

Varietal assessment and variability studies on gladiolus under south Gujarat conditions

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ABSTRACT

The present investigation was carried out to evaluate the performance of 16 gladiolus (*Gladiolus hortulanus*) varieties under south Gujarat agro-climatic conditions. Significant differences were observed for all the growth, flowering and yield characters during experimentation. The three years pooled data revealed that maximum plant height (73.04 cm) was recorded in variety Her Majesty. Variety Sancerre recorded maximum leaf area (104.79 cm²) and was found superior with respect to qualitative parameters like floret size (10.47 cm), florets per spike (14.29), rachis length (43.78 cm), spike length (76.86 cm), duration of spike (17.80 days), vase-life (10.31 days) and weight of corms (48.74 g). Early flower spike initiation (52.82 days) and first floret opening (65.36 days) was noted in variety Green Star. Variety *Psittacinus* Hybrid recorded the maximum number of leaves (9.09) and spikes per plant (2.64). Corm size (7.56 cm) and corms per plant (2.53) was obtained maximum in variety Candyman and Priscilla, respectively. Whereas, maximum weight of corms per plant (11.10 g) was noted in variety Gunjan. The molecular investigation through RAPD markers revealed the highest genetic similarity (0.824) between the accessions Punjab Dawn and Wine & Roses, whereas, the lowest genetic similarity (0.172) was registered between the accessions Eurovision and Her Majesty.

Key words: Gladiolus, genetic variability, performance.

INTRODUCTION

Gladiolus (*Gladiolus hortulanus* Hort.) is an important bulbous flower crop, commercially cultivated for its beautiful spikes used as a cut flower grown throughout the world and belongs to family Iridaceae. Large scale production of gladiolus cut flowers is seen in USA, Holland, Italy, France, Poland, Bulgaria, Brazil, Australia and Israel. It stands fourth in the international cut flower trade after carnation, rose and chrysanthemum. The selection of variety is very important for success in growing of gladiolus for commercial cut flower. There are many cultivars with wide range of colours in different parts of the world; many varieties have been developed and critically evaluated for different climatic conditions based on flower quality and quantity. Normally, performance of variety depends upon genetic constitution, whereas, expressions of traits depend upon climatic conditions of the region.

Besides varietal evaluation, variability studies helps in crop improvement programme. Therefore, this experiment was designed to identify suitable high yielding gladiolus varieties for the farmers of south Gujarat to get higher profit and to study molecular variations through RAPD marker among different gladiolus varieties.

MATERIALS AND METHODS

An experiment was carried out to evaluate 16 gladiolus varieties at Floriculture Research Farm, Department of Floriculture and Landscape Architecture, ASPEE College of Horticulture and Forestry, Navsari Agricultural University 2008-09, 2009-10 and 2010-11 in a randomized block design (RBD) with three replications. Geographical location of Navsari falls between latitude of 20°95' north and the longitude of 75°-95' east at an altitude of about 10 m above m.s.l. The climate of the experimental site is characterized by fairly hot summer, moderately cold winter and warm monsoon with heavy rainfall. Temperature range varying from 29.6 to 39.8°C during summer season and in winter it goes down to 10 to 23.8°C. The gladiolus corms were treated with 0.1% carbendanzim (50 WP) and planted at about 6 cm depth with 30 cm × 30 cm spacing in last week of September. Data on growth, flowering and yield parameters were recorded and all the mean values of three years pooled data were analyzed statistically, whereas, molecular variations through RAPD molecular analysis of different gladiolus varieties was done only once. The genomic DNA was amplified using random primers of OPK, OPM, OPE and OPG series (Operon Tech., California, USA). The cluster analysis of varieties was carried out on similarity coefficients using the unweighed pair group

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method arithmetic average (UPGMA) using NTSYS-PC, version 1.80.

RESULTS AND DISCUSSION

The mean performance of three year pooled data of vegetative growth and flowering pattern of the gladiolus varieties have been presented in Table 1, where all the varieties showed significant differences. It was observed that significantly highest plant height (73.04 cm) was recorded by Her Majesty, which was at par with Sancerre (72.98 cm) and Shagun (72.65 cm). Significantly maximum number of leaves (9.09) was recorded in *Psittacinus* Hybrid, while leaf area of third leaf was significantly maximum (104.79 cm²) in Sancerre, which was statistically at par with Wine & Roses (97.55 cm²) and Spic & Span (96.40 cm²). Differences in vegetative characters of different varieties may be due to varied growth rate and their genetic capability. Similar results for vegetative characters in gladiolus were also observed and reported by Kamble *et al.* (5), Pratap and Rao (10) and Lepcha *et al.* (9). Swaroop *et al.* (13) also reported similar results in gladiolus cvs Sancerre and Her Majesty.

