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Genetic Variability Analysis, Correlation Coefficient and Path Coefficient Analysis of Dahlia (*Dahlia variabilis* L.) Varieties in Saurashtra Region of Gujarat, India

K. R. Zala [a++*], S. M. Makwana [b], V. S. Patel [a++] and K. S. Solanki [a++]

[a] Department of Floriculture and Landscape Architecture, COH, JAU, Juangadh, India.
[b] Deparatment of Basic Science, COH, JAU, Juangadh, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Identification of genotypes better suited for particular region and their improvement is of immediate task to exploit their full potential. The improvement can be brought out after confirming the association among the most important growth with quality attributes. Hence, varietal evaluation becomes necessary to find out suitable variety for a particular region. Experiment was conducted with 20 different decorative types of dahlia varieties at Jambuvadi Farm, College of Horticulture, Junagadh Agricultural University, Junagadh which falls under South Saurashtra Agro-climatic Zone

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[++] *Ph.D Scholar;*
**Corresponding author: E-mail: kuvarsinhzala@gmail.com;*

during 2021-22. The analysis of variance revealed significant differences among the genotypes for eleven characters in dahlia *viz.,* plant height, number of leaves per plant, number of branches per plant, stem girth, days taken to first bud initiation, diameter of flower, stalk length, vase life, anthocyanin content, chlorophyll content and flower yield which indicated the existence of variability in the experimental material. The estimates of genotypic (σ^2g) and phenotypic variances (σ^2p) of each character were carried out.

Keywords: Anthocyanin; chlorophyll; variance; genotypic; phenotypic.

1. INTRODUCTION

These eight species include pompons, extravagant varieties, anemone flowered, desert plant and semi-prickly plant types, peony, enhancing, ball types, imbriated, water lily, star type, and *D. variabilis* and *D. rosea*, which are used in landscaping. A naturally occurring fruit sugar generated from inulin was isolated from dahlia tubers in Europe and America prior to the discovery of insulin in 1923, and this inulin is still used in clinical trials today for renal functions. Dahlia tubers that have been roasted are used to flavor drinks. Depending on the variety, dahlia plants can grow to a height of 30 to 180 cm.

The scope of variety in dahlia is enormous. Thinking about the significance of the harvest and probability of developing the yield, there is a requirement for its improvement [1-4]. Dahlias contain many transposons – genetic pieces that move from place to place on an allele, thereby contributing to great floral diversity [5-9]. Evaluation is a necessary pre-requisite for crop improvement and it will provide a rapid, reliable and efficient means of information to augment the utilization of germplasm [10-12]. It is the stepping stone in order to utilize any crop to its full potential. Since, the performance of each variety varies with regions; season and growing environment, therefore testing the performance of the available varieties for suitability and adaptability take prime importance [13-15].

Identification of varieties better suited for particular region and their improvement is of immediate task to exploit their full potential [16-19]. The improvement can be brought out after confirming the association among the most important growth with quality attributes [20]. The modern dahlia cultivars offer a diversity of colors, shapes, and sizes and it is very rich in its varietal wealth and every year there is an addition of new varieties; hence varietal evaluation becomes necessary to find out suitable variety for a particular region [21-26]. The investigation was carried out keeping in mind the following objectives; 1) To measure the magnitude and extent of genotypic and phenotypic variability, 2) To estimate correlation and path coefficient between yield and component traits.

2. MATERIALS AND METHODS

Dahlia terminal clippings made up the experimental material. The gap between the plants is 60 × 40 cm. 20 varieties were chosen for the experiment. During the course of the inquiry, all the plants were maintained using identical cultural methods in accordance with the standard guidelines for manures and fertilizers, irrigation, and plant protection measures.

2.1 Experimental Layout

The experiment was laid out in Randomized block design (RBD) having the gross plot size of 3.6 m x 2.4 m and the net plot size of 1.8 m x 1.2 m.

