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Variability, heritability and genetic advance in marigold

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Abstract

Twelve genotypes of marigold were evaluated to determine genetic variability, heritability and genetic advance. Analysis of Variance revealed that magnitude of the Phenotypic Coefficient of Variation (PCV) was higher than Genotypic Coefficient of Variation (GCV) for all the traits. High level of GCV and PCV were recorded for seed yield per plant followed by leaf biomass of flower, number of leaves per plant, flower yield per plant, stem diameter, average fresh weight of flower, number of seeds per peduncle, 100 seed weight, weight of seed per peduncle, average fresh weight of leaf (g), number of secondary branches per plant, plant height, days taken to bud appearance, plant spread and number of primary branches per plant. High heritability was obtained for all the recorded traits. High heritability coupled with high genetic advance as per cent of mean was recorded for and 100-seed weight, average fresh weight of leaf and flower, number and weight of seeds per peduncle, number of flowers per plant and seed yield per plant showing greater chances of improvement through breeding programme.

Keywords: Marigold, heritability, variability, genetic advance.

Introduction

Marigold is a top-ranking loose flower in India followed by chrysanthemum, jasmine, tuberose and crossandra (Anonymous, 2019). In India, total floricultural area is approximately 3,13,000 hectares with a production of 33,01,000 tonnes loose flower and 7,62,000 tonnes cut flowers. It is one of the popular flowers that values for a high price. In India, major cut and loose flower growing states are Karnataka, Tamil Nâdu, Maharashtra and Andhra Pradesh. Marigold (*Tagetus* 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. The word 'Marigold' is derived from the Greek word 'Mary' meaning 'Mother of Jesus' and 'Gold' meaning 'flower colour'. 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, flower colour and flower types along with 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. The phenotypic expression of the plant character is mainly controlled by the genetic makeup of the plant and the environment in which it is grown alongwith the interaction between the genotypes and environment. Further, the genotype of the plant is controlled by different gene action *i.e.* additive gene effect (heritable), non-additive gene effect or dominance (non-heritable) and epistasis (non-allelic dominance). The goal of any crop improvement programme is to achieve high level of yield.

Materials and Methods

The present study was conducted at Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India during winter season, 2020-21. The experiment was laid out in Randomized Block Design (RBD) with three replications. Nursery preparation work was started on 16th October started 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 5g of each germplasm were sown evenly in well manage nursery for raising seedling. Land was brought to a good tilth by 4-5 ploughings and levelled properly followed by incorporation of 30 kg Farm Yard Manure per m^2. Farm Yard Manure was uniformly sprinkled and mixed thoroughly uniformly. Nitrogen @100kg/ha, phosphorous @80kg/ha and potassium @80kg/ha were incorporated in the soil as basal dose in form of urea, single super phosphate, Muriate of Potash, respectively. Nitrogen at 200kg/ha was applied in two split doses at 30 and 60 days after transplanting. The data on plant height (cm), number of secondary branches per plant, days taken to first flower bud appearance, days taken to flowering, peduncle length, flower diameter (cm), flower yield per plant (g), days taken to seed ripening, number and weight of seeds per peduncle, seed yield per peduncle,100-seed weight were recorded. Mean values were subjected to analysis of variance, genotypic and phenotypic coefficient of variation were estimated based on estimate of genotypic and phenotypic variance by Burton and Devane (1953).

Results and Discussion

Perusal of data in (Table 1) showed high level of GCV and PCV for seed yield per plant (GCV=99.59%, PCV=99.93 %) followed by leaf biomass of flower (GCV=93.55 %, PCV=94.23 %), number of leaves per plant (GCV=89.05.18 %, PCV=89.68%), flower yield per plant (GCV=75.82 %, PCV=76.33 %), stem diameter (GCV=67.33 %, PCV=67.57 %), average fresh weight of flower (GCV=66.45 %, PCV=66.56 %), number of seeds per peduncle (GCV=58.55 %, PCV=58.71%),100 seed weight (GCV=46.45%, PCV=46.49 %), weight of seeds per peduncle (GCV=54.71 %, PCV=54.82 %), average fresh weight of leaf (g) (GCV=46.25 %, PCV=46.32 %), number of secondary branches per plant (GCV=45.31 % and PCV=46.14%), plant height (GCV=43.63 and PCV=44.17),days taken to

Table 1. Genetic estimates for various growth, flowering and quality parameters in marigold

S. No.	Traits	Range	GCV	PCV	Heritability (%)	GA as % mean
1.	Plant height (cm)	23.81-72.19	43.63	44.17	97.56	88.77
2.	Number of leaves per plant	181.33-2028.67	89.05	89.68	98.59	182.14
3.	Number of primary branches per plant	6.44-26.67	35.43	35.77	98.11	72.29
4.	Number of secondary branches per plant	11.33-55.34	45.31	46.14	96.45	91.67
5.	Plant spread (cm)	16.49-75.45	35.94	36.18	98.67	73.54
6.	Average fresh weight of leaf (g)	0.25-1.54	46.25	46.32	99.69	95.13
7.	Stem diameter (cm)	0.54-3.7	67.33	67.57	99.29	138.21
8.	Leaf biomass(g)	45.28-1745.61	93.55	94.23	98.56	191.31
9.	Days taken to first bud appearance	24.56-80.22	37.08	37.21	99.33	76.13
10.	Days taken to first flower opening	54.78-123.00	26.98	27.20	98.37	55.13
11.	Flowering duration (days)	44.56-107.22	25.58	25.81	98.28	52.25
12.	Flower diameter (cm)	2.11-6.84	25.31	25.52	98.37	51.71
13.	Number of flowers per plant	45-163	56.26	56.49	99.19	115.43
14.	Average fresh weight of flower	1.69-11.3	66.45	66.56	99.67	136.67
15.	Flower peduncle length	1.41-2.71	19.49	19.71	97.76	39.69
16.	Days taken to seed ripening	79.11-164.78	22.88	22.97	99.18	46.93
17.	No. of seeds per peduncle	38.78-163.89	58.55	58.71	99.45	120.26
18.	Weight of seeds per peduncle	0.13-0.71	54.71	54.82	99.59	112.47
19.	100 seed weight	0.25-0.91	46.45	46.49	99.81	95.59
20.	Seed yield per plant	5.92-134.98	99.59	99.93	99.35	204.51
21.	Flower yield per plant	40.39-676.87	75.82	76.33	98.65	155.13