The earliness in flower spike initiation was observed in variety Green Star (52.82 days), which

was statistically at par with Punjab Dawn (53.24 days), Her Majesty (53.31 days), Sancerre (53.44 days) and Candyman (57.64 days). It was also noted that significantly minimum days were taken for first floret opening (63.76 days) in variety Her Majesty, which was statistically at par with Punjab Dawn, Green Star, Sancerre and Candyman. However, maximum duration for first floret opening (92.07 days) was recorded in Eurovision (Table 1). These results are in accordance with those of Kamble (5), Pratap and Rao (10) and Kumar *et al.* (6) in gladiolus.

It is evident from the data presented in Table 2 that the size of 3rd floret was significantly higher in variety Sancerre (10.47 cm) and the lowest floret diameter (6.53 cm) was recorded in Eurovision. The result is in agreement in the earlier studies conducted by Kamble *et al.* (5), and Pratap and Rao (10) in gladiolus cvs Sancerre and Her Majesty and Lepcha *et al.* (9) with respect to various gladiolus cultivars. The number of florets per spike was found significantly higher in variety Sancerre and T-512 being 14.29, which was statistically at par with Punjab Dawn and Spic & Span. The rachis length was found significantly maximum (43.78 cm) in Sancerre, which was statistically at par with Punjab Dawn (43.69 cm) and Candyman (41.81 cm) in pooled data. However,

Table 1. Various growth and flowering parameters as influenced by different varieties of gladiolus (3 year pooled data).

Variety	Plant height (cm)	Leaves per plant	Leaf area (cm ²)	Days to spike initiation	Days to first floret opening	Size of 3 rd floret (cm)	Florets per spike	Rachis length (cm)	Spike length (cm)	Spike duration (days)	Vase-life (days)
Green Star	63.59	6.56	89.90	52.82	65.36	7.68	8.13	33.20	61.15	10.82	7.84
Shagun	72.65	5.71	67.48	64.51	76.29	7.20	10.56	31.27	66.69	10.98	8.02
<i>Psittacinus</i> Hybrid	56.97	9.09	44.04	74.44	83.27	6.67	10.57	36.64	62.87	12.27	6.42
American Beauty	55.91	7.20	41.99	65.51	75.44	8.43	10.02	28.97	53.95	12.71	8.73
Fidelio	65.56	6.73	78.94	65.47	76.33	7.71	10.11	36.66	66.25	12.67	9.11
Eurovision	62.77	5.61	65.43	82.20	92.07	6.43	8.91	34.97	56.81	13.09	8.49
Candyman	57.58	5.91	75.88	57.64	68.87	9.75	12.67	41.81	72.33	15.84	9.60
T512	64.25	6.24	72.99	74.44	88.07	8.33	14.29	39.52	63.88	14.47	9.56
Spice & Span	57.91	5.84	96.40	66.51	82.64	7.52	13.87	41.56	66.93	11.02	8.91
Peter Pears	54.62	6.40	76.20	66.64	80.69	7.02	11.71	32.79	64.26	12.89	9.04
Priscilla	55.94	6.33	59.30	63.27	75.91	8.48	10.49	32.87	58.45	13.62	8.73
Her Majesty	73.04	6.49	66.51	53.31	63.76	8.69	11.50	34.62	69.14	11.53	8.87
Punjab Dawn	60.86	6.60	70.22	53.24	64.29	8.64	14.21	43.69	70.60	15.88	9.64
Wine & Roses	59.59	6.73	97.55	64.00	74.27	7.73	9.11	30.98	55.28	9.91	8.69
Gunjan	64.59	6.42	62.11	62.73	74.64	8.23	11.53	32.32	64.58	15.02	8.71
Sancerre	72.98	6.62	104.79	53.44	66.69	10.47	14.29	43.78	76.86	17.80	10.31
CD at 5%	4.80	0.48	5.81	3.87	5.73	0.64	1.29	3.76	5.20	1.31	0.84
CV (%)	8.16	7.82	8.43	6.42	8.04	8.46	12.03	11.08	8.58	10.53	10.17

Table 2. Spike yield, various corms and cormels characters as influenced by different gladiolus varieties (3 years pooled data).

