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EVALUATION OF GENETIC VARIABILITY, HERITABILITY AND GENETIC ADVANCES IN DAHLIA (*DAHLIA VARIABILIS* L.) GENOTYPES

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Abstract– The present investigation was carried out to know the genetic variability, heritability and genetic advances in dahlia with thirty five genotypes. High genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were observed for flower diameter, shelf life, individual weight of flower, number of flowers per plant, flower yield per hectare, tuber yield per plant. Whereas, high heritability (h^2) coupled with genetic advance over mean (GAM) was registered highest in plant height, number of secondary branches per plant, leaf area, leaf area index number of days taken to first flowering, flower diameter, shelf life, individual flower weight number of flowers per plant, flower yield per hectare and tuber weight per plant.

INTRODUCTION

Dahlia (*Dahlia variabilis* L.) is a tuberous rooted half hardy herbaceous perennial plant belonging to the family Asteraceae having its origin in Mexico, which is a popular plant in landscaping, cut flower and loose flower purposes (Smith, 1971). Eight species are commonly found in dahlia they are, *Dahlia variabilis, D. imperialis, D. exelsa, D.coronata, D. coccinea, D. merkii, D. zuarezii* and *D. rosea*. Out of these eight species, *D. variabilis* and *D. rosea* are of horticultural importance. The performance of dahlia varieties varies with region, season, cultivation aspects and growing environment. In India, there is a wide fluctuation in temperature, light intensity, rainfall and humidity, which not only affects the yield and quality of flowers but also limits their availability for a particular period of the year. Though there are many species and many cultivars of dahlia with different number, placement, texture, colour and size of florets, with different peduncle length, symmetry and vigour available in the world but there is still scope for improving these characters through breeding. The range of variation in dahlia is quite large, considering the potentiality of this crop; present experiment was conducted with the objective of variability and heritability studies for growth, quality and yield attributes.

MATERIALS AND METHODS

The experiment entitled with "Evaluation of genetic variability, heritability and genetic advances in dahlia (*Dahlia variabilis* L.) genotypes" was carried out at the Department of Floriculture and Landscape Architecture, College of Horticulture, Sirsi, University of Horticultural Sciences, Bagalkot, Karnataka with 35 genotypes of dahlia *viz*. HUBD-1 to HUBD-35 (Table 1) were planted according to randomized block design with two replications.

Estimation of genetic parameters

Coefficient of variation

The coefficient of variation (CV) being a standardized form of variance is useful for comparing the extent of variation between different characters with different scales (Singh and

Choudhary, 1979). Genotypic and phenotypic coefficient of variation was estimated according to Burton and Dewane (1953) based on estimate of genotypic and phenotypic variance.

$$GCV \quad \frac{\sqrt{GV}}{\bar{x}} \times 100$$

$$PCV \quad \frac{\sqrt{PV}}{\bar{x}} \times 100$$

Where,
GV – Genotypic variance
PV – Phenotypic variance
$\bar{x}$ = Grand mean

PCV and GCV were classified as per Robinson *et al*. (1949) was given below.

0-10%	- Low
>10-20%	- Moderate
>20% and above	- High

Heritability (h^2) in broad sense

Heritability in broad sense was calculated as the ratio of genotypic variance to the phenotypic variance and expressed in percentage (Falconer, 1981).

$$h^2 = \frac{GV}{PV} \times 100$$

Where,
GV = Genotypic variance
PV = Phenotypic variance

Heritability percentage was categorized as per Robinson (1966).

0-30%	- Low
>30-60%	- Moderate
>60% and above	- High

Genetic advance as percentage over mean

Genetic advance as percentage over mean (GAM) was worked out as suggested by Johnson *et al.* (1955).

$$GAM = \frac{GA}{\bar{x}} \times 100$$

Where,
GA = Genetic advance
= General mean of the character

The genetic advance as per cent mean was categorized as suggested by Johnson *et al.* (1955).

0-10%	- Low
>10-20%	- Moderate
>20% and above	- High

RESULTS AND DISCUSSION

The analysis of variance was estimated to the test of significance of difference among genotypes for the characters. In the present study significant differences were observed for all the fourteen characters in thirty five genotypes (Table 2). The estimates of various genetic variability parameters *viz.*, mean, range, phenotypic coefficient of variability, genotypic coefficient of variability, broad sense heritability and genetic advance over per cent of mean for various characters were presented in Table 3. Genetic parameters like genotypic coefficient of variation, phenotypic coefficient of variation, heritability and genetic advance over mean are useful biometrical tools for determination of genetic variability. Significant differences for the characters indicated appreciable amount of variability exists among the genotypes studied. The genotypic coefficient of variation measures the extent of variability among the different genotypes for different traits caused due to the inherent capacity of the genotype. The genotypic and phenotypic coefficients of variation are required to understand the effect of environment on various polygenic traits. The difference between GCV and PCV gives us an idea about role of genotype and environment on the character. (Naresh *et al*., 2015).

