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Appraisal for flower yield and genetic correlation of *Chrysanthemum morifolium* genotypes in Semi-Arid Haryana

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Abstract
Fifteen genotypes of Chrysanthemum were evaluated under Hisar District, West Haryana the experiment was carried out at the Experimental Orchard of the Department of Horticulture, CCS Haryana Agricultural University, Hisar (Haryana) during the winter season of 2016-17 to identify the suitable variety for successful cultivation and flower production. Fifteen genotypes namely, Aparajita, Anastasia, Braca Splendid, Charlia, Celtic, Cologne, Fortune, HF-164, Paladov Sunny, Paiwer-W, Paladov Dark, Papaya, Tocovar- 6, Vanilla Sorbet and White Double were selected for their evaluation. The experiment was laid out in randomized block design with thrice replication. Recommend package of practices were followed throughout the experiment to grow a healthy crop. Significant differences were noticed for vegetative and flowering characters. The maximum plant height was recorded in genotypes Tocovar-6 (57.93 cm) followed by the Braca Splendid (56.60 cm). However, genotypes Fortune recorded maximum plant spread (31.86 cm), number of branches, leaves per plant and average weight was noticed maximum in genotypes Charlia. Early flowering was observed in the genotypes Paladov Sunny and fifty per cent of flowering in genotypes Paladov Dark. Longest duration of flowering (days) was observed in genotypes Celtic, maximum average weight of flower Charlia (8.64 g) significant genetic correlation between different traits chrysanthemum cultivars.

Keywords: chrysanthemum, appraisal, flower yield and genetic correlation

Introduction
Floriculture or flower farming is a discipline of horticulture concerned with the cultivation of flowering and ornamental plants for trade and floristry, comprising the floral industry. India is bestowed with several agro-climatic zones conducive for the production of sensitive and delicate floriculture produce. In India, total area under flower production in 2013-14 was 2.55 lakh ha with the production of loose and cut flowers 1754 and 543 thousand tonnes, respectively (Anonymous, 2014) [2]. The total area under flower production in Haryana in 2013-14 was 6,480 ha with a production of loose flowers 65.45 60 ha and cut flowers 11.26 thousand tonnes, respectively and total area under chrysanthemum crop was 60 ha with a production of loose flowers 60 tonnes and cut flowers 650 tonnes and (Anonymous, 2014) [2].
Chrysanthemum (*Chrysanthemum morifolium* Ramat.), a native to northern hemisphere, chiefly Europe and Asia and distributed almost throughout the world mainly in China, Japan, Europe, USA and India, belongs to the family Asteraceae (Compositae) with chromosome number (2n) 18. It bears two types of floret, *i.e.*, (i) ray floret and (ii) disc floret. There are two types of chrysanthemum *viz*., standard type and spray type. Standard type of chrysanthemum has genetic potential to produce bigger size flower than spray type and mostly grown for cut flower production and as potted flowering plant for exhibition and decoration. About 2000 varieties have been reported in the world and about 1000 genotypes in India (Datta and Bhattacharjee, 2001) [8].
The successful cultivation of chrysanthemum depends on selection of suitable genotypes. The study of genotypes is very important for standardizing the production technology and its transfer to farmers' field. Study of the performance of commercially important genotypes with varying growth habit, shape, size and colour of flowers will enable the farmers to make choice according to the market demand. The speed of these changes depends at least in part on the amount of reserves that are present in flowers, when they are cut. Therefore, an exogenous carbohydrate supplement like sucrose would be enough to delay senescence, considering that the main effect would be to maintain the structure and activity of mitochondria. To increase vase life of chrysanthemum cut flower, sucrose solution is good Amiri *et al.* (2009) [1].

Materials and Methods

The experimental materials consist of fifteen genotypes of chrysanthemum, names of which are mentioned below in Table-1:

Table 1: Genotypes of *C. morifolium*

Plant tag no.	Genotypes name	Colour	Plant tag no.	Genotypes name	Colour
V_1	Aparajita	Yellow	V_9	Celtic	Green
V_2	Fortune	White	V_{10}	Paiwer-W	White
V_3	Anastasia	White	V_{11}	HF-164	Yellow Purple
V_4	Charlia	Purple Yellow	V_{12}	Paladov Dark	Orange
V_5	Vanilla Sorbet	Cream	V_{13}	Tocovar- 6	Red
V_6	Paladov Sunny	Yellow	V_{14}	Papaya	Orange
V_7	White Double	White	V_{15}	Cologne	White
V_8	Braca Splendid	Magenta			

