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Short communication

Studies on genetic variability, heritability and genetic advance in marigold

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ABSTRACT

The present investigation on variability, heritability, genetic advance in twenty three marigold genotypes was carried out for plant growth and flower yield. The highest value of PCV and GCV was observed for number of flowers per plant (117.95 and 116.50, respectively). High heritability was observed for days to bud initiation (98.48) followed by days to first flower opening (98.36), number of flowers per plant (97.55), plant height (96.44), flower diameter (94.08), flower yield per plant (90.66).The estimates of genetic advance were comparatively maximum for number of flowers per plant (237.02%) followed by flower yield (105.37% per plant and 104.66%/ m^2).

Key words: Marigold, variability, heritability, genetic advance.

Marigold (*Tagetes* spp.) is one of most important flower crops grown commercially in different parts of India especially in plains. It has gained popularity because of adaptability to various soil and climate conditions and longer blooming periods. Now a days marigold is being used as bedding plant, in hanging baskets, rock garden and in interior decoration. Essential oil of marigold has a great use in perfumery industries and intercropping of marigold has been found beneficial to control nematode population. Besides this petals of marigold are a good source of natural carotenoid pigments for poultry, textile and pharmaceutical industry. It is essential to develop varieties suited to specific climatic conditions and which can be further utilized for genetic improvement of marigold. The knowledge about nature and extent of genetic variability present in the germplasm collection is important in planning successful breeding programme involving selection and hybridization. For a sound breeding programme, knowledge of the mean performance, magnitude of genetic variability, heritability and genetic advance is essential. Genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability (h^2) and genetic advance (GA) as percentage of mean constitute the important genetic parameters frequently applied in plant breeding. Coefficients of variation allows the meaningful comparison of the variation of several traits of plants belonging to the same population, as well as a comparison of the variation of the same trait as expressed by different populations of the same or different crops.

The study was conducted in the experimental farm area of Floriculture and Landscaping Department, PAU, Ludhiana, during 2011-2012. The experimental material comprised of 23 marigold genotypes, which were collected from different and diverse sources under the presumption that wider genetic diversity could be presented. These were transplanted as per Randomized Block Design (RBD) with three replications on 15th July, 2011 at 40 cm × 40 cm spacing. For morphological analysis, these genotypes were evaluated for 12 traits, *viz.* plant height, plant spread, number of branches per plant, days to 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 m^2. The coefficients of variation were calculated by using the formula suggested by Lush (5). Heritability in 'broad sense' was computed as the ratio between genotypic variance to total phenotypic variance and expressed in percentage (Henson *et al.*, 1). The expected genetic advance was computed by the method described by Johnson *et al.* (2).

It is evident from the results of Table 1 that the highest coefficient of variation was observed in number of flowers per plant (18.47%) suggesting high degree of variation in the studied genotypes for this character. It was followed by flower yield per m^2 (17.75%), average flower weight (15.33%), number of branches per plant (13.46%) and plant spread (11.70). The minimum coefficient of variation (3.49%) was recorded for days to first flower opening followed by days to bud initiation (3.69%) and plant height (4.76%). In general, phenotypic coefficient of variation (PCV) was higher in magnitude than the genotypic coefficient of variation (GCV). The maximum phenotypic coefficient of variation (117.95%) was found with number of flowers per plant followed by flower yield per plant (56.42%). The maximum genotypic coefficient of variation (116.5%) was found with number

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Table 1. Estimation of genotypic coefficient of variation and phenotypic coefficient of variation, heritability (%) and genetic advance (%).

Character	GCV (%)	PCV (%)	Heritability h^2 (%)	Genetic advance (%)
Plant height (cm)	24.76	25.21	96.44	50.09
Plant spread (cm)	22.89	25.71	79.28	41.98
No. of branches per plant	26.29	29.54	79.24	48.21
Flower stalk length (cm)	21.05	23.55	79.94	38.78
Flower diameter (cm)	29.30	30.21	94.08	58.54
Average flower weight (g)	43.47	46.09	88.94	84.45
Days to bud initiation (days)	29.73	29.95	98.48	60.77
Days to first flower opening (days)	26.96	27.19	98.36	55.08
No. of flowers per plant	116.50	117.95	97.55	237.02
Flower yield per plant (g)	53.72	56.42	90.66	105.37
Flower yield per m^2 (g)	53.53	56.39	90.09	104.66
Duration of flowering (days)	23.48	25.06	87.79	45.33

of flowers per plant followed by flower yield per plant (53.72%). The phenotypic coefficient of variation was higher than genotypic coefficient of variation, which indicates of genotype × environment interaction. The phenotypic and genotypic coefficient of variation was also maximum for flower number in marigold, which is in line with the finding of Namita *et al.* (6), and Kishore and Raghava (4).

Heritability is a measure of genetic relationship between parent and progeny and has been widely used in determining the degree to which a character may be transmitted from parents to offspring. It helps in identifying the appropriate characters for selection. Estimation of heritability in broad sense gives the extent of heritable component of variation. The heritability ranges between 79.24 and 98.48% (Table 1) for different parameters. High heritability was observed for days to bud initiation (98.48), days to first flower opening (98.36), number of flowers per plant (97.55), plant height (96.44), flower diameter (94.08), flower yield per plant (90.66), flower yield per m^2 (90.09), average flower weight (88.94) and duration of flowering (87.79). While, the parameters such as flower stalk length (79.94%), plant spread (79.28%) and branches per plant (79.24%) showed moderate heritability. Similar results on high heritability along with high genetic gain was recorded for plant height and flower yield as reported by Pattnaik and Mohanty (7). These results also corroborate the findings of Karuppaiah *et al.* (3) who reported that the low to medium PCV, low GCV and low to moderate heritability with low genetic advance for all the characters in M_2 generation after mutagen treatment of marigold.

Heritability estimates along with genetic advance is useful in prediction for the selection of individual (Johnson e*t al.*, 3). The estimates of genetic advance (%) were high in nature and varied from 38.78 to 237.02%. These were comparatively maximum for number of flowers per plant (237.02%) followed by flower yield per plant (105.37%) and flower yield per m^2 (104.66%). These observations suggested that genotypic variation in the genotypes studied for said characters was probably due to high additive gene. Selection for these characters would, therefore, be effective when based on phenotypic performance which is in the line of results of Namita *et al* (6), and Singh and Misra (8) in marigold.

The magnitude of heritable variability is the most important aspect of genetic constitution of the breeding material which has direct effect on the response of selection. The results of present study reveal high heritability with low genetic advance for stalk length, plant spread and flowering duration indicating that the selection for these characters would not be effective for their improvement. The character such as flower yield per plant, per unit area and number of flowers per plant showed high heritability with high genetic advance can be improved through rigid selection. Combining ability studies are helpful in assessing the measure of additive and non additive gene action. Therefore the information obtained from the study will have practical application in the breeding programme for the development of new superior genotypes of different economic traits like days to flower, flower yield, flowering duration.

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