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Studies on Path Co-efficient Analysis in Marigold (*Tagetes Sps*)

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ABSTRACT
Path coefficient analysis was worked out for flower yield in 20 genotypes of marigold. In the present investigation, 15 characters were used as independent variables to measure the direct and indirect effects on dependent variable i. e. flower yield per plant. The results revealed that in both the years of investigation, number of flowers per plant had highest positive and direct effect on flower yield per plant, followed by fresh weight of flower. The significant and positive correlation of flower yield per plant in the years 2016-16 and 2017-18 was obtained with plant spread, number of secondary branches per plant, fresh weight of plant, number of buds per plant, number of flowers per plant and fresh weight of flower indicating that more the plant spread and number of secondary branches per plant, more will be the number of buds and number of flowers through better vegetative growth, thus, ultimately increasing the flower yield per plant.
Key words : Marigold, Tagetes species, flower yield, path coefficient analysis

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INTRODUCTION

Marigold (Tagetes species), a member of family Asteraceae, is the native of Central and South America, especially Mexico. Marigold ranks first among the loose flowers followed by chrysanthemum, jasmine, tuberose and crossandra (4). It is popular among flower growers because of wide spectrum of attractive colours, shape, size and good keeping quality and has attracted the attention of flower growers. They are extensively used as a loose flower, pot plant and also as a bedding plant. Loose flowers are in great demand for garland making as well as in religious and social functions. Globular shaped flowers with long stalks are used for cut flower purposes. The plant is very useful as both the leaves and flowers are equally important from medicinal point of view. Development of high yielding varieties with better quality flowers has been main objective of most of the breeding programmes. Heritable traits of yield and flower quality are complex characters and are known to be collectively influenced by various polygenically inherited traits which are highly vulnerable to environmental effects. Hence, for an effective and efficient selection of genotypes in marigold for yield and quality parameters, the knowledge of direction and magnitude of association between yield and its components, quality components and within components themselves becomes necessary.The path coefficient analysis method splits the correlation coefficients into direct and indirect effects which help in assessing the relative influence of each important character on the ultimate yield and flower quality. With this background information, a study on path coefficient analysis was undertaken in marigold.

MATERIALS AND METHODS

The experiment was conducted at Citrus Research Station, Tirupati from November, 2016-17 and September, 2017-18. The soil of the experimental field is red loamy with ph 6.4. The region lies in Seshachalam hill ranges dominated by sedimentary rocky-hilly terrain It receives an average rainfall of 900- 1000 mm with sub-humid conditions and remains almost free from frost. During summers the temperature touches the mark of 42-45 degrees centigrade, whereas during winters it falls to 18- 20o C. The source of planting material is from Indian Institute of Horticultural Research, Namdhari Seeds and Indus Seeds Bangalore.

The materials utilized for the present study consisted of 20 genotypes of African marigold (*Tagetes erecta J).* Raised nursery beds of size 3.0 x 1.0 m were first prepared and drenched with captan (0.01%). Seeds of different genotypes were sown in lines. The nursery beds were watered daily twice for first 10 days and daily once for the remaining period. The seedlings were ready for transplanting at 28-30 days after sowing. One month old, healthy, vigorous and uniform seedlings were selected and transplanted in 60 beds during September. The plot size was kept 3x3 mt and in each plot consisted of 30 plants and they were transplanted at a spacing of at a spacing of 30 x 30 cm in beds of at a depth of 6-8 cm in three replications.(RBD) All the fertilizer and protection measures were carried out as per the recommendations.

In the present study, path coefficient was worked out using flower yield per plant as dependant and remaining 15 characters viz., plant height, plant spread, stem diameter, stalk length, number of primary branches per plant, number of secondary branches per plant, fresh weight of plant, dry weight of plant, days taken to first flower opening, duration of flowering, number of buds per plant, number of flowers per plant, flower diameter, fresh weight of flower and dry weight of flower as independent variables. The data were analyzed for path coefficient analysis by the method suggested by [1].

RESULTS AND DISCUSSION

The data on direct and indirect effects of various characters along with their genotypic correlation coefficient with flower yield per plant are presented in Tables I and 2 for the year 2016-17 and 2017-18 respectively. Path coefficient is used in partitioning the total correlation coefficient into direct and indirect effects, which help us in measuring the relative importance of casual factors individually (1).

In the present study, for analysing path coefficient, flower yield per plant was considered as dependent variable and remaining 14 characters as independent variables. The data depicted in Table I show that maximum positive and direct effect on flower yield per plant was contributed by number of flowers per plant (2.023). It was closely followed by fresh weight of flower (1.112), stalk length (0.375) and number of secondary branches per plant (0.315), dry weight of flower (0.252) , dry weight of plant (0.199) and days taken for first flower opening (0.072) also had direct positive effect on flower yield per plant. This is an agreement with the findings of (3,8) in marigold.

