Environment Conservation Journal 24 (1):198-203, 2023

Journal homepage:https://www.environcj.in/

Environment Conservation Journal

ISSN 0972-3099 (Print) 2278-5124 (Online)

Evaluation of genotypes and correlation studies in Marigold (*Tagetes spp.*) for growth and yield attributes

Thakur Tanya ✉

Department of Floriculture and Landscaping, Punjab Agricultural University, Ludhiana, India

Dhatt Kiranjeet Kaur

Department of Floriculture and Landscaping, Punjab Agricultural University, Ludhiana, India

ARTICLE INFO

Received : 20 January 2022
Revised : 31 July 2022
Accepted : 28 August 2022

Available online: 15 January 2023

Key Words:
Marigold
genetic diversity
correlation
yield attributes
genotypes
growth

ABSTRACT

The study was conducted to evaluate 23 genotypes of marigold (*Tagetes spp.)* collected from different and diverse sources and correlation studies were performed for various growth and yield characters. The results shows that the maximum plant height (92.60 cm) is recorded in the genotype AMS-15, whereas maximum plant spread (52.80 cm), flower weight (8.93 g) and largest flower size (7.63 cm) was recorded in the genotype 'AMS-16'. The highest number of branches (11.13), flowers per plant (509.93), flower yield per plant (622.27 gm), flower yield per m^2 (4635.83 gm) and duration of flowering (88.47 days) was recorded in genotype 'AMS-3'. The genotype 'AMS-4' showed earliest bud initiation (38.20 days) and flower opening (47.53 days). Plant spread is positively correlated with number of branches, flower stalk length, flower diameter, days to bud initiation, first flower opening, flower yield per plant and per m^2, whereas, plant height has positive correlation with plant spread, number of branches per plant, flower stalk length and flower diameter. The study concludes that the genotype AMS-3 is the best amongst all the genotype with respect to flower yield and flowering duration. The various growth parameters *viz.* plant spread, number of branches, flower diameter, days to bud initiation, days to first flower opening and number of flowers per plant has positive correlation with flower yield, hence, these characters may be considered as selection indices in improving yield attributes in marigold.

Introduction

Marigold (*Tagetes* spp.) belonging to family Asteraceae is traditional ornamental crop commercially grown for loose flower in different parts of the world. It has gained massive trend and popularity due to its wider versatility and adjustability to various soil and atmospheric conditions, short duration, free and longer flowering durations. It can be used as bedding plant, pot plant or in rock gardens and floral arrangements for interior decoration. The essential oil and carotenoids extracted from petals are used in perfumery, textile and pharmaceutical industry. In order to enhance chicken skin colour and egg yolk pigmentation the petals are used as dietary supplement in poultry industry (Hojnik *et al.*, 2008). Marigold is grown as intercrop or trap crop as it is beneficial to control nematode population (Soule, 1993). The demand for varieties with uniform, medium size and compact growth with bright colour flowers having more shelf life are very high and development of such varieties requires genetically stable genotypes with more flower yield (Bharathi *et al.*, 2014). Variation with respect to character is an essential requirement for selection of superior variety and successful breeding programme. To enhance variation in heterozygous crop like marigold, the open pollinated crops are utilized and are gaining considerable importance (Singh and Misra, 2008).

Correlation coefficient is considered as principal device for the selection of advantageous traits for genetic improvement of particular character, it can measures relationship between various plant characters and this can be utilized to magnify the

Corresponding author E-mail: *tanyathakurflori@gmail.com*
Doi:https://doi.org/10.36953/ECJ.10542285

productivity of marigold. Character association of marigold revealed that quantitative traits had a significant genotypic and phenotypic correlation coefficient with flower yield (Karuppaiah *et al*., 2010). Singh *et al*. (2008) reported that flower yield per plant exhibited positive correlation with number of primary and secondary branches and flowers per plant. The selection based on the component traits can be easier and smoother if plant breeder knows the degree of relationship between yield and its various components (Prasad *et al*., 2011). Hence, due to the ever-changing scenario and rapid advancement in floriculture sector, evaluation of marigold germplasm is essential to bring the suitable genotypes with desirable quality parameters and recommended to farmers for exploitation of their potential. It is of great importance to employ correlation studies in marigold to discover the traits having interrelationship with flower yield and quality parameters.

