Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.2501

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **5 (2):** 751-757 (2017)

Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

Genetic Variability Studies for Various Quantitative Traits in Marigold

Nilima Gobade[1], Shalini Badge[2*], Shanti Patil[3] and Gourao Gormade[4]

[1,4]P.G. Students, Horticulture Section, College of Agriculture, Nagpur (M.S.)

[2]Asstt. Professor, Horticulture Section, College of Agriculture, Nagpur (M.S.)

[3]Asstt. Professor, Botany Section, College of Agriculture, Nagpur (M.S.)

*Corresponding Author E-mail: shalinibadge@gmail.com

Received: 24.01.2017 | Revised: 5.02.2017 | Accepted: 6.02.2017

ABSTRACT

To assess the genetic variability present in thirteen genotypes (12 local collections and one check ie. African double orange) of marigold the experiment was conducted in a randomized block design with three replication in a plot size of 1.8 m x 3.0 m The plants were transplanted at spacing 45 x 30 cm. during the year 2015-16 in the Horticulture Section, College of Agriculture, Nagpur. Genetic variability and heritability studies indicated that there were highly significant differences between the genotypes for yield of flower ha^{-1} and eighteen other characters. Comparison of genotypic and phenotypic co-efficient of variation for different traits indicated that the values of PCV were higher as compared to GCV due to the influence of environment. The coefficient of variation both at genotypic and phenotypic levels were maximum for disc diameter, yield of flowers ha^{-1}, weight of flower, diameter of fully opened flower, shelf life, number of flower plant^{-1} and length of pedicel. Heritability estimates for all the characters except plant spread at 50% flowering were high. High heritability along with high genetic advance as per cent of mean was observed for disc diameter, yield of flowers ha^{-1}, weight of flower, diameter of fully opened flower, number of flowers plant^{-1}, shelf life, and length of pedicel which were due to additive gene effects thus suggesting that selection for these characters would be very effective. Based on these seven traits, genotypes NAM-2, NAM-6 and NAM-12 were found significantly superior and identified for further purification and multiplication for their commercial exploitation

Key words: *Marigold, Variability, Genetic Advance, Heritability*

INTRODUCTION

Marigold (*Tagetes erecta*. L.) of family Asteraceae is one of the most Popular flowering plants and grown in commercial scale in our country. It is grown mostly for loose flowers and are used in making garland, veni and for floral decoration. It is native of central and South America especially Mexico. In India, about two third of total area under floriculture are devoted is production of traditional flowers like marigold, jasmine, chrysanthemum, rose, aster and tuberose.

Cite this article: Gobade, N., Badge, S., Patil, S. and Gormade, G., Genetic Variability Studies for Various Quantitative Traits in Marigold, *Int. J. Pure App. Biosci.* **5(2):** 751-757 (2017). doi: http://dx.doi.org/10.18782/2320-7051.2501

Among them marigold occupies the top most position in loose flower production. The area under commercial cultivation of marigold is substantially increasing due to its multipurpose uses in social and religious function in essential oil industries for oil and pigment extraction and in plant protection to control nematodes.

These wide uses depend on the variable performance of different genotypes. The sources of any breeding programme for developing suitable varieties depends largely on the availability of genetic variability in a given species. Heritability estimates give a measure of transmission of characters from one generation to the other as consistency in the performance of the selection depends on the heritable portion of the variability, thus enable the plant breeder in isolating the elite selection in the crop. Since, most of the characters influence yield and are polygenetic, it is essential for plant breeders to estimate the type of variation available in the germplasm.

Use of open pollinated crops for exploiting increased variations especially in heterozygous crop like marigold is gaining considerable importance[11]. Estimation of heritability reveals transmission of characters from one generation to another generation. Heritability alone is not useful for breeding programmes, heritability along with genetic advance is pre-requisite for selection process. The adequate information on extent of variability parameters may be helpful to improve the yield by selecting the yield component traits because yield is a complex trait, whose manifestation depends on the component traits. Being a cross pollinated crop there is need of high yielding variety with specific coloured flowers to overcome farmer's predicament. Variability results due to differences either in the genetic constitution of the individuals of a population or in the environment in which they are grown. Selection is effective when there is genetic variability[8]. Hence, an insight into the magnitude of genetic variability present in a population is very important for starting a judicious attempt in the present study.

