Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2020; 9(4): 3134-3137
Received: 04-05-2020
Accepted: 06-06-2020

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Assessment of genetic variability among dahlia (*Dahlia variabilis* L.) genotypes for productivity and quality traits

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Abstract
An experiment was conducted with 32 genotypes of dahlia to study the genotypic and phenotypic coefficients of variation, heritability and expected genetic advance. The data indicated that estimates of genotypic coefficient of variation (GCV) are higher than those of phenotypic coefficient of variation (PCV) for all the traits studied indicating little influence of environment and the presence of inherent association between various characters. High heritability coupled with high genetic advance and high GCV were observed for most of the traits indicating the presence of additive gene action. High estimates of GCV (>20%), PCV (>20%), heritability (>60%) and genetic advance over mean(>20%) were obtained for plant height at 90 days after planting, leaf area index, duration of flowering, number of flowers/plant, flower yield per ha, tuber weight, number of tubers per plant, individual flower weight, flower diameter, petal length and stalk length showing that selection of these characters may be relied upon for pure line selection for improvement.

Keywords: Dahlia, genetic variability, heritability, productivity traits

Introduction
Dahlia (*Dahlia variabilis* L.) is a tuberous rooted half hardy herbaceous perennial 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) [13]. 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. A systematic study of vegetative characters would facilitate the breeders to select suitable genotypes for planned breeding programme (Mahajan *et al.*, 2011) [7]. Selection of proper variety for producing the desired quantity and quality of flowers for domestic market is of greater importance. Improvement in any crop depends on the magnitude of genetic variability, association between various characters and to the extent transmission of characters from one generation to the next (Bhujbal *et al.*, 2013) [3]. With these points in view, the present investigation was undertaken to evaluate the genetic variability in thirty two cultivars of dahlia.

Material and Methods
The experiment was carried out at department of Floriculture and Landscape Architecture, Kittur Rani Channamma college of Horticulture, Arabhavi, which is situated in the northern dry zone (Zone III) of Karnataka. The experiment was laid out in randomized block design with spacing of 60 cm × 40 cm, which was replicated twice with 32 genotypes in open field condition. The details of 32 genotypes used in the study are presented in the table 1. Recommended agro techniques were followed and observations were made on the vegetative and floral parameters. The data regarding parameters of variability like mean, range, phenotypic and genotypic coefficient of variation (Burton and Devane, 1953) [4], broad sense heritability (Johnson *et al.*, 1955) [6] and genetic advance (Johnson *et al.*, 1955) [6].

Results and discussion
The analysis of variance revealed highly significant differences among the genotypes for all traits studied (Table 2) indicating that genotypes used in the present study are genetically diverse. The data presented in Table 3 and Fig-1 proves that there was high variability among the cultivars for vegetative traits such as plant height at 45 and 90 DAP, LAI, plant spread

towards N-S and E-W directions and duration of crop. Similar variation in plant height among the cultivars was also observed in dahlia by Dhane and Nimbalkar (2002) [5], Vikas *et al.* (2011) [14]; in China aster by Munikrishnappa (2011) [9] and Zosiamliana *et al.* (2012) [15]. Parameters like days taken to first flower bud initiation, days to fifty per cent flowering and duration of flowering varied significantly among cultivars due to their genetic makeup which is in concurrence with the conclusions of Raghupathi *et al.*(2019) [10], Baburao *et al.* (2018) [1] in dahlia and Arulmani *et al.* (2016) in gaillardia.

The evaluated genotypes exhibited significant variation for various yield parameters like flower yield per plant, flower yield per hectare, tuber weight and number of tubers per plant. Differences in yield among the genotypes was mostly due to genetic variation and effect of growing environment, which is supported by studies of Shukla *et al.* (2018) [12], Bajaraya *et al.* (2018) [2], Verma and Kulkarni (2017) and Manjula *et al.* (2017) [8] in dahlia; by Namita *et al.* (2008) and Narsude *et al.* (2010) in marigold. Parameters related to flower quality like individual flower weight, flower diameter, petal length and stalk length also exhibited wide variations among the different genotypes. Variations in flower characters were expected due to innate variation in genotypes at genetic level coupled with environmental interaction. Similar variations among varieties were noticed by Gupta *et al.* (2015) and Kumar *et al.* (2015) in dahlia.