Variety	Spikes per plant	Size of corms (cm)	Corms per plant (g)	Corms per plant (No.)	Cormels per plant (No.)	Weight of cormel per plant (g)
Green Star	1.60	5.61	35.02	1.64	37.84	5.64
Shagun	1.71	6.77	43.97	2.49	27.66	4.09
<i>Psittacinus</i> Hybrid	2.64	4.86	32.55	1.98	30.94	10.81
American Beauty	2.06	5.83	30.60	1.96	20.66	6.22
Fidelio	1.78	5.45	42.82	1.60	23.92	4.26
Eurovision	1.53	4.59	26.84	1.44	23.09	6.71
Candyman	1.48	7.56	47.69	2.00	34.47	5.70
T512	1.22	6.25	43.44	1.69	51.41	4.52
Spice & Span	1.56	5.33	42.04	1.83	22.00	5.48
Peter Pears	1.47	5.30	36.19	1.78	24.61	6.77
Priscilla	1.60	5.99	42.55	2.53	24.83	7.44
Her Majesty	1.99	5.36	40.69	1.58	49.22	3.46
Punjab Dawn	1.69	7.42	32.92	2.42	46.08	10.07
Wine & Roses	1.62	5.91	24.21	2.16	31.70	5.29
Gunjan	1.44	5.18	32.36	2.38	62.74	11.10
Sancerre	2.00	7.32	48.74	2.13	67.69	5.66
CD at 5%	0.23	0.51	3.48	0.23	3.40	0.79
CV (%)	14.04	9.07	9.79	12.30	9.97	10.91

minimum rachis length (28.97 cm) was observed in American Beauty. Likewise, higher spike length (76.86 cm) was observed in Sancerre, which was statistically at par with Candyman (72.33 cm), while minimum (53.95 cm) in American Beauty. The results conforms the reports of Kamble *et al.* (5), Pratap and Rao (10) and Lepcha *et al.* (9) in gladiolus. The pooled data indicated that maximum spike duration *in situ* (17.80 days) was found in variety Sancerre and minimum (9.91 days) in Wine & Roses. It was also observed that Sancerre recorded significantly maximum vase-life (10.31 days), which was statistically at par with Punjab Dawn, Candyman and T-512 (9.64, 9.60 and 9.56 days, respectively). While, minimum vase-life of spike (6.42 days) was noted in *Psittacinus* Hybrid. The long lasting spike durability of variety may be due to

possession of more number of florets per spike. These results conform the reports of Lepcha *et al.* (9) and Lata and Basantia (7) in gladiolus. Variations in vase-life may be attributed to the differential accumulation of carbohydrates due to varied leaf production and sensitivity of cultivars to ethylene. Variations in these aspects might also be due to genetical make up of plants. Present finding is also corroborated with the results obtained by Kumar *et al.* (6), Arya and Kumar (1), and Sankari *et al.* (12).

It is evident from the three years pooled data (Table 3) that variety *Psittacinus* Hybrid recorded significantly maximum number of spikes per plant (2.64). On the other hand, variety T-512 produced less number of spikes per plant (1.22). Variations for spike yield among the cultivars were mainly

Table 3. Details of amplification obtained with different RAPD primers in sixteen gladiolus varieties.

Primer	Sequence (5'—3')	No. of total band(s)	No. of monomorphic bands	No. of polymorphic bands	Polymorphism (%)	Total No. of bands amplified
OP-X 01	CTGGGCACGA	10	1	9	90.00	101
OP-X 02	TTCCGCCACC	12	1	11	91.66	88
OP-X 04	CCGCTACCGA	10	2	8	80.00	84
Total		32	4	28	87.22	273

attributed to the variations in the number of shoots produced per plant, which is a genetically controlled character. Superiority of some genotypes over the other genotypes for spike yield was also reported by Kamble *et al.* (5) in *gladiolus*. The largest corm (7.56 cm) was obtained in variety Candyman which was statistically at par with Punjab Dawn (7.42 cm) and Sancerre (7.32 cm), whereas the lowest corm size was found in Eurovision (4.59 cm) in pooled analysis. The data indicated that the weight of corms per plant (48.74 g) was significantly maximum in Sancerre, which was statistically at par with Candyman (47.69 g). On the other hand, the minimum weight of corms per plant (24.21 g) was observed in Wine & Roses. The data indicated that the significantly maximum number of corms per plant (2.53) was recorded higher in variety Priscilla, which was statistically at par with varieties Shagun, Punjab Dawn and Gunjan (Table 3). Production of daughter corms per plant, weight and size may be attributed to the good vegetative growth of plants at initial stages which provides good amount of photosynthates for storage in corms. The results are in accordance with Basavaraddy (2), Rashmi (11) and Swaroop *et al.* (13) in *gladiolus* with respect to Sancerre and Her Majesty.