MATERIALS AND METHODS

The present study was carried out at, Horticulture Section, College of Agriculture, Nagpur during the year 2016. Experimental material consisted of thirteen genotypes of marigold *viz.*, NAM-1, NAM-2, NAM-3, NAM-4, NAM-5, NAM-6, NAM-7, NAM-8, NAM-9, NAM-10, NAM-11, NAM-12 collected from different places and African Double Orange. The experiment was laid out in Randomized Block Design (RBD) with three replications. For planting of tuberose plot was prepared at the dimension of 1.8 m x 3.0 m. Before planting, the seed were treated with copper oxychloride (0.1%) and the individual seed weighing 300-350 g were selected for planting. The treated seed were planted at 5 cm depth at a spacing of 45 x 30 cm between the plant and row as per the standard recommendation on 22nd July, 2016. Uniform cultural practices were followed throughout the experimentation. The data were recorded on five random plants from each genotype in each replication for nineteen characters which includes vegetative parameters like plant height, stem diameter, number of branches^{-1}, leaf area at 50 per cent flowering, and plant spread at 50 per cent flowering, reproductive parameters like days to first flower bud initiation, days to opening of flower bud emergence, days to 50 per cent flowering and blooming period flower, quality parameters like weight of flower, diameter of fully opened flower, length of flower along with pedicel, length of pedicel, number of petals^{-1}, disc diameter, shelf life, consumer acceptance and yield parameters like number of flowers^{-1} and flower yield plot^{-1}. Data were subjected to statistical analysis as per method given by Panse and Sukhatme[6]. Genetic parameters like genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were estimated according to Singh and Chaudhary[7] and heritability in broad sense as suggested by Falconer[2] and genetic advance was calculated using the formula given by Johnson *et al*[3].

RESULTS AND DISCUSSION

The analysis of variance revealed that mean squares were significant for all the nineteen characters studied. This suggested the presence of wide range of variability for different characters in the material studied. The results pertaining to various genetic parameters *viz.*, phenotypic coefficient of variation (PCV), genotypic co-efficient of variation, heritability and genetic advance as per cent of mean are presented in Table 1.

In this study the highest range of variation was reported with yield of flower ha^{-1} (313.62) followed by number of petals flower^{-1} (132.19), plant height (47.94), and number of flower plant^{-1} (38.18). The results are in close conformity with the work done by Singh and Singh[9], Singh *et al*[10]., and Kavitha and Anburani[4] in marigold who also reported highest range of variation for yield of flower ha^{-1}, plant height and flower plant^{-1}. This indicated the presence of considerable amount of genetic variation in marigold genotypes. These results revealed that characters like yield of flower ha^{-1}, number of petals flower^{-1}, plant height, and number of flower plant^{-1} showing maximum mean and range can be considered as traits for selecting superior genotypes. Such high proportion of mean and range values for yield of flower ha^{-} , number of petals flower^{-1}, plant height, and number of flower plant^{-1} were also reported by Kavitha and Anburani[4] in marigold. Higher extent of variation reflecting in high range could be attributed to difference in the genetic composition of the rose genotypes collected from different places. This might be due to genetic characteristic and/or acclimatization to the environment from were collected.

Results in table 1 indicated a considerable range of variation with respect to phenotypic and genotypic coefficient of variation. The estimates of phenotypic coefficient of variation (PCV) were higher than genotypic coefficient of variation (GCV) for all the nineteen characters under consideration indicating higher degree of environmental influence in the expression of the genotypes. These results are in agreement with the results of Singh and Kumar[5], Singh and Misra[11], Kavitha and Anburani[4] and Kumar *et al*[5]., who also reported higher value of PCV than GCV for different characters in marigold indicating high degree of environmental influence. The PCV and GCV were estimated from the corresponding variances and were used for the assessment of variability among the characters studied. Genotypic and phenotypic coefficient of variation exhibited the values from low to high category.