Material and Methods

The study was conducted in the Department of Floriculture and Landscaping, Punjab Agricultural University, Ludhiana during 2019-20. The experimental material comprised of 23 genotypes of marigold (*Tagetes spp.)* which were collected from distinct and diverse sources. The genotypes Pusa Narangi Gainda, Pusa Basanti Gainda, Summer Saugat were collected from IARI, New Delhi, whereas, other all genotypes were local selections. The seeds were sown in nursery beds and then transplanted at 40x40 cm as per Randomized Block Design (RBD) with three replications. Five randomly selected plants from each replication were marked for recording observations on plant height, plant spread, number of branches per plant, bud initiation, days to first flower opening, flower stalk length, flower diameter, average flower weight, number of flowers per plant, duration of flowering, flower yield per plant, flower yield per unit area. The following formula suggested by Al -Jibouri *et al*. (1958) was used to compute correlation coefficients-

$$rp = \frac{pcov\ x\cdot y}{\sqrt{\delta^2 px\cdot\delta^2 py}}$$

$$rg = \frac{gcov\ x\cdot y}{\sqrt{\delta^2 gx\cdot\delta^2 gy}}$$

√Where: rp and rg are phenotypic and genotypic correlation coefficients, respectively; pcov x·y and gcov x·y are phenotypic and genotypic covariances between variables x and y, respectively; δ^2px and δ^2gx are phenotypic and genotypic variances, respectively, for variable x; and δ^2py and δ^2gy are phenotypic and genotypic variances, respectively, for variable y.

Results and Discussion

Evaluation of genotypes

The 23 genotypes of marigold exhibited pronounced variation and significant differences for growth and yield attributes as presented in Table 1 and 2.

Table 1: Genetic variability in 23 marigold genotypes for growth and yield attributes

Cultivars	Plant height (cm)	Plant spread (cm)	Number of branches per plant	Days to bud initiation	Days to first flower opening	Duration of flowering (days)
Pusa Narangi	63.27	33.87	7.80	65.27	78.93	48.67
Pusa Basanti	67.20	31.93	5.33	58.07	71.00	56.53
Jafri	59.27	43.40	7.93	75.40	87.73	56.20
Summer Saugat	80.40	41.40	10.80	51.27	68.40	41.00
AMS -1	68.53	34.00	8.93	81.20	92.47	60.67
AMS-2	83.53	49.60	10.87	74.20	89.67	42.73
AMS-3	68.00	45.47	11.13	147.07	167.67	88.47
AMS-4	48.27	30.33	6.60	38.20	47.53	50.80
AMS-5	48.53	28.40	6.60	42.33	50.33	75.93

AMS-6	41.80	24.07	4.40	60.33	68.40	52.60
AMS-7	88.53	52.73	8.93	49.87	72.60	47.07
AMS-8	63.33	36.27	5.47	72.67	85.00	43.80
AMS-9	56.73	32.20	5.60	69.00	82.13	45.07
AMS-10	46.87	27.03	8.93	58.47	68.43	32.03
AMS-11	54.60	34.40	9.73	73.67	82.07	62.33
AMS-12	44.60	27.20	7.47	62.20	74.40	54.27
AMS-13	70.67	33.00	7.20	75.00	81.13	67.53
AMS-14	90.83	34.00	7.83	77.00	83.50	46.50
AMS-15	92.60	45.67	5.20	78.53	85.73	42.33
AMS-16	82.26	52.80	7.80	79.87	89.60	38.27
AMS-17	57.00	31.40	5.60	70.20	79.97	47.93
AMS-18	56.80	35.20	9.67	88.87	95.03	62.27
AMS-19	41.87	24.00	4.27	78.93	89.20	52.40
C.D. (P=0.05)	5.02	6.93	1.68	4.30	4.71	7.61

Table 2: Genetic variability in 23 marigold genotypes for growth and yield attributes