bud appearance (GCV=37.08 and PCV=37.21), plant spread (GCV= 35.94 and PCV=36.18) and number of primary branches per plant (GCV=35.43 and PCV=35.77). The result was close conformity to Thirumalmurugan *et al.* (2020), Singh *et al.* (2014) and Yuvraj and Dhatt (2014). Since all the above characters have high range of variation and affected by the environmental factors, it is difficult to improve the characters through selection.

Moderate level of GCV and PCV was observed for days taken to first flowering (GCV=26.98 %, PCV=27.20 %) followed by flower duration (GCV=25.58 %, PCV=25.81%), flower diameter (GCV=25.31 %, PCV=25.52 %), days taken to seed ripening (GCV=22.88 %, PCV=22.97 %), flower peduncle length (GCV=19.49 %, PCV=19.71 %). Results of similar trend to the present findings have been reported by Latha and Dharmatti (2018), Godabe *et al.* (2017), Anuja and Jahnavi (2012) and Singh *et al.* (2014).

The higher heritability was obtained for 100 seed weight (99.81%) followed by average fresh weight of leaf (99.69 %), average fresh weight of flower (99.67 %), weight of seed per peduncle (99.59 %), number of seeds per peduncle (99.45 %), seed yield per plant (99.35 %), days taken to first bud appearance (99.33%), stem diameter (99.29 %), number of flowers per plant (99.19 %), days taken to seed ripening (99.18%), plant spread (98.67 %), flower yield per plant (98.65 %), days taken to first flowering (98.37 %), flower diameter (98.37%), number of primary branches per plant (98.11), flowering duration (98.28 %), number of primary branches per plant (98.11 %), peduncle length (97.76%), plant height (97.56 %) and number of secondary branches per plant (96.45%). The high heritability indicated that the characters were less influenced by the environment. Similar finding was given by Singh *et al.* (2009), Singh and Kumar (2008), Anuja and Jahnavi (2012), Omem and Singh (2019) and Singh and Saha (2009).

High genetic advance as percent mean was observed for seed yield per plant (204.51), leaf biomass (191.31g), number of leaves per plant (182.14), flower yield per plant (155.13), stem diameter (138.21), average fresh weight of flower (136.67), number of seeds per peduncle (120.26), number of flowers per plant (115.43), weight of seed per peduncle (112.47), 100 seed weight (95.59), average fresh weight of leaf (95.13), number of secondary branches per plant (91.67%) plant height (88.77%), days taken to first bud appearance (76.13%), plant spread (73.54%), number of primary branches per plant (72.29%), days taken to first flowering (55.13%), flowering duration (52.25%) and flower diameter (51.71%). Similar, results were reported by Singh and Mishra (2008), Mathew *et al.* (2005) and Verma *et al.* (2002).

High heritability together with high genetic advance as percent of mean was recorded in 100 seed weight (h^2= 99.81%, GA=95.59%), average fresh weight of leaf (h^2= 99.69 %, GA = 95.13 %), average fresh weight of flower (h^2 = 99.67%, GA=136.67%), weight of seeds per peduncle(h^2= 99.59 %, GA= 112.47%), number of seeds per peduncle (h^2= 99.45 %, GA=120.26 %), seed yield per plant (h^2= 99.35 %, GA=204.51 %) and days taken to first bud appearance (h^2= 99.33 %,GA=76.13%). Therefore, improvement in these characters can be done through direct selection to select better genotypes of marigold. Analogous observations were found by Poulose *et al.* (2021), Kumar *et al.* (2014), Singh and Kumar (2008) and Singh *et al.* (2008) in marigold and Priya and Singh (2022) in chrysanthemum.

High heritability together with moderate genetic advance as per cent of mean was observed in days taken to seed ripening (h^2 = 99.18 %, GA= 46.93 %), and flower peduncle length (h^2= 97.76 %), GA= 39.69 %), Similar results reported by Kumar *et al.* (2014) and Kishore and Raghava (2001).

Conclusion

In present study differences between GCV and PCV value for morphological quality and seeds traits were very nominal, suggesting that these traits were less affected by environmental effects. The traits like average fresh weight of leaf and flower, weight and number of seeds per peduncle,seed yield per plant, days taken to first bud appearance, flowering and seed ripening, stem diameter, number of flowers per plant, plant spread, flower yield per plant, flower diameter and duration,number of primary and secondary branches per plant, peduncle length and plant

height exhibited maximum heritability that can further be utilized for the crop improvement through appropriate breeding programme.

Application of Research: With the research findings of the present study, good performing genotypes under Bihar conditions can be further evaluated in multi-locations and can be recommended for further commercial cultivation.

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