



Divergence studies in gladiolus

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ABSTRACT

The present investigation was carried out with twenty eight genotypes of gladiolus (*Gladiolus hybridus* Hort.) which were evaluated to assess the genetic diversity during 2006-07 to 2009-10 for three years in a completely randomized block design with three replications. The mean performance of gladiolus data were highly significant for all the twelve growth, flowering and corms traits studied indicating the presence of variability. The genotypes were grouped into 8 clusters. Among the 8 clusters, cluster-VIII was largest with twelve genotypes, followed by cluster-I having 4 genotypes. The remaining cluster had 2 genotypes each. The maximum intra-cluster distance was exhibited by genotypes of cluster VIII, while the lowest by the genotypes of cluster-II. The inter-cluster distance was highest between the cluster VI and VIII and lowest between cluster I and VI, and II and V. The different clusters have higher mean values for different traits, the genotypes 'Anjali' from cluster-I, 'Dhanvantari' and 'Her Majesty' from cluster VIII, 'American Beauty' from cluster-III and 'Sylvia' from cluster-VI deserve to be considerably to divergence.

Key words: Gladiolus, cluster, divergence and D² analysis.

INTRODUCTION

Gladiolus (*Gladiolus hybridus* Hort.) is one of the most important bulbous ornamental for cut flower, which has both internal and international market. It is also ideal both for garden display, floral arrangements for table and interior decoration as well as making high quality bouquet, Lepcha *et al.* (6). The main emphasis in gladiolus improvement has been on the development of varieties having attractive colour and large number of florets mainly for cut flower, long spikes, more number of well spaced large sized florets, and good corm multiplication ability. Gladiolus is very rich in varietal wealth and every year, there is an addition of new varieties (Rajiv Kumar and Yadav, 5). Multiplication of planting material of gladiolus is most important because the cut flower trade is lagging behind over the recent years, owing to the unavailability of sufficient quality planting material at large scale, Barman *et al.* (2). Moreover, new varieties also come from other countries, and the performance of these varieties depends upon climatic conditions of the region under which they are grown. As a result, cultivars which perform well in one region, may not perform same in other regions of varying climatic conditions, Kamble *et al.* (4). It is also important to study the performance of existing cultivars for their superior desirable

characters, Archana *et al.* (1). Hence, it becomes very much necessary to study the divergence among the genotypes and also to identify the suitable genotypes of gladiolus for hybridization programme on the basis of their clustering pattern.

MATERIALS AND METHODS

Twenty eight diverse types of gladiolus were assessed for their growth, flowering and yield contributing characters. The experiments were carried out at the Research Farm of Floriculture and Landscaping, IARI, New Delhi during 2006-07 to 2009-10. Uniform size of corms (4.0-5.0 cm dia) was planted during September-October in each year. The experiments were laid out in randomized block design with three replications, by keeping the row-to-row distance of 45 cm and the plant-to-plant distance of 15 cm, in a plot size of 4.50 cm x 2.25 m. Uniform package of practices were followed throughout the experiment to grow the crop successfully. The biometrical observations on various growth, flowering and corm production parameters were recorded. The Mahalanobis D² statistic (7) and Rao (10) was used to find out generalized distance between the genotypes. The D² values were used to have clustering which was done following Tocher's method.

RESULTS AND DISCUSSION

The mean performance (3 years) of gladiolus cultivars varied significantly for growth, flowering and corm