Table 1. Direct (diagonal) and indirect (above and below diagonal) effects of different characters on flower yield per plant in marigold during 2016-17

Traits	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	r_g
X_1	**-0.317**	-0.094	-0.121	0.238	-0.008	0.154	0.006	0.141	0.015	0.044	0.014	0.375	-0.040	0.106	0.485*
X_2	-0.215	**-0.139**	-0.096	0.180	0.008	0.094	0.002	0.066	0.018	-0.030	1.012	0.622	-0.088	0.143	0.553*
X_3	-0.076	-0.026	**-0.506**	0.175	-0.019	0.009	0.005	0.120	0.033	0.107	0.408	0.363	-0.075	0.120	0.223

0.141	0.132	0.630**	0.594*	0.441	0.370	0.317	0.464*	0.901**	0.689**	0.854**	X-14
0.025	0.036	0.092	0.137	0.111	0.134	0.030	0.084	0.224	0.196	**0.252**	-0.169	X-13
-0.010	-0.079	-0.046	-0.089	-0.038	-0.106	-0.058	0.005	-0.182	**-0.217**	-0.169	0.988	X-12
0.005	0.188	0.342	0.502	0.291	0.517	0.321	0.212	**1.112**	0.931	0.988	-0.008	X-11
0.015	0.904	2.016	1.511	1.501	0.701	2.001	**2.023**	-0.504	-0.001	-0.008	-0.033	X-10
0.018	0.104	-0.071	-0.053	0.020	0.013	**-0.273**	-0.001	-0.079	-0.073	-0.033	0.088	X-9
0.010	0.008	-0.009	0.021	0.021	**0.072**	-0.003	0.002	0.034	0.035	0.038	0.006	X-8
0.137	0.030	0.109	0.170	**0.199**	0.057	-0.015	0.150	0.052	0.035	0.088	0.146	X-7
0.005	0.003	0.007	**0.011**	0.009	0.003	0.002	0.005	0.005	0.005	0.006	-0.091	X-6
0.105	0.038	**0.315**	0.201	0.172	-0.038	0.082	0.222	0.097	0.067	0.115	0.169	X-5
-0.009	**-0.054**	-0.007	-0.017	-0.008	-0.006	0.021	0.009	-0.009	-0.020	-0.008	0.006	X-4
0.375	0.061	0.125	0.166	0.258	0.054	-0.024	0.247	0.002	0.018	0.038	0.138	X-3
-0.237	-0.177	-0.015	-0.233	-0.306	-0.229	0.199	-0.181	-0.165	-0.175	-0.241	-0.062	X-2
-0.067	0.019	-0.041	-0.026	-0.046	-0.034	-0.015	-0.069	-0.078	-0.056	-0.079	-0.212	X-1
-0.202	-0.049	-0.155	-0.184	-0.225	-0.065	0.051	-0.196	-0.107	-0.058	-0.134	-0.060	Traits

*significant at 5% level, ** significant at 1% level ;Residual effect: 0.093

Where,

X_{-1}: Plant height (cm)' X_{-5}: No of primary branches per plant; X_{-9}: Days taken to first flower opening X_{-13}: Flower Diameter (cm)

X_{-2}: Plant Spread (cm), X_{-6}: No of secondary branches per plant, X_{-10}: Duration of flowering, X_{-14}: Dry weight of flower (g)

X_{-3}: Stem Diameter (cm) , X_{-7}: Fresh weight of stem (g), X_{-11}: No of flowers per plant, r_g: Genotypic correlation with Flower yeild per plant (g)

X_{-4}: Stalk length (cm), X_{-8}: Dry weight of plant (g), X_{-12}: Fresh weight of flower (g)

Table 2. Direct (diagonal) and indirect (above and below diagonal) effects of different characters on flower yield per plant in marigold during 2017-18

Traits	X-1	X-2	X-3	X-4	X-5	X-6	X-7	X-8	X-9	X-10	X-11	X-12	X-13	X-14	rg
X-1	**-0.090**	-0.141	-0.080	0.210	-0.007	0.287	-0.290	0.338	0.004	0.006	-0.189	0.387	-0.028	0.074	0.481*
X-2	-0.060	**-0.212**	-0.062	0.138	0.006	0.169	-0.091	0.146	0.007	-0.008	1.137	0.695	-0.115	0.114	0.591**

