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Anil Kumar
Department of Horticulture,
NDUAT, Ayodhya,
Uttar Pradesh, India

Bhanu Pratap
Department of Horticulture,
NDUAT, Ayodhya,
Uttar Pradesh, India

Dharmendra Kumar Gautam
Department of Horticulture,
NDUAT, Ayodhya,
Uttar Pradesh, India

Vikas Yadav
CHES (ICAR-CIAH),
Panchmahal, Gujrat, India

Gangadhara K
CHES (ICAR-CIAH),
Panchmahal, Gujrat, India

Karam Beer
ICAR-Indian Institute of Soil
and Water Conservation,
Koraput, Odisha, India

Ashutosh Kumar Singh
Department of Horticulture,
NDUAT, Ayodhya,
Uttar Pradesh, India

Vivek Kumar Singh
Department of Horticulture,
NDUAT, Ayodhya,
Uttar Pradesh, India

Correspondence
Anil Kumar
Department of Horticulture,
NDUAT, Ayodhya,
Uttar Pradesh, India

Variability, heritability and genetic advance studies in French marigold (*Tagetes patula* L.)

Anil Kumar, Bhanu Pratap, Dharmendra Kumar Gautam, Vikas Yadav, Gangadhara K, Karam Beer, Ashutosh Kumar Singh and Vivek Kumar Singh

Abstract

A field experiment was conducted at Main Experimental Station of Department of Horticulture, Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya. The experiment was laid out in Randomized Block Design with 10 treatments and replicated thrice. The healthy seedlings were transplanted at a spacing of 30cm X 30cm. The observations were recorded from five plants selected randomly in each genotype per replication for 10 characters namely, plant height (cm), stem diameter (cm), plant spread (cm), number of primary branches, number of secondary branches, days taken to flower bud initiation, duration of flowering (days), number of flowers per plant, flower weight (g) and flower yield per plant (g). Analysis of variance showed highly significant differences for all the ten characters. In general, estimates of phenotypic coefficient of variation (PCV) were found to be higher than their corresponding genotypic coefficient of variation (GCV). High broad sense heritability coupled with high genetic advance was reported for number of flowers per plant ($h^2 = 99.62\%$, $GA = 59.78$) and flower yield per plant ($h^2 = 99.53\%$, $GA = 133.82$), showing additive gene effects and shows the effectiveness of selection of these characters.

Keywords: Variability, heritability, genetic advance, french marigold

Introduction

Marigold (*Tagetes spp.*), a member of Asteraceae family. It is one of the most important flower grown commercially in India. It is native of Central and South America especially Mexico. Genus *Tagetes* consists of 33 species, out of these species, *Tagetes erecta* L., commonly called African marigold, and *Tagetes patula* L. popular as French. Both the species of marigold are suitable for garden display and grown commercially for use as cut flowers and loose flowers. It is highly suitable as a bedding plant in an herbaceous border and is also ideal for newly planted shrubberies to provide colour and to fill the space. It has attracted the attention of flower growers due to its wide spectrum of attractive colours, shape, size and good keeping quality. Flowers of African marigold can be used for extraction of 1-lemoene, ecomene, 1-linylactate, 1-linauol (Narsude *et al.*, 2010) [9]. An extract obtained from the flowers is mixed with other ingredients in the preparation of an obtained which is used in curing ulcer. Orange colour marigold has emerged as rich source of carotenoid pigments namely xanthophyll, which is widely used as dietary supplement in poultry industry to enhance the chicken skin colour and egg yolk pigmentation (Naik *et al.*, 2004) [8]. The demand for uniform, medium sized, compact bright colour flowers with more shelf life are very high in domestic flower market (Singh and Misra, 2012) [13]. Therefore, it is realized that under the changing scenario and advancement of 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.

Genetic variation and genetic relationship among genotypes is an important consideration for classification, utilization of germplasm resources and breeding (Kumar *et al.*, 2013) [7]. The presence and magnitude of genetic variability in a gene pool is the pre-requisite of a breeding programme (Bhujpal *et al.*, 2013) [10]. Heritability provides us information about the additive genotypic variance and phenotypic variance. A knowledge of the estimates of genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability (h^2) and genetic advance as percentage of mean (GA) would help the breeder in selection of appropriate breeding methods. Keeping in view its wide importance, a study was conducted to assess the performance of ten marigold genotypes under Ayodhya conditions of Uttar Pradesh.

