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Genetic studies for flower yield and component traits in *Chrysanthemum morifolium* Ramat

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Abstract: Study on genetic variability, character association and path analysis was carried out with sixty chrysanthemum genotypes keeping in mind of their applicability in future crop improvement programmes. High phenotypic and genotypic coefficient of variation were found for the character such as number of flower per plant, number of branches per plant, number of primary branches, number of secondary branches, plant spread and plant height. High heritability coupled with high expected genetic advance was observed for number of flower per plant, number of secondary branches and branches per plant. In general, genotypic correlation coefficients were found to be higher than the phenotypic correlations for most of the characters. Number of flowers per plant showed highly positive significant correlation at both genotypic and phenotypic level with plant spread (0.977,0.974), number of primary branches (0.952,0,828), number of branches per plant (0.956, 0.950), number of flower per spray (0.932, 0.821) and number of secondary branches (0.770, 0.744). Path analysis revealed that plant spread, number of primary branches, number of flower per spray and number of branches per plant had highest positive and direct effects on number of flowers per plant at genotypic and phenotypic levels. Thus, the useful cultivars can be used as parents in hybridization programme to obtain admirable progenies.

Keywords: Correlation, Genetic variability, Heritability, Path analysis

INTRODUCTION

Chrysanthemum (*Chrysanthemum morifolium* Ramat.) which belongs to the family Asteraceae, is a highly attractive and charming short day plant, which behaves both as an annual as well as a perennial flowering herb. Variation between species and within a species is a must for any crop improvement programme. The knowledge of variability exists in a crop species has special significance to bring about the success in any hybridization programme (Kameswari *et al.,* 2014). Hence, for effective selection, a thorough study on genotypic and phenotypic variability is essential.
It is a known fact that there exists a complex association among different characters in the plant system and the characters do not exist in isolation. Knowledge of association of various characters should provide necessary information on indirect selection for improvement flower yield. The association between two characters is generally through a complicated pathway involving various other attributes which may have direct or indirect effect on the resultant or end character (Lal *et al.,* 2014). Therefore, the direct contribution of the component characters to resultant character from the indirect effects due to the inter relationship of different characters can be determine with the help of path coefficient analysis. Keeping in view the above facts, the present investigation was carried out to determine the extent of variability, the nature and degree of association among the characters and their direct and indirect effect on flower yield.

MATERIALS AND METHODS

The experiment was carried out at the Horticulture Research Station, Mondouri farm under AICRP on Floriculture, BCKV, Kalyani, Nadia, West Bengal in a randomized block design (RBD) with three replications during 2010-11. A total of sixty genotypes were taken for the study. Rooted cuttings of the cultivars were planted in plots (1.6m x 1.6m) at a spacing of 40cm x 40cm and standard cultural practices were followed during the growth and flowering period of the crop. The experimental data were collected on eleven traits viz. plant spread, number of primary branches,

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number of secondary branches, number of branches per plant, leaf length, leaf breadth, Days to 50% flowering, number of flower per spray, flower diameter and number of flower per plant. The mean values of five randomly selected plants from each genotypes in each replication were used for data analysis were subjected to statistical analysis following Panse and Sukhatme (1995). Character association and path analysis of various characters was assessed by the method designed by Weber and Moorthy (1952) and Dewey and Lu (1959) respectively.

RESULTS AND DISCUSSION

In the present study data on mean values, range and coefficient of variation, heritability and genetic advance for the eleven characters of morphological as well as flower characters of *C. morifolium* studied are presented in Table 1. The results clearly indicated significant differences among the sixty cultivars for all the eleven characters studied. The magnitude of range was highest for days to 50% flowering of 92.33- 121. Among the parameters number of flower per plant showed maximum phenotypic and genotypic variation of 49.58% and 49.03% followed by number of branches per plant with 47.46% and 46.78% respectively. The estimates of phenotypic coefficient of variance (PCV) were found higher than genotypic coefficient of variance (GCV) for all the eleven characters studied indicating that the apparent variation was not only due to genotypes but was also due to the influence of environment in the expression of characters The results were in agreement with the results of Senapati *et al*. (2013) for variability studies in *Gerbera jamesonii* Bolus. In this study, high phenotypic and genotypic coefficient of variation were found for the character such as number of flower per plant, number of branches per plant, number of primary branches, number of secondary branches, plant spread and plant height indicating high variation in these characters, indicating that there is urgent need of improvement of these characters. Similar results were obtained for number of flowers per plant followed by number of branches per plant and disc diameter in chrysanthemum (Sirohi and Behera, 2000).

