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Assessment of Genetic Variability, Heritability and Genetic Advance in French Marigold (*Tagetes patula*) Genotypes

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ABSTRACT

A study was done in 2021-2022 at the Department of Floriculture and Landscape Architecture, College of Horticulture, Bagalkot. The research examined 17 different growth and flower traits in French marigold (*Tagetes patula*) plants to check for genetic differences, inheritance patterns and improvement potential. The results showed clear variations among the plants for all traits studied. Flower yield per plant (204.66) and flower yield per hectare (7.01) exhibited high genetic coefficient of variation (GCV) values of 55.98% and 61.10%, respectively. Both traits demonstrated exceptional heritability estimates of 99.03% and 99.01%, indicating a strong genetic foundation for improvement through selection. The genetic advance (GA) for flower yield per plant was 234.87 (114.76% GAM), highlighting the potential for substantial yield improvements. Individual flower weight, another critical yield-related trait, showed considerable variability with a GCV of 58.94%, a heritability estimates of 98.37%, and a genetic advance of 2.02 (120.42% GAM). These findings emphasized the potential of using flower yield per plant, flower yield per hectare and individual flower weight as key traits for selection in breeding programs focused on improving marigold productivity. Additionally, shelf life, though exhibiting moderate variability, also showed heritable potential, contributing to both yield and marketability. These results underscored the efficacy of breeding programs targeting enhanced yield traits, as they exhibit high heritability and genetic advance, making them suitable characters for genetic improvement in French marigold.

Keywords: Breeding potential,Flower, French marigold, Genetic variability, Heritability, Yield.

INTRODUCTION

Floriculture is rapidly expanding as a global industry due to its diverse applications such as fulfilling aesthetic needs, creating employment, increasing rural incomes, and boosting foreign revenue. Flowers also serve as essential raw materials in the production of essences, fragrances, pharmaceuticals, and confectioneries. In India, a large share of land used for floriculture is allocated to growing traditional or loose flowers. Over two-thirds of the total area under floriculture is used to cultivate flowers such as marigold, crossandra, jasmine, rose, chrysanthemum, and tuberose. Among the states, Tamil Nadu ranks first in the production of loose flowers, with Karnataka following closely behind in both cultivated area and yield. Other key states involved in the production of loose flowers include Andhra Pradesh, Maharashtra, West Bengal, Delhi, Punjab, and Uttar Pradesh. (Anonymous, 2019).

Marigold is the leading traditional flower crop in India, contributing to over 50% of the country's total loose flower production. It covers approximately 66.13 thousand hectares, yielding around 603.18 thousand metric tons annually (Anumala and Kumar, 2021). Among the major producing states, Karnataka ranks second, with 12.10 thousand hectares under marigold cultivation and an output of 121.93 thousand metric tons. Madhya Pradesh leads with the highest production, covering 14 thousand hectares and yielding 224.87 thousand MT. Other key contributing states include Gujarat, Andhra Pradesh, Haryana, West Bengal, and Maharashtra (Anonymous, 2019). Marigold (*Tagetes* spp.) is a highly valued commercial flower globally, prized for its vibrant colors, striking appearance, diverse sizes, shapes, and fragrance, along with its extensive applications in industrial and medicinal sectors (Priyambada *et al*, 2015). Among the 33 species in the *Tagetes* genus, only two are commercially cultivated: *Tagetes erecta* L. (African marigold) and *Tagetes patula* L. (French marigold). These species are widely used in landscaping and as loose flowers due to their varying plant heights and colorful blooms.

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French marigolds play a vital role in landscaping, offering vibrant hues that span from golden yellow to rich orange and crimson. In addition to their visual appeal, they serve as a natural pest deterrent, promoting the growth and well-being of nearby plants. Their compact size and abundant blooms make them ideal for defining garden edges, filling empty spaces in flower beds, or adding lively color to potted arrangements. Beyond their ornamental benefits, these flowers help sustain ecological balance by deterring harmful pests while attracting pollinators that support a healthy garden ecosystem.