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parameters. The data pertaining to vegetative growth is presented in the Table 1. 'Dhanvantari' gave tallest plants (130.21 cm) followed by 'Anjali' which produced (123.88 cm) whereas 'Sylvia' was the smallest (76.11cm). Kumar and Yadav (5) reported that 'Dhanvantari' gave tallest plant (125.00 and 115.83 cm) respectively, which confirms the present findings. Differences in vegetative characters of different cultivars may be due to varied growth rate and their genetic make up. The maximum number of tillers/plant was recorded by cultivar 'American Beauty' (3.44), followed by 'Chandni' (2.77) and 'Her Majesty' (2.55). The perusal of data on flowering appearance revealed that variety 'Vink's Glory' and 'Rose Spire' were the earliest to give first flowering (63.88 and 68.77 day respectively), while 'American Beauty' was last to initiate first flower. In gladiolus, spike length is one of the most important characters and in the present investigation; 'Dhanvantari' and 'Anjali' produced significantly longer spike (93.99 and 93.88 cm respectively) while 'African Star' (55.22 cm) recorded smallest spike. The maximum length of rachis (57.33 and 50.77 cm) was recorded by 'Anjali' and 'Dhanvantari' respectively; whereas minimum (25.77cm) by 'Sylvia'. Number of florets/spike was recorded maximum in

'Anjali' (16.77) followed by 'Dhanvantari' (15.99), whereas it was minimum in 'Vandna' (8.10). 'American Beauty' produces highest number of corms/mother plant (3.33), followed by 'Tiger Flame' (2.99). Cultivars such as 'American Beauty', 'Her Majesty', 'Tiger Flame' and 'Dhanvantari' showed maximum number of corms, cormels and weight of cormels per plant. The diameter of corm was recorded maximum by cultivar 'Her Majesty', 'Hunting Song', 'Dhanvantari' and 'American Beauty' were at par to each other. The weight of single corm was recorded maximum by 'Her Majesty' (158.22 g), followed by 'Gold Dust' (123.22 g) and 'Dhanvantari' (117.66 g). Sharma and Gupta (11) reported that availability of more food material stored in bigger sized mother corms that helped in better plant growth might be associated with the beneficial effect and cormels production depends on the size of corms. The maximum spikes vase life of 6.88 day was recorded by 'Vink's Glory' and followed by 'Anjali', 'Friendship' and 'Her Majesty' (6.77 day each) which were at par with 'Vinks Glory'. Beura and Singh (3), Pal *et al.* (9) also had reported that variety 'Her Majesty' recorded 6.33 and 7.00 day vase life respectively.

Analysis of variance revealed significant differences

Table 1. Mean performance (pooled data of 3 years) for growth, flowering and corms characters of gladiolus genotypes.