3. RESULTS AND DISCUSSION

3.1 Genetic Variability Parameters

Knowledge of nature and magnitude of variation present in the base population is a pre- requisite for effective selection of superior genotypes from a variable population. However, it is essential that the population should possess large amount of heritable variation. Thus, the extent of genetic variability is more important than total variation. The variability parameters viz., range, genotypic coefficient of variation (GCV %), phenotypic coefficient of variation (PCV %), heritability in broad sense (h^2bs) and genetic advance (GA) as per cent of mean were computed from variance components and mean values as depicted in Table 1.

3.2 Estimation of Components of Variance

The phenotypic, genotypic and environmental variances calculated for all the eleven characters

under present study are presented in Table 1. The results revealed that magnitude of phenotypic components of variance was higher than genotypic components of variance for all the character studied. The genotypic component of variation was found to be higher than the environmental component of variance for all the character except width of inflorescence, exhibited a close correspondence with phenotypic variance in most characters. This suggest that phenotypic variability was reliable measure of genotypic variability as most of the characters were least influenced by the environment.

The magnitude of genotypic variance was highest for days taken to first bud initiation (987.09) followed by number of leaves per plant (813.96) and anthocyanin content (739.86). The phenotypic variances ranged between 0.083 (chlorophyll content) to 987.63 (days taken to first bud initiation). A very low genotypic variances coupled with low environmental variances has been observed for Chlorophyll content (0.083 to 0.0002), Vase life (1.36 to 0.01) and Stem girth (3.13 to 0.05).

The present study showed wide range of phenotypic variability and highly significant varietal differences for all the characters, indicating considerable amount of variability under present investigation.

3.3 Coefficient OF Variation

The estimates for genotypic coefficient of variation (GCV) were lower than PCV for all characters. The results revealed that the magnitude of genetic variability was very close to phenotypic variability for all the characters. This indicates that phenotypic variability is larger due to genetic differences for different traits.

In the present studies phenotypic coefficient of variation were more than genotypic coefficients of variation in all the traits. This might be due to environmental effect. Similar findings were reported by Venkatesh *et al.* (2014), Sheelamary and Phogat (2016) and Kumar *et al.* (2018).

3.4 Heritability and Genetic Advance

The ratio of genotypic variance to the phenotypic variance is known as broad sense heritability.

It is generally expressed in percentage. The heritability is heritable portion of phenotypic variance.

Improvement of mean genotypic value of selected plants over parental population is known as genetic advance. It is measure of genetic gain under selection. The success of genetic advance under selection depends on three main factors viz., genetic variability, heritability and selection intensity.

3.5 Heritability Percentage (B.S.)

The estimates of heritability as percentage in broad sense for all the characters under present study are presented in Table 2.

The heritability (b.s.) estimate ranged from 99.99 per cent (anthocyanin content) to 93.69 per cent (plant height). All the ten characters showed high heritability which indicates that these characters are least influenced by the environmental effects, the selection for improvement of such characters may not be useful because broad sense heritability is based on total genetic variance which includes both fixable (additive) and non-fixable variance (dominance and epistatic). The lowest heritability not recorded which highly influenced by the environmental effects and genetic improvement through selection will be difficult due to masking effect of the environment on the genotypic effect.

3.6 Genetic Advance as Percent of Mean

The character anthocyanin content (178.73) showed highest genetic advance followed by number of flowers per plant (149.87), vase life (118.27) and number of branches per plant (118.19). Moderate genetic advance was recorded in, number of branches per plant days taken to first bud initiation (117.29), stalk length (115.48), diameter of flower (109.98) and number of leaves per plant (95.52).The lowest genetic advance observed for chlorophyll content (23.10), plant height (36.32)and stem girth (46.92).

3.7 Correlation Coefficient

For estimation of characters association, correlation analysis has been used to determine the type and magnitude of association between a pair of characters. These associations provide a better understanding of the contribution of one trait in building-up the genetic makeup of the other traits of a crop. The knowledge about correlations between economically important traits and characters contributing to that in all combinations will help to decide the parameters for selection, so that improvement in the associated characters can be made.

