

## CHARACTER ASSOCIATION AND PATH ANALYSIS STUDIES IN FRENCH MARIGOLD

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### ABSTRACT

Thirty French marigold genotypes were assessed for 14 characters. There was high genotypic response than corresponding phenotypic response for almost all the characters. Plant height showed highly significant and positive correlation with plant spread (0.802-0.794). Plant spread showed highly significant and positive correlation with stalk length (0.781-0.760) and total yield per plant (0.777-0.749). Number of flowers per plant showed positive correlation with total yield per plant (0.340-0.349), but it showed negative correlation with flower size and weight per flower. Flower size showed significant and positive correlation with weight per flower (0.735-0.665). The weight per flower also showed highly significant correlation with total yield.

**Key words :** Correlation, path analysis, French marigold.

French marigold (*Tagetes patula*), an annual flower forming a bushy plant finds its origin from Mexico and belongs to Asteraceae family. It is suitable for rockery, edging, hanging baskets, window boxes, loose flower production etc. Most of the varieties of French marigold being grown in India are local causing poor production of flower per unit area. It calls for evolving new varieties to fulfill different needs.

Information on genetic association under a particular environment helps in formulating the most effective breeding programme and simplifies the approach for selection. The genetic correlation for each pair of traits reflects the expected correlation response in the first cycle of selection programme. The major cause underlying genetic associations are pleiotropy, linkage and developmental induced relationships (1). Keeping this in view the present investigation was undertaken on character association and path analysis studies in French marigold involving 30 genotypes.

### MATERIALS AND METHODS

The present studies were carried out in the Division of Floriculture and Landscaping, Indian Agricultural Research Institute, New Delhi with 30 genotypes of French marigold grown in RBD with three replications. Thirty days old seedlings were transplanted in main field at a spacing of 30 × 30 cm. The crop was maintained well following uniform cultural operations for all the genotypes. Observations were recorded on various vegetative and flowering parameters. The correlation between different

characters at genotypic and phenotypic levels were estimated according to formula suggested by (2).

### RESULTS AND DISCUSSION

The perusal of data presented in table 1 reveals that genotypic correlation for most of the characters were higher than phenotypic correlation. These results are in agreement with (3, 6, 10, 11) in gladiolus and (14) in chrysanthemum. It indicates that there is strong inherent association between various characters and phenotypic expression is lessened under the influence of environment. The direction of phenotypic and genotypic correlations was almost similar in all the character combinations.

In the present study, plant height showed highly significant and positive correlation with plant spread (0.802, 0.794), followed by total yield per plant (0.619, 0.595) at genotypic and phenotypic level. The similar results were also reported by (4) in African marigold. Spread of plant showed positive correlation with stalk length (0.781, 0.760), total yield per plant (0.777, 0.749) and leaf length (0.704, 0.649). These are in accordance with findings of (4) obtained in African marigold. Number of flowers per plant exhibited significantly higher genotypic and phenotypic relationship with total yield per plant (0.340, 0.349), followed by duration of flowering (0.273, 0.267), negative with weight per flower (-0.412, -0.404). Similar results were also obtained by (4 and 8) in China aster and African marigold, respectively. Studies also revealed that weight per flower had highly significant association with total yield per plant (0.641, 0.617).



Table 1 : Phenotypic (above) and genotypic (below) correlation coefficient between different characters of French marigold.

