS CHRY-77 at time of first bud initiation. The variation in number of leaves plant^{-1} among different cultivars might be due to the distinguished varietal inherent genetic makeup of a particular cultivar as a result, variations in phenotypic expression were expected to occur. Hence, wide variations for vegetative characters were observed.

However, pooled data indicated for maximum plant spread from North-South (27.31 cm) and east-west direction (28.34 cm) were obtained in cv. UHFS CHRY-77. Whereas, minimum north-south (11.69 cm) and east west (12.07 cm) plant spread were observed in 'UHFS CHRY-83', while rest of the cultivar came in between the range. This plant spread increase was mainly due to production of increased number of branches and wider angles from point of origin. Greater plant spread shows better vegetative growth of plant. Present findings are in conformity with the findings of Peddi *et al.* (12) who reported range of earlier cv. (18.47 cm) 'Basanthi' to (34.77 cm) 'Raichur' in chrysanthemum showing much variation.

The pooled data revealed that there was a significant difference among all the cultivars with respect to number of spray produced plant^{-1}. The maximum number of sprays plant^{-1} were recorded in cv. UHFS CHRY-77 (16.73), which was statistically at *par* with cv. Jaya (15.33), while minimum number of sprays plant^{-1} were noted in cv. UHFS CHRY-83 (5.93). Present findings for number of sprays

Table 1. Vegetative and floral parameters in perennial chrysanthemum under sub-humid southern plains and Aravalli hills of Rajasthan.

Cultivar	Plant height (cm)	No. of leaves plant^{-1}	Plant spread North-South (cm)	Plant spread East-West (cm)	Spray plant^{-1}	First bud initiation (days)	Flower bud opening (days)	Complete flower bud opened (days)
Ajina Purple	20.83	100.98	17.47	16.52	8.60	79.42	99.02	105.68
Anmol F-1	21.54	61.93	25.55	26.33	9.27	96.87	111.92	118.02
Autman Joy	17.87	76.00	14.51	15.39	8.53	71.07	84.42	92.80
Garden Beauty	35.15	45.63	24.45	23.48	9.20	79.78	98.57	105.47
Jaya	37.93	79.40	21.45	21.47	15.33	79.87	101.93	109.20
PAU A-43	25.91	129.77	26.33	25.90	14.60	92.07	110.20	115.93
PAU B-107	25.24	41.12	24.28	23.22	11.67	80.05	99.48	107.02
PAU D-1	34.45	153.53	26.87	26.93	12.13	79.93	96.73	105.00
UHFS CRY-83	21.61	29.53	11.69	12.07	5.93	80.27	99.80	106.60
UHFS CRY-77	44.21	185.87	27.31	28.34	16.73	78.53	95.33	101.73
Winter Queen	35.23	173.80	25.12	24.01	10.00	80.00	99.93	107.00
$CD_{0.05}$	2.22	5.60	2.06	1.60	1.23	5.20	6.25	4.57

plant^{-1} are in conformity with the findings reported by Gaikwad and Dumbre-Patil (6) that range from cv. (11.88), Mountaineer to (20.16), Indira in chrysanthemum and Kumar *et al*. (8) in dahlia cv. Jyotsna (11.67).

Whereas, pooled data indicate that days to first bud initiation was earlier in cv. Autumn Joy (71.07 days), followed by UHFS CHRY-77 (78.53 days), whereas it was very late in Anmol F_1 (96.87 days). Similar findings are reported by Swaroop *et al.* (16), which ranges from 80.66 days (Yellow Bangla) to 108.33 days (Thai Chin Queen) in chrysanthemum. The variation in number of days to first bud initiation was primarily due to the different genetic constitution of various cultivars under prevailing environmental conditions during the period of crop growth.

Moreover, pooled data indicated days to first flower bud opening ranged from a minimum in 84.42 days (Autumn Joy) to a maximum in 111.92 days (Anmol F_1) days after transplanting. Present findings are in conformity with the findings of Peddi *et al.* (12) as reported minimum days to first flower bud initiation observed in cv. CO-1 (63.46 days) to maximum in cv. Raichur (97.67 days), Swaroop *et al.* (16) found first bud initiation of 83.50 days in cv. Thai Chin Queen, Rao and Pratap (15) reported the range from 77.00 days in cv. Ravikiran to 86.00 days in cv. Yellow Gold in chrysanthemum and Kumar *et al.* (8) found cv. NT Pompon with bud initiation of 81.60 days in dahlia. This variation in number of days to first flower bud opening in various cultivars of chrysanthemum may be due to different genetic makeup and prevailing environmental conditions.