Materials and Methods

The present investigation was carried out at the Research Farm of Department of Horticulture, NDUAT, Ayodhya to study the performance of different. Geographically, Ayodhya is situated between 24.47 ° & 26.56 ° N latitude and 82.12 ° & 83.98 ° E longitude at an elevation of about 113 meters above mean sea level. The materials utilized for the present study consisted of 10 genotypes of French marigold (*Tagetes patula* L.). Raised nursery beds of size 3.0 m 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. The standard package of practices were followed (Anonymous, 2011) [1] for the entire crop period. Five plants were selected in each replication of each genotype for taking observations after discarding the border plants at both the ends. The observations were recorded on plant height (cm), stem diameter (cm), plant spread (cm), number of primary branches, number of secondary branches, days taken to flower bud initiation, duration of flowering (days), number of flowers per plant, flower weight (g) and flower yield per plant (g). Genotypic coefficient of variation and phenotypic coefficient of variation were calculated according to method suggested by Burton (1952) [2]. Heritability and genetic advance were calculated according to method suggested by Burton and De Vane (1953) [3] and Johnson *et al.* (1955) [4].

Results and Discussion

Significant differences were observed among all the genotypes for all the ten characters. The extent of variability

was measured in terms of range, mean, genotypic coefficient of variation and phenotypic coefficient of variation are given in Table 1.

The French marigold genotypes showed wide range of differences for all the ten characters. In general, estimates of phenotypic coefficient of variation (PCV) were found to be higher than their corresponding genotypic coefficient of variation (GCV), which can be attributed to environmental effect. These findings are in agreement with the findings of Sirohi and Behera (2000) [12]. The magnitude of GCV and PCV were highest in case of flower yield per plant (PCV = 49.93, GCV = 49.81) followed by number of flowers per plant (PCV = 36.09, GCV = 36.02) and number of primary branches (PCV = 34.11, GCV = 33.05). These findings were in agreement with the findings of Singh and Kumar (2008) [11].

It is clear from table 2 that in general high broad sense heritability estimates were observed for all the ten characters studied. Highest broad sense heritability estimates were recorded for number of flowers per plant (99.62%) and flower yield per plant (99.53%). These results were in agreement with the findings of Karuppaiah *et al.* (2011) [5]. High broad sense heritability coupled with high genetic advance was reported for number of flowers per plant ($h^2 = 99.62\%$, GA = 59.78) and flower yield per plant ($h^2 = 99.53\%$, GA = 133.82) showing additive gene effects, whereas the characters like diameter of flower ($h^2 = 96.99\%$, and GA = 0.69) and flower weight ($h^2 = 94.29\%$, GA = 0.79) exhibited high heritability and low genetic advance, indicating non-additive gene action. Similar findings were reported by Kavitha and Anburani (2010) [6].

Table 1: Estimation of variability for various characters in french marigold

| Sr. no. | Character | GM±SEM | Range | PCV (%) | GCV (%) |
|---------|---------------------------------|-------------|--------------|---------|---------|
| 1 | Plant height (cm) | 20.45±0.75 | 15.20-31.20 | 26.83 | 26.06 |
| 2 | Stem diameter (cm) | 01.47±0.03 | 01.10-2.00 | 23.50 | 23.14 |
| 3 | Plant spread (cm) | 20.47±0.63 | 14.64-30.10 | 24.21 | 23.60 |
| 4 | No. of primary branches/plat | 07.86±0.38 | 04.47-12.32 | 34.11 | 33.05 |
| 5 | No. of secondary branches/plant | 25.93±0.93 | 15.75-39.41 | 28.89 | 28.19 |
| 6 | Days to flower bud initiation | 38.16±1.25 | 25.68-53.21 | 20.97 | 20.18 |
| 7 | Flowering duaration (days) | 33.57±1.18 | 28.33-40.00 | 11.98 | 10.29 |
| 8 | No. of flowers/plant | 80.72±1.03 | 45.37-112.07 | 36.09 | 36.02 |
| 9 | Flower weight (g) | 1.58±0.05 | 1.05-2.17 | 25.67 | 24.93 |
| 10 | Flowers yield /plant | 139.68±2.59 | 66.07-228.52 | 49.93 | 49.81 |

PCV- Phenotypic coefficient of variation, GCV- Genotypic coefficient of variation

Table 2: Estimation of heritability, genetic advance and genetic advance as per cent of mean for various characters in French marigold

| Sr. No. | Characters | H (%) | GA | GA (%) |
|---------|---------------------------------|-------|--------|--------|
| 1 | Plant height (cm) | 94.36 | 10.67 | 52.15 |
| 2 | Stem diameter (cm) | 96.99 | 0.69 | 46.96 |
| 3 | Plant spread (cm) | 95.06 | 9.71 | 47.41 |
| 4 | No. of primary branches/plat | 93.88 | 5.18 | 65.97 |
| 5 | No. of secondary branches/plant | 95.29 | 14.70 | 56.71 |
| 6 | Days to flower bud initiation | 92.64 | 15.27 | 40.01 |
| 7 | Flowering duaration (days) | 73.84 | 6.12 | 18.23 |
| 8 | No. of flowers/plant | 99.62 | 59.78 | 74.06 |
| 9 | Flower weight (g) | 94.29 | 0.79 | 49.86 |
| 10 | Flowers yield /plant | 99.53 | 133.82 | 102.37 |

(H²- Heritability, GA- Genetic Adavance, GA %- Genetic Advance as per cent of mean)

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