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Inter-trait relation studies for quantative production of marigold

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Abstract

Correlation studies were carried out among twenty important parameters of marigold for different yield attributing traits in order to differentiate the contribution made by each parameter towards total flower yield. The results revealed that the genotypic correlation were higher than the phenotypic correlation for the characters obtained, indicating the high heritable nature of the characters. Number of leaves per plant number of primary branches per plant, number of flowers per plant and average fresh weight of flower were reported highly significant and positive correlation with flower yield per plant, whereas stem diameter and 100 seed weight were found significant and positive correlated with flower yield per plant at both genotypic and phenotypic level. Since these association are in desirable direction, hence selection of these traits may ultimately improve the total flower yield.

Keywords: Correlation, germplasm, marigold, quality, yield

Marigold is a top-ranking loose flower in India followed by chrysanthemum, jasmine, tuberose, and crossandra. Marigold (*Tagetes* spp.) is one of the most important species grown commercially for loose flowers in different parts of India, especially in the tropical and sub-tropical regions. It symbolizes prosperity and is related to the renowned, strong and brave lion. It belongs to family Asteraceae and is originated from central and southern America specially Mexico. Its basic chromosome number is 12 and has diverse growth habit, size, floral colour along with types and utility. Besides commonly used as bedding and loose flowers, it is used for adding food flavour and as pharmaceutical, nutraceutical, industrial, pesticide and organic manure with a lot of opportunities in value added products. Growth, flowering and seed production of marigold is highly influenced by light and temperature. Since the performance of genotypes varies with region, season and growing conditions, hence selection is an important method for identifying marigold genotypes with desirable horticultural traits for specific purposes. Thus, the present study was taken to identify best genotypes in Bihar in terms of commercial cultivation. Many cultivars have been developed from local material collected from different parts of the country. Despite of varietal development, there is need to develop genotypes with stable and better yield, quality and their adaptation under different environment. A variety may perform well only in a particular environment and therefore the genetic potentiality of different genotypes and their interaction with environmental condition is to be established and according to their performance, selection of best growth and flowering traits genotype needs to be done. The wide range of groups and varieties of this flower made the workers research more complex. Its flower yield is a complex character and is the result of interrelationship of various components. Correlation analysis furnishes information regarding the nature and magnitude of various associations and help in the measurement of

direct influence of one variable on others. The correlation coefficient indicates the degree of relationship between characters for selecting suitable genotypes for improving flower yield.

Materials and Methods

The present study was conducted was at Botanical Garden. Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India during winter season, 2021-22. The experiment was laid out in Randomized Block Design with three replications. Nursery preparation work was started on 14th October by mixing well rotten FYM at 10 kg/m^2. Raised beds of 15 cm were prepared with plot size 4 x 4 m^2. The nursery was prepared on 16th October and approximately 5 g seeds of each germplasm were sown evenly for raising seedlings. Land was brought to a good tilth by 4-5 ploughings and leveled properly followed by incorporation of 30 kg Farm Yard Manure per m^2. Farm Yard Manure was uniformly sprinkled and mixed thoroughly. Nitrogen @100kg/ ha, phosphorous @100kg/ha and potassium @100kg/ha were incorporated in the soil as basal dose in form of urea, single super as and muriate of potash, respectively. Nitrogen at 200 kg/ ha was applied in two split doses at 30 and 60 days after transplanting. The data on plant height (cm), stem diameter (cm), plant spread (cm), number of primary branches per plant, number of leaves per plant, leaf biomass (g), days taken to first flower opening, average fresh weight of flower (g), flower duration (days), flower diameter (cm), number of flowers per plant and flower yield per plant (g) were recorded. Correlation coefficient was computed by the formula suggested by Al-Jibauri *et al*., 1958; Dewey and Lu, 1959; and Lush, 1940.