Although, pooled data revealed that maximum days to complete flower opening after transplanting were recorded 118.02 days in cv. Anmol F_1 followed by PAU A-43 (115.93 days), whereas, minimum in Autumn Joy (92.8 days) . The present findings are in close conformity with the results of Mishra *et al*. (11) in dahlia. Similar findings were also noted by Kumar *et al*. (8) in dahlia, *i.e.* 113.57 to 136.07 days and Rao and Pratap (15) in chrysanthemum. This variation may be attributed because of varied genetic makeup of different cultivars along with prevailing environmental conditions.

Whereas, pooled data are presented in Table 2 showed significant differences among different cultivars with respect to days to end of flowering under study. The longest duration taken to end of flowering was noted in cv. UHFS CRY-77 (145.33 days) followed by Jaya (145.30 days), and Ajina Purple (144.62 days) were statistically at par, while it was shortest in 'Autumn Joy' (129.13 days). This variation in days to end of flowering among various cultivars may be due to the hereditary traits and prevailing environmental conditions, which resulted in varied growth rate. In chrysanthemum similar findings are reported by Peddi *et al.* (12), *i.e.* which range from 102.33 (Co-1) to 151.0 days (Raichur).

However, pooled data indicated highly significant variation for flower duration which ranges from a minimum in 'PAU A-43' (48.23 days) to maximum in 'UHFS CHRY-77' (63.47 days). Present results are in close conformity with the findings obtained by Deepa and Chezhiyan (4) showing range of 47.50 days (Acc1) to 89.50 days (Acc3). Earlier, Swaroop *et al.*

Table 2. Floral parameters in chrysanthemum under sub-humid southern plains and Aravalli hills of Rajasthan.

Cultivar	End of flowering (days)	Flower duration (days)	Freshness of flower (days)	Flower plant^{-1}	Flower dia. (cm)	Ten-flower wt. (g)	Ray florets flower^{-1}	Spray length (cm)	Disc floret flower^{-1}
Ajina Purple	144.62	49.40	14.87	28.47	4.09	9.18	92.48	12.68	62.30
Anmol F-1	141.13	56.33	15.33	31.95	3.99	8.79	28.80	14.99	139.47
Autumn Joy	129.13	49.28	16.13	25.96	6.53	21.74	131.73	12.46	29.80
Garden Beauty	136.74	48.75	15.28	32.23	9.68	17.43	49.05	25.92	171.13
Jaya	145.30	60.15	16.98	59.74	6.01	32.63	170.13	26.52	90.87
PAU A-43	139.60	48.23	14.13	52.76	6.73	10.77	50.73	18.81	147.33
PAU B-107	139.03	49.87	14.73	40.76	6.05	28.27	148.33	18.67	28.40
PAU D-1	139.78	53.90	14.40	43.04	6.25	30.96	154.00	24.95	60.07
UHFS CRY-83	137.77	48.40	12.53	15.62	3.70	9.92	182.40	14.89	12.07
UHFS CRY-77	145.33	63.47	17.53	66.86	7.18	37.30	187.60	34.56	209.27
Winter Queen	144.00	51.27	12.47	34.43	8.87	8.44	72.33	25.92	115.13
$CD_{0.05}$	7.21	3.35	1.28	7.30	0.57	1.72	11.19	1.56	8.26

(16) recorded 56.83 days in cv. Flirt in chrysanthemum and Kumar *et al.* (8) in 90.73 days (NT Pompon) in dahlia. This variation in flower duration among various chrysanthemum cultivars may be due to different genetic makeup, which might be further modified by the prevailing environmental conditions.