Genotype	Plant height (cm)	Tiller per plant	Days to first flowering	Spike length (cm)	Rachis length (cm)	Florets per spike	Corms per plant	Cormels per plant	Cormels wt./plant (g)	Corn weight (g)	Corn diameter (cm)	Normal vase-life (day)
African Star	90.9	1.66	71.7	55.2	42.10	14.88	1.00	16.32	12.43	102.99	4.86	5.77
Anjali	123.8	2.44	88.3	93.8	57.33	16.77	1.55	9.44	7.66	96.32	5.85	6.77
American Beauty	99.2	3.44	90.2	86.6	47.10	14.99	3.33	20.22	24.33	109.44	6.40	6.66
Bis-Bis	92.6	1.66	71.5	72.6	29.33	11.88	1.55	10.66	4.66	76.44	5.37	6.66
Candyman	84.5	2.00	88.4	75.2	41.99	12.44	2.33	15.77	15.33	87.77	5.25	5.11
Chandni	101.2	2.77	68.5	80.2	36.99	13.22	1.99	9.22	16.33	98.32	6.01	5.66
Dhanvantari	130.2	1.88	86.7	93.9	50.77	15.99	1.11	8.99	8.33	117.66	6.63	6.00
Friendship	101.1	1.33	78.2	71.4	41.77	13.33	1.22	10.66	7.65	95.33	6.11	6.77
Gold Beauty	91.4	1.77	71.3	73.4	35.77	13.99	1.00	9.21	4.33	92.88	5.53	6.55
'Gold Dust'	92.4	1.44	71.4	78.9	29.55	13.33	1.55	6.77	5.88	123.22	5.79	5.88
Her Majest'	83.9	2.55	89.6	67.8	41.66	11.55	2.66	20.00	18.00	158.22	6.97	6.77
Hunting Son'	90.7	1.55	69.2	75.1	31.77	14.10	1.00	7.88	3.88	91.77	6.68	6.44
Mayur	85.3	1.33	70.6	63.2	35.22	13.66	1.00	8.88	3.99	88.33	5.35	6.11
Melody	87.8	1.44	72.3	71.8	47.66	15.55	1.00	8.22	3.77	85.99	5.49	6.22
Neelum	95.8	1.55	88.5	76.4	30.88	11.10	1.55	11.22	3.00	81.99	5.26	5.88
Pacifica	78.6	2.00	87.8	56.6	36.99	14.44	2.00	14.77	15.77	95.33	4.59	5.22
Rose spire	82.5	1.44	68.7	61.4	25.88	11.99	1.00	12.11	4.55	94.88	5.76	5.33
Sahezadey	83.9	1.77	74.9	66.6	37.99	14.44	1.00	9.33	5.22	90.88	4.13	5.88
Sancerre	99.7	1.77	69.2	63.5	44.44	15.44	1.33	12.44	8.55	99.33	4.62	6.10
Snowprincess	97.5	2.11	70.8	72.3	30.77	12.55	1.11	9.33	4.33	96.21	5.74	6.44
Suchitra	89.88	2.00	69.44	69.77	33.11	13.77	1.3	8.77	4.77	91.55	5.72	5.44
Sunayana	93.8	1.88	73.33	70.55	40.44	13.88	1.4	9.33	5.44	97.66	6.55	5.22
Suryakiran	90.5	2.10	71.55	64.66	36.22	13.33	1.3	9.77	7.32	90.88	4.85	5.99
Sylvia	76.1	1.00	75.66	55.44	25.77	9.66	1.0	6.22	4.77	82.21	5.25	6.32
TigerFlame	102.9	2.33	83.33	82.88	41.33	11.55	2.9	19.00	19.66	102.55	5.07	6.28
Vandna	82.22	1.33	69.55	63.22	32.66	8.10	1.1	12.10	4.21	78.88	5.20	5.22
'Vink's Glory'	86.22	1.88	63.88	70.66	28.55	11.66	1.0	11.21	4.44	66.00	5.76	6.88
White Butterfly	81.55	1.33	78.44	64.55	34.10	12.88	1.0	8.66	4.99	84.33	4.32	6.10

among the genotypes for all the 12 morphological characters studied, indicating considerable amount of variability in gladiolus genotypes. All the genotypes were grouped into 8 clusters, indicating the variation for different, growth and flowering traits among the various genotypes. The cluster VIII (12) had highest number of genotypes, followed by cluster I (4) and remaining clusters had (2) genotypes each (Table 2). Grouping of genotypes into 8 clusters suggested presence of considerable divergence and variation in material under investigation. It was also observed that genotypes within cluster VIII are almost similar to each other in one and another characters. Nimbak Kar *et al.* (8) formed 18 clusters in 101 genotypes of gladiolus on the basis of 13 characters.

The data on intra- and inter-cluster (Table 3), showed the maximum intra-cluster distance within cluster VIII

Table 2. Clustering pattern of 28 gladiolus genotypes.

Cluster	No. of genotype	Genotypes
I	4	African Star , Anjali, Bis-Bis, Snowprincess
II	2	Gold Beauty , Suchitra
III	2	Sahezadey, White Butterfly
IV	2	Hunting Son, Sunayana
V	2	Her Majest, Vink's Glory
VI	2	Sylvia, Vandna
VII	2	Sancerre, Anjali, American Beauty
VIII	12	Candyman, Chandni, Dhanvantari, Friendship, Gold Dust, Melody, Neelum, Pacifica, Rose spire, Suryakiran, Tiger Flame, Mayur

(33.29), followed by cluster I(24.70), while minimum distance was in cluster II (5.28). Result indicates that genotypes of cluster VIII appeared to be of varied genetic architecture and might have originated from different genetic pool. The inter-cluster distance between the genotypes of cluster VI and VIII was maximum (36.25). The genotypes of cluster I and VI (5.88), and II and V (6.97) exhibited lowest inter-cluster distance indicating the resemblance among the genotypes of this group for all the growth and flowering traits studied.

