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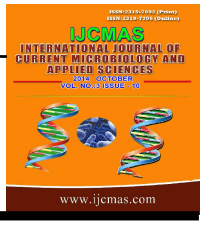

Original Research Article

Studies on reproductive parts of flower and palynology of Gladiolus (Gladiolus L.) varieties

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A B S T R A C T

Keywords

Gladiolus, Pollen, Androecium, Gynoecium, Morphology

Gladiolus (*Gladiolus* L.) belong to the family Iridaceae and is an important crop for cut-flower trade in India. A large number of varieties are grown commercially. There is great variation in reproductive structures of the flower among the varieties. The variability exists with respect to quantitative characters (length of androecium, filament, anther, style, stigma lobe, angle of filament to anther, pollen size) and qualitative characters (pollen shape, anther colour, androecium and gynoecium colour). These variations were recorded by studying morphological characters among the 35 varieties of *Gladiolus*. All varieties showed significant difference and concluded as genetically controlled. The observations on various parameters helped to characterize all the varieties for proper identification in a scientific way.

Introduction

Gladiolus (*Gladiolus* L.) is an important floral crop grown in India commercially for the production of cut-flowers. In India about hundreds of varieties are available. There is wide variation in flower colour as well as other floral structures among the varieties. Palynology refers the studies on morphological structure of pollen grains (Kallajxhiu, 2014). In higher plants pollen have a unique morphology which is considered as a genetically stable character. Therefore studies on pollen grains are helpful in the identification of varieties. Pollen structure especially aperture and exine ornamentation is an important character for assessing the relationship, taxonomic and cytological status of varieties (Domez & Isik, 2008; Hanif, 2013).

It was observed that there is morphological diversity and variability in pollen grains besides variability in androecium and gynoecium both in size and colour. Therefore, it was decided to undertake studies on palynology and diversity of reproductive parts of gladiolus.

Materials and Methods

In present experiment corms (4-5 cm) of thirty five leading varieties was planted 30 x 20 cm apart accommodating 25 corms in one bed (1.5 x 1.0 m). The experiment was conducted in the Botanic Garden, CSIR-N.B.R.I, during 2011-12 and 2012-13 in randomized block design with three replications. The standard package and

practices were followed. Three healthy plants were randomly selected from the bed and the basal floret of the spike at full bloom stage was collected for the study. The flower was dissected and floral parts were separated out. The mean values for the following observations on eight parameters *viz.*, length of androceium, filaments, anther, style, stigma lobe, angle of filament to anther and pollen size were recorded along with qualitative characters *viz.,* pollen shape, anther colour, androceium and gynoceium colour. The colour was matched with Royal Horticulture Society (RHS) colour charts. The shape and size of pollen was seen under the compound microscope with power 20X and 40X by following standard method and measurement was recorded with the help of micrometer scale.

Fresh flowers specimens were kept in diluted acetic acid in Petri plates for about 10-15 minute. Then anthers were removed from the flowers by using dissecting microscope and placed on a clean glass slide. With the help of dissecting needle, the pollen grains were crushed in 45% acetic acid to release pollen grains on the slide. Anther wall material was removed with needle, while excess of acetic acid was removed with tissue paper. Pollen was stained with safranin. Then cover slip was placed on it. Three to five slides of each species were prepared. The prepared slides were studied under the microscope. Microphotographs were taken by using CCD digital camera. (Niamat et al., 2012) The data was subjected to statistical analysis.

Results and Discussion

The data presented in table 1 and 2 showed the considerable morphological diversity and significant differences observed for all the characters studied in different varieties of Gladiolus (Sheikh & Jhon, 2005). The analysis of variance (Table 1) for the above characters showed that the variability due to treatments was significant for all the characters. The significant values indicate the presence of substantial genetic variability among genotypes.

For the mean performance (Table 2), it was observed that the length of androceium was significantly maximum in Urvashi (7.77 cm) followed by Picardy (5.70 cm), Tropic Sea (5.70 cm) and Zeus (5.53 cm). While the length of filament was significantly maximum in Praha (5.86 cm) and minimum in Picardy (4.30 cm). Record of length of anther was varied from 1.63 cm to 0.833 cm with a mean value of 1.272 cm. The variety Amethyst had maximum length followed by My Love (1.50 cm), Friendship Pink (1.47 cm) and Roshni (1.47 cm) while minimum length was recorded in Classic Pink. The similar findings were observed by Roy (2003). The angle of filament to anther was significantly varied from 11.33^0 to 32.67^0 with the mean value 23.16^0. Minimum angle was found in Neelima and maximum in Thamboliana. Similar findings were observed by Roy (2003) and Farhat & Roy (2005) in gladiolus.