MATERIALS AND METHODS

A field experiment was carried out at the Department of Floriculture and Landscape Architecture, College of Horticulture, UHS Bagalkot, situated at approximately 75°42' E longitude, 16°10' N latitude, and an elevation of about 533 meters above mean sea level. The study was laid out using a randomized block design with two replications. The study utilized genotypes of French marigold (*Tagetes patula*). Seeds were sown in protrays containing a 3:1:1 soil less mixture of cocopeat, perlite, and vermiculite, and planted in a polyhouse during August 2021. Daily irrigation was maintained using a rose can, and seedlings were drenched with 0.5% 19:19:19 fertilizer 15 days after sowing. Transplanting was carried out at the four- to five-leaf stage with a spacing of 60 × 45 cm. A basal application of N:P:K at 225:60:60 kg/ha was given at planting, followed by a foliar spray of urea one month post-transplanting. During the rainy season, irrigation was applied weekly, with hoeing and weeding carried out as required

For data collection, five central plants were selected, excluding border plants. The data were collected on various parameters of vegetative, flowering and flower yield from the five randomly tagged plants in each plot at grand growth stage.

Analysis of variance (ANOVA) was performed following Panse and Sukhatme (1967), using mean values from randomly selected plants across replications. Genotypic and phenotypic coefficients of variation were calculated based on genotypic and phenotypic variances as per Burton and Devane (1953).

$$\text{a) PCV (\%)} = \frac{\sqrt{\sigma^2_p}}{\bar{X}} \times 100$$

$$\text{b) GCV (\%)} = \frac{\sqrt{\sigma^2_g}}{\bar{X}} \times 100$$

Where,

σ^2_p = Phenotypic variance

σ^2_g = Genotypic variance

$\bar{X}$ = Grand mean

PCV and GCV were classified as suggested by Sivasubramanian and Madhavamenon (1973).

0-10 % = Low

10-20 % = Moderate

> 20 % = High

Broad-sense heritability was estimated for all the traits using the following formula which was given by Johnson *et al* (1955).

$$h^2 (\%) = \frac{\sigma^2_g}{\sigma^2_p} \times 100$$

Where,

σ^2_p = Phenotypic variance

σ^2_g = Genotypic variance

The heritability percentage was categorized as suggested by Robinson *et al.* (1949)

0-30 % = Low 30-60 % = Moderate >60 % = High

The extent of genetic advance expected for each character was estimated by using the following formula as suggested by Johnson *et al* (1955).

$$GA = h^2 \times k \times \sigma_p$$

Where,

h^2 = Heritability in broad sense

k = Selection differential (2.06) at 5 per cent selection intensity

σ_p = Phenotypic standard deviation

RESULTS AND DISCUSSION

The results (Table 1) revealed significant differences among the genotypes for all seventeen characters studied. In this study, the phenotypic coefficient of variation (PCV) was consistently higher than the genotypic coefficient of variation (GCV) for

Table 1: Genetic variability estimates for growth, yield and quality parameters in French marigold genotypes

Sr. No	Character	Mean	Range		GCV (%)	PCV (%)	h^2 (%)	GA	GAM (%)
			Min	Max					
1	Plant height	35.17	25.50	60.50	24.62	24.98	97.16	17.59	50.00
2	Plant spread [E -W] (cm)	34.08	26.42	51.15	21.62	21.85	97.94	15.05	44.08
3	Plant spread [N -S] (cm)	33.83	26.19	49.15	18.28	18.43	98.40	12.64	37.36
4	Primary branches	12.97	10.48	15.57	8.56	8.63	98.39	2.27	17.57
5	Secondary branches	22.95	16.43	30.05	13.41	13.52	98.40	6.29	27.40
6	Leaf length (cm)	7.43	5.12	19.90	39.92	40.11	97.15	6.08	81.83
7	Leaf width (cm)	4.90	3.48	12.87	43.76	43.98	97.17	4.40	89.41
8	Days to first flowering	34.00	27.60	60.20	20.34	20.63	97.16	14.04	41.29
9	Days to 50% flowering	47.75	39.50	71.50	16.35	16.43	99.02	16.00	33.58
10	Duration of flowering	46.90	40.40	51.00	4.98	5.00	99.02	4.79	10.20
11	Number of flowers /plant	121.93	94.97	175.77	15.26	15.34	99.02	38.14	31.28
12	Shelf life (days)	3.45	2.30	5.05	21.98	22.16	98.42	1.55	44.93
13	flower weight (g)	1.67	0.87	4.75	58.94	59.43	98.37	2.02	120.42
14	Flower diameter (mm)	36.25	31.14	45.97	11.87	11.97	98.39	8.79	24.26
15	Flower yield /plant (g)	204.66	105.33	500.32	55.98	56.26	99.03	234.87	114.76
16	Flower yield per plot (kg)	6.37	3.55	15.58	54.49	54.76	99.68	7.11	111.71
17	Flower yield per ha (t)	7.01	3.53	18.38	61.10	61.40	99.01	8.78	125.25