Cultivars	**Flower diameter (cm)**	**Stalk length (cm)**	**Average flower weight (g)**	**Number of flowers per plant**	**Flower yield per plant (g)**	**Flower yield per m^2 (g)**
Pusa Narangi	4.93	2.73	6.50	25.93	160.20	1193.47
Pusa Basanti	4.37	3.30	4.77	29.87	143.13	1066.33
Jafri	4.43	3.00	4.83	37.07	182.80	1361.83
Summer Saugat	6.37	2.57	3.40	151.73	409.73	3052.47
AMS -1	4.37	2.90	5.47	24.93	129.07	961.50
AMS-2	4.20	2.73	4.37	31.67	133.07	991.33
AMS-3	3.80	4.23	1.20	509.93	622.27	4635.83
AMS-4	4.57	3.53	6.50	29.07	161.93	1206.40
AMS-5	3.90	3.63	6.30	35.93	190.53	1419.47
AMS-6	3.43	1.93	4.10	41.87	141.00	1050.40
AMS-7	4.47	3.30	3.23	101.53	285.00	2122.70
AMS-8	5.17	3.57	5.33	22.00	102.53	760.83
AMS-9	4.50	3.33	4.77	23.47	132.13	984.33
AMS-10	3.67	3.30	4.97	54.07	252.67	1882.33
AMS-11	2.47	2.17	1.07	244.73	260.47	1944.93
AMS-12	2.83	2.63	1.43	111.47	140.33	1045.47
AMS-13	2.63	3.60	1.70	132.67	214.47	1597.73
AMS-14	5.57	4.67	5.07	39.93	184.80	1376.70
AMS-15	7.17	3.33	4.53	88.07	409.00	2931.17
AMS-16	7.63	3.83	8.93	45.93	457.13	3405.57
AMS-17	5.60	3.27	4.17	83.53	308.27	2296.53
AMS-18	3.77	2.17	2.30	237.00	444.20	3309.23
AMS-19	6.63	2.13	6.13	74.87	411.07	3062.37
C.D. (P=0.05)	0.56	0.54	1.11	28.77	72.49	554.29

P= 0.05., Significant at 5%

The maximum plant height (92.60 cm) was recorded in genotype 'AMS-15' followed by genotype 'AMS-14' (90.83 cm) and minimum (41.80 cm) was observed in genotype 'AMS-6'. The maximum plant spread (52.80 cm) was observed in genotype 'AMS-16' followed by genotype 'AMS-7' (52.73 cm) and minimum (24.00 cm) was observed in genotype 'AMS-19'. The highest number of branches (11.13) was recorded in genotype 'AMS-3' and lowest (4.40) was observed in genotype 'AMS-19'. Similar findings were reported previously by Bharathi and Jawaharlal (2014), Shivakumar *et al*. (2014) and Singh *et al*. (2014) while determining the variability among African marigold genotypes. It was observed that the genotypes with more plant height recorded greater plant spread and those with short height recorded less spread thus, exhibiting the direct relationship between these characters. These results were true for genotypes 'AMS-15' and 'AMS-16'. The plant height, spread and branch count vary are among genotypes due to genomic sequence of the plants as these are varietal traits. The accessibility of compatible environment to express the dominant gene in the genotypes may be the reason for variation (Maynard and David, 1987).The highest number of flowers per plant (509.93), flower yield per plant (622.27 g), flower yield per m^2 (4635.83 g) and duration of flowering (88.47 days) were recorded in genotype 'AMS-3'. The greater number of branches resulted in building and accumulation of maximum photosynthates which directly resulted in greater number of flowers with bigger size and this might be the reason for variation in flowers number within genotypes. The largest flower size (7.63 cm) and maximum flower weight (8.93 g) was recorded in genotype 'AMS-16' and smallest flower size (2.47 cm) and minimum flower weight (1.07 g) was observed in genotype 'AMS-11'. The weight of flowers was observed more in genotypes whose flower size was found larger. This variation in flower weight among different genotypes might be attributed to the higher water and carbohydrates level in the flower that helps to maintain flower turgidity, freshness and petal orientation. The ultimate effect of all these factors resulted in long flower stalks, large sized flower and finally increases flower weight. Similar results were reported by Panwar *et al*. (2013). The longest flower stalk length (4.67 cm) was recorded in genotype 'AMS-14', whereas shortest stalk length was observed in genotype 'AMS-6'. The variation in number of flowers per plant, flower diameter, stalks length, fresh flower weight, flower yield per plant and duration of flowering is due to genetic makeup of genotypes and environmental variation. The earliest bud initiation (38.20 days) and first flower opening (47.53 days) were recorded in genotype 'AMS-4'. The days taken to bud initiation and flower opening signifies the availability of flowers in the market (Behera *et al*., 2002). Singh *et al*. (2008) reported that variation in days taken to flowering is attributed to genetic makeup of various germplasm lines. Moreover, due to favorable climatic conditions there is more dry matter accumulation which favors early flowering in marigold (Rao and Reddy, 2002).