The field experiment was conducted to study the Appraisal for flower yield and genetic correlation of *Chrysanthemum morifolium* genotypes in Semi-Arid Haryana for cut flower production on growth and flowering characters of Chrysanthemum at Experimental Orchard of the Department of Horticulture, CCS Haryana Agricultural University, Hisar (Haryana) during the winter season of 2016-17. It is a semi-arid zone and situated at an altitude of 215 meters above mean sea level. The geographical situation is 29.09°N latitude and 75.43°E longitude in western Haryana. The maximum temperature of around 45ºC during summer months of May to June and average annual rainfall of the region is about 450 mm is received during July to September. The Experiment was laid out in Randomized Block Design (R.B.D.) replicated thrice in 1.0 m x 1.0 m size plant spaced at 20 x 20 cm. Data on various parameters like plant height (cm), plant spread (cm), no. of branches per plant, no. of leaves per plant, no. of flowers per stem, no. of flowers per cut flower, flower size (cm), days to 50% flowering, Days to first flowering, duration of flowering, average weight and genetic correlation were recorded on five plant of each varieties. Statistical-Analysis were analysed with the help of window based computer package OPSTAT. The calculated value of 'r' was compared with 't' table value with n-2 degrees of freedom at 5% and 1% level of significance, where, n refers to number of pairs of observations.

Results and Discussion

The data in Table 2(a) show the plant height (cm) recorded at 30, 45, 60 and 120 days after transplanting (DAT). Plant height at different stages varied significantly with genotypes. At 30, 45 and 60 days after transplanting, the plants of genotype Braca Splendid had the maximum height (41.23, 46.70 and 53.40 cm), closely followed by the genotype Tocovar-6 (40.16, 46.50 and 53.40 cm) and the plants of genotype Charlia had the minimum height (15.30, 21.73 and 30.13 cm). However, at 120 days after transplanting, the maximum plant height (57.93 cm) was recorded by the genotype Tocovar-6 and minimum plant height (32.06 cm) was recorded by the genotype Paladov Sunny. The genotype Tocovar-6 recorded the maximum and genotype Charlia the minimum plant height at 120 days after transplanting. Among the genotypes, plant height ranged from 32.06 to 57.93 cm. Differences in plant height might be attributed to several factors including genetic and climatic like soil conditions, temperature, light, nutrition, *etc*. During experimentation, since all the genotypes were cultivated under similar soil and climatic conditions, the differences in plant height could be attributed mainly to variation in genotypes. Similar findings were recorded by Choudhary *et al.* (2003) [7], Verma *et al.* (2010) [9], Mehta *et al.* (2010) [20], Kumar (2014) [17] and Srilatha *et al*. (2015) [29].

The data concerning plant spread recorded at harvesting stage varied significantly with genotypes are presented in Table (2b). Plant spread was registered highest (31.86) with the genotype Fortune, whereas, the minimum plant spread (12.13) was registered with genotype Vanilla Sorbet, which was closely followed by the genotype Paladov Dark. The maximum plant spread noticed in genotype Fortune, while minimum in Vanilla Sorbet. Plant spread lied between 12.13-31.86 cm. Differences in plant spread could be attributed mainly due to genetic variation in genotypes. The results of present study are in conformity with the finding of Balaji and Reddy (2006) [4] in cultivar PG Purple. Chavan *et al*. (2010) [6] in variety Phule Ganesh, Puneetha and Sharma (2011) [26] in genotype Paris. The number of branches per plant noticed at harvesting stage varied significantly with genotypes presented in Table 3 indicate that the genotype Charlia (18.46/plant) had the maximum number of branches per plant followed by the genotype Fortune (15.06 plant), however, the genotype Paladov Dark had the minimum number of branches per plant (6.00/plant). The genotype Charlia showed maximum number of branches per plant. Similar results were recorded by Gaikwad and Patil, (2001) [11] in cultivar Indra. Poornima *et al.* (2006) [25] in cultivar Violet Cushion, Uddin *et al.* (2015) [22] in cultivar V6 and Srilatha *et al.* (2015) [29] in cultivar Red Gold. The genotypes had significant effect on number of leaves per plant taken at harvesting stage. The maximum number of leaves per plant was found in genotype Charlia (252.73/plant) and the minimum number of leaves per plant was found in genotype Paladov Dark (34.66/plant). The genotype Charlia had maximum and Paladov Dark the minimum number of leaves per plant. Similar findings were recorded by Ona *et al.* (2015) [22] in cultivar White mum (maximum) and in Chandramukhi (minimum) and Kumar *et al.* (2015) [18] in Decorative White.

