

Studies on genetic divergence in gladiolus genotypes, *Gladiolus hybridus* Hort

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ABSTRACT

Genetic diversity is the first and important parameter in crop improvement programme. In the present investigation thirty gladiolus genotypes were assessed to know the nature and magnitude of genetic divergence using Mahalanobis D^2 statistics. The population was grouped into eight clusters. The corm weight, corm diameter, rachis length, days to for sprouting, spike girth, leaf width, days taken for full spike emergence, inter-floret length, floret diameter and vase life components were found main parameters contributing towards divergence and played dominant role in the improvement of gladiolus quality. Cluster-I retained maximum number of treatments which showed genetic similarities; cluster-II and cluster-IV each with 7 and 6 genotypes, cluster-III with 3 genotype and cluster-VI with 2 genotypes. Rest of the clusters were of solitary type which had considerable differences in their parents. Therefore selection for divergent parents based on these traits is recommended for getting desirable hybrids or segregates in gladiolus.

Keywords: Gladiolus genotypes; genetic divergence; cluster

INTRODUCTION

Gladiolus is one of the most important bulbous cut flower groups grown for its beauty, elegance and majestic blooms. It has colorful florets borne on spikes. Gladiolus is a tender herbaceous perennial plant belonging to family Iridaceae growing from both seeds and corms. This flower crop possesses a great potential for export market to European countries especially during winter. It is also a popular decorative plant for use in herbaceous

borders bedding and for growing in pots and bowls.

D^2 statistic has been employed widely to resolve genetic divergence at inter-varietal, subspecies and species levels in classifying problems in crop plants (Murthy and Tiwari 1967, Siddique and Swaminathan 1971). In the process of formulating the gladiolus crop improvement programmes understanding about the nature and degree of genetic divergence available in the germplasm plays a pivotal

role. Genetic divergence existing in the population helps in selecting suitable parents for hybridization programme. Therefore present investigations were undertaken to examine the nature and magnitude of genetic divergence in thirty gladiolus genotypes.

MATERIAL and METHODS

Present investigations were carried out with thirty varieties of gladiolus obtained from Indian Institute of Horticulture Research, Bangalore selected on the basis of phenotypic variability in different quantitative characters (Table 1). The experiment was conducted in Department of Horticulture, University of Agricultural Sciences, Dharwad during the year 2010-11. The genotypes were planted in randomized block design with two replications consisting of single row length of 3 m and 10 plants for each entry. Fifteen observations were recorded on agronomic and flower attributes. The germplasm was subjected to D^2 statistics to estimate the genetic diversity suggested by Mahalanobis (1928).

RESULTS and DISCUSSION

The analysis of variance revealed that the genotypes varied significantly for all the fifteen morphological characters under present investigations. After computing D^2 value for all the possible pairs thirty genotypes were grouped into eight clusters using Toucher's method (Singh and

Choudhary 1977) which indicated large genetic diversity.

Contribution of each character towards genetic divergence was estimated from the number of times that character appeared in first rank (Table 2). It was observed that floret diameter contributed maximum (20.46%) towards genetic divergence followed by number of florets per spike (11.26%), vase life (10.57%), spike length (5.75%) and plant height (5.29%). These characters showed highest contribution in differentiating at intra-cluster level. Similar observations have been recorded by Desh Raj and Misra (2000), Pal et al (2006) in gladiolus crop.

Thirty genotypes were grouped into 8 clusters (Table 3) and among them cluster-I was the largest with 9 genotypes followed by cluster-II and cluster-IV each with 7 and 6 genotypes, cluster-III with 3 genotypes and Cluster-VI with 2 genotypes. Rest of the clusters were of solitary type. The formation of solitary clusters may be due to total isolation preventing the gene flow or intensive natural/human selection for diverse adaptive complexes. These genotypes may be very unique and useful from breeding point of view.

Divergence values (D^2 value) ranged from zero to 7.97 indicating considerable amount of moderate variability in the material studied. All the 30 genotypes

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Table 1. Gladiolus genotypes used for phenotypic diversity analysis