High GCV was exhibited for disc diameter (80.39%), yield of flowers ha^{-1}(47.14%), weight of flower (33.52%), diameter of fully opened flower (29.31%), shelf life (25.53%), number of flower plant^{-1} (25.51%) and length of pedicel (22.48%). Moderate GCV was noticed for leaf area at 50% flowering (19.65%), consumer acceptance (17.14%), number of petals flower^{-1} (15.27%), number of branches planr^{-1} (15.19), length of flower along with pedicel (13.28%) and plant height (13.27%). Low GCV was observed for blooming period (9.88 %), stem diameter (9.79%), days to first flower bud initiation (8.75%), days to 50% flowering (8.46%), days to opening flower bud emergence (7.33%) and plant spread at 50% flowering (E-W=4.47%, N-S=4.76%).

Similarly phenotypic coefficient of variation was also observed to be low to high for different characters. High PCV was exhibited for disc diameter (80.91%), yield of flowers ha^{-1} (47.27%), weight of flower (33.93%), diameter of fully opened flower (30.29%), shelf life (26.29%), number of flower plant^{-1} (26.02%), length of pedicel (23.05%) and leaf area at 50% flowering (20.29%). Moderate PCV was noticed for, consumer acceptance (17.97%), number of petals flower^{-1} (16.10%), number of branches planr^{-1} (16.00), plant height (14.41%), length of flower along with pedicel (14.27%) , blooming period (11.20%), stem diameter (11.06%), days to first flower bud initiation (10.57%) and days to opening flower bud emergence (9.64%). Low PCV was observed for days to 50% flowering (9.91 %), and plant spread at 50% flowering (E-W=6.81%, N-S=6.87%).

Amongst all the characters studied, the highest GCV and PCV were recorded for disc diameter, yield of flowers ha^{-1}, weight of flower, diameter of fully opened flower, shelf life, number of flower plant^{-1} and length of pedicel. Indicating high variation in these characters, predicting greater scope for improvement of these seven characters. Higher GCV for above mentioned characters can effectively be utilized in formulating breeding strategy. Similarly, high variability has been reported by Anuja, and Jahnavi[1], Kavitha and Anburani[4], Singh *et al*[10]., and Singh and Singh[9] for disc diameter, yield of flowers ha^{-1}, weight of flower, number of flower plant^{-1} in marigold. PCV and GCV detect the amount of variability in the available germplasm. Selection based on lying variability alone is efficiency governed by heritability and genetic advance. It predicts the resultant effect for selecting the best individuals. Heritability

estimates give an idea of heritable portion of variability and enabling the plant breeder in isolating the elite selection in the crop. Heritability and genetic advance increase the efficiency of the selection in a breeding programme by assessing the influence of environmental factors and additive gene effect.

The estimates of heritability in broad sense give a measure of transmission of characters from one generation to another, thus giving an idea of heritable portion of variability and enabling the plant breeder in isolating the elite selection in the crop. Heritability and genetic advance increase the efficiency of the selection in a breeding programme by assessing the influence of environmental factors and additive gene action. The estimates of heritability in broad sense specifying the heritable portion of total variation, helps in identification of the appropriate characters for selection.

High estimates of heritability values were recorded for all the nineteen characters except for plant spread at 50% flowering reflecting the importance of these traits in selection programme. This indicated that these characters were governed by a polygenes or additive gene effect and therefore, selection of these characters would be more effective for yield improvement. These findings suggested scope of improvement of these characters through direct selection which was in line with the work of Singh *et al*[10]., Singh and Misra[11] and Singh *et al*[12]., who also reported high heritability for these traits. The magnitude of heritable variability is the most important aspect of genetic constitution of the genetic material which has close bearing on the response to selection.

Genetic advance as percentage of mean value were high for all the characters studied except for stem diameter, plant spread at 50% flowering, days to flower bud initiation, days to first opening flower bud emergence, days to 50 % flowering and blooming period.