The perusal of data in Fig-1(a) indicates that the difference in days to first flowering was statistically significant among the genotypes. The earliest flowering was found in genotype Paladov Sunny (47.26 days). However flowering was too late in the genotype Charlia (82.20 days). Days taken to first flowering ranged from 47.26 to 82.20 days among genotypes. Earliness in flowering was found in the genotype Paladov Sunny and late in Charlia. The results of present study corroborate the finding of Arora *et al.* (2002) [3] under pot culture. Janakiram and Meenakshi (2007) [14] in cultivar IIHR-1 (pink) and IIHR-2 (brown), Uddin *et al.* (2015) [22] in cultivar V3 and V9 and Negi *et al.* (2015) [21] in Baggi.

The data on days to 50% flowering are presented in Fig-1(b), which indicates that days to 50% flowering significantly varied with genotype. The genotype Paladov Sunny showed

flowering in 50% plants earlier (68.45 Days) however, the genotype Vanilla Sorbet showed flowering in 50% plants late (105.53 Days). Early flowering in 50% plants was noticed genotype Paladov Dark and late flowering in 50% plants in Vanilla Sorbet. The days to 50 per cent flowering ranged from 63.3 to 105.53 days. Similar results were obtained by Uddin *et al.* (2015) [22] in cultivar V6 (rose pink) and V4. The data recorded significant influence of different cultivars on duration of flowering (Days). The genotype Celtic had the maximum duration of flowering (51.13 Days), while, the genotype Paladov Dark had the minimum duration of flowering (25.66 Days). Similar results have also been reported by Gaikwad and Patil (2001) [11] in cultivar Pusa Semi double. Dilta *et al.* (2005) in chrysanthemum cultivar Surf (longest flowering period), Mahawer *et al.* (2008) in cv. Miss India, Kumar (2014) [17] in cultivar Anmol (shortest flowering duration), Negi *et al.* (2015) [21] in chrysanthemum cultivar Purnima (longest flowering duration) and Dewan *et al.* (2016) [10] in cultivar Gambit (longest flowering duration). The data concerning number of flowers recorded significantly with genotypes are presented in table 2(b). The genotype Fortune (5.46/stem) produced the maximum number of flowers, while the genotype Cologne produced the minimum number of flowers (2.13/stem). The results are in conformity with the findings of Palai *et al.* (1999) [23] in cultivar ACC-13, Singh *et al.* (2008) [28] in cultivar A-115, B-4, and Puneetha. The perusal of data was a significant difference in genotypes in the production of number of flowers per cut flower. The maximum number of flowers per cut flower was produced by the genotype Fortune (60.34/cut flower) and the minimum number of flowers per cut flower was produced by the genotype Cologne (19.78/cut flower). The data presented significantly with genotype Fortune (5.73 cm) had the maximum flower size and the genotype Paladov Sunny had the minimum flower size (2.59 cm). Similar results were reported by Choudhary *et al.* (2003) [7], Swaroop *et al.* (2006) [30], Gurav *et al.* (2005) [13], Joshi *et al.* (2009) [15], Uddin *et al.* (2015) [22] and Reddy *et al.* (2016) [27]. The data on average weight of flower are presented in Fig-2, which indicate maximum average weight of flower was found in the genotype Charlia (8.64 g) and the minimum was found in genotype Celtic (4.91 g). Variation in average weight of flower among the varieties was also reported by Joshi *et al.* (2009) [15], Gantait *et al.* (2009) [12] and Baskaran *et al.* (2010) [5]. In Table 3 showed genetic correlation between different genotypes of chrysanthemum. Plant height was highly correlated with average weight of flower, plant spread was highly correlated with number of branches, number of leaves per plant, flowers per stem and per cut flower, while plant spread was correlated with days to 50 per cent flowering and average weight of flower. Number of branches per plant was highly correlated with number of leaves per plant, days to first flowering, number of flowers per stem and per cut flower, flower size, number of leaves per plant was highly correlated with days to first flowering, number of flowers per stem per cut flower and correlated with flower size, days to first flowering was highly correlated with days to 50 per cent flowering, number of flowers per stem, flower size and correlated with duration of flowering, days to 50 per cent flowering was highly correlated with duration of flowering, number of flowers per stem per cut flower and flower size. Duration of flowering was highly correlated with number of flowers per stem and number of flowers per stem with number of flowers per cut flower. Similar results were observed by Pal and George (2002) [24], Gantait and Pal (2009) [12] and Kumar *et al.* (2012) [16].