S/N	Genotype	Parentage	Color description
1.	American Beauty	Unknown	Petals carmine red, lower three petals inside and outside cream at lip portion
2.	Sylvia	Comm Koehl x Moorish King	Cherry petals or 2 corlet, here and there blood red specks, lower two inside petals butler cup yellow 5-6 red lines around 1 yellow long streak
3.	Melody	Unknown	Peach pink petals lower 3 petals inside scarlet lip
4.	Summer Sunshine	Unknown	Florets are yellow with reddish orange in color
5.	Vadanapoli	Unknown	Florets are light to dark pink in color with whitish throat
6.	Copper King	Unknown	Florets are with fan shaped yellow throat on red base, ruffled
7.	Red Ginger	Unknown	Florets pink in color with whitish central throat
8.	Candiman	Unknown	Florets are dark pink in color with light pinkish central blotch
9.	Priscilla	Diamond x Leana	Florets are pinkish move petals and yellowish white throat
10.	Jester Yellow	Jester Sport	Florets are yellow in colour with greenish central blotch
11.	White Friendship	(Maid of Orleans x Piardy) x (Gloaming x Seedling)	Florets are creamish white in color
12.	White Prosperity	Unknown	Florets are white in color
13.	Eight Wonder	Unknown	Florets are yellow in color
14.	Pacific	Unknown	Florets are pure white in color, petals fading to light pink with red blotch on throat petals heavily ruffled
15.	Light Purple	Unknown	Florets are light purple in colour petals are shaded with cream
16.	Peter Pears	Salmoe x Maolete	Flowers are peach in colour medium in size
17.	Snow Princess	Unknown	
18.	Apple Blossom	Beautys Blush x Rose Charm	Petals are delicate light pink with darker dots, ruffled open faced Flower

19.	Rose Delight	Picardy x Early Rose	
20.	Arati	Shielely x Melody	Poppy-red with purple-red and canary-yellow blotch
21.	Tropic Sea	Unknown	Petal lip portion royal purple, inside the below petals with creamy $\frac{3}{4}$ portion
22.	Ham Van Magareen	Unknown	Pale sober yellow semi open faced
23.	Ethyl Cav cole	Unknown	Petals crimson (32), here and there white blotches
24.	Summer Pearl	Unknown	Petals bluish pink, inside ivory base is cream
25.	Thumbelina	Unknown	Snow white with red margin
26.	Oscar	Unknown	Deep velvety red and huge flowers
27.	Red charm	Unknown	Flowers are blood red in colour small flowers and compact
28.	Legend	Unknown	Flowers are red with white throat ruffled and compact
29.	Tiger flame	Unknown	
30.	Appollo	Unknown	Flower shades of orange, light salmon and deep yellow heavily ruffled

Genotypes were collected from IIHR, Bangalore

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Table 2. Per cent contribution of 17 quantitative characters towards diversity in gladiolus genotypes

Character	Contribution (%)	Ranking
Corm weight (g)	0.69	-
Corm diameter (cm)	3.45	-
Cormels per plant	2.53	-
Days taken for sprouting	2.30	-
Plant height (cm)	5.29	V
Leaves per plant	2.76	-
Leaf width (cm)	4.14	-
Days taken for spike initiation	3.22	-
Days taken to first floret to show colour	1.38	-
Days taken to full emergence of spike	1.84	-
Spike length (cm)	5.75	IV
Rachis length (cm)	0.00	-
Spike girth (cm)	1.54	-
Florets per spike	11.26	II
Inter floret length (cm)	4.37	VI
Floret diameter (cm)	20.46	I
Vase life	10.57	III

Table 3. Grouping gladiolus genotypes based on D² analysis

Cluster	# genotypes	Genotype
I	3	Sylvia, Melody, Summer Sunshine
II	7	Tropic Sea, Han Vam Meegreen Ethyl Cavcole, Legend, Summer Pearl, Appollo, Thumbelina
III	9	White Friendship, White Prosperity, Jester Yellow, Priscilla, Candiman, Red Ginger, Eight Wonder, Copper King, Pacifica
IV	6	Peter pears, Snow Princess, Apple Blossom, Rose Delight, Arati, Red Charm
V	1	Vadanapoli
VI	2	IIHR Watermelon Pink , White Chiffer
VII	1	Light Purple
VIII	1	American Beauty

were randomly distributed into eight clusters (Table 4).

The intra-cluster D^2 values ranged from zero (clusters-V, VII and VIII) to 7.97 (cluster-I) indicating moderate diversity (Table 5). Cluster-III was largest and comprised of 9 genotypes followed by cluster-II having seven genotypes, cluster-IV having six genotypes, cluster-VI with two genotypes and clusters-V, VII and VIII were solitary.

The formation of distinct solitary clusters might be due to the fact that they had recorded too high and too low cluster mean values (Table 6). The cluster-V recorded highest cluster mean value for corm weight, corm diameter and rachis length. Cluster-VII recorded the highest mean values for sprouting and spike girth. Highest mean values for leaf width, maximum days taken for full spike emergence, high inter-floret length, floret diameter and vase life were recorded by cluster-VIII. Since these traits had contributed highest towards genetic divergence such clusters might have been formed.