Since, heritability estimates are influenced by environment, genetic material and also other factors hence their utility will be restricted. Thus, heritability in conjunction with genetic advance would give a more reliable index of selection value[3]. Heritable variation can be determined with greater accuracy when heritability along with genetic advance is studied. High heritability with high genetic advance tells that, the character is governed by additive gene action, for that simple selection is advocated. Heritability estimates along with high genetic advance is more useful criterion in predicting the resultant effect for selecting the best individual. This is due to the fact that a character may have very high heritability but very less phenotypic variation gives rise to very low genetic gain. In the present study, high heritability along with high genetic gain was observed for disc diameter (98.72% 164.54%), yield of flowers ha^{-1} (99.42, 96.82%), weight of flower (97.60%, 68.21%), diameter of fully opened flower (93.61%, 58.41%), number of flowers plant$^{-1,}$ (96.09%, 51.51%), shelf life (94.28%, 51.06%) and length of pedicel (95.15%, 45.18%) respectively. Estimates of genetic advance help in understanding the type of gene action involved in the expression of various polygenic characters. High heritability along with high genetic gain indicated that in these characters was due to considerable additive gene effects. Thus, selection on the basis of these characters would be more effective for further breeding programs. It revealed that crop improvement could be brought about by practicing phenotypic selection. This association owing to additive gene effects indicating that selection for these characters on phenotypic performance would be more effective. Similar to this finding, Singh *et al*[10] and Kavitha and Anburani[4] also reported high heritability accompanied with high genetic advance is most likely due to additive gene effect and selection may be effective in marigold.

Out of the nineteen characters mentioned above, seven characters *viz.*, disc diameter, yield of flowers ha^{-1}, weight of flower, diameter of fully opened flower, number of flowers plant^{-1}, shelf life and length of pedicel exhibited high heritability and genetic advance. Therefore, based on these seven traits, genotypes NAM-2, NAM-6 were found to significantly superior over check (African Double orange) for six characters as observed from table 2. These were followed by NAM-12 which was significantly superior for four characters.

Table 1: Genotypic and phenotypic co-efficient of variation, heritability and genetic advance as per cent of mean among different African marigold genotypes

Characters	Range	General Mean ± S.E.	GCV (%)	PCV (%)	Heritability (%)	GA (%) of mean
Plant height	47.94 (75.00-122.94)	98.34 ± 4.52	13.27	14.41	84.76	25.16
Stem diameter	0.43 (1.16-1.59)	1.33 ± 0.06	9.79	11.06	78.37	17.85
Number of branches^{-1}	9.7 (11.11-20.81)	15.94 ± 0.66	15.19	16.00	90.09	29.70
Leaf area at 50% flowering	13.44 (15.45-28.89)	22.21 ± 0.98	19.65	20.29	92.91	39.02
Plant spread at 50% flowering E-W	7.58 (32.56-40.14)	37.15 ± 1.56	4.47	6.81	43.09	6.04
N-S	8.18 (33.00-41.18)	38.15 ± 1.54	4.76	6.87	48.01	6.80
Days to first flower bud initiation	14.1 (38.16-52.26)	45.24 ± 2.19	8.75	10.57	68.54	14.92
Days to opening flower bud emergence	4.85 (15.07-19.92)	18.12 ± 0.93	7.33	9.64	57.90	11.49
Days to 50% flowering	17.28 (50.50-67.78)	57.94 ± 2.43	8.46	9.91	73.02	14.90
Blooming period	16.02 (48.47-64.49)	56.20 ± 2.42	9.88	11.20	77.77	17.85
Weight of flower	7.69 (3.47-11.16)	6.63 ± 0.28	33.52	33.93	97.60	68.21
Diameter of fully opened flower	5.83 (1.37-7.20)	5.04 ± 0.32	29.31	30.29	93.61	58.41
Length of flower along with pedicel	4.7 (9.65-14.35)	11.74 ± 0.50	13.28	14.27	86.54	25.45
Length of pedicel	5.88 (6.44-12.32)	8.86 ± 0.37	22.48	23.05	95.15	45.18
Number of petals flower^{-1}	132.19 (175.27-307.46)	247.69 ± 10.35	15.27	16.10	89.90	29.82
Disc diameter	1.48 (0.19-1.67)	0.49 ± 0.04	80.39	80.91	98.72	164.54
Shelf life	2.06 (2.09-4.15)	2.84 ± 0.15	25.53	26.29	94.28	51.06
Consumer acceptance	2.95 (4.99-7.94)	6.01 ± 0.26	17.14	17.97	91.05	33.70
Number of flower^{-1}	38.18 (25.59-63.77)	49.59 ± 2.08	25.51	26.02	96.09	51.51
Yield of flowers ha^{-1}	313.62 (108.00-421.62)	194.23 ± 5.69	47.14	47.27	99.42	96.82