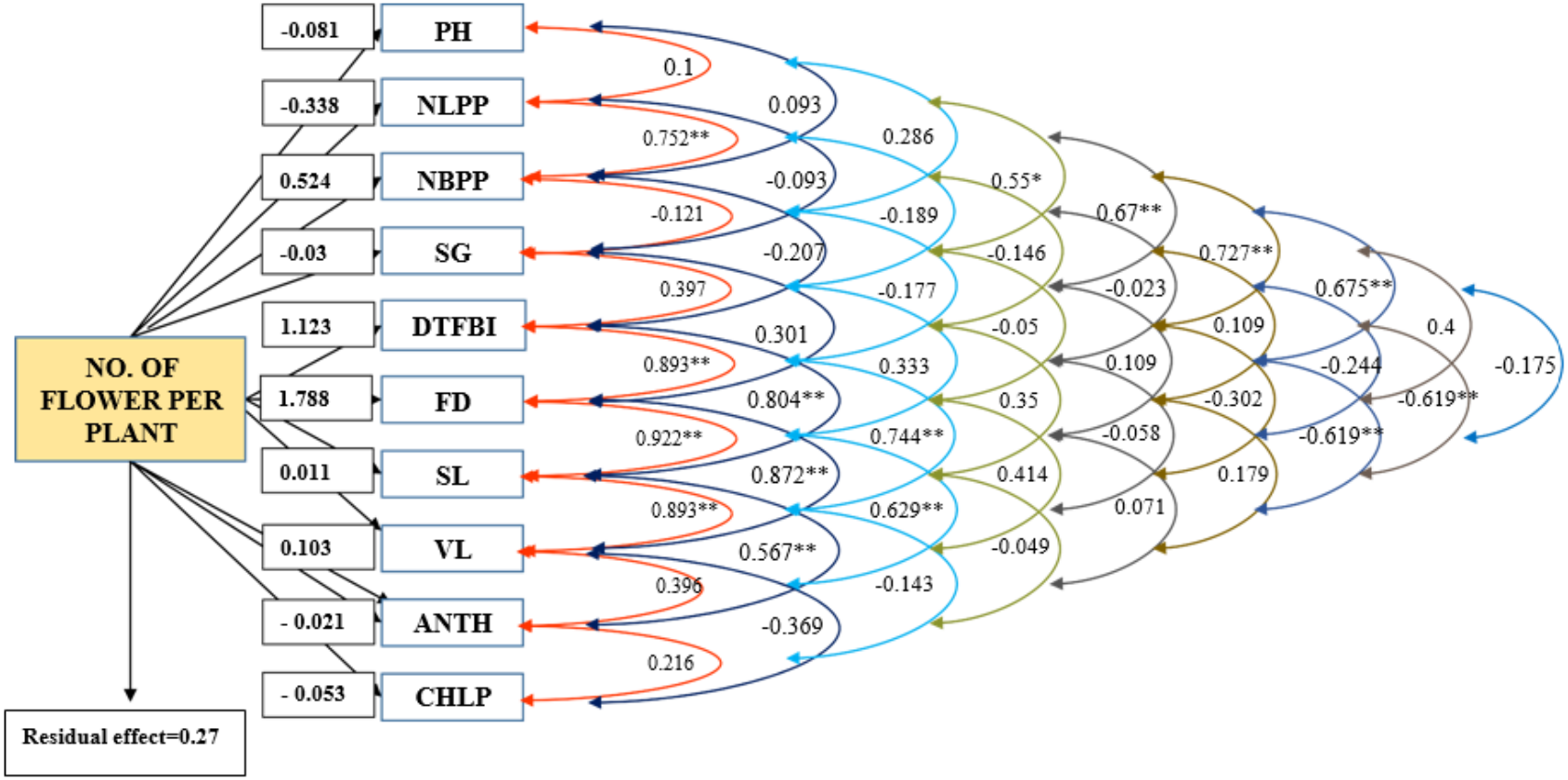

Fig. 1. Genotypic path diagram for number of flower per plant

Where,

***PH** = Plant height (cm), **NLPP** = Number of leaves per plant, **NBPP** = Number of branches per plant, **SG** = Stem girth (mm), **DTFBI** = Days taken for first bud initiation, **FD** = Flower diameter (cm), **SL**= Stalk length, **VL** = Vase life , **ANTH** = Anthocyanin content, **CHLP** = Chlorophyll content*