As far as the cluster means are concerned, different clusters have higher mean values for different traits indicating that few of the cluster contained genotypes with most of the desirable characters. It was observed that the cluster I included the genotypes with highest plant height, more normal vase life and second in production of tillers/plant, spike length, rachis length,

Table 3. Intra and inter-cluster average D² values and D values (in parenthesis).

Cluster	I	II	III	IV	V	VI	VII	VIII
I	610.27 (24.70)	332.19 (18.22)	406.51 (20.16)	361.96 (19.02)	408.09 (20.20)	670.09 (5.88)	310.67 (17.62)	933.90 (30.56)
II		27.95 (5.28)	123.48 (11.11)	64.09 (8.00)	48.60 (6.97)	237.61 (15.41)	169.80 (13.03)	966.89 (31.09)
III			35.48 (5.95)	262.46 (16.20)	138.59 (11.77)	240.73 (15.51)	157.32 (12.54)	1013.94 (31.84)
IV				65.73 (8.10)	113.97 (10.67)	319.67 (17.88)	271.95 (16.49)	947.87 (30.78)
V					70.04 (8.36)	169.36 (13.01)	218.51 (14.78)	1086.34 (32.96)
VI						78.61 (8.86)	471.83 (21.72)	1314.31 (36.25)
VII							91.88 (9.58)	821.90 (28.66)
VIII								1108.35 (33.29)

Table 4. Cluster mean for different growth, flowering and corm traits in gladiolus genotypes.

Genotype	Plant height (cm)	Tiller per plant	Days to first flowering	Spike length (cm)	Rachis length (cm)	Florets per spike	Corms per plant	Cormels per plant	Cormels wt./plant (g)	Corm weight (g)	Corm diameter (cm)	Normal vase-life (day)
I	101.2	1.96	75.6	73.5	39.8	14.0	1.30	11.44	7.27	92.99	5.45	6.41
II	90.6	1.88	70.3	71.6	34.4	13.8	1.61	8.99	4.55	92.21	5.62	5.99
III	82.7	1.55	76.7	65.6	36.0	13.6	1.00	8.99	5.10	87.60	4.23	5.99
IV	92.3	1.66	71.2	72.8	36.1	13.9	1.22	8.60	4.66	94.71	6.61	5.83
V	85.7	1.61	67.2	66.9	31.8	12.6	1.00	10.05	4.21	77.16	5.55	6.49
VI	79.1	1.16	72.6	59.3	29.2	8.8	1.05	9.16	4.49	80.55	5.22	5.33
VII	95.1	1.94	70.3	64.1	40.3	14.3	1.33	11.10	7.93	95.10	4.73	6.05
VIII	94.2	2.01	81.1	75.3	39.3	13.2	1.89	13.69	11.82	104.20	5.78	5.98

florets/spike, cormels /plant and single corm weight (Table 4). In cluster-II, the genotypes possessed medium plant height, second in days to first flowering, corms/plant and 3rd in corm diameter and normal vase life. The genotypes included in cluster-III were dwarfness, late flowering and least corm diameter. Genotypes included in cluster- IV were highest corm diameter and least cormels/plant. In cluster-V, the genotypes were early flowering and less corm/plant, less weight of cormels/plant and less single corm's weight. Likewise, Cluster-VI was marked with short spike and rachis length, less number of florets/spike and short normal vase life. Cluster-VII with longest rachis length and more florets/spike and second in producing plant height, weight of cormels/plant, single corm weight and normal vase life. Cluster-VIII with highest tillers/plant, longest spike length and highest producer of corms/plant, cormels/ plant, weight of corms and cormel weight/plant.

The genotypes 'Anjali' from Cluster-I, 'Dhanvantari' and 'Her Majesty' from cluster-VIII, 'American Beauty' from cluster-III and 'Sylvia' from cluster-VI respectively deserve to be considered as potent parents for further utilization in gladiolus improvement programme. Therefore, based on D² analysis, it has been understood that characters need to be given more weightage, while selecting parents for improvement of gladiolus, Sheikh and Khanday (12).

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