

Morphological variation and evaluation of gladiolus germplasm*

KISHAN SWAROOP¹

Indian Agricultural Research Institute, New Delhi 110 012

Received: 4 August 2009; Accepted: 14 May 2010

Key words: Cluster and D² analysis, Evaluation, Germplasm, Gladiolus

Gladiolus is one of the most important bulbous ornamentals for cut flower trade in India. 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.* 2007). 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, viz 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 (Kumar and Yadav 2005). 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.* 2005). Moreover, new varieties also come from other countries, and the performance of these varieties depend 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.* 2004). It is also important to study the performance of existing cultivars for their superior desirable characters (Archana *et al.* 2008). Hence, it becomes very much necessary to study the morphological variation and evaluation of genotypes and also to identify the suitable germplasm for further improvement programme in Delhi region.

The present experiments were carried out at the Research Farm of Floriculture and Landscaping, Indian Agricultural Research Institute, New Delhi during 2005–08. Uniform size of corms (3.00–4.00 cm diameter) with 28 genotypes were planted during September in each year. The experiments were laid out in randomized block design with 3 replications, at a spacing of 45 cm × 15 cm, in a plot size of 4.50 cm × 2.25 m. Uniform package of practices were followed throughout the experiment to grow a healthy crop.

The biometrical observations on various morphological

parameters of vegetative growth, flowering and corm production were recorded. The Mahalanobis D² statistic (1936) and Rao (1952) 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.

The mean performance (3 years) of gladiolus cultivars varied significantly for growth, flowering and corm parameters. The data pertaining to vegetative growth is presented in the Table 1. 'Dhanvantari' gave tallest plants (130.21 cm), followed by 'Anjali' (123.88 cm), whereas 'Sylvia' was the smallest (76.11 cm). Kumar and Yadav (2005) 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 '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' gave 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 (25.77 cm) 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' gave 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/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'

*Short note

¹Senior Scientist (email: kishan.swaroop@rediffmail.com), Division of Floriculture and Landscaping

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

Genotype	Plant height (cm)	Tillers/plant	Days to first flowering	Spike length (cm)	Rachis length (cm)	Florets/spike	Corms/plant	Cormels/plant	Cormels wt./plant(g)	Corm weight (g)	Corm diameter (cm)	Normal vase life (day)
'African star'	90.99	1.66	71.77	55.22	42.10	14.88	1.00	16.32	12.43	102.99	4.86	5.77
'Anjali'	123.88	2.44	88.32	93.88	57.33	16.77	1.55	9.44	7.66	96.32	5.85	6.77
'American Beauty'	99.21	3.44	90.21	86.66	47.10	14.99	3.33	20.22	24.33	109.44	6.40	6.66
'Bis-Bis'	92.66	1.66	71.55	72.66	29.33	11.88	1.55	10.66	4.66	76.44	5.37	6.66
'Candyman'	84.55	2.00	88.44	75.21	41.99	12.44	2.33	15.77	15.33	87.77	5.25	5.11
'Chandni'	101.22	2.77	68.55	80.22	36.99	13.22	1.99	9.22	16.33	98.32	6.01	5.66
'Dhanvantari'	130.21	1.88	86.77	93.99	50.77	15.99	1.11	8.99	8.33	117.66	6.63	6.00
'Friendship'	101.10	1.33	78.22	71.44	41.77	13.33	1.22	10.66	7.65	95.33	6.11	6.77
'Gold Beauty'	91.44	1.77	71.33	73.44	35.77	13.99	1.00	9.21	4.33	92.88	5.53	6.55
'Gold Dust'	92.44	1.44	71.44	78.99	29.55	13.33	1.55	6.77	5.88	123.22	5.79	5.88
'Her Majesty'	83.99	2.55	89.66	67.88	41.66	11.55	2.66	20.00	18.00	158.22	6.97	6.77
'Hunting Song'	90.77	1.55	69.22	75.10	31.77	14.10	1.00	7.88	3.88	91.77	6.68	6.44
'Mayur'	85.33	1.33	70.66	63.22	35.22	13.66	1.00	8.88	3.99	88.33	5.35	6.11
'Melody'	87.88	1.44	72.33	71.88	47.66	15.55	1.00	8.22	3.77	85.99	5.49	6.22
'Neelum'	95.88	1.55	88.55	76.44	30.88	11.10	1.55	11.22	3.00	81.99	5.26	5.88
'Pacifica'	78.66	2.00	87.88	56.66	36.99	14.44	2.00	14.77	15.77	95.33	4.59	5.22
'Rose spire'	82.55	1.44	68.77	61.44	25.88	11.99	1.00	12.11	4.55	94.88	5.76	5.33
'Sahezadey'	83.99	1.77	74.99	66.66	37.99	14.44	1.00	9.33	5.22	90.88	4.13	5.88
'Sancerre'	99.77	1.77	69.22	63.55	44.44	15.44	1.33	12.44	8.55	99.33	4.62	6.10
'Snowprincess'	97.55	2.11	70.88	72.33	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	1.33	8.77	4.77	91.55	5.72	5.44
'Sunayana'	93.88	1.88	73.33	70.55	40.44	13.88	1.44	9.33	5.44	97.66	6.55	5.22
'Suryakiran'	90.55	2.10	71.55	64.66	36.22	13.33	1.33	9.77	7.32	90.88	4.85	5.99
'Sylvia'	76.11	1.00	75.66	55.44	25.77	9.66	1.00	6.22	4.77	82.21	5.25	6.32
'TigerFlame'	102.99	2.33	83.33	82.88	41.33	11.55	2.99	19.00	19.66	102.55	5.07	6.28
'Vandna'	82.22	1.33	69.55	63.22	32.66	8.10	1.11	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	1.00	11.21	4.44	66.00	5.76	6.88
'White Butterfly'	81.55	1.33	78.44	64.55	34.10	12.88	1.00	8.66	4.99	84.33	4.32	6.10

(123.22 g) and 'Dhanvantari'(117.66 g). Sharma and Gupta (2003) 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', followed by 'Anjali', Friendship' and 'Her Majesty' (6.77 day each) which were at par with 'Vinks Glory'. Beura and Singh (2003), Pal *et al.*(2003) also had reported that variety 'Her Majesty' recorded 6.33 and 7.00 day vase life, respectively.