Table 3: Genetic correlation between different genotypes

	PH	PS	B/P	L/P	F1	F50	DF	F/S	F/C	AW	FS
PH											
PS	0.050										
B/P	-0.117	0.623**									
L/P	-0.001	0.600**	0.976**								
F1	-0.174	0.264	0.550**	0.482**							
F50	-0.035	0.332*	0.273	0.253	0.789**						
DF	-0.284	0.122	-0.192	-0.163	0.305*	0.664**					
F/S	-0.139	0.953**	0.701**	0.608**	0.634**	0.657**	0.445**				
F/C	0.050	0.843**	0.877**	0.833**	0.524**	0.403**	-0.005	0.924**			
AW	0.505**	0.351*	-0.097	-0.116	-0.083	0.027	-0.143	0.136	0.100		
FS	-0.121	0.146	0.483**	0.450**	0.537**	0.439**	0.036	0.180	0.283	0.251	

Table 2(a): Performance of chrysanthemum genotypes for plant height at 30, 45, 60 and 120 days after transplanting

Population No.	Genotypes	Plant height (cm)			
		30 days	45 days	60 days	120 days
V_1	Aparajita	20.80	26.40	35.90	41.46
V_2	Fortune	22.16	29.83	38.00	43.20
V_3	Anastasia	19.70	26.29	35.10	38.86
V_4	Charlia	15.30	21.73	30.13	38.20
V_5	Vanilla Sorbet	19.63	23.13	33.66	48.20
V_6	Paladov Sunny	25.10	28.50	30.93	32.06
V_7	White Double	33.36	38.93	49.16	55.26
V_8	Braca Splendid	41.23	46.70	53.40	56.60
V_9	Celtic	27.26	32.70	38.53	45.86
V_{10}	Paiwer-W	28.70	34.90	40.86	46.53
V_{11}	HF-164	24.76	30.26	33.70	37.00
V_{12}	Paladov Dark	34.00	36.73	40.46	47.66
V_{13}	Tocovar- 6	40.16	46.50	51.60	57.93
V_{14}	Papaya	30.76	37.33	48.43	56.40
V_{15}	Cologne	32.86	36.20	40.86	45.13
C.D. at 5% level of significance		6.44	5.97	4.64	4.48

Table 2(b): Performance of chrysanthemum genotypes for vegetative characters

Population No.	Genotypes	Plant spread (cm)	No. of branches per plant	No. of leaves per plant	No. of flowers per stem	No. of flowers per cut flower	Flower size (cm)
V_1	Aparajita	26.06	13.66	156.33	4.73	55.44	3.73
V_2	Fortune	31.86	15.06	140.93	5.46	60.34	5.73
V_3	Anastasia	17.86	07.53	51.00	4.33	27.33	5.43
V_4	Charlia	22.40	18.46	252.73	4.46	52.38	3.28
V_5	Vanilla Sorbet	12.13	10.06	73.93	2.60	23.80	3.92
V_6	Paladov Sunny	16.26	11.26	82.13	2.86	31.74	2.59
V_7	White Double	23.80	13.26	156.00	4.26	46.16	5.71
V_8	Braca Splendid	21.26	09.46	75.40	3.53	34.13	5.15
V_9	Celtic	21.00	06.20	57.46	4.26	26.11	3.04
V_{10}	Paiwer-W	23.66	09.33	98.33	4.60	43.93	5.11
V_{11}	HF-164	20.93	08.06	72.00	2.93	21.74	5.13
V_{12}	Paladov Dark	13.66	06.00	34.66	2.20	20.53	4.58
V_{13}	Tocovar- 6	23.00	12.00	145.40	3.13	38.87	5.05
V_{14}	Papaya	19.40	10.13	99.46	3.06	38.88	5.21
V_{15}	Cologne	18.73	09.40	77.86	2.13	19.78	4.93
C.D. at 5% level of significance		3.63	3.29	5.58	1.56	1.99	0.17