Higher GCV and PCV were recorded in the parameters like flower diameter (25.11% and 26.56%, respectively), shelf life (25.68 and 27.07%, respectively), individual weight of flower (36.37 and 37.26%, respectively), number of flowers per plant (44.87%, 45.34%, respectively) flower yield per hectare (51.14% and 52.77%, respectively), tuber yield per plant (24.01% and 24.84%, respectively). This suggests that presence of sufficient genetic variability, which can be exploited through practicing pure line selection. Similar results were reported by Kumar *et al*. (2015) in chrysanthemum and Rashmi *et al*. (2016) in gladiolus. Moderate GCV and PCV were recorded plant for height (13.30% and 14.28%, respectively), number of secondary branches (15.87% and 16.37 %, respectively), leaf area (18.04% and 19.07%, respectively), leaf rear index (18.04% and 19.07%, respectively) and number of days taken for first flowering (11.40% and 14.25%, respectively). However, low GCV and PCV were registered in stem girth (8.60 and 9.60%, respectively), crop duration (4.45% and 5.56%,

respectively) and chlorophyll (8.84% and 9.34%, respectively). Similar results were obtained in dahlia by Basavaraj (2006), Mishra and Saini (1997), in chrysanthemum by Telem *et al*. (2017). Narrow difference between GCV and PCV were observed for all the characters except number of days taken to first flowering and shelf life; which indicated that least influence of environment on these characters. Similar results were obtained by Mishra *et al*. (2001) in dahlia, Lydia *et al*. (2019) in marigold and Kumar *et al*. (2011) in gladiolus.

The heritability (h^2) of a character can be relied upon as it enables the plant breeder to decide on extent of selection pressure to be applied under a particular environment, which separates out the environmental influence from the total variability. Nevertheless, its use would be limited as this is prune to changes in environment and experimental material. The estimation of heritability has a greater role to play in determining the effectiveness of selection of a character provided; when it is conjunction with the predicted genetic advance as suggested by Panse and Sukhatme (1967) and Johnson *et al*. (1955). The heritability is influenced by biometrical method, generation of hybrid, sample size of experimental material and environment. The high estimate of heritability coupled with high genetic advance over per cent of mean were observed in plant height (86.76 % and 25.52 % respectively), number of secondary branches per

Table 1. Details of dahlia genotypes used in the study

Sl. No	Genotypes	Inflorescence type	Petal colour
1	HUBD-1	Decorative	Yellow
2	HUBD-2	Anemone	Dark pink
3	HUBD-3	Water lily	Light pink
4	HUBD-4	Peony	Light red variegated
5	HUBD-5	Single	Light Saffron
6	HUBD-6	Decorative	Light pink
7	HUBD-7	Semi cactus	Variegated pink
8	HUBD-8	Ball	Blue lilac
9	HUBD-9	Cactus	Blood red
10	HUBD10	Decorative	Light yellow
11	HUBD-11	Decorative	Baby pink
12	HUBD-12	Pumpon	Light saffron
13	HUBD-13	Single	Yellow
14	HUBD-14	Water lily	Dark pink
15	HUBD-15	Single	Light pink variegated
16	HUBD-16	Water lily	Pink
17	HUBD-17	Water lily	Dark saffron
18	HUBD-18	Decorative	Light pink
19	HUBD-19	Decorative	Orange
20	HUBD-20	Decorative	Light orange
21	HUBD-21	Decorative	Light pink
22	HUBD-22	Decorative	Dark yellow
23	HUBD-23	Water lily	Pink variegated
24	HUBD-24	Fimbriated	Light yellow
25	HUBD-25	Pumpon	Red
26	HUBD-26	Water lily	Pink
27	HUBD-27	Decorative	Maroon variegated
28	HUBD-28	Decorative	Light yellow
29	HUBD-29	Decorative	Light red
30	HUBD-30	Decorative	Red
31	HUBD-31	Decorative	Dark red
32	HUBD-32	Decorative	Dark orange
33	HUBD-33	Fimbriated	Pink
34	HUBD-34	Pumpon	Orange
35	HUBD-35	Orchid	Red variegated