Table 2: Performance of marigold genotypes for twenty different traits

Genotypes	Plant height (cm)	Stem diameter (cm)	Number of branches^{-1}	Leaf area at 50% flowering (cm^2)	Plant spread at 50% flowering stage (cm)		Days to first flower bud initiation (days)	Days to opening of flower from bud emergence (days)	Days to 50% flowering (days)	Blooming period (days)
					E-W	N-S				
NAM-1	75.00	1.19	11.11	15.45	32.56	33.00	50.08	17.80	62.52	63.14
NAM-2	122.94	1.59	20.81	28.89	40.14	41.18	45.79	16.40	58.16	60.52
NAM-3	84.17	1.21	13.20	17.86	36.14	37.18	52.26	19.92	64.84	64.49
NAM-4	115.90	1.56	18.60	26.15	38.72	39.74	40.04	17.48	52.14	48.68
NAM-5	100.48	1.34	15.60	26.59	38.90	39.97	45.91	17.54	57.37	52.38
NAM-6	100.92	1.36	15.92	22.85	37.08	38.10	42.92	17.50	54.07	56.13
NAM-7	99.05	1.28	16.80	23.37	37.14	38.19	40.06	19.83	52.11	49.16
NAM-8	112.78	1.47	16.90	21.18	36.57	37.62	49.92	17.82	61.22	62.13
NAM-9	95.84	1.25	18.08	28.85	40.01	41.12	45.12	19.85	58.91	60.15
NAM-10	94.64	1.23	13.92	19.59	36.42	37.45	43.55	17.62	55.04	56.90
NAM-11	99.12	1.31	15.62	17.12	36.03	37.07	48.16	19.15	67.78	58.14
NAM-12	82.38	1.16	15.23	21.90	36.92	37.96	46.15	19.62	58.58	50.37
African Double Orange	95.15	1.37	15.38	18.95	36.33	37.35	38.16	15.07	50.50	48.47
Mean	98.34	1.33	15.94	22.21	37.15	38.15	45.24	18.12	57.94	56.20
SEd	4.52	0.06	0.66	0.98	1.56	1.54	2.19	0.93	2.43	2.42
LSD (0.05)	9.32	0.12	1.35	2.03	3.21	3.19	4.52	1.91	5.02	5.00
CV (%)	5.63	5.14	5.04	5.43	5.13	4.96	5.93	6.25	5.14	5.28