Correlation Coefficient

The correlation coefficient between various yield components and interrelationship among the traits were computed and presented in Tables 3. The results indicate a strong association between plant morphological characters with yield. The plant height revealed a significant and positive correlation with plant spread, number of branches per plant, flower stalk length and flower diameter. Plant spread is positively correlated with number of branches, flower stalk length, flower diameter, days to bud initiation, days to first flower opening, flower yield per plant and flower yield per m^2. Number of branches per plant is positively and significantly associated with number of flowers per plant, flower yield per plant and flower yield per m^2. The days to bud initiation exhibited significant positive correlation with days to first flower opening, duration of flowering. Flower diameter is positively and significantly associated with average flower weight, flower yield per plant and flower yield per m^2. Flower yield per plant has shown positive and significant association with flower yield per m^2. Thus, the increase in plant spread, number of branches, flower diameter, days to bud initiation, days to first flower opening and number of flowers per plant can enhance the flower yield per plant and flower yield per m^2. These results are in conformity with the finding of Anuja and Jahnavi (2012), Vishnupriya *et al*. (2015) in marigold.

Table 3: Phenotypic (rp) and Genotypic (rg) correlation co-efficient between different pairs of characters in marigold

Characters `	rp rg	Plant height	Plant spread	Number of branches per plant	Flower stalk length	Flower diameter	Average flower weight	Days to bud initiation	Days to first flower opening	Number of flowers per plant	Flower yield per plant	Flower yield per m^2	Duration of flowering
Plant height	rp rg	 1.000											
Plant spread	rp rg	0.759** 0.815	 1.000										
Number of branches per plant	rp rg	0.314** 0.359	0.465** 0.533	 1.000									
Flower stalk length	rp rg	0.418** 0.476	0.250* 0.318	0.048 0.017	 1.000								
Flower diameter	rp rg	0.434** 0.458	0.315** 0.381	-0.243* -0.252	0.180 0.226	 1.000							
Average flower weight	rp rg	0.030 0.049	0.017 0,024	-0.345** -0.415	0.195 0.233	0.603** 0.660	 1.000						
Days to bud initiation	rp rg	0.175 0.186	0.270* 0.317	0.291* 0.344	0.192 0.217	0.008 0.007	-0.313** -0.344	 1.000					
Days to first flower opening	rp rg	0.218 0.232	0.347** 0.408	0.351** 0.417	0.190 0.224	0.013 0.011	-0.328** -0.362	0.979** 0.982	 1.000				
Number of flowers per plant	rp rg	0.031 0.030	0.203 0.228	0.501** 0.550	0.044 0.043	-0.262* -0.270	-0.660** -0.698	0.716** 0.731	0.735** 0.751	 1.000			
Flower yield per plant	rp rg	0.204 0.229	0.357** 0.406	0.308* 0.325	0.085 0.079	0.353** 0.392	-0.155 -0.188	0.574** 0.602	0.575** 0.607	0.709** 0.728	 1.000		
Flower yield per m^2	rp rg	0.194 0.221	0.353** 0.403	0.315** 0.333	0.084 0.077	0.345** 0.385	-0.154 -0.191	0.574** 0.604	0.576** 0.670	0.713** 0.733	0.999** 0.999	 1.000	
Duration of flowering	rp rg	-0.214 -0.242	-0.102 -0.132	0.169 0.181	0.088 0.087	-0.474** -0.519	-0.428** -0.456	0.429** 0.492	0.407** 0.476	0.598** 0.644	0.204 0.238	0.209 0.244	 1.000

Conclusion

It was concluded that genotype AMS-3 was best amongst all with respect to highest number of branches, flowers per plant, flower yield per plant, flower yield per m^2 and duration of flowering. Plant spread is positively correlated with number of branches, flower stalk length, flower diameter, days to bud initiation, first flower opening, flower yield per plant and per m^2, whereas, plant height has positive correlation with plant spread, number of branches per plant, flower stalk length and flower diameter. The various growth parameters *viz.* plant spread, number of branches, flower diameter, days to bud initiation, days to first flower opening and number of flowers per plant has positive correlation with flower yield, hence, these characters may be considered as selection indices in improving yield attributes in marigold.