High heritability coupled with high expected genetic advance was observed for number of flower per plant, number of secondary branches and branches per plant. While high heritability along with moderate genetic advance was found for number of primary branches, plant spread and plant height. The characters such as days to 50% flowering and flower diameter had high heritability and low genetic advance. High heritability coupled with high genetic gain suggests that the gene action is mostly of additive type and therefore, direct selection of such trait will be rewarding. This result was in accordance with Peddi *et al.* (2009) for traits like suckers per plant, yield per plant, number of flowers per plant, number of branches per plant and duration of flowering in chrysanthemum. High heritability and low genetic advance indicating contribution of non -additive gene effect on the expression. The high heritability is due to favorable influence of environment rather than genotype and selection for such traits may not be rewarding.

In general genotypic correlation coefficients were found to be higher than the phenotypic correlations (Table 2). Baskaran *et al.* (2009) have also reported higher genotypic correlation coefficient than phenotypic correlation coefficient among the various traits in chrysanthemum. The number of flowers per plant showed highly positive significant correlation with plant spread (0.977, 0.974), number of primary branches (0.952, 0.828), number of branches per plant (0.956, 0.950), number of flower per spray (0.932, 0.821) and number of secondary branches (0.770, 0.774) whereas it has negative and significant correlation with days to 50% flowering (-0.353, -0.349). These results are in close agreements with the findings for variability studies of Sirohi and Behera (2000) and Kumar *et al.* (2012). in chrysanthemum Therefore, selection for the improvement of one character will lead to the simultaneous improvement of the other character i.e if we improved plant spread than simultaneously the number of flowers per plant will be increased and vice versa.

The data on direct and indirect effects of different characters on number of flowers per plant are presented in Table 3. In the present investigation, that plant spread (0.573), number of primary branches

Table 1. Genetic components of eleven quantitative traits of *Chrysanthemum morifolium*.

Characters	GM	Range	GV	PV	EV	GCV (%)	PCV (%)	ECV (%)	h^2	GAM (%)
Plant Height (cm)	53.14	92 - 23.33	224.55	237.86	13.31	28.19	29.02	1.82	0.94	56.19
Plant Spread (cm)	55.96	28.33-91.17	319.2	327.12	7.92	31.92	32.32	1.4	0.97	64.58
No. of primary branches	2.86	5.67 - 1.33	1.21	1.62	0.41	38.46	44.50	21.58	0.75	68.75
No. of secondary branches	9.56	2 - 19.67	13.29	14.3	1.27	38.13	39.55	9.51	0.92	74.96
Branches/plant	18.19	5.33 – 41	72.43	74.54	2.11	46.78	47.46	3.51	0.97	94.84
Leaf length (cm)	7.09	3.00 - 11.37	2.62	3.1	0.48	22.82	24.83	9.53	0.84	42.97
Leaf breadth (cm)	4.52	1.77 - 7.43	1.40	1.8	0.4	26.17	29.68	12.01	0.77	47.08
Days to 50% flowering	104.20	92.33 - 121	42.56	48.36	5.8	6.26	6.67	0.57	0.88	12.09
No. of flower/spray	5.26	2.33 - 10.00	1.54	2.11	0.57	23.59	27.61	14.34	0.73	41.52
Flower diameter (cm)	6.02	3.8 - 8.47	1.04	1.32	0.28	16.94	19.08	1.17	0.79	31.05
No. of flower/plant	310.13	38 - 710	23121.7	23647.6	525.9	49.03	49.58	3.28	0.97	98.65

Table 2. Genotypic and Phenotypic correlation coefficient between different traits of *Chrysanthemum morifolium*.