Length of style was significantly shorter in Hallmark (5.90 cm) while longer in Grock (8.77 cm). The length of stigma lobe was significantly showed variation from 1.27cm to 0.567 cm. It was found that the variety Summer Sunshine had long stigma lobe length (1.27cm) and Green Woodpecker had shorter length (0.567 cm).

The pollen size measurements showed that the length and width was significantly more in Roshni (47.33 µm) and Video (24.33 µm) and smallest in Black Beauty (length -19.57; width - 9.93 µm) respectively. The variations of colour of different floral parts were recorded.

Table.1 ANOVA for eight quantitative characters of *Gladiolus* genotypes

S.No.	Source of variation		Mean sum of Squares		
			Replicates	Treatment	Error
	Characters	df	2	34	68
1.	Androecium Length		0.22	0.85*	0.15
2.	Filament Length		0.10	0.50*	0.10
3.	Anther Length		0.00	0.09*	0.03
4.	Style Length		0.11	1.58*	0.27
5.	Stigma Lobe Length		0.01	0.09*	0.06
6.	Angle		10.07	120.87*	37.77
7.	Pollen Length		1.83	55.65*	7.68
8.	Pollen Width		1.69	19.38*	2.94

*** Significant at 5% level, respectively.**

Table.2 Mean performance of 35 varieties of *Gladiolus* for eight quantitative characters

Characters →		Androecium Length (cm)	Filament Length (cm)	Anther Length (cm)	Style Length (cm)	Stigma Lobe Length (cm)
S.no.	Genotype					
1	Classic Pink	6.700	5.500	**0.833**	7.433	0.767
2	White Prosperity	6.200	5.067	1.267	7.100	0.733
3	Grock	6.967	5.667	1.233	**8.767**	1.133
4	Her Majesty	6.133	4.733	1.200	7.333	0.733
5	Eurovision	6.200	5.533	1.200	7.233	1.000
6	Topaz	6.100	4.333	1.400	6.300	0.633
7	Rashmi	5.900	4.867	1.233	7.700	0.967
8	Thamboliana	6.567	5.033	1.167	7.967	0.833
9	Tropic Sea	5.700	4.667	1.100	6.867	0.867
10	Parade	6.133	5.367	1.367	8.700	1.133
11	Roshni	6.200	5.400	1.467	7.300	0.867
12	Snow Princess	6.333	5.233	1.333	8.067	0.767
13	Inter-Pearl	6.033	4.867	1.200	7.333	1.067
14	Friendship Pink	6.733	5.333	1.467	7.500	1.100
15	Green Woodpecker	6.333	5.333	1.100	7.967	**0.567**
16	Urvashi	**7.767**	5.433	1.333	7.367	0.833
17	Zeus	5.533	4.833	1.400	6.633	1.100
18	Priscilla	6.300	5.333	0.967	8.267	0.933
19	Neelima	6.000	4.800	1.400	8.067	1.100
20	My Love	7.600	5.733	1.500	7.667	1.067
21	Amethyst	6.700	5.100	**1.633**	8.633	1.233
22	Aldebaran	6.333	5.100	1.267	7.933	1.067
23	Black Beauty	6.367	5.033	1.433	7.033	0.833
24	Video	5.767	4.767	1.000	7.133	1.167
25	Yellow Stone	6.500	5.033	1.467	8.633	1.100
26	Praha	7.300	**5.867**	1.400	**8.767**	0.900
27	Pacifica	6.367	5.800	1.000	7.200	0.900
28	Regency	6.600	4.900	1.467	7.267	1.067
29	Picardy	5.700	**4.300**	1.100	6.533	0.733
30	Nicole	6.967	5.667	1.233	8.233	0.867
31	Peter Pears	6.367	5.467	1.267	8.300	0.700
32	Summer Sunshine	6.567	5.467	1.233	8.367	**1.267**
33	Arka Kesar	6.633	5.367	1.467	7.200	0.867
34	Tiger Flame	6.033	5.200	1.267	8.033	0.967
35	Hall Mark	**5.300**	4.367	1.133	**5.900**	1.133
Mean		**6.370**	**5.157**	**1.272**	**7.621**	**0.943**
C.V. %		6.119	6.060	14.278	6.853	24.947
C.D. (5%)		0.635	0.509	0.296	0.851	0.383

Contd……..