Conflict of interest

The authors declare that they have no conflict of interest.

References

Al-Jibouri, H.A., Muller, P.A., & Robinson, H.P. (1958). Genetic and environmental variance and covariance in an upland cotton crop of inter specific origin. *Agronomy Journal, 30*, 633-636.

Anuja, S., & Jahnavi, K. (2012). Correlation and path co-efficient analysis in French Marigold. *Asian Journal of Horticulture*, *7*(2), 269-271.

Behera, T.K., Sirohi, P.S., & Pal, A. (2002). Assessment of chrysanthemum germplasm for commercial cultivation under Delhi condition. *Journal of Ornamental Horti*culture, *5*(2), 11-14.

Bharathi, T.U., & Jawaharlal, M. (2014). Evaluation of African marigold (*Tagetes erecta* L.) genotypes for growth and flower yield under Coimbatore conditions. *Indian of Journal Animal Nutrition, 7*, 2197-2201.

Bharathi, U.T., Jawaharlal, M., Kannan, M., Manivannan, N., & Raveendran, M. (2014). Correlation and path analysis in African marigold (*Tagetes erecta* L.). *The Bioscan*, *9*(4), 1673-1676.

Hojnik, M., Škerget, M., & Knez, Ž. (2008). Extraction of lutein from Marigold flower petals. *Food Science Technology,* 41(10), 2008-2016.

Karuppaiah, P., Kumar, P.S., 2010. Correlation and path analysis in African marigold (*Tagetes erecta* L.). *Electronic Journal of Plant Breeding,* 1(2), 217–220.

Maynard G.H., & David M.O. (1987). The physiology of plant under stress. Willy Inter-science publications. New York.

Panwar, S., Singh, K.P., Janakiram, T., & Namita. (2013). Genetic variability, heritability and genetic advance in African marigold (*Tagetes erecta* L.) genotypes. *Progressive Horticulture, 45*, 135-40.

Prasad, Y., Kumar, K., & Mishra, S.B. (2011). Studies on genetic parameters and inter-relationships among yield and yield contributing traits in Pigeonpea [*Cajanus cajan* (L.) Millsp.]. *The Bioscan*, *8*, 207-211.

Rao, C.C., & Reddy, K.M. (2002). Effect of planting date on African marigold. Floriculture research trend in India. Proceedings of the national symposium on Indian floriculture in the new millennium, Lal-Bagh, Bangalore, pp.191-195.

Shivakumar, S., Ketana, V., Ketana, G. B., Shivayya, K. M., & Chougala, S. (2014). Characterization of African marigold (*Tagetes erecta* L.) genotypes using morphological characters. *International Journal of Biological Sciences, 5*, 93-99.

Singh, D., Kumar, S., Singh, A.K., & Kumar, P. (2008). Assessment of African marigold (*Tagetes erecta*) genotypes in Uttarakhand. *Journal of Ornamental Horticulture, 11*, 112-137.

Singh, D., & Misra, K.K. (2008). Genetic variability in quantitative characters of marigold. *Indian Journal of Horti*culture, *65*(2), 187-192.

Singh, K.P., Raju, D.V.S., & Namita. (2014). Determination of genetic variation for vegetative and floral traits in African marigold (*Tagetes erecta* L.). *The Indian Journal of Agriculture Sciences, 84*, 1057-63.

Soule, J. 1993. *Tagetes minuta*: A potential new herb from South America. Pp. 649-654 in: Janick, J. and J. E. Simon (eds.), New Crops, Wiley, NY.

Vishnupriya, K., Jawaharlal, M., & Kannan, M. (2015). Correlation studies in African marigold (*Tagetes erecta* L.). *Trends in Biosciences, 8*(8), 2023-202.

Publisher's Note: ASEA remains neutral with regard to jurisdictional claims in published maps and figures.