GCV: Genotypic coefficient of variance
PCV: Phenotypic coefficient of variance
h^2: Heritability (Broad sense)
GA: Genetic advance
GAM: Genetic advance as percent mean

all traits, with a narrow difference between the two, indicating minimal environmental influence. Similar observations in marigold were reported by Sreekala *et al* (2003), Namita *et al* (2008), and Tamut and Singh (2019) in French marigold.

This highlights the role of environmental interactions in character expression. The narrow gap between PCV and GCV across all traits indicates minimal environmental influence. Estimates of genetic parameters, including PCV, GCV, heritability (broad sense), and genetic advance as a percentage of the mean (GAM), are summarized in Table 1.

High genotypic and phenotypic coefficients of variation were observed for plant height (24.62% and 24.98%), plant spread (East-West) (21.62% and 21.85%), leaf length (39.92% and 40.11%), leaf width (43.76% and 43.98%), days to first flowering (20.34% and 20.63%), shelf life (21.98% and 22.16%), individual flower weight (58.94% and 59.43%), and flower yield (g/plant: 55.98% and 56.26%; kg/plot: 54.49% and 54.76%; t/ha: 61.10% and 61.40%). These results suggested substantial genetic diversity among the genotypes, indicating that selection based on these traits would be effective and offers significant scope for genetic improvement (Fig. 1). Similar findings have been reported by Anuja and Jahnavi (2012), Singh and Singh (2010), Yuvraj and Dhatt (2014), and Kumar *et al* (2014) in marigold.

Moderate genotypic and phenotypic coefficients of variation were recorded for plant spread (North-South) (18.28% and 18.43%), number of secondary branches (13.41% and 13.52%), days to 50% flowering (16.35% and 16.43%), flower diameter (11.87% and 11.97%), and number of flowers per plant (15.26% and 15.34%). These findings are consistent with those reported by Kavitha and Anburani (2010), Sahu *et al* (2017), and Patel *et al* (2019) in marigold. Low genotypic and phenotypic coefficients of variation were observed for the number of primary branches and flowering duration, in agreement with the results of Santhosh *et al* (2018) in marigold.

High heritability is essential for plant breeders, as it enables selection based on phenotypic performance. With high heritability, the genotype closely corresponds to the phenotype, making selection more effective by minimizing environmental influence on trait expression.

Heritability is a key genetic parameter that indicates the transmissibility of traits to the next generation. In the present study, high heritability (in the broad sense) was recorded for all traits evaluated. This suggests that genetic factors predominantly govern the expression of these characters, making them suitable targets for direct selection to improve flower yield. Similar high heritability estimates have been reported by Yuvraj and Dhatt (2014) and Patel *et al* (2019) in African marigold, and by Sharma and Raghuvanshi (2011) in French marigold. These findings were also supported by earlier studies in marigold (Singh and Singh, 2010; Kavitha and Anburani, 2010; Singh and Saha, 2006) and chrysanthemum (Talukdar *et al*, 2003). Heritability estimates exceeded 80% for most traits, except for the number of harvests of loose flowers.

High genetic advance as a percentage of the mean was observed for plant height, plant spread (East-West and North-South), secondary branches, leaf length, leaf width, days to first flowering, days to 50% flowering, flower diameter, individual flower weight, number of flowers per plant, and flower yield. These findings are consistent with those reported by Anuja and Jahnavi (2012) in French marigold.

Moderate genetic advance was observed for the number of primary branches per plant, duration of flowering, and shelf life. Similar results were reported by Sahu *et al* (2017) and Giri *et al* (2019) in marigold.

CONCLUSION

The analysis revealed high phenotypic (PCV) and genotypic (GCV) coefficients of variation for flower yield and number of flowers per plant, reflecting significant genetic diversity within the germplasm. Moderate variability was observed for morphological traits, including plant height, plant spread, leaf length, leaf biomass, biomass at flowering initiation, and flower diameter, indicating a wide genetic base for these characteristics.

