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GENETIC DIVERSITY IN DAHLIA (*DAHLIA VARIABILIS*)

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ABSTRACT

Multivariate analysis of divergence among 23 varieties of dahlia for nine developmental characters led to their grouping into 10 clusters. The first two clusters had four varieties, the next two clusters had three varieties each, three clusters comprised two varieties each, and the last three clusters included one variety each. Thus, these three varieties were more diversed than others. Based on cluster means, characters like flower weight, flower diameter, number of flowers and shoots/plant, and length of floral stalk were the major factors of differentiation among these 23 varieties. The intercluster D^2 values ranged from 74 to 3033, suggesting very little domestication in this crop.

Key words: Genetic diversity, dahlia.

Dahlia variabilis (Compositae), grown as background crop for beddings and for cut flowers, is a very popular ornamental. However, very limited studies have been carried out for its improvement. The objective of the present study is to know the amount of variability available for different component characters in this crop. Therefore, the main objective was to gather information on (i) genetic divergence among the existing varieties, (ii) the relationship of genetic diversity with their geographic and ecological background, (iii) the factors influencing genetic divergence, and (iv) the parental groups which are likely to yield superior segregants on hybridization.

MATERIALS AND METHODS

The material for the present investigation consisted of 20 released varieties and three strains (18 exotic and 5 indigenous) of dahlia. They were grown at IARI Regional Station, Katrain, Kullu Valley, during 1981 and 1982 in RBD replicated thrice, allowing feeding area of 75 x 60 cm per plant and keeping seven plants per replication. The data were recorded on five plants (leaving the first and the last plants in each row) per replication for plant height, number of shoots per plant, days to first flower, durability of one flower, number of flowers per plant, flower diameter, length of floral stalk, flower weight at full bloom stage, and plant spread.

The data were subjected to multivariate analysis using Mahalanobis' generalized distance D^2. The 9 x 9 dispersion matrix was used for simultaneous testing of significance of differences in the character means using Wilk's criterion [1] and the varieties were grouped into clusters according to Tocher's method [1]. The criterion used for clustering was that any two varieties belonging to the same cluster, on an average, show a smaller intracluster distance than the intercluster distances.

RESULTS AND DISCUSSION

The importance of genetic diversity in crop plants was first realized by Darwin [2] and the term morphism employing genetic morphs was given by Huxley [3], which means the existence of distinct genetic forms in balance in a population. Several improvements were made in crop plants by making use of genetic diversity. The present study has indicated that the 23 varieties of dahlia differ from each other in nine characters under study, as is evident from the significant mean squares for these characters (Table 1).

Table 1. ANOVA for various characters of dahlia

Character	Mean sum of squares		
	replications (d.f. = 2)	treatments (d.f. = 22)	error (d.f. = 44)
Plant height	316.17*	1147.39**	96.03
Shoots per plant	0.22	1.81**	0.12
Days to first flower	0.06	1.66**	0.36
Durability of one flower	0.66*	4.19**	0.20
Flowers per plant	634.63	4538.03**	206.17
Flower diameter0.45	72.82*	0.34	
Length of floral stalk	8.61	88.75**	3.71
Flower weight	3.36	634.94**	3.39
Plant spread	650.57**	834.38**	54.64

** P = 0.01, * P = 0.05.

On the basis of D^2 analysis, the 23 varieties were grouped in 10 clusters (Table 2). Maximum number of varieties, i.e. four in each, were observed in clusters I and II. Cluster I included three exotics (My Beauty, Silkin Sheen, Elizabeth Margarette) and one indigenous (Decorative Yellow Mutant) varieties. All three exotics gave average performance for all the characters, whereas the indigenous variety had minimum plant spread (44.8 cm). Similarly, cluster II comprised two exotics (Dark Red, Variegated) and two indigenous varieties (Fojal Mutant, Bharat Laxmi). Both the exotics had average performance for length of floral stalk, flower weight and flower diameter, but they were good for flower durability (7.7 days). On the

Table 2. Varieties included in 10 clusters of dahlia

Cluster	Varieties
I	Decorative Yellow Mutant, My Beauty, Silkin Sheen, Elizabeth Margarette
II	Dark Red, Fojal Mutant, Variegated, Bharat Laxmi
III	Potridgar, Creamy Violet, Kitty
IV	Avalanche, Garden Glory, Annapurna
V	Decorative Yellow, Selection-8
VI	Powder Puff, Egglestion
VII	Duston Stone, Tam Tam
VIII	Arthur Godfrey
IX	African Queen
X	Pioneer

other hand, both indigenous varieties were taller and early to medium in flowering. Cluster III comprised three exotics (Potridgar, Creamy Violet, Kitty). Variety Kitty showed maximum flower durability (9.4 days) and minimum flower weight (3.8 g). The flower diameter in var. Kitty was also smallest among all the varieties under study. Cluster IV included two exotics (Avalanche, Garden Glory) and one indigenous (Annapurna) varieties. The indigenous var. Annapurna produced heaviest flowers (49.0 g). Cluster VI comprised two varieties of exotic origin (Powder Puff, Egglestion), while cluster V had one indigenous (Selection-8) and one exotic (Decorative Yellow) varieties. Var. Egglestion flowered earliest in our conditions. Cluster VII also consists of two exotics (Duston Stone, Tam Tam), but among these var. Tam Tam produced smallest flowers (diameter 4.6 cm). Clusters VIII, IX and X comprised one exotic variety each, i.e. Arthur Godfrey, African Queen, and Pioneer. Varieties African Queen and Arthur Godfrey produced flowers with longest stalks (30.7 cm) and maximum diameter (21.8 cm), respectively.