0.161	0.142	0.158	0.623**	0.597**	0.397	0.337	0.317	0.503*	0.901**	0.657**	0.838**	**X-3**
0.072	0.019	0.032	0.060	0.099	0.073	0.098	0.021	0.065	0.171	0.144	**0.187**	**X-4**
-0.057	0.004	-0.091	-0.045	-0.106	-0.026	-0.137	-0.074	0.008	-0.239	**-0.288**	-0.222	**X-5**
0.306	-0.033	0.229	0.364	0.567	0.287	0.533	0.300	0.258	**1.218**	1.013	1.113	**X-6**
0.519	0.191	1.007	1.225	1.365	1.220	0.715	1.916	**2.090**	-0.061	0.008	-0.101	**X-7**
0.022	0.004	0.020	-0.014	-0.009	0.004	-0.001	**-0.051**	-0.003	-0.013	-0.013	-0.006	**X-8**
0.008	0.005	0.003	-0.002	0.009	0.008	**0.027**	0.001	0.001	0.012	0.013	0.014	**X-9**
0.304	0.341	0.093	0.257	0.400	**0.478**	0.136	-0.038	0.363	0.113	0.044	0.186	**X-10**
-0.208	-0.224	-0.189	-0.335	**-0.504**	-0.421	-0.167	-0.087	-0.287	-0.235	-0.186	-0.267	**X-11**
0.064	0.207	0.095	**0.596**	0.396	0.320	-0.036	0.162	0.463	0.178	0.093	0.191	**X-12**
-0.010	-0.008	**-0.038**	-0.006	-0.014	-0.007	-0.004	0.015	0.001	-0.007	-0.012	-0.007	**X-13**
0.152	**0.317**	0.066	0.110	0.141	0.226	0.057	-0.024	0.209	-0.008	-0.004	0.033	**X-14**
-0.307	-0.148	-0.084	-0.033	-0.127	-0.195	-0.086	0.131	-0.126	-0.077	-0.061	-0.119	
-0.043	-0.093	0.031	-0.060	-0.038	-0.065	-0.053	-0.033	-0.100	-0.121	-0.085	-0.129	
-0.024	-0.060	-0.015	-0.043	-0.052	-0.064	-0.014	0.010	-0.059	-0.029	-0.009	-0.036	

*significant at 5% level, ** significant at 1% level; Residual effect: 0.088

X-1: Plant height (cm); X-5: No of primary branches per plant'; X-9: Days taken to first flower openingX-13: Flower Diameter (cm)

X-2: Plant Spread (cm) X-6: No of secondary branches per plant X-10: Duration of flowering, X-14: Dry weight of flower (g)

X-3: Stem Diameter (cm) X-7: Fresh weight of stem (g) X-11: No of flowers per plant, r_g: Genotypic correlation with Flower yield per plant (g), X-4: Stalk length (cm), X-8: Dry weight of plant (g). X-12: Fresh weight of flower (g)

Similarly on the other hand duration of flowering had the high negative and direct effect on stem diameter (-0.506), plant height (-0.317) duration of flowering (-0.273) followed by flower diameter (-0.217) plant spread (-0.139) number of primary branches per plant (-0.054). Similar results were also observed by (4) in marigold for plant height, number of laterals per plant and days to first flowering.

In second year (Table 2),number of flowers per plant exhibited strong direct and positive effect (2.090) on flower yield per plant followed by fresh weight of flower (1.218), number of secondary branches per plant (0.596), dry weight of flower (0.478),stalk length (0.317), dry weight of flower (0.187). The high negative direct effect was recorded for fresh weight of stem (-0.504), followed by stem diameter (-0.307), flower diameter(-0.288),plant spread (-

0.212) duration of flowering (-0.051). Similar results were observed in the earlier studies in marigold who observed highly positive and direct effect of number of flowers per plant on flower yield per plant. [3,6,9].

Regarding indirect effects, it was observed that number of secondary branches per plant had the highest positive indirect effect via number of flowers per plant (2.016). It was closely followed by duration of flowering (2.001) fresh weight of plant (1.511) dry weight of plant (1.501) plant spread (1.012) and number of primary branches per plant (0.904) through number of flowers per plant in the year 2016-17.

In 2017-18, duration of flowering had the highest positive indirect effect (Table 2) via number of flowers per plant (1.916). It was closely followed by high positive indirect effects fresh weight of stem (1.365) number of secondary branches per plant (1.225) dry weight of plant (1.220), plant spread (1.137) number of primary branches per plant (1.007). These findings are in line in marigold [7] and in gerbera [5].

The dry weight of stem had high negative indirect effect (-0.306) via stem diameter in the first year, whereas in second year dry weight of plant showed high negative indirect effect (-0.421) through fresh weight of stem. The present results are in confirmation with the earlier findings in marigold [6]. The magnitude of residual effects was low in both the years of investigation, which indicated that major portion of contribution towards flower yield per plant might be explained on the basis of characters included in the present study. However, some more characters not included in the present study may contribute to account for the residual effect.

CONCLUSION

It may be concluded that the significant improvement in flower yield per plant can be expected through selection in the component traits with high positive direct effects.

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