Results and Discussion

Correlation coefficient

The correlation coefficient between different characters of marigold is depicted in Table 1. In majority of the characters genotypic correlation coefficient was greater than phenotypic correlation coefficient. This indicated a strong inherent association among various characters and their phenotypic expression impeded by the influence of environmental factors. Table 1 revealed that at phenotypic level, plant height showed highly significant and positive correlation with plant spread (0.738), average fresh weight of leaves (0.541), stem diameter (0.440), days taken to first bud initiation (0.573), days taken to first flowering (0.663), flower duration (0.447), flower diameter (0.692), flower peduncle length (0.590), days taken to seed ripening (0.467), number of seeds per peduncle (0.861), weight of seed per peduncle (0.861) and seed yield per plant (0.879), whereas significant but positive correlation was observed with number of secondary branches per plant (0.381). This might be due to the reason of higher photosynthates production with increased number of leaves and branches, which provided vigorous growth and more number of flowers per plant at reproductive phase. Similar observation were resulted by Lydia and Ponnuswami (2019), Srinivasan *et al*. (2018), Patel *et al*. (2018), Kumar *et al*. (2018), Giri *et al*. (2018), Singh and Kumar (2008), Sahu *et al*. (2018), Bharathi (2014), Panwar *et al*. (2014) and Karuppaiah and Kumar (2010).

Number of leaves per plant exhibited highly significant and positive correlation with number of primary branches per plant (0.752), number of secondary branches per plant (0.698), plant spread (0.617), leaf biomass (0.929), number of flowers per plant (0.936) and flower yield per plant (0.603), whereas number of primary branches per plant showed highly significant and positive correlation with plant spread (0.560), leaf biomass (0.668), number of flowers per plant (0.625), days taken to seed ripening (0.574) and flower yield per plant (0.455) and was with significant but positive correlation with number of secondary branches per plant (0.392) and days taken to first bud initiation (0.370). Secondary branches per plant exhibited highly significant and positive correlation with plant spread (0.725), leaf biomass (0.743), number of flowers per plant (0.539), whereas significant and positive correlation was found with average fresh weight of leaves (0.336). Similar results were concluded by finding by Poulose *et al*. (2021), Kumar *et al*. (2018), Sahu *et al*. (2018), Singh and Saha (2009), Singh and Singh (2009), Singh and Misra (2008) and Panwar *et al*. (2013).

Plant spread recorded highly significant and positive correlation with average fresh weight of leaf (0.512), leaf biomass (0.697), days taken to first

bud initiation (0.458), number of seeds per peduncle (0.528), weight of seeds per peduncle (0.456) and seed yield per plant (0.448), whereas significant and positive correlation was observed with flower diameter (0.407) and number of flowers per plant (0.402). The results are in line with the work done by Singh and Misra (2008), Singh and Singh (2009), Karuppaiah *et al.* (2004) and Choudhary *et al.*(2015).

Average fresh weight of leaves exhibited highly significant and positive correlation with leaf biomass (0.486), days taken to first bud initiation (0.517), peduncle length (0.518), number of seeds per peduncle (0.502), whereas significant and positive correlation was recorded with days taken to flowering (0.396), flower diameter (0.346), peduncle length (0.518) and days taken to seed ripening (0.403) along with significant and negative correlation with 100 seed weight (-0.388). Stem diameter exhibited highly significant and positive correlation with flower duration (0.554), flower diameter (0.497), average fresh weight of flower (0.519), peduncle length (0.643), weight of seeds per peduncle (0.549) and seed yield per plant (0.428), whereas significant and positive correlation was noted with number of seeds per plant (0.356) and flower yield per plant (0.390). Leaf biomass recorded highly significant and positive correlation with number of flowers per plant (0.851) and significant and positive correlation with flower yield per plant (0.414). This might be due to reason that with increased plant height, the number of branches is enhanced with the production of more leaves and higher photosynthates and vigour which when switches off to reproductive phase leads to higher yield of flowers and seed. The results are in agreement with the finding of Singh and Misra (2008), Singh and Singh (2009), Karuppaiah *et al*. (2004) and Choudhary *et al*. (2015).

Days taken to first bud initiation showed highly significant and positive correlation with days taken to first flowering (0.856), flower diameter (0.518), peduncle length (0.542), days taken to seed ripening (0.752) and number of seeds per peduncle (0.634), whereas significant but positive correlation was seen with seed yield per plant (0.398) and significant but negative correlation with 100 seed weight (-0.338). Days taken to flowering noticed highly significant and positive correlation with flower diameter (0.609), peduncle length (0.657), days taken to seed ripening (0.825), number of seeds per plant (0.759), weight of seeds per peduncle (0.508) and seed yield per plant (0.627), whereas flower duration recorded highly significant and positive significant correlation with flower diameter (0.495), peduncle length (0.469), number of seeds per peduncle (0.474), weight of seeds per peduncle (0.660) and seed yield per plant (0.643). On the other hand, flower diameter showed highly significant and positive correlation with peduncle length (0.727), number of seeds per peduncle (0.772), weight of seeds per peduncle (0.647) and seed yield of plant (0.718), whereas number of flowers per plant recorded highly significant and positive correlation with flower yield per plant (0.609). Similar trend of correlation was noticed by Kumar *et al.* (2018), Sahu *et al.* (2018) and Singh and Misra (2008).