Characters		Plant Height	Plant Spread	No. of primary branches	No. of secondary branches	Branches /plant	Leaf length	Leaf breadth	Days to 50% flowering	No. of flower/ spray	Flower diameter
Plant Spread	G	0.369**									
	P	0.368**									
No. of primary branches	G	0.364**	0.945**								
	P	0.318**	0.816**								
No. of secondary branches	G	0.102	0.793**	0.740**							
	P	0.098	0.766**	0.624**							
Branches/plant	G	0.396**	0.957**	0.939**	0.769**						
	P	0.393**	0.952**	0.811**	0.742**						
Leaf length	G	-0.094	-0.245	-0.199	-0.223	-0.238					
	P	-0.085	-0.224	-0.160	-0.194	-0.218					
Leaf breadth	G	0.005	-0.205	-0.200	-0.237	-0.198	0.845**				
	P	0.000	-0.178	-0.145	-0.198	-0.176	0.823**				
Days to 50% flowering	G	-0.226	-0.362**	-0.425**	-0.339**	-0.327**	0.268*	0.191			
	P	-0.223	-0.359**	-0.361**	-0.320	-0.323	0.244	0.165			
No. of flower/spray	G	-0.076	-0.004	-0.010	-0.103	-0.015	-0.176	-0.133	-0.107		
	P	-0.056	-0.009	0.013	-0.095	-0.010	-0.106	-0.106	-0.093		
Flower diameter	G	0.016	-0.132	-0.118	-0.171	-0.123	0.194	0.209	0.282*	-0.360**	
	P	0.016	-0.130	-0.101	-0.168	-0.122	0.175	0.179	0.280*	-0.301*	
No. of flower/plant	G	0.391**	0.977**	0.952**	0.770**	0.956**	-0.237	-0.184	-0.353**	0.932**	-0.159
	P	0.390**	0.974**	0.828**	0.744**	0.950**	-0.217	-0.161	-0.349**	0.821**	-0.158

G= Genotypic correlation coefficient and P= Phenotypic correlation coefficient

Table 3. Path coefficient analysis showing direct and indirect effects on flower yield of *Chrysanthemum morifolium.*

Characters	Plant Height	Plant Spread	No. of primary branches	No. of secondary branches	Branches /plant	Leaf length	Leaf breadth	Days to 50% flowering	No. of flower/ spray	Flower diameter
Plant Height	0.031	0.011	0.011	0.003	0.012	-0.003	0.000	-0.007	-0.002	0.001
Plant Spread	0.211	0.573	0.541	0.454	0.548	-0.140	-0.117	-0.207	-0.002	-0.075
No. of primary branches	0.113	0.293	0.310	0.229	0.291	-0.062	-0.062	-0.132	-0.003	-0.037
No. of secondary branches	0.002	0.018	0.016	0.022	0.017	-0.005	-0.005	-0.008	-0.002	-0.004
Branches/plant	0.039	0.093	0.091	0.075	0.097	-0.023	-0.019	-0.032	-0.001	-0.012
Leaf length	0.008	0.021	0.017	0.019	0.020	-0.084	-0.071	-0.023	0.015	-0.016
Leaf breadth	0.001	-0.019	-0.018	-0.022	-0.018	0.077	0.092	0.017	-0.012	0.019
Days to 50% flowering	-0.011	-0.018	-0.021	-0.017	-0.017	0.014	0.010	0.050	-0.005	0.014
No. of flower/spray	-0.001	0.000	0.000	-0.001	0.000	-0.002	-0.001	-0.001	0.109	-0.003
Flower diameter	-0.001	0.006	0.005	0.008	0.006	-0.009	-0.010	-0.013	0.016	-0.046

Residual effect = 0.17, Direct effects are in bold diagonals

(0.310,), number of flower per spray (0.109,) and number of branches per plant (0.097,) had highest positive and direct effects on number of flowers per plant at genotypic and phenotypic levels. Whereas, leaf length (-0.084) and flower diameter (-0.046,) had negative direct effect on number of flowers per plant. Similar findings have been reported in chrysanthemum by Kumar *et al.* (2012) where days to flowering, number of primary branches per plant and plant spread had highest direct positive effect on number of flowers per plant at phenotypic level and genotypic level. The estimated residual effect was 0.17 (~ 0.2) indicating that 80% of the variability in flower yield was contributed by the characters which show highest positive and direct effects studied in the path analysis.

Conclusion

From the present study it can be concluded that characters effecting flower yield were plant spread, number of primary branches, number of flower per spray and number of branches per plant. Hence, for the better improvement of number of flowers per plant, these characters should be consider together. The information obtained from the current variability studies can be used as selection criteria for increasing yield in terms of number of flowers per plant in chrysanthemum genotypes.

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