HUBD – Horticulture University of Bagalkot Dahlia

plant (94.04% and 31.71% respectively), leaf area (89.50% and 35.16%, respectively), leaf area index (89.50 % and 35.16%, respectively), number of days taken to first flowering (75.70% and 22.22%, respectively), crop duration (64.08% and 20.87%, respectively), flower diameter (89.37% and 48.89%, respectively) shelf life (91.01% and 50.19%, respectively), individual flower weight (95.30% and 77.14%, respectively), number of flowers per plant (97.93% and 91.47%, respectively), flower yield per hectare (95.39% and 103.69%, respectively) and tuber weight per plant (93.44% and 47.80%, respectively). However high heritability with moderate genetic advance over mean was recorded in stem girth (80.39% and 15.89%, respectively), crop duration (64.08 and 7.34 %, respectively) and chlorophyll (89.51% and 17.22%, respectively). High heritability associated with high GAM proves more useful for efficient improvement of a character through simple selection. High heritability with high GAM indicating the possible role of additive gene action. Whereas, moderate heritability with low GAM, can be exploited through heterosis. Similar, findings were in accordance with the results

Table 2. Analysis of variance (mean sum of squares) for growth, flowering, quality and yield parameters in dahlia genotypes

Sources of variation	Replications	Genotypes	Error	S. Em ±	CD @ 5%	CD @ 1%
Degrees of freedom	1	24	24			
Plant height (cm)	111.132	289.383**	20.521	3.203	9.206	12.359
Number of secondary branches/plant	0.153	4.608**	0.141	0.265	0.763	1.025
Leaf area	2235873	3389787.2699**	187846.502	306.46	880.79	1182.51
Leaf area index	0.3	0.469**	0.02	0.11	0.32	0.43
Stem girth (mm)	0.847	1.492**	0.162	0.28	0.81	1.09
Days to first flowering	4.32	78.502**	10.85	2.33	6.69	8.99
Crop duration (days)	17.08	87.22*	19.09	8.88	11.92	3.09
Flower diameter (cm)	6.83	11.28**	0.367	0.95	0.60	2.30
Shelf life (days)	0.002	1.968*	0.103	0.227	0.653	0.877
Individual flower weight (g)	0.467	17.635**	0.423	0.46	1.322	1.775
Chlorophyll	7.63	35.541**	1.966	0.997	2.85	3.826
Number of flowers per plant	51.086	15174.25*	158.639	1.527	4.39	5.898
Flower yield per hectare (q)	700.95	51230.54*	121.039	7.779	22.358	30.017
Tuber yield per plant (g)	200.18±9.01	11.83-314.7	24.01	24.84	93.44	47.80

*and**indicates significant at 5 % and 1 % level respectively

Table 3. Estimates of mean, range, components of variance, heritability and genetic advance over mean for growth, flowering, quality and yield parameters in dahlia genotypes

Character	Mean	Range	GCV (%)	PCV (%)	h^2 bs (%)	GAM (%)
Plant height (cm)	87.18±3.20	66.44-116.69	13.30	14.28	86.76	25.52
Number of secondary branches / plant	9.41±0.27	6.90-13.90	15.87	16.37	94.04	31.71
Leaf area (cm^2)	7012.93±306.48	4498-9805	18.04	19.07	89.50	35.16
Leaf area index	2.6±0.11	1.67-3.63	18.04	19.07	89.50	35.16
Stem girth (mm)	9.40 ± 0.28	8.45-12.70	8.60	9.60	80.39	15.89
Number of days taken to first flowering	46.91 ± 2.33	31.40-56.40	11.40	14.25	75.70	22.22
Crop duration (days)	131.19 ± 3.09	122.50-151.50	4.45	5.56	64.08	7.34
Flower diameter (cm)	8.07 ± 0.46	4.42-13.52	25.11	26.56	89.37	48.89
Shelf life (days)	3.76 ± 0.23	2.00-10.00	25.68	27.07	91.01	50.19
Individual flower weight (g)	8.16 ± 0.47	2.43-15.33	36.37	37.26	95.30	77.14
Chlorophyll	46.37±0.99	36.23-54.19	8.84	9.34	89.51	17.22
Number of flowers per plant	33.12±1.53	15.50-67.40	44.87	45.34	97.93	91.47
Flower yield per hectare (q)	97.11±7.78	21.31-207.05	51.14	52.77	95.39	103.69
Total tuber weight per plant (g)	200.18±9.01	11.83-314.7	24.01	24.84	93.44	47.80

GCV- Genotypic Co-efficient of Variation, PCV- Phenotypic Co-efficient of Variation, h^2- Heritability in Broad sense, GAM- Genetic Advance as per cent of Mean

reported by Singh (2003) in dahlia, Negi *et al*. (1983) in China aster, Telem *et al*. (2017) and Hebbal *et al*. (2018) in chrysanthemum, Vishnupriy *et al*. (2015) in marigold.