Moreover, the pooled data revealed that freshness of flower on the plant under open field conditions ranged from a minimum in cv. Winter Queen (12.47 days) to maximum in cv. UHFS CHRY-77 (17.53 days). This variation in chrysanthemum cultivars may be due to different genetic makeup of cultivar, which is affected by the prevailing environmental condition, ultimately, which affects physiological processes of the plant like cell turgidity, water loss through evaporation, transpiration and breakdown of the reserve food material, which reduces the freshness of the flower under field conditions. These results are in conformity with the findings of Mishra *et al*. (11) as reported the longevity of flower under open field condition ranges from 13.32 (Vigour) to 14.41 days (Kenya) in dahlia; and Kumari *et al*. (10) reported shelf-life in gerbera cv. Balance (10.11 days) at 25ºC ambient temperature and (15.30 days) at 18ºC temperature, respectively.

Whereas, the pooled data revealed that there are significant differences for number of flowers plant^{-1} among all the chrysanthemum cultivars during experimentation. The maximum number of flowers plant^{-1} was recorded in cv. UHFS CHRY-77 (66.86), followed by Jaya (59.74), while minimum was observed in 'UHFS CHRY-83' (15.62). The variation in number of flowers plant^{-1} may be due to genetic variability among the different chrysanthemum cultivars, which were tested under this trial. Another probable reason for this variation in number of flowers plant^{-1} may be due to effect of environmental condition prevailing during field trial. Similar variation for number of flowers plant^{-1} were reported by Puneeta *et al*. (14) in cv. Suneel (66.33) to cv. Paris White (301), Dilta *et al.* (5) in cv. Glance (65.67 flower / plant) in chrysanthemum.

Although, the pooled data showed that flower diameter differed significantly and maximum flower diameter was recorded in cv. Garden Beauty (9.68 cm), while minimum in cv. UHFS CHRY-83 (3.70 cm). Similar findings were obtained by Poonam and Kumar (13) in cv. Garden Beauty (9.97 cm); Rao and Pratap (15) in cv. Silper (5.83 cm) in chrysanthemum. It may be concluded that variation in flower diameter is mainly due to genetic makeup, which might have been further modified by the prevailing environmental conditions.

However, pooled data revealed that maximum ten flower weight was recorded in cv. UHFS CRY-77 (37.30 g), while, minimum in Winter Queen (8.44 g). Variation in flower weight might be due to different genetic makeup of the different cultivars. The present findings are in conformity with the results reported by Poonam and Kumar (13) reported range in cv. Sadhbhawna (10.62 g) to Ratlam Selection (46.00 g); and Swaroop *et al.* (16) in cv. Pink Cloud (8.5 g) to Thai Chin Queen (70.6 g) in chrysanthemum.

Moreover, pooled data result shows that maximum ray florets flower^{-1} was recorded in cultivar UHFS CRY-77 (187.60), while minimum in 'Anmol F_1' (28.80). The variation in number of ray florets flower^{-1} among different cultivars might be due to the distinguished varietal inherent genetic makeup of a particular cultivar. Similarly wider variations for ray florets flower^{-1} are observed by Swaroop *et al.* (16) that range from 90.00 to 308.66 in cvs. Snow Ball to Flirt; Baskaran *et al.* (1) in chrysanthemum cv. Nilima (253.2).

However, pooled data revealed that there was highly significant difference among all the cultivar for the spray length. The maximum spray length was recorded in 'UHFS CHRY-77' (34.56 cm), while minimum was in cv. Autumn Joy (12.46 cm). This variation in spray length might be due to the distinguished genetic makeup among various cultivars, which were used for investigation. Similar findings are recorded by Rao and Pratap (15) for spray length (22.50 cm) in cv. Neelima; Poonam and Kumar (13) reported the range from 22.30 cm in cv. Punjab Anuradha to 58.73 cm in cv. Garden Beauty. Peddi *et al*. (12) too obtained similar variation in chrysanthemum cultivars.

Although, pooled data results shows that maximum numbers of disc florets flower^{-1} were recorded in cultivar UHFS CHRY-77 (209.27), whereas minimum in cultivar UHFS CRY-83 (12.07). The variations in number of disc florets were primarily due to the different genetic constitution of various cultivars under study. Hence, wide variations for yield contributing characters were observed. Similar results are found by Kumar *et al.* (9) in cv. Basanti disc florets (160.00) produced in chrysanthemum.