In present study genotypes from clusters-V, VII and VIII can be chosen for hybridization programme as cluster-V recorded the high cluster mean values for four important characters followed by cluster-VIII which showed highest cluster mean values for five characters. Most of

these were important flower attributing characters. These clusters can be preferred in selecting the genotypes for the respective traits as they recorded good means.

In breeding programme parents having high flower quality potential with wide genetic diversity are likely to yield superior segregants within short period. In the present study clusters-I and VII recorded highest intra-cluster distance hence crosses might be made between genotypes of cluster-VII with genotype light purple in order to obtain better segregants.

The genetic divergence analysis revealed presence of substantial amount of genetic variability among the genotypes. The pattern of distribution of genotypes into various clusters in random showed that geographical diversity and genetic diversity were not related to each other. The choice of parents is of paramount importance in breeding programmes where crosses are to be assessed. Selection based on extent of genetic divergence has been successfully utilized in different crop species by Nimbalkar et al (2006) and Desh Raj and Misra (2000).

Heterosis is of direct relevance for developing hybrids in both cross and self-pollinated crops. It is increasingly realized that crosses between divergent

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Table 4. Average intra- and inter-cluster D² values of 8 clusters in gladiolus genotypes

Cluster	I	II	III	IV	V	VI	VII	VIII
I	2.72	6.92	6.88	7.18	4.11	6.47	7.97	3.46
II		3.46	5.13	5.22	5.20	6.09	4.81	7.37
III			3.51	6.19	4.79	6.46	4.93	7.44
IV				3.89	5.60	5.44	4.60	7.65
V					0.00	5.36	6.28	4.73
VI						2.48	6.16	6.75
VII							0.00	8.49
VIII								0.00

Diagonal values indicate intra-cluster distance
Above diagonal values indicate inter-cluster distance

Table 5. The nearest and farthest clusters from each cluster based on D² values in gladiolus genotypes

Cluster	Nearest cluster with D ² value	Farthest cluster with D ² value
I	V (4.11)	VI (7.97)
II	VII (4.81)	VIII (7.37)
III	V (4.79)	VIII (7.44)
IV	VII (4.60)	VIII (7.65)
V	I (4.11)	VII (6.28)
VI	IV (5.44)	VIII (6.75)
VII	VI (6.16)	VIII (8.49)
VIII	I (3.46)	VIII (8.49)

Values in parentheses indicate inter-cluster D² values

parent usually produced greater heterotic effect than those between closely related ones (Patil and Apte 2002).

It can be concluded that available diversity present in the existing germplasm

indicated the possibility of selecting the right variety for developing cut flower varieties. Genetic divergence analysis indicated the right cluster combinations as parents for hybridization to develop progenies with long spike length and keeping quality.

Table 6. Mean values of clusters for different quantitative characters in gladiolus genotypes

Character/cluster	I	II	III	IV	V	VI	VII	VIII
Corm Weight (gm)	48.88	50.17	57.11	28.87	77.63	44.35	33.18	29.17
Corm diameter (cm)	5.84	6.08	6.67	6.15	7.03	6.33	6.52	3.71
Cormels per plant	61.45	28.49	52.22	20.09	49.24	31.63	38.21	32.57
Days taken for sprouting	8.83	13.85	12.85	14.24	14.19	14.20	14.33	5.94
Plant height (cm)	70.3	89.91	93.48	110.20	88.53	80.23	108.96	37
Leaves per plant	8.24	9.69	8.68	10.38	8.84	11.23	9.36	7.02
Leaf width (cm)	3.81	4.94	3.77	4.24	4.88	3.48	3.85	5.10
Days taken for spike initiation	61.69	74.42	70.36	70.33	69.36	63.73	69.58	34.74
Days taken for first floret to show colour	71.27	82.16	80.91	81.62	80.65	72.80	78.85	40.40
Days taken for full emergence of spike	83.59	92.71	94.35	93.39	93.65	84.83	87.75	47.07
Spike length (cm)	82.92	79.65	98.73	66.80	89.47	69.64	82.22	44.00
Rachis length (cm)	40.50	47.78	47.00	49.46	49.91	40.16	46.14	25.57
Spike girth (cm)	0.86	0.83	0.87	0.86	0.87	0.83	0.88	0.86
Florets per spike	14.00	10.69	13.20	11.83	12.56	10.81	12.22	12.47
Inter floret length (cm)	6.40	5.60	6.34	5.33	5.60	5.60	6.95	10.65
Floret diameter (cm)	10.41	9.59	12.20	9.37	12.46	10.54	9.58	13.12
Vase life	7.80	8.36	8.60	9.18	9.45	9.36	9.14	12.38

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