It is evident from the pooled data that significantly maximum number of cormel per plant (67.69) was

recorded in variety Sancerre, while the minimum in American Beauty (20.66 cormels/plant). The weight of cormels per plant was found significantly highest in Gunjan (11.10 g/plant), which was statistically at par with *Psittacinus* Hybrid (10.81 g/plant). The findings are in accordance with Jhon *et al.* (4) and Rashmi (11). Production of number of cormels per plant may be attributed to the genetic makeup of a cultivar and to some extent agro-climatic conditions.

The data (Table 4) revealed that three decamer primers produced a total of 32 scorable bands in the 16 *gladiolus* varieties, out of which, 4 were monomorphic and 28 were polymorphic. The percentage of polymorphism ranged from a maximum 91.66 by OP-X 02 to a minimum of 80.00% by OP-X 04. The dendrogram (Fig. 1) generated from RAPD amplification data using UPGMA method clearly indicated two distinct main clusters I and II. Cluster-I included 15 varieties and cluster-II showed one variety. According to dendrogram (Fig. 1) and similarity matrix (Table 5), at a similarity level of 33.00%, the accessions were divided in 2 clusters. Variety Her Majesty was found in second cluster, having minimum similarity (0.172) with other varieties, while rest of 15 varieties in first cluster. Moreover, first cluster was again divided into two sub-clusters. Among this, the first sub-cluster consisted of six varieties and

Table 4. Jaccard's similarity coefficient between 16 *gladiolus* varieties based on the RAPD data.

Variety	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
A	1.000															
B	0.522	1.000														
C	0.391	0.650	1.000													
D	0.565	0.762	0.545	1.000												
E	0.520	0.773	0.714	1.739	1.000											
F	0.650	0.478	0.476	0.458	0.542	1.000										
G	0.542	0.520	0.667	0.560	0.640	0.440	1.000									
H	0.591	0.500	0.571	0.609	0.560	0.417	0.652	1.000								
I	0.478	0.667	0.600	0.636	0.583	0.435	0.542	0.750	1.000							
J	0.400	0.500	0.571	0.423	0.500	0.478	0.583	0.500	0.591	1.000						
K	0.409	0.391	0.526	0.375	0.522	0.579	0.478	0.455	0.476	0.524	1.000					
L	0.650	0.417	0.409	0.458	0.480	0.524	0.565	0.545	0.500	0.545	0.500	1.000				
M	0.684	0.435	0.429	0.478	0.440	0.550	0.522	0.650	0.600	0.500	0.526	0.824	1.000			
N	0.333	0.269	0.250	0.172	0.286	0.401	0.296	0.269	0.280	0.435	0.318	0.409	0.364	1.000		
O	0.478	0.346	0.391	0.385	0.462	0.500	0.480	0.591	0.478	0.522	0.550	0.650	0.600	0.524	1.000	
P	0.417	0.591	0.600	0.500	0.652	0.320	0.682	0.591	0.545	0.522	0.476	0.571	0.455	0.280	0.478	1.000

A – Green Star B – Shagun C – *Psittacinus* Hybrid D – American Beauty E – Fidelio
 F – Eurovision G – Candyman H – T512 I – Spice & Span J – Peter Pears
 K – Priscilla L – Her Majesty M – Punjab Dawn N – Wine & Roses O – Gunjan
 P – Sancerre