Table 1. Genetic parameters of variation for number of flowers per plant and its contribution in variation in dahlia

Sr.No	Characters	Range	Mean	Components of Variance			GCV%	PCV%	h^2bs %	G.A % of mean
				σ^2 g	σ^2 p	σ^2 e				
1.	Plant height (cm)	30.93 - 72.11	53.85	96.24	102.73	6.48	18.21	18.82	0.93	36.32
2.	Number of leaves per plant	28.25 -128.87	61.35	813.96	818.42	4.45	46.49	46.62	0.99	95.52
3.	Number of branches per plant	1.12 - 12.37	6.90	15.90	16.11	0.20	57.75	58.12	0.98	118.19
4.	Stem girth (mm)	5.41 - 11.45	7.70	3.13	3.18	0.05	22.96	23.15	0.98	46.92
5.	Days taken to first bud initiation	46.25 - 95.25	55.16	987.09	87.63	0.54	56.95	56.97	0.99	117.29
6.	Diameter of flower (cm)	10.83 - 16.99	11.01	34.63	34.70	0.07	53.44	3.50	0.99	109.98
7.	Stalk length (cm)	12.72 - 25.09	13.76	59.68	59.80	0.11	56.11	56.17	0.99	115.48
8.	Anthocyanin content (mg/l)	2.22 - 83.82	31.34	739.86	739.79	0.07	86.76	86.77	0.99	178.73
9.	Chlorophyll content (mg/l)	1.88 - 3.13	2.57	0.083	0.084	0.0002	11.23	11.24	0.99	23.10
10.	Number of flowers per plant	1.25 - 5.75	2.84	4.34	4.40	0.06	73.28	73.81	0.98	149.87

Where, σ^2g,σ^2 σ^2e are genotypic, phenotypic, environmental variance, respectively; GCV (%), PCV (%) and ECV (%) are genotypic, phenotypic and environmental coefficient of variance, respectively; and h^2 (%), GA, GAM (%) are heritability, genetic advance and geneticadvance expressed as per cent of mean, respectively

Table 2. Genotypic and phenotypic correlation coefficient for different characters in dahlia

Characters		01. Plant height (cm)	02. Number of leaves	03. Number branches	04. Stem girth (mm)	05. Days taken to first bud initiation	06. Diameter of flower (cm)	07. Stalk length (cm)	08. Vase life (days)	09. Anthocyanin content (mg/l)	10. Chlorophyll content (mg/l)	11. Number of flowers per plant
01	**rg**	**1.0000**	0.1001	0.0930	0.2856	0.5504*	0.6698**	0.7271**	0.6748**	0.3995	-0.1751	**0.5481***
	rp	**1.0000**	0.0964	0.0936	0.2731	0.5348*	0.6476**	0.7017**	0.6539**	0.3864	-0.1706	0.5389*
02	**rg**		**1.0000**	0.7524**	-0.0928	-0.1894	-0.1462	-0.0230	0.1094	-0.2445	-0.6720**	-0.0167
	rp		**1.0000**	0.7448**	-0.0906	-0.1895	-0.1439	-0.0238	0.1082	-0.2439	-0.6686**	-0.0161
03	**rg**			**1.0000**	-0.1209	-0.2066	-0.1770	-0.0504	0.1088	-0.3024	-0.6192**	0.1667
	rp			**1.0000**	-0.1180	-0.2052	-0.1758	-0.0485	0.1064	-0.3002	-0.6155**	0.1697
04	**rg**				**1.0000**	0.3975	0.3013	0.3332	0.3496	-0.0584	0.1790	0.0498
	rp				**1.0000**	0.3945	0.2994	0.3308	0.3513	-0.0577	0.1779	0.0496
05	**rg**					**1.0000**	0.8932**	0.8037**	0.7443**	0.4141	0.0714	0.4357
	rp					**1.0000**	0.8922**	0.8032**	0.7419**	0.4140	0.0710	0.4327
06	**rg**						**1.0000**	0.9222**	0.8718**	0.6294**	-0.0494	0.7416**
	rp						**1.0000**	0.9201**	0.8689**	0.6288**	-0.0498	0.7368**