Estimates of phenotypic coefficient of variance (PCV) was higher compared to genotypic coefficient of variance (GCV) for all the characters (Table 3), indicating the role of environmental factors for the expression of these traits. High estimates of GCV coupled with PCV were obtained for plant height at 90 days after planting (26.91%, 27.21%), leaf area index (34.81%, 34.95%), duration of flowering (29.34%, 29.68%), number of flowers/plant (25.71%, 26.59%), flower yield (49.30%,49.61%), tuber weight (28.49%, 29.60%), number of tubers per plant (26.00%, 26.45%), individual flower weight (21.27%,25.13%), flower diameter (21.79%, 23.81%), petal length (28.17%, 29.55%) and stalk length (22.00%, 23.00%).

High heritability coupled with high genetic advance as per cent of mean was evident (Fig. 1) for plant height at 90 days after planting (97.85%,54.818%), leaf area index (99.2%, 71.409%), plant spread in E-W (83.7%, 24.93%), duration of crop (85.6%,24.71%), days to first flowering (94.9%, 35.51%), days to fifty per cent flowering (93.3%, 27.59%), duration of flowering (97.7%,59.74%), number of flowers/plant (93.5%, 51.19%), flower yield (98.8%, 100.93%), tuber weight (92.6%, 56.47%), number of tubers per plant (96.7%, 52.66%), flower diameter (83.7%, 41.07%), petal length (90.8%, 55.30%) and stalk length (91.5%, 43.34%) indicating the presence of additive gene action for these traits. Similar results were reported by Raghupathi *et al.* (2019) [10] in dahlia and Rajiv *et al.* (2012) [11] in gerbera. Hence, these characters can be relied upon for further crop improvement.

Table 1: Details of the dahlia genotypes used in present study

S. No.	Genotype	Plant stature	Flower colour and scheme
1	Krishna	Tall	Light blend (Pink and light yellow)
2	Barakachri	Tall	Monochromatic (Yellow)
3	Binayananda	Tall	Light blend (orange)
4	Good Day	Tall	Monochromatic (Pink)
5	Glory of India	Tall	Monochromatic (Pink)
6	M Trangini	Tall	Light blend (Tan)
7	Gargi	Tall	Monochromatic (White)
8	Master Pic	Tall	Monochromatic (Red)
9	Hiranmayi	Tall	Bicolour (Red and white)
10	Satya Samrat	Tall	Monochromatic (Orange)
11	Silpa	Tall	Monochromatic (Red)
12	Santashima	Tall	Light Blend (Red and white)
13	Sachin	Tall	Monochromatic (White)
14	Pagaltahaker	Tall	Monochromatic (White)
15	Eternity	Tall	Monochromatic (Yellow)
16	Buddha's Mother	Tall	Bicolour (Red and white)
17	Santi	Tall	Monochromatic (Orange)
18	Jayal Singh	Tall	Monochromatic (Red)
19	Nilkamal	Tall	Light blend (White and red)
20	Salini	Medium	Monochromatic (Yellow)
21	Pusona	Medium	Monochromatic (Pink)
22	Jisu	Medium	Light Blend (White and maroon)
23	Sowmitha	Medium	Light Blend (White and orange)
24	Kaviguru	Medium	Monochromatic (Red)
25	WOK	Medium	Monochromatic (Pink)
26	Sourav	Medium	Monochromatic (Orange)
27	Guddy	Dwarf	Monochromatic (Yellow)
28	OK	Dwarf	Monochromatic (Orange)
29	YBK	Dwarf	Light Blend (Orange and yellow)
30	YK	Dwarf	Light Blend (White and orange)
31	WBK	Dwarf	Monochromatic (Orange)
32	WK	Dwarf	Monochromatic (Orange)