Analysis of variance revealed significant differences 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 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. Nimbal Kar *et al.* (2006) formed 18 clusters in 101 genotypes of gladiolus on the basis of 13 characters.

Looking into the data on intra and inter-cluster (Table 3), the maximum intra cluster distance was observed within cluster VIII (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

Table 2 Clustering pattern of 28 genotypes of gladiolus

Cluster	No. of genotypes	Genotypes
I	4	1, 2, 4, 20
II	2	9, 21
III	2	18, 28
IV	2	12, 22
V	2	13, 27
VI	2	24, 26
VII	2	19, 23
VIII	12	3, 5, 6, 7, 8, 10, 11, 14, 15, 16, 17, 25

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

	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 of gladiolus genotypes

	Plant height (cm)	Tillers/ plant	Days to first flowering	Spike length (cm)	Rachis length (cm)	Florets/ spike	Corms/ plant	Cormels/ plant	Cormels wt./ plant (g)	Corm weight (g)	Corm diameter (cm)	Normal vase life (day)
I	101.27	1.96	75.63	73.52	39.88	14.02	1.30	11.44	7.27	92.99	5.45	6.41
II	90.66	1.88	70.38	71.60	34.44	13.88	1.61	8.99	4.55	92.21	5.62	5.99
III	82.77	1.55	76.72	65.60	36.05	13.66	1.00	8.99	5.10	87.60	4.23	5.99
IV	92.32	1.66	71.27	72.83	36.10	13.99	1.22	8.60	4.66	94.71	6.61	5.83
V	85.77	1.61	67.27	66.99	31.88	12.66	1.00	10.05	4.21	77.16	5.55	6.49
VI	79.16	1.16	72.60	59.33	29.22	8.88	1.05	9.16	4.49	80.55	5.22	5.33
VII	95.16	1.94	70.38	64.10	40.33	14.38	1.33	11.10	7.93	95.10	4.73	6.05
VIII	94.22	2.01	81.18	75.31	39.38	13.29	1.89	13.69	11.82	104.20	5.78	5.98

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, 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 cormels weight/plant.

Keeping in view the above aspects, 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 (Sheikh and Khanday 2008).

SUMMARY

Twenty eight genotypes of gladiolus were planted for morphological variation and evaluation during 2005–08 in a completely randomized block design with 3 replications. The mean performance (3 years) 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 12 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 intercluster 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 considered as potent parents for further improvement programme.

ACKNOWLEDGEMENT

The author is very much thankful to Dr L K Bharathi, Scientist (Senior Scale), Regional Station, IIHR, Bhubaneswar for his kind help in analysis of data.

REFERENCES

- Archana B, Patil A A, Hunje Ravi and Patil V S. 2007. Studies on genetic variability analysis in gladiolus hybrids. *Journal of Ornamental Horticulture* **11** (2): 121–6.
- Barman D, Rajni K, Rampal and Upadhyaya R C. 2005. Corm multiplication of gladiolus as influenced by application of potassium and spike removal. *Journal of Ornamental Horticulture* **8** (2): 104–7.
- Beura, Sashikala and Singh Ranvir. 2003. Effect of strong temperature and wrapping material on post harvest life of gladiolus cultivar Her Majesty. *Journal of Ornamental Horticulture* **6** (4): 322–7.
- Kamble B S, Reddy B S, Patil R T and Kulkarni B S. 2004. Performance of gladiolus (*Gladiolus hybridus* Hort.) cultivars for flowering and flower quality. *Journal of Ornamental Horticulture* **7** (3-4): 51–6
- Kumar R, and Yadav D S. 2005. Evaluation of gladiolus cultivars under sub-tropical hills of Meghalaya. *Journal of Ornamental Horticulture* **8** (2): 86–90.
- Lepcha B, Nautiyal M C and Rao V K. 2007. Variability studies in gladiolus under mid hill conditions of Uttarakhand. *Journal of Ornamental Horticulture* **10**(3): 169–72.
- Mahanobis P C. 1936. On generalized distance in statistics. *Proceedings of National Institute of Science* **11** (1): 49–55.
- Nimbal Kar C A, Katawate S M, Singh B R, Bajaj V.H. and Warade S D. 2006. Genetic divergence in gladiolus. *Journal of Ornamental Horticulture* **9** (3): 179–83.
- Pal Anju, Kumar S, and Srivastava Ranjan. 2003. Effect of floral preservatives on post harvest management in gladiolus spikes. *Journal of Ornamental Horticulture* **6** (4): 367–71.
- Rao C R. 1952. *Advance Statistical Methods in Biometric Research*. John Willey and Sons, New York. United States of America.
- Sharma T R and Gupta R B. 2003. Effect of corm size and spacing on group, flowering and corm production in gladiolus. *Journal of Ornamental Horticulture* **6** (4): 352–6.
- Sheikh M Q and Khanday B A. 2008. Genetic diversity in gladiolus (*Gladiolus hybrida* L.) under two environments. *Journal of Ornamental Horticulture* **11**(3): 216–9.