Average fresh weight of flower showed highly significant and positive correlation with 100 seed weight (0.599) and flower yield per plant (0.799), whereas peduncle length recorded highly significant and positive correlation with days taken to seed ripening (0.518), number of seeds per plant (0.731), weight of seeds per peduncle (0.497) and seed yield per plant (0.576). This might be due to the reason, that after proper vegetative -reproductive phase there is increase in flower number and continuation with more dry matter content and with the enhanced diameter and peduncle of flower there is production of bold and viable seed which ultimately resulted in higher seed yield.

Days taken to seed ripening showed highly significant and positive correlation with number of seeds per peduncle (0.579) and significant and positive correlation with seed yield per plant. Number of seeds per peduncle showed highly significant but positive correlation with weight of seed per peduncle (0.692), seed yield per plant (0.917) and significant but negative correlation (-0.462) with 100 seed weight. Weight of seeds per peduncle recorded highly significant and positive correlation with seeds yield per plant (0.871), whereas 100 seed weight showed significant and positive correlation with flower yield per plant (0.386). This might be due to the reason that with increase number and weight of seeds per peduncle

Table 1. Genotypic and phenotypic correlation among vegetative, flood and seed attributes for twenty one characters of twelve genotypes of marigold

Trait		PB	SB	PS	FFL	SD	LB	FBA	FFO	FDU	FD	F/P	FWF	FPL	DSR	S/P	W/P	100SW	SY/P	FY/P
PH	P	0.253	0.381*	0.738**	0.541**	0.440**	0.275	0.573**	0.663**	0.447**	0.692**	0.043	0.001	0.590**	0.467**	0.861**	0.861**	0.151	0.879**	0.061
	G	0.257	0.398*	0.748**	0.549**	0.448**	0.280	0.577**	0.671**	0.459**	0.701**	0.045	0.002	0.597**	0.476**	0.878**	0.878**	0.153	0.899**	0.065
L/P	P	0.752**	0.698**	0.617**	0.145	0.440**	0.275	0.573**	0.057	0.045	0.015	0.936**	0.046	0.163	0.094	0.042	0.074	0.121	0.075	0.603**
	G	0.762**	0.708**	0.623**	0.149	0.448**	0.280	0.577**	0.057	0.049	0.020	0.948**	0.049	0.168	0.098	0.047	0.078	0.127	0.074	0.616**
PB	P		0.392*	0.560**	0.125	0.038	0.668**	0.370*	0.282	0.019	0.054	0.625**	0.056	0.028	0.574**	0.154	0.043	0.045	0.099	0.455**
	G		0.405*	0.565**	0.126	0.041	0.677**	0.376*	0.295	0.020	0.057	0.632**	0.057	0.032	0.585**	0.157	0.045	0.047	0.106	0.463**
SB	P			0.725**	0.336*	0.321	0.743**	0.113	0.176	0.107	0.029	0.539**	0.095	0.119	0.164	0.108	0.276	0.014	0.179	0.238
	G			0.736**	0.348*	0.329	0.757**	0.118	0.183	0.111	0.027	0.553**	0.095	0.122	0.166	0.114	0.282	0.015	0.186	0.249
PS	P				0.512**	0.314	0.697**	0.458**	0.296	0.032	0.407*	0.539**	0.030	0.222	0.263	0.528**	0.456**	0.254	0.488**	0.224
	G				0.518**	0.322	0.704**	0.465**	0.295	0.032	0.409*	0.406*	0.029	0.221	0.271	0.533**	0.462**	0.255	0.495**	0.227
FFL	P					0.216	0.486**	0.517**	0.396*	0.090	0.346*	0.032	0.278	0.518**	0.403*	0.502**	0.247	-0.388*	0.274	0.219
	G					0.218	0.488**	0.520**	0.400*	0.092	0.347*	0.031	0.279	0.525**	0.406*	0.504**	0.249	-0.389*	0.274	0.221
SD	P						0.120	0.045	0.102	0.554**	0.497**	0.008	0.519**	0.643**	0.004	0.356*	0.549**	0.241	0.428**	0.390*
	G						0.121	0.045	0.106	0.562**	0.503**	0.010	0.521**	0.657**	0.005	0.359*	0.551**	0.242	0.432**	0.391*