Genotypes	Weight of flower (g)	Diameter of fully opened flower (cm)	Length of flower along with pedicel (cm)	Length of pedicel (cm)	Number of petels flower^{-1}	Disc diameter (cm)	Shelf life (days)	Consumer acceptance	Number of flower^{-1}	Yield of flowers ha^{-1}
NAM-1	7.12	4.81	10.70	7.37	300.15	0.34	2.11	7.07	25.59	108.00
NAM-2	11.16	7.20	12.31	9.16	280.78	0.66	3.11	7.94	63.77	421.62
NAM-3	7.59	4.53	9.67	6.53	307.46	0.43	2.10	7.38	26.47	119.01
NAM-4	3.47	1.37	9.65	6.44	175.27	1.67	4.11	4.99	60.15	123.60
NAM-5	6.15	5.15	12.22	8.28	275.15	0.19	3.09	5.01	49.20	179.06
NAM-6	6.76	6.03	14.21	12.15	211.12	0.25	3.14	5.20	60.62	242.81
NAM-7	5.29	5.28	11.26	8.67	248.14	0.19	2.43	5.27	53.33	166.96
NAM-8	5.42	6.12	14.35	12.32	215.84	0.28	2.09	5.87	62.84	201.87
NAM-9	5.48	4.25	13.91	11.65	239.44	0.25	3.14	5.24	40.19	130.37
NAM-10	5.17	4.27	11.47	8.84	230.13	0.30	3.15	5.40	58.19	178.22
NAM-11	4.48	4.03	11.35	8.70	223.46	0.60	2.24	5.27	47.93	127.30
NAM-12	10.59	6.95	10.29	7.14	235.12	0.57	2.10	6.27	52.80	331.25
African Double Orange	7.55	5.56	11.21	7.91	277.92	0.65	4.15	7.27	43.60	194.91
Mean	6.63	5.04	11.74	8.86	247.69	0.49	2.84	6.01	49.59	194.23
SEd	0.28	0.32	0.50	0.37	10.35	0.04	0.15	0.26	2.08	5.69
LSD (0.05)	0.59	0.65	1.04	0.76	21.36	0.08	0.30	0.54	4.30	11.73
CV (%)	5.26	7.65	5.24	5.07	5.12	9.16	6.29	5.37	5.14	3.58

CONCLUSION

From the various aspects of genetic parameters (GCV, PCV, heritability and genetic advance expressed as percentage of mean), studied in this experiment, seven characters i.e., *viz.*, disc diameter, yield of flowers ha^{-1}, weight of flower, diameter of fully opened flower, number of flowers $plant^{-1,}$, shelf life and length of pedicel were identified for primary selection as they had high GCV, PCV, high heritability along with genetic advance. Considering these characters, the three genotypes NAM-2, NAM-6 and NAM-12 which showed significantly superiority in mean performance were identified for further purification and multiplication for their commercial exploitation.

REFERENCES

1. Anuja, S. and K. Jahnavi., Variability and genetic advance studies in French marigold (*Tagetes patula L.*), *Asian J.Hort.*, **7(2):** 362-364 (2012).
2. Falconer, D.S., Introduction to Quantitative genetics. Oliver a14nd Boyd. Ltd. Edinburgh (1981).
3. Johnson, H.W., Robinson, H.F and Comstock, R.E., Estimates of genetic and environmental variability in soybean. *Agron. J*., **47:** 314-318 (1955).
4. Kavitha, R. and Anburani, A., Genetic variability in African marigold (*Tagetes erecta* L.). *Asian J. Hort*., **5(2):** 344-346 (2010).
5. Kumar, A., Bhanu Pratap and Karmabeer., Studies on genetic variability and character association in French marigold (*Tagetes patula* L). *Trends In Bioscience*., **7(2):** 122-124 (2014).
6. Panse, V.G. and Sukhatme, P.V., Statistical Methodsfor Agricultural Workers (2nd Edn.) Indian Council of Agricultural Research, New Delhi (1957).
7. Singh, R.K. and Choudhary, B.D., Biometrical methods in Qunatitative genetic analysis. Kalyani Publications. Ludhiana (1979).
8. Singh, P. and Narayana, S.S., Biometrical techniques in plant breeding. Kalyani Publishers, New Delhi, 182 pp (2000).
9. Singh, D. And Singh, A.K., Correlation and path coefficient analysis in marigold (*Tagetes spp.*). *Prog. Hort*., **37(2):** 385-388 (2005).
10. Singh, S.R.P., Syamal, M.M. and Sharma, O., Studies on Genetic variability in Marigold. *Indian J. Hort*., **64(4):** 483-485 (2007).
11. Singh, D. and Misra, K.K., Genetic variability in quantitative characters of marigold. *Indian J. Hort*., **65(2):** 187-192 (2008).
12. Singh, D. and Kumar, S., Studied on genetic variability, heritability, genetic advance and correlation in marigold. *J.Orna. Hort*., **11(1):** 27-31 (2009).