CONCLUSION

From the present study it can be concluded that, selection of genotypes based on characters like flower diameter, shelf life, individual weight of flower, number of flowers per plant, flower yield per hectare, tuber yield per plant which are showing high GCV, PCV, heritability and genetic advance and it will give potential parent in breeding program.

REFERENCES

Basavaraj, 2006. *Genetic variability studies in dahlia.* M.Sc. (Hort). *Thesis,* Univ. Agric. Sci. Bagalkot.

Burton, G.W. and Dewane, E.M. 1953. Estimating heritability from replicated clonal material. *Agron. J.* 45: 478–481.

Falconer, D.S. 1981. *Introduction to Quantitative Genetics.* Oviler and Boyd, Edinburgh.

Hebbal, M., Shiragur, M., Mahantesha B.N., Seetharamu, G.K., Nishani, S. and Patil, B.C. 2018. Assessment of genetic variability, heritability and genetic advance in chrysanthemum (*Dendranthema grandioflra* Tzvelve). *Int. J. Curr. Microbiol. App. Sci.* 7(8): 4544-4553.

Johnson, H.W., Robinson, H.F. and Comstock, R.E. 1955. Estimates of genetic and environmental variability in soyabeans. *Agron. J.* 47 : 314-318.

Kumar, A., Dubey, P., Patanwar, M. and Sharma, R. 2015. Evaluation of chrysanthemum varieties for loose flower production in Chhattisgarh plains. *Trends in Bioscan*. 8(1): 175-177.

Kumar, J., Kumar, R. and Krishan, P. 2011. Variability and character association in gladiolus (*Gladiolus grandiflorus* L.). *Agri. Sci. Digest*. 31(4) : 280–284.

Lydia, J., Ponnuswami, V and Thangaselvabai, T. 2019. Genetic diversity analysis in *Tagetes erecta* L. genotypes. *Int. J. Chemical Studies*. 7(3) : 2766-2768.

Mishra, M., Mohanty, C.R. and Mahapatra, K. 2001. Genetic variability with respect to floral traits in dahlia. *J. Orn. Hort.* 4(2) : 79-82.

Mishra, R.L. and Saini, H.C. 1997. Genotypic and phenotypic variability in dahlia (*Dahlia variabilis*). *Indian J. Hort.* 17 : 148-152.

Naresh, S., Rao, A.V.D.D., Baskhar, V.V., Rao, M.M., Krishna, U.K. 2015. Genetic variability, heritability and genetic advance in gladiolus hybrids. *Plant Arch*. 15(1) : 377-381.

Negi, S.S., Sharma, T.V.R.S., Raghava, S.P.S. and Srinivasan, V.R. 1983. Variability studies in gladiolus. *Indian J. Hort*. 40 : 269-272.

Panse, V.G. and Sukhatme, P.V. 1967. *Statistical Methods for Agricultural Workers*, ICAR. New Delhi.

Rashmi, R., Chandrashekar, S.Y., Arulmani, N. and Geeta, S.V. 2016. Genetic divergence studies in gladiolus genotypes (*Gladiolus hybridus* L.). *Res. Environ. Life Sci*. 9(3) 274-276.

Robinson, H.F. 1966. Quantitative genetics in relation to breeding on centennial of mendelism. *Indian J. Genet*. 26 : 171-177.

Robinson, H.F., Comstock, R.E. and Harvey, P.M. 1949. Estimates of heritability and degree of dominance in corn. *Agron. J.* 41: 353–359.

Singh, R.K. 2003. Variability studies in dahlia for some quantitative traits. *J. Orn. Hort.* 7(1): 58-60.

Singh, R.K. and Chaudhary, B.D. 1979. *Biometrical Methods in Quantitative Genetics Ananlysis*. 3rd edition. Kalyani Publishers. New Delhi, pp. 53-54.

Smith, A.W. 1971. In: *A Gardener's Dictionary of Plant Names*. Cassell and Company Ltd, London. 390 p.

Telem, R.S., Sadhukhan, R., Sarkar, H.K., Akoijam, R., Haribhushan, A. and Wani, S.H. 2017. Genetic studies for flower yield and component traits in *Chrysanthemum morifolium* Ramat. *J. Appl. Natural Sci*. 9(1): 211-214.

Vishnupriy, A.K., Jawaharlal, M. and Manivannan, N. 2015. Variability studies in African marigold (*Tagetes erecta* L.). *The Bioscan*. 10(1): 407-409.