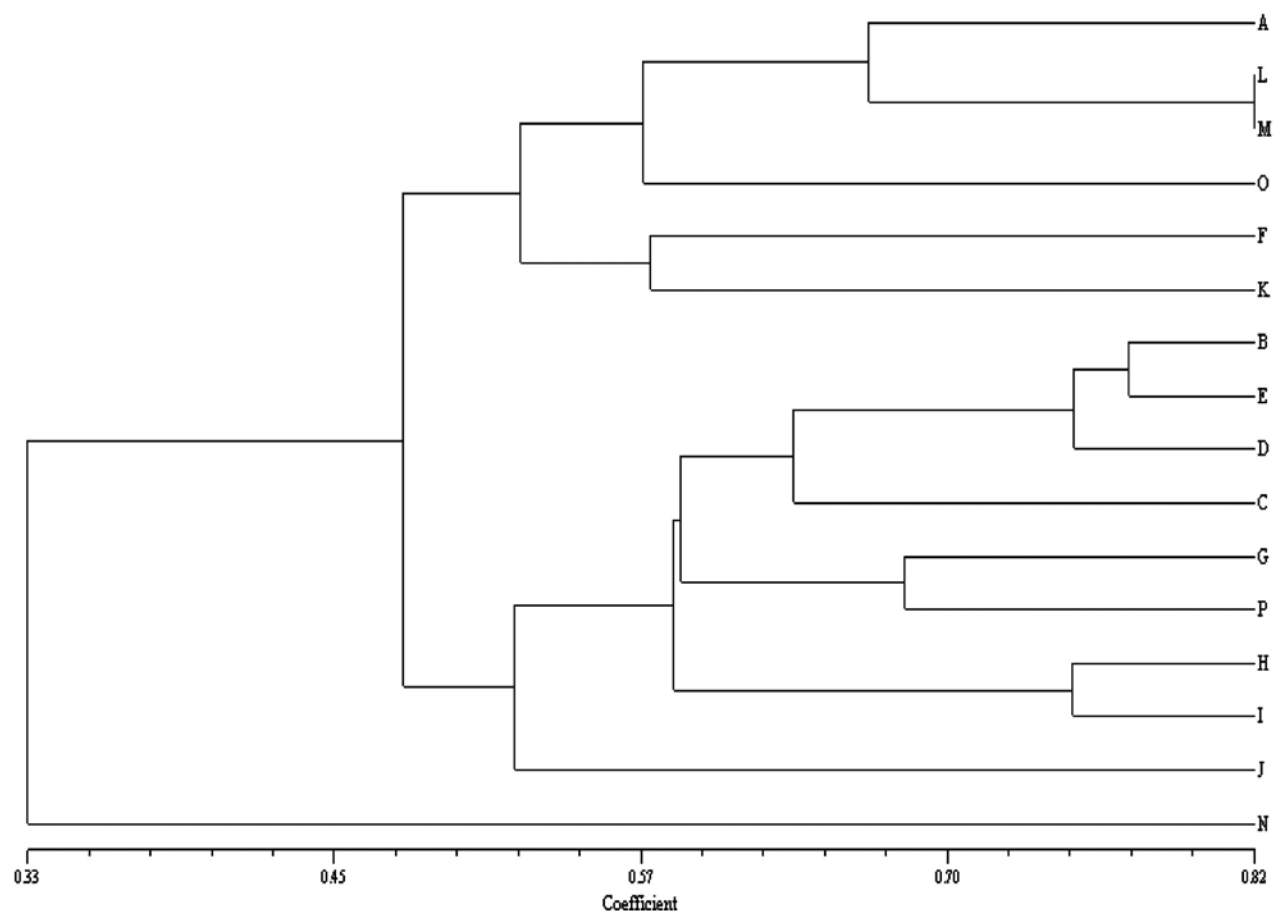


Fig. 1. Dendrogram depicting the genetic relationship among 16 gladiolus varieties based on RAPD data.

second of nine varieties. The first sub-cluster further divides into two sub-sub-clusters, first consisting of four varieties and second only two, viz. Punjab Dawn and Wine & Roses had maximum similarity, i.e. 0.824. The second sub-cluster supplementary divide into two sub-sub-cluster first consisting 8 varieties and second consisting Sancerre variety, which had minimum similarity with remain 8 varieties of same group. In this sub-sub-cluster, Gunjan and Spic & Span varieties had maximum similarity 0.773 and minimum similarity was noted in Gunjan and American Beauty (0.478). It is evident from Table 5 that the lowest genetic similarity coefficient 0.33 between clusters I & II. Lowest genetic similarity (0.172) was observed between the accessions Eurovision and Her Majesty. However, the highest genetic similarity (0.824) was recorded between the accessions Punjab Dawn and Wine & Roses. Several workers have used RAPD markers to detect genetic variation, viz., Benedetii *et al.* (3) in 5 putative interspecific hybrids of *Alstroemeria* and Lee *et al.* (8) in 55 inter-specific hybrids between *Dianthus giganteus* and *D. carthusianorum* and their

parents. Based on the results obtained, it can be concluded that the variety Sancerre is most preferable for qualitative cut spike production of gladiolus in south Gujarat conditions. However, varieties Punjab Dawn, Candyman, Her Majesty, Spic & Span and Priscilla are also adaptable for quality flower production.

ACKNOWLEDGEMENT

The authors acknowledge the faculty of the Department of Floriculture & Landscape Architecture for the facility and support.

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Received : September, 2014; Revised : May, 2015;
Accepted : July, 2015