Table 3. Cluster mean values for nine characters of dahlia

Cluster	Character means								
	plant height (cm)	shoots per plant	days to first flower	flower durability (days)	flowers per plant	flower diameter (cm)	length of floral stalk (cm)	flower weight (g)	plant spread (cm)
I	114.2	1.9	122.5	7.6	25.0	15.7	20.7	9.4	58.9
II	115.8	1.9	118.7	7.7	39.9	14.0	19.6	30.3	59.9
III	118.0	2.4	109.2	8.1	73.3	6.8	21.2	6.4	67.2
IV	124.2	2.5	111.9	8.1	97.8	15.6	24.4	43.9	90.0
V	107.0	1.6	115.5	7.4	28.3	15.1	21.8	20.0	59.8
VI	106.1	1.9	110.4	7.5	36.1	19.2	22.1	29.0	74.6
VII	93.6	2.6	107.8	9.3	81.8	5.5	16.1	32.5	64.9
VIII	73.3	2.0	113.1	5.1	40.9	21.8	16.3	48.2	73.0
IX	123.2	1.3	112.8	6.6	36.2	18.6	30.7	34.6	82.5
X	99.5	1.0	102.6	8.0	54.8	12.5	29.4	10.1	68.6

Average cluster means for different characters show that the varieties included in cluster I had poor plant spread, average plant height and shoot formation per plant, but highest number of flowers per plant (Table 3). Cluster IV showed maximum plant height, maximum number of flowers/plant and highest spread, whereas the varieties included in clusters III, V, VIII and X were poor for flower weight, flowers/plant, plant height and shoots/plant, respectively. Varieties included in clusters IX and VIII had maximum floral length and flower weight, respectively.

The lowest D^2 value of 18 was observed for cluster V and maximum of 32 for cluster VI (Table 4). Clusters II, III and IV had relatively moderate to high D^2 values (202, 133, 143, respectively), indicating that the varieties constituting these clusters were more diverse genetically. Similar conclusions were also derived from the intercluster D^2 values, which were maximum between clusters VI and IV (3033) and minimum between clusters V and I (74).

Table 4. Intra- and intercluster distances in dahlia

Clusters	I	II	III	IV	V	VI	VII	VIII	IX	X
I	56	279	338	539	74	265	791	680	310	128
II		202	432	232	231	275	419	442	234	276
III			133	731	309	734	387	1303	754	182
IV				143	291	3033	492	270	194	491
V					18	143	536	452	157	93
VI						32	879	373	338	359
VII							74	1115	849	546
VIII								–	189	825
IX									–	340
X										–

The present study has revealed that plant spread, flower durability, flowers/plant, and flower diameter had maximum variation among the 23 varieties of dahlia studied. Significant mean squares for all the characters analysed also indicated that they showed maximum variation, while multivariate analysis also indicates that the varieties displayed high genetic diversity for all the characters. However, improvement in this crop would be possible if promising varieties are chosen irrespective of origin for individual characters to create best recombinants. In this regard, var. Arthur Godfrey for flower diameter, Kitty for early flowering and flower durability, Bharat Laxmi for plant height, Garden Glory for plant spread, flowers and shoots/plant, African Queen for length of floral stalk, and Annapurna for flower weight should be crossed, in single or double crosses to obtain the best hybrid and to create further variability for these characters.

Our earlier study with 23 varieties of dahlia [4] indicated that high flower number and plant spread can be easily combined due to significant positive correlation among these two characters, and var. Garden Glory possesses both these characteristics. This study also suggested that varieties Garden Glory and Annapurna are the best parents for hybridization. Bhattacharjee and Wahi [5] also pointed out that characters like flower diameter, plant height, flower longevity and number of branches were important component characters for flower yield per plant in dahlia. The important components for flower diameter are number of flowers and leaves/plant.

Though the exotic genotypes had poor performance for some of the characters, these are a good source for increasing flower diameter, flower weight, plant spread, and number of flowers/plant. These can directly help in increasing flower number/plant and flower diameter. Thus, by increasing the total plant height and shoots/plant more remunerative varieties with more flowers of larger size and weight can be produced.

In the past dahlia has remained neglected, and improvement through breeding was not very effective due to limited genetic diversity. The recent germplasm accessions provide scope for vigorous improvement through hybridization. The clusters comprising only one variety, i.e. Arthur Godfrey, African Queen and Pioneer, with specific valuable traits can also be used in hybridization to exploit hybrid vigour. The highly divergent groups are also likely to produce new genotypes with hitherto unknown combinations.

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