LB	P							0.196	0.071	0.002	0.089	0.851**	0.114	0.002	0.197	0.203	0.014	0.279	0.003	0.414*
	G							0.200	0.074	0.004	0.085	0.861**	0.112	0.001	0.203	0.122	0.014	0.281	0.004	0.424**
FBA	P								0.856**	0.120	0.518**	0.009	0.033	0.542**	0.752**	0.634**	0.275	-0.338*	0.398*	0.005
	G								0.865**	0.122	0.526**	0.007	0.033	0.547**	0.757**	0.638**	0.276	-0.340*	0.401*	0.005
FFO	P									0.306	0.609**	0.075	0.132	0.657**	0.825**	0.759**	0.508**	0.235	0.627**	0.013
	G									0.313	0.617**	0.075	0.135	0.665**	0.836**	0.766**	0.512**	0.237	0.634**	0.015
FDU	P										0.495**	0.079	0.153	0.469**	0.144	0.474**	0.660**	0.148	0.643**	0.106
	G										0.505**	0.081	0.155	0.480**	0.142	0.478**	0.665**	0.149	0.650**	0.112
FD	P											0.017	0.147	0.727**	0.314	0.772**	0.647**	0.207	0.718**	0.048
	G											0.015	0.149	0.739**	0.320	0.783**	0.657**	0.208	0.729**	0.053
F/P	P												0.027	0.199	0.010	0.143	0.209	0.136	0.204	0.609**
	G												0.026	0.201	0.012	0.146	0.211	0.137	0.207	0.608**
FWF	P													0.184	0.010	0.173	0.195	0.599**	0.061	0.799**
	G													0.189	0.009	0.172	0.196	0.600**	0.061	0.801**
PL	P														0.518**	0.731**	0.497**	0.194	0.576**	0.008
	G														0.526**	0.742**	0.508**	0.199	0.587**	0.004
DSR	P															0.579**	0.245	0.273	0.419*	0.021
	G															0.582**	0.247	0.276	0.423*	0.022
S/P	P																0.692**	0.462**	0.917**	0.261
	G																0.693**	0.464**	0.918**	0.264
W/P	P																	0.251	0.871**	0.022
	G																	0.251	0.872**	0.023
100SW	P																		0.195	0.386*
	G																		0.196	0.388*
SY/P	P																			0.215
	G																			0.212

PH- Plant-height (cm), PB/P- Number of primary branches per plant, SB/P- Number of secondary branches per plant, L/P- Number of leaves per plant, SD- Stem diameter(cm), PS- Plant spread (cm), FWL- Average fresh weight of leaves (g), FBA- Days taken to first flower bud appearance, FFO- Days taken to first flower opening, FDU- Flower duration (days), FD- Flower diameter (cm), F/P- Number of flowers per plant, FFW- Average fresh weight of flower (g), FPL- Flower peduncle length (cm), FY/P- Flower yield per plant (g), DSR-Days taken to seed ripening, S/P-Number of seeds per peduncle, W/P-Weight of seed per peduncle,100SW-100 seed weight, SY/P-Seed yield per plant, FY/P-Flower yield per plant(g). *Significant at 0.05, **significant at 0.01.

the seed yield also increased. The similar results were observed by Singh and Kumar (2008) and Singh and Misra (2008).

At genotypic level, general trends of association were similar to phenotypic level among various traits, except leaf biomass had highly significant positive correlation with flower yield (0.424). This results obtained may be due to the reason that with increase leaf biomass formed, the photosynthates and plant vigour lead to the quality and quantity of flower production. The results are line with Kumar *et al.* (2018) and Sahu *et al.* (2018).

Conclusion

Based on correlation analysis traits like flower diameter, number of flowers per plant and average fresh weight of flowers had direct positive effect towards flower yield per plant with highly significant positive corelation values which further facilitates the selection of superior genotypes of marigold.

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