Whereas, the pooled data in Table 3 indicate highly significant differences among different chrysanthemum cultivars for flower yield per plant. The flower weight plant^{-1} ranged from minimum in cv. UHFS CHRY-83 (15.59 g) to maximum in cv. UHFS CHRY-77 (249.52 g). The different genetic makeup contributed different growth and yield attributing character for flower weight plant^{-1} in cultivars of chrysanthemum. Thus, the cultivar UHFS CHRY-77 was found to be high yielder followed by cultivars Jaya and PAU D-1. Similar findings were also noted by Peddi *et al.* (12) on chrysanthemum.

The variation in flower colour among chrysanthemum cultivars (Table 3) is mainly due to genetic makeup and colouring pigments present in

Table 3. Relative economic parameters in chrysanthemum under sub-humid southern plains and Aravalli hills of Rajasthan.

Cultivar	Flower yield plant^{-1} (g)	Flower colour as par R.H.S Colour Chart	Spray ha^{-1} (No.)	Suckers ha^{-1} (No.) (Rs.)	Gross return (Rs. ha^{-1})	Net return (Rs. ha^{-1})	B:C ratio
Ajina Purple	26.03	Red purple 61(A)	955555.5	505555.51	651944.40	284661.30	0.78
Anmol F-1	28.08	Yellow Group 9(A)	1029999.9	438888.85	676222.16	308939.06	0.84
Autumn Joy	56.51	Red purple 62(D)	947777.7	472222.18	639333.28	272050.18	0.74
Garden Beauty	56.13	Red purple 71(C)	1022222.1	405555.52	663611.04	296327.94	0.81
Jaya	195.95	Red Group 46(A)	1703333.2	399999.96	1036833.25	669550.15	1.82
PAU A-43	56.84	Yellow Group 8(A)	1622222.1	116666.66	921388.82	554105.72	1.51
PAU B-107	115.13	White Group NN 155(D)	1296666.5	516666.62	842333.23	475050.13	1.29
PAU D-1	133.10	White Group NN 155(D)	1347777.6	522222.17	871833.22	504550.12	1.37
UHFS CRY-83	15.59	Yellow Group 6(A)	658888.8	116666.66	391555.51	24272.41	0.07
UHFS CRY-77	249.52	White Group NN 155(C)	1858888.7	516666.62	1151555.44	784272.34	2.14
Winter Queen	29.13	Red purple 70(C)	1111111.0	522222.17	741666.59	374383.49	1.02
$CD_{0.05}$	10.92	-	-	-	-	-	-

Estimated total cost of cultivation was Rs. 3,67,283.10 ha^{-1} selling price for each spray @ Rs. 0.55 and suckers @ Rs. 0.25.

a particular genotype. Red colour flower is due to anthocyanin pigment in cultivar Jaya, yellow colour flower is due to chalcones and aurones as colouring matter exist in cultivars UHFS CRY-83, PAU-A-43 and Anmol F_1. The white colour of flower is due to flavonols and carotenoid pigment exist in 'UHFS CHRY-77', 'PAU B-107' and 'PAU D-1', while purplish colour in 'Ajina Purple', 'Winter Queen', 'Autumn Joy' and 'Garden Beauty' is due to cyanidin pigment as reported by Bhattacharjee (2). These findings are in close conformity with the results obtained by Kumar *et al.* (8) in various dahlia cultivars.

Relative economics were calculated for different cultivars under study (Table 3) revealed that cultivar 'UHFS CHRY-77' was found best with a gross income of Rs. 11,51,555.44 ha^{-1} on the basis of number of cut spray 18,58,888.7 and number of suckers 5,16,666.62 obtained ha^{-1}. The selling price for each cut spray and per suckers were Rs 0.55 and 0.25, respectively. Hence, the maximum net income of Rs. 7,84,272.34 ha^{-1} was obtained from cv. 'UHFS CHRY-77' while the cost of cultivation was Rs. 3,67,283.10 ha^{-1}. Among various cultivars the net returns / Rs investment (B: C ratio) was maximum, *i.e.* Rs 2.14 in cultivar UHFS CHRY-77, while it was minimum in 'UHFS CHRY-83', *i.e.*, Rs. 0.07.

On the basis of two year experimentation (2010-12) pooled data it was concluded that cv. UHFS CHRY-77 was found best for maximum flower duration, freshness of the flower, number of flowers plant^{-1}, flower weight plant^{-1} and B: C ratio, therefore, recommended for cut flower production for sub- humid southern plains and Aravalli hills of Rajasthan.

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