Trait	Plant spread (cm)	Number of branches/plant	Leaf length (cm)	Leaflets /leaf	Leaflet length (cm)	Leaflet breadth (cm)	Stalk length (cm)	No. of flowers/plant	Flower size (cm)	Weight per flower (g)	Time taken for flowering (days)	Duration of flowering (days)	Total yield/plant (g)
Plant height (cm)	0.794** 0.802**	0.035 0.416**	0.588** 0.645**	0.337 0.473*	0.350 0.421*	0.01 0.002	0.588** 0.569**	0.436* 0.443*	0.057 0.067	0.267 0.273	0.518** 0.526**	0.289 0.293	0.545** 0.619**
Plant spread (cm)		0.433** 0.487**	0.649** 0.704**	0.403* 0.532**	0.398* 0.494**	0.004 0.102	0.760** 0.781**	0.666** 0.679**	0.083 0.105	0.268 0.272	0.527** 0.533**	0.311 0.321	0.794 0.777
Number of branches/plant			0.502** 0.655**	0.418* 0.519**	0.401* 0.498**	0.015 0.004	0.218 0.225	0.322 0.370	0.181 0.228	0.185 0.203	0.186 0.217	0.122 0.150	0.411* 0.493**
Leaf length (cm)				0.486** 0.644**	0.767** 0.891**	0.211* 0.409*	0.401* 0.434*	0.496** 0.562**	0.181 0.128	0.170 0.182	0.570** 0.627**	0.262 0.306	0.603** 0.603**
Leaflets/leaf					0.322** 0.523**	0.110 0.046	0.354 0.474*	0.211 0.285	0.306 0.406*	0.275 0.337	0.215 0.279	-0.053 -0.080	0.339 0.419*
Leaflet length (cm)						0.355 0.680**	0.230 0.263	0.402* 0.503**	0.128 0.080	-0.041 -0.064	0.402* 0.492**	0.199 0.273	0.410* 0.490**
Leaflet breadth (cm)							-0.140 -0.196	0.166 0.187	-0.189 -0.334	-0.165 -0.246	0.105 0.138	0.023 0.002	0.005 0.052*
Stalk length (cm)								0.445 0.459	0.018 0.184	0.018 0.186	0.391* 0.401*	0.247 0.252	0.449* 0.487**
No. of flowers/plant									-0.422 -0.469	-0.404 -0.412	0.172 0.178	0.267 0.273	0.349 0.340
Flower size (cm)										0.665** 0.735**	0.145 0.164	0.034 0.038	0.364 0.420*
Weight per flower (g)											0.387* 0.392*	-0.044 -0.040	0.635** 0.641**
Time taken for flowering (days)												0.103 0.114	0.617** 0.639**
Duration of flowering (days)													0.311 0.339
Total yield/plant (g)													

\*, \*\* = Significant at 5% and 1% level, respectively.



Table 2 : Direct (bold) and indirect effects of different traits on total yield of flowers per plant in French marigold at phenotypic and genotypic levels.