Characters		01. Plant height (cm)	02. Number of leaves	03. Number branches	04. Stem girth (mm)	05. Days taken to first bud initiation	06. Diameter of flower (cm)	07. Stalk length (cm)	08. Vase life (days)	09. Anthocyanin content (mg/l)	10. Chlorophyll content (mg/l)	11. Number of flowers per plant
07	**rg**							**1.0000**	0.8926**	0.5671**	-0.1430	0.7197**
	rp							**1.0000**	0.8889**	0.5668**	-0.1431	0.7137**
08	**rg**								**1.0000**	0.3963	-0.3690	0.7425**
	rp								**1.0000**	0.3950	-0.3667	0.7331**
09	**rg**									**1.0000**	0.2164	0.5788**
	rp									**1.0000**	0.2159	0.5748**
10	**rg**										**1.0000**	-0.2450
	rp										**1.0000**	-0.2450
11	**rg**											**1.0000**
	rp											**1.0000**

**, ** Significant at 5 and 1 per cent level of significance, respectively.*

Table 3. Direct and indirect effects of different characters on number of flowers per plant

Trait s	01. Plant height (cm)	02. Number of leaves	03. Number branches	04. Stem girth (mm)	05. Days taken to first bud initiation	06. Diameter of flower (cm)	07. Stalk length (cm)	08. Vase life (days)	09. Anthocyanin content (mg/l)	10. Chlorophyll content (mg/l)	11. Number of flowers per plant
1	**-0.0814**	-0.0082	-0.0076	-0.0233	-0.0448	-0.0545	-0.0592	-0.0549	-0.0325	0.0143	0.5481*
2	-0.0338	**-0.3380**	-0.2544	0.0314	0.0640	0.0494	0.0078	-0.0370	0.0826	0.2272	-0.0167
3	0.0488	0.3945	**0.5243**	-0.0634	-0.1083	-0.0928	-0.0264	0.0570	-0.1585	-0.3246	0.1667
4	-0.0086	0.0028	0.0036	**-0.0302**	-0.0120	-0.0091	-0.0101	-0.0105	0.0018	-0.0054	0.0498
5	-0.6182	0.2127	0.2320	-0.4464	**-1.1231**	-1.0032	-0.9027	-0.8359	-0.4650	-0.0802	0.4357
6	1.1979	-0.2615	-0.3165	0.5388	1.5974	**1.7884**	1.6493	1.5591	1.1256	-0.0884	0.7416**
7	-0.0081	0.0003	0.0006	-0.0037	-0.0089	-0.0102	**-0.0111**	-0.0099	-0.0063	0.0016	0.7197**
8	0.0692	0.0112	0.0112	0.0359	0.0763	0.0894	0.0915	**0.1026**	0.0406	-0.0378	0.7425**
9	-0.0084	0.0051	0.0063	0.0012	-0.0087	-0.0132	-0.0119	-0.0083	**-0.0209**	-0.0045	0.5788**
10	-0.0093	-0.0356	-0.0328	0.0095	0.0038	-0.0026	-0.0076	-0.0196	0.0115	**0.0530**	-0.2450

*** Significant at p=0.01*, Significant at p=0.05 and Residual effect = 0.2704*

The association between characters, which is directly observed, is the phenotypic correlation. The knowledge about phenotypic correlation between yield contributing characters helps in selection programme for yield improvement of a crop. The genotypic correlation permits the prediction of correlated response as well as evaluation of the relative influence of one character on other and helpful in the construction of selection indices. The phenotypic and genotypic correlation coefficients (Table 2) were estimated for eleven characters using twenty varieties of dahlia to find out the with other yield contributing characters.

4. CONCLUSION

Genotypic correlation coefficients were higher than the phenotypic coefficients. Number of flowers was found positively and significantly correlated with plant height, flower diameter, flower stalk length, vase life and anthocyanin content. Therefore, selection based on these characters can give better results for number of flowers.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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