Table 2: Analysis of variance for productivity and quality traits in dahlia

S. No.	Character	Replication d.f = 2	Genotypes d.f = 32	Error d.f = 31	Sem±	CD @ 5%
1	Plant height at 45 DAP (cm)	0.83	17.66**	2.25	1.06	3.06
2	Plant height at 90 DAP (cm)	479.71	780.84**	8.63	2.07	5.99
3	Leaf Area Index	0.004	0.85**	0.003	0.04	0.12
4	Plant spread (N-S) (cm)	9.72	29.84**	3.54	1.33	3.84
5	Plant spread (E-W) (cm)	7.56	61.89**	5.48	1.65	4.77
6	Duration of crop (days)	0.05	833.65**	64.52	5.68	16.38
7	Days to first flowering	595.36	305.90**	7.99	1.99	5.76
8	Days to 50% flowering	655.04	264.91**	9.20	2.14	6.18
9	Duration of flowering (days)	24.44	923.27**	10.64	2.30	6.65
10	Number of flowers/plant	88.83	116.85**	3.93	1.40	4.04
11	Flower yield (t/ha)	2.62	52.16**	0.32	0.40	1.15
12	Tuber weight (g)	0.13	159.72**	6.13	1.75	5.05
13	Number of tubers per plant	0.39	3.85**	0.06	0.18	0.52
14	Individual flower weight (g)	8.99	23.96**	3.96	1.40	4.06
15	Flower diameter (cm)	6.83	11.28**	0.99	0.70	2.03
16	Petal length (cm)	2.11	3.47**	0.16	0.28	0.83
17	Stalk length (cm)	4.70	9.33**	0.14	0.45	1.31
18	Vase life (days)	0.090	0.77**	0.01	0.07	0.20

Table 3: Estimates of range, mean, components of variance, heritability and genetic advance for various parameters of dahlia

S. No	Character	Range	Mean	GCV (%)	PCV (%)	h^2 (%)	GAM (%)
1	Plant height at 45 DAP (cm)	25.97 – 37.85	29.96	9.27	10.53	77.4	16.79
2	Plant height at 90 DAP (cm)	24.77 – 106.38	73.03	26.91	27.21	97.8	54.81
3	Leaf Area Index	1.04 – 3.36	1.87	34.81	34.95	99.2	71.40
4	Plant spread (N-S) (cm)	24.35 – 40.30	33.59	10.80	12.17	78.8	19.73
5	Plant spread (E-W) (cm)	31.60 – 54.64	40.15	13.23	14.46	83.7	24.93
6	Duration of crop (days)	119.75 – 209.65	151.27	12.96	14.01	85.6	24.71
7	Days to first flowering	49.20 – 107.80	68.96	17.70	18.17	94.9	35.51
8	Days to 50% flowering	63.22 – 112.75	81.53	13.87	14.36	93.3	27.59
9	Duration of flowering (days)	38.30 – 118.45	72.81	29.34	29.68	97.7	59.74
10	Number of flowers/plant	15.45 – 50.45	29.23	25.71	26.59	93.5	51.19
11	Flower yield (t/ha)	4.39 – 26.30	10.33	49.30	49.61	98.8	100.93
12	Tuber weight (g)	14.62 – 49.32	30.76	28.49	29.60	92.6	56.47
13	Number of tubers per plant	3.55 – 9.10	5.29	26.00	26.45	96.7	52.66
14	Individual flower weight (g)	9.31 – 25.06	14.87	21.27	25.13	71.6	37.06
15	Flower diameter (cm)	5.63 – 16.54	10.41	21.79	23.81	83.7	41.07
16	Petal length (cm)	1.62 – 6.59	4.57	28.17	29.55	90.8	55.30
17	Stalk length (cm)	5.76 – 14.28	9.60	22.00	23.00	91.5	43.34
18	Vase life (days)	3.32 – 5.87	4.07	15.17	15.37	97.4	30.83