Notably, flower yield, flower count per plant, biomass at flowering initiation, and leaf biomass exhibited both high heritability and substantial genetic advance. This combination suggests that additive gene effects predominantly govern these traits, making them particularly suitable for selective breeding. Their strong genetic control and minimal environmental influence enhance their potential for rapid improvement through selection. Consequently, these traits represent promising selection criteria in breeding programs aimed at developing superior French marigold cultivars.

REFERENCES

Anonymous (2019). Indian Horticulture Database, National Horticulture Board.

Anumala N V and Kumar R (2021). Floriculture sector in India: current status and export potential. *J Hort Sci Biotechnol* **96**(5): 673-680.

Priyambada S, Alok K, Vinod K, Swadhinta K, Kuldip S, Madhuri G and Sohan S (2015). Chemistry and biology of industrial crop *Tagetes Species*: a review. *J Essent Oil Res* **28** (1): 1–14.

Anuja S and Jahnavi K (2012). Variability, heritability and genetic advance studies in French marigold. *Asian J Hort* **7**(2): 362-364.

Burton G W and Devane E W (1953). Estimating heritability in tall fescue (*Festuca arundinaceae*) from replicated clonal material. *Agron J* **45**:478-481.

Johnson H W, Robinson H F and Comstock R S (1955). Estimation of genetic advance and environmental variability in soyabean. *Agron. J* **41:** 314-318.

Kavitha R and Anburani A (2010). Genetic variability in African marigold (*Tagetes erecta* L.). *Asian J Hort* **5**(2): 344-346.

Kumar A, Pratap B and Beer K (2014). Studies on genetic variability and character association in French marigold (*Tagetes patula* L.). *J Biosci* **7**(1):1007-1009.

Mishra Y K, Joshi R P and Solanki S S (1997). Genetic variability in Dahlia. *Prog Hort* **29**(1-2):61-64.

Namita Singh K P, Raju D V S, Prasad K V and Bharadwaj C (2018). Studies on genetic variability, heritability and genetic advance in French marigold (*Tagetes patula*) genotypes. *J Ornam Horti* **12**(1):30-34.

Panse V G and Sukhatme P V (1976). *Statistical Methods for Agricultural Workers.*2nd Edn ICAR, New Delhi 361.

Patel M A, Chawla S L, Chavan H P, Shah and Sudha D P (2019). Genetic variability, heritability and genetic advance studies in marigold (*Tagetes* spp.) under the South-Gujarat region. *Electron J Plant Breed* **10**(1): 272-276.

Sahu K J, Sharma G, Nair S K and Singh R (2017). Studies on genetic variability, heritability and genetic advances in African marigold (*Tagetes erecta* L.). *The Bioscan* **12**(2): 1177-1180.

Santhosh N, Tejaswini, Shivashankar K S, Seetharamu G K and Gadre A (2018). Genetic diversity for morphological characters and biochemical components in African marigold. *Int J Chem Stud* **6**(6): 624-627.

Sharma B P and Raghuvanshi A (2011). Genetic variability and correlation studies in French marigold. *Prog Agric* **11**(1): 54-57.

Singh A K and Singh D (2010). Genetic variability, heritability and genetic advance in marigold. *Indian J Hort* **67**(1): 132-136.

Singh D and Misra K K (2010). Diallel analysis for combining ability in marigold (*Tagetus* spp). *Karnataka J Agri Sci* **23**(2):298-301.

Singh K P and Saha T N. Genetic variability, heritability and genetic advance in French marigold (*Tagetes patula* L.). *Indian J Plant Genetic Res* (2006) **19**(2):42-43.

Sivasubramanian S and Madhavamenon P (1973). Genotypic and phenotypic variability in rice. *Madras Agric. J.,* **60** (9-12): 1093-96.

Sreekala C, Raghava S P S, Misra R L, Voleti S R (2003). Assessment of variability for carotenoids and yield components African marigold. *J Ornamen Horti* **5**(2):5-7.

Talukdar M C, Mahanta S, Sharma B, and Das S. Extent of genetic variation for growth and floral characters in chrysanthemum cultivars under Assam condition. *J Ornamen Horti* **6**(3):201-211.

Tamut O and Singh K P (2019). Studies on genetic variability, heritability and genetic advance in French marigold (*Tagetes patula*). *J Pharmacogn Phytochem* **8**(5): 2476-2478.

Yuvraj and Dhatt K K (2014). Studies on genetic variability, heritability and genetic advance in marigold. *Indian J Hort* **71**(4): 592-594.

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