Trait	Plant height (cm)	Plant spread (cm)	Number of branches/plant	Leaf length (cm)	Leaflets/leaf	Leaflet length (cm)	Leaflet breadth (cm)	Stalk length (cm)	No. of flowers/plant	Flower size (cm)	Weight per flower (g)	Time taken for flowering (days)	Duration of flowering (days)	Correlation with total yield
Plant height (cm)	P-0.026	0.101	-0.001	-0.083	-0.022	0.060	0.000	-0.092	0.293	0.007	0.217	0.097	0.044	0.545**
	G 0.075	0.060	0.040	0.256	-0.096	0.092	0.000	-0.055	0.360	0.021	0.223	0.117	0.037	0.619**
Plant spread (cm)	P-0.021	<b>0.127</b>	-0.002	-0.091	-0.026	0.069	-0.001	-0.126	0.447	0.010	0.218	0.099	0.047	0.794
	G 0.060	<b>0.075</b>	0.047	-0.279	-0.108	-0.108	-0.017	-0.075	0.552	0.033	0.222	0.118	0.041	0.777
Number of branches/plant	P-0.009	0.055	<b>-0.004</b>	-0.079	-0.027	0.069	0.000	-0.036	0.216	0.022	0.150	0.035	0.018	0.411*
	G 0.031	0.086	<b>0.097</b>	-0.259	-0.105	0.109	0.001	-0.022	0.301	0.072	0.166	0.048	0.019	0.493**
Leaf length (cm)	P-0.015	0.082	0.002	<b>0.141</b>	0.031	0.132	0.005	0.066	0.333	0.022	0.138	0.107	0.039	0.603**
	G 0.048	0.053	0.064	<b>-0.396</b>	-0.131	0.195	0.068	-0.042	0.457	0.040	0.149	0.139	0.039	0.603**
Leaflets/leaf	P-0.009	0.051	-0.002	-0.06	<b>-0.065</b>	0.055	0.002	-0.059	0.142	0.038	0.224	0.040	-0.012	0.339
	G 0.035	0.040	0.050	-0.255	<b>-0.203</b>	0.115	-0.008	-0.046	0.232	0.128	0.275	0.062	-0.007	0.419*
Leaflet length (cm)	P-0.009	0.051	0.002	-0.108	-0.021	<b>0.172</b>	0.008	-0.038	-0.270	0.016	-0.033	0.075	0.030	0.410*
	G 0.031	0.037	0.048	-0.353	-0.106	<b>0.219</b>	0.113	-0.025	0.109	0.025	-0.052	0.109	0.035	0.490**
Leaflet breadth (cm)	P-0.000	0.006	0.000	-0.030	-0.007	0.061	<b>0.022</b>	0.023	0.077	-0.023	-0.134	0.020	0.004	0.005
	G 0.000	-0.008	0.000	-0.162	0.009	0.149	<b>0.166</b>	0.019	0.152	-0.105	-0.210	0.031	0.000	0.052*
Stalk length (cm)	P-0.015	0.097	-0.001	-0.056	-0.023	0.040	-0.003	<b>-0.165</b>	0.299	0.023	0.144	0.073	0.037	0.449*
	G 0.043	0.058	0.022	-0.172	-0.096	0.058	-0.033	<b>-0.096</b>	0.373	0.058	0.152	0.089	0.032	0.487**
No. of flowers/plant	P-0.011	0.035	-0.001	-0.070	0.014	0.069	0.022	-0.074	<b>0.671</b>	-0.052	-0.328	0.032	0.040	0.349
	G 0.033	0.051	0.036	-0.233	-0.058	0.110	0.031	-0.044	<b>0.813</b>	-0.148	-0.336	0.039	0.035	0.340
Flower size (cm)	P-0.002	0.011	-0.001	-0.025	-0.020	0.022	-0.004	-0.031	-0.283	<b>0.124</b>	0.541	0.027	0.005	0.364
	G 0.005	0.008	0.022	-0.051	-0.082	0.018	-0.055	-0.018	-0.381	<b>0.315</b>	0.599	0.036	0.005	0.420*
Weight per flower (g)	P-0.007	0.034	-0.001	-0.024	-0.018	-0.007	-0.004	-0.029	-0.271	0.082	<b>0.813</b>	0.073	-0.007	0.635**
	G 0.020	0.020	0.020	-0.072	-0.068	-0.014	-0.041	-0.018	-0.355	0.231	<b>0.816</b>	0.087	-0.005	0.641**
Time taken for flowering (days)	P-0.014	0.067	-0.001	-0.080	-0.140	0.069	0.002	0.065	0.116	0.018	0.315	<b>0.187</b>	0.016	0.617**
	G 0.039	0.040	0.021	-0.249	0.057	0.108	0.023	-0.039	0.114	0.052	0.320	<b>0.222</b>	0.014	0.639**
Duration of flowering (days)	P-0.008	0.040	0.000	-0.037	0.005	0.034	0.001	-0.041	0.179	0.040	-0.036	0.019	<b>0.151</b>	0.311
	G 0.022	0.024	0.015	0.121	0.011	0.060	0.000	0.024	0.222	0.012	-0.032	0.025	<b>0.012</b>	0.339

For phenotypic path (P) : Residual = 0.0746

For Genotypic path (G) : Residual = 0.0183

\*\* , \* significant at 1% and 5% level, respectively.



Significant association in zinnia flowers was also reported by (9). Flower size showed highly significant and positive correlation with weight of flowers.

Phenotypic correlation is normally reflection of genetic and/or environmental interaction and provides information about the association observed between two traits. Genotypic correlations may be interpreted as the correlation of breeding values (additive-genetic) and normally used in selection. The major cause underlying genetic associations are pleiotropy, linkage and developmentally induced relationship (1). It was also stated by (12) that genetic correlation might be accounted for linkage or pleiotropy.

Path analysis is used in partitioning the total correlation coefficient in to direct and indirect effects, which helps us in measuring the relative importance of casual factors individually (7). In the present study, for analysing path coefficient, total yield per plant was considered as the dependent variable and remaining 13 characters as independent variables. The data depicted in table 2 shows that maximum direct effect

on the total yield per plant was contributed by weight per flower (0.813) and number of flowers per plant (0.671). Traits which contribute positive direct effects, included plant spread (0.127), duration of flowers (0.151) and flower size (0.124). The negative indirect effects towards total yield per plant were attributed by plant height (-0.026), leaflets per leaf (-0.065) and leaf length (-0.141).

The indirect effects revealed that most of the characters had very low contribution towards total yield per plant through other characters. Both weight per flower and number of flower per plant showed a very high direct effect on yield on both phenotypic and genotypic levels (Table 2) and their correlation was also positive with yield. This indicates that these characters were important yield components and the effective improvement in yield could be achieved through selection based on these characters. These findings are in accordance with the results obtained by (13) in African marigold, (15) in jasmine and (5) in dahlia.

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