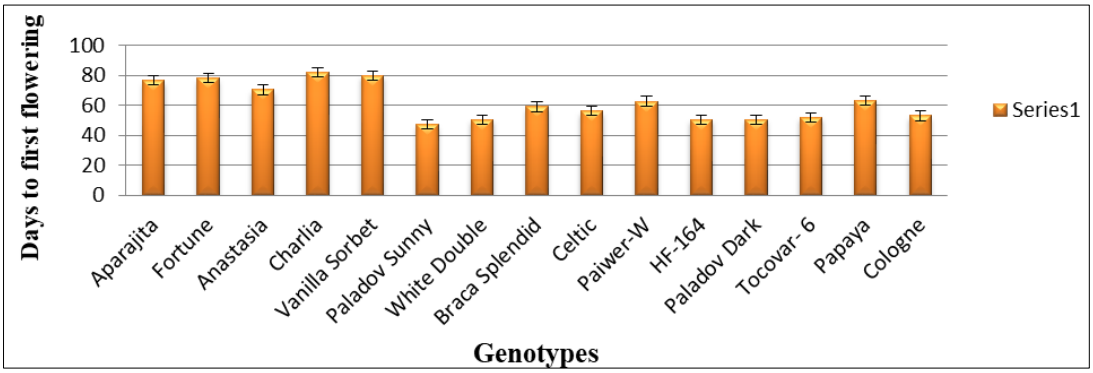

Fig 1(a): Performance of chrysanthemum genotypes on Days to first flowering

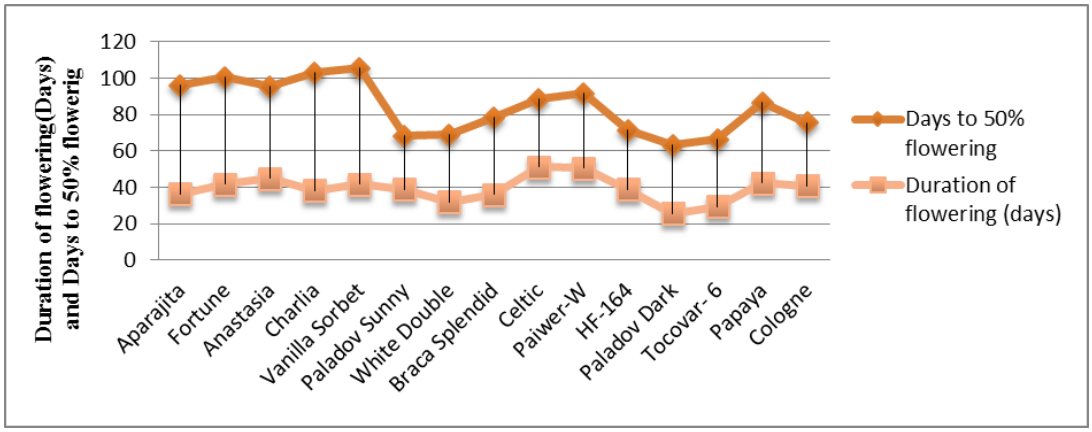

Fig 1(b): Performance of chrysanthemum genotypes on flower parameters

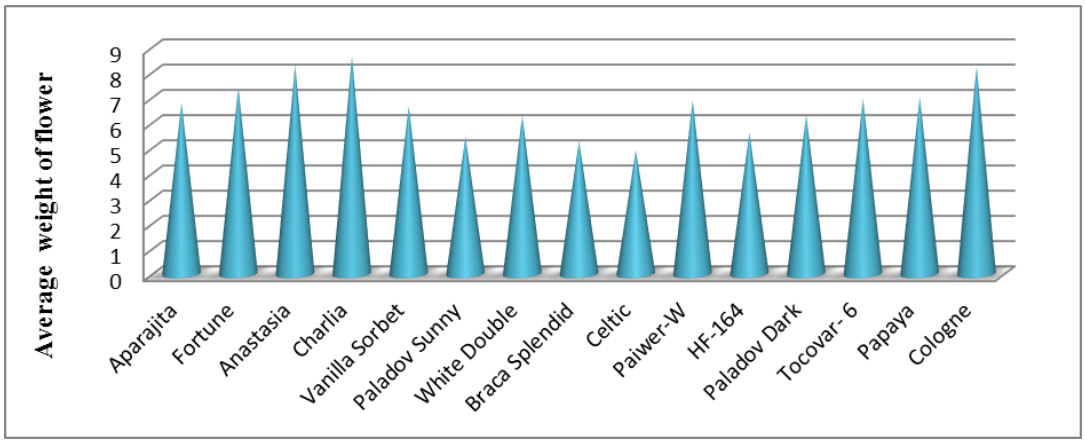

Fig 2: Performance of chrysanthemum genotypes on average weight of flower

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