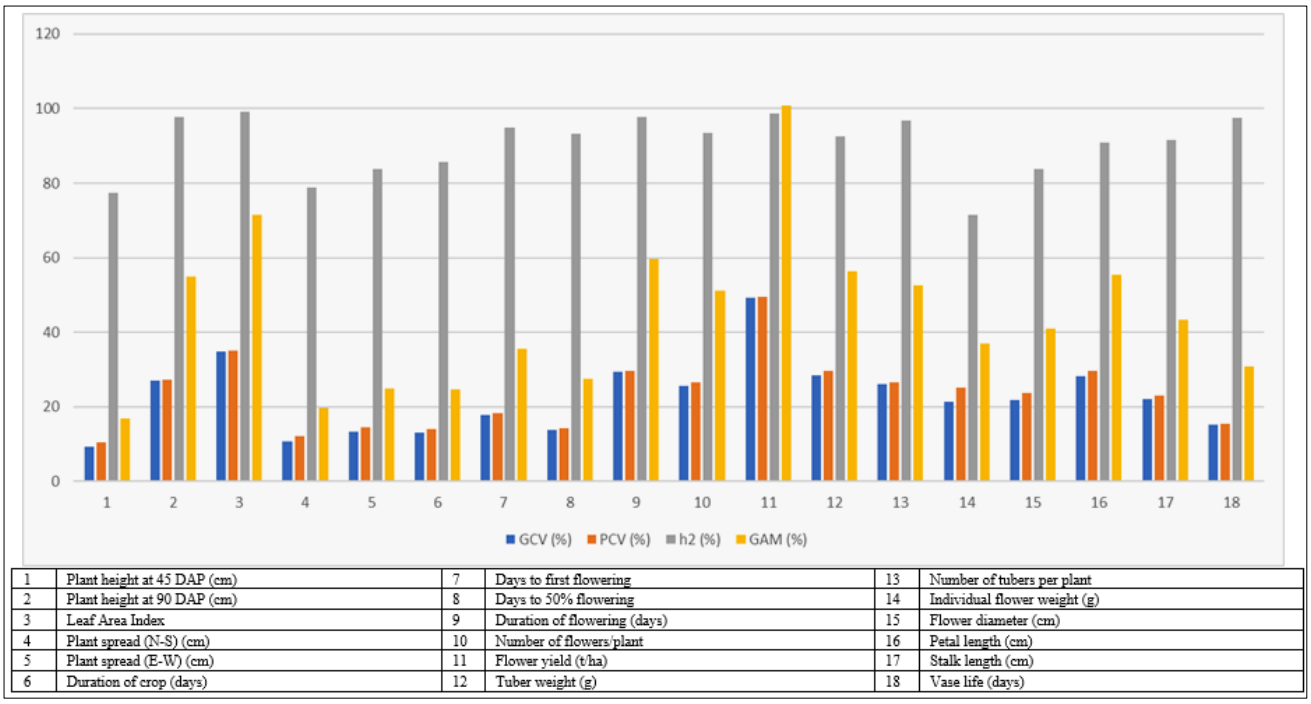

Fig 1: Estimates of components of variance, heritability and genetic advance over mean for various parameters of dahlia

Conclusion

In conclusion, there was a wide range of variability for various growth, flowering, quality and yield parameters in dahlia. Most of the parameters included in the study exhibited high estimates of GCV coupled with PCV and high heritability coupled with high genetic advance as per cent of mean. For most of the traits, the difference between PCV and GCV was less indicating that these characters are not considerably influenced by environmental factors suggesting the presence of sufficient genetic variability, which can be exploited by practicing selection.

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