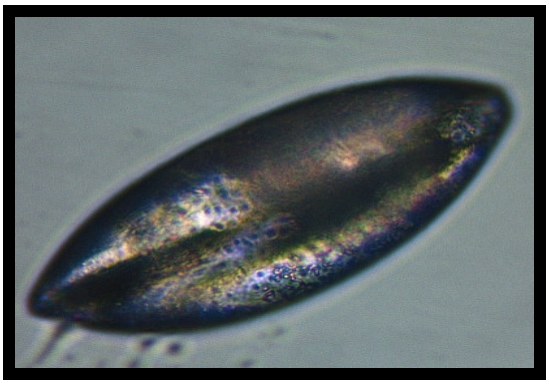
Characters →		Angle (degree)	Pollen length (µm)	Pollen Width (µm)
S.no.	Genotype			
1	Classic Pink	31.67	34.60	17.83
2	White Prosperity	17.67	37.10	18.77
3	Grock	28.33	34.23	19.73
4	Her Majesty	26.67	39.10	23.73
5	Eurovision	11.67	37.87	19.50
6	Topaz	30.00	34.50	21.43
7	Rashmi	30.67	36.30	21.23
8	Thamboliana	**32.67**	31.67	19.27
9	Tropic Sea	19.33	40.97	16.80
10	Parade	15.00	34.20	18.50
11	Roshni	26.67	**47.30**	23.73
12	Snow Princess	17.33	32.63	18.37
13	Inter-Pearl	25.67	32.00	20.93
14	Friendship Pink	32.00	34.80	21.00
15	Green Woodpecker	25.00	35.37	18.83
16	Urvashi	26.00	36.77	20.73
17	Zeus	18.33	38.73	18.63
18	Priscilla	14.33	32.83	18.40
19	Neelima	**11.33**	33.17	17.70
20	My Love	15.00	30.17	18.67
21	Amethyst	22.33	32.27	20.53
22	Aldebaran	27.00	36.10	18.47
23	Black Beauty	31.67	**19.57**	**9.93**
24	Video	14.33	42.33	**24.30**
25	Yellow Stone	30.33	37.17	19.10
26	Praha	20.00	35.83	19.27
27	Pacifica	25.67	38.17	20.00
28	Regency	17.33	35.23	19.03
29	Picardy	29.333	34.20	17.27
30	Nicole	26.00	36.23	18.20
31	Peter Pears	25.67	33.10	23.17
32	Summer Sunshine	18.67	38.17	15.87
33	Arka Kesar	19.33	37.23	17.97
34	Tiger Flame	26.67	36.27	19.63
35	Hall Mark	21.00	37.93	19.47
	Mean	**23.16**	**35.56**	**19.32**
	C.V. %	26.55	7.79	8.87
	C.D. (5%)	10.01	4.52	2.79

Table.3 Pollen shape for 35 varieties of *Gladiolus* studied under microscope (20x, 40x)

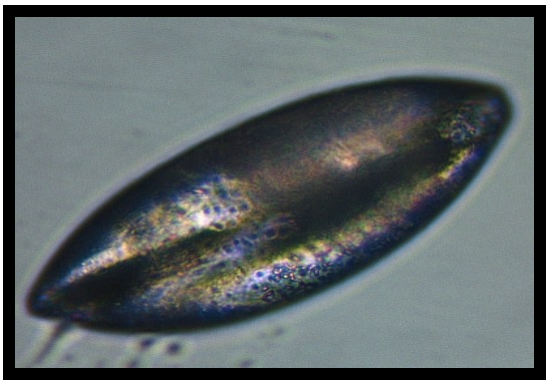
S.no.	Shape of pollen	Variety	No of varieties
1	Oval shape	Classic Pink, Rashmi, Grock, Her Majesty, Thamboliana, Tropic Sea, Snow Princess, Inter-Pearl, Friendship Pink, Green Woodpecker, My Love, Aldebaran, Video, Pacifica, Regency, Summer Sunshine, Tiger Flame	17
2	Boat shape	Nicole, Peter Pears, Arka Kesar, Neelima, Eurovision, Roshni, Praha	7
3	Round shape	Picardy, Parade, Black Beauty, Urvashi Topaz	4
4	Elliptical shape	Yellow Stone, Zeus, Hall Mark	3
5	Drop shape	White Prosperity, Priscilla, Amethyst	3

Table.4 Colour performance of 35 varieties of *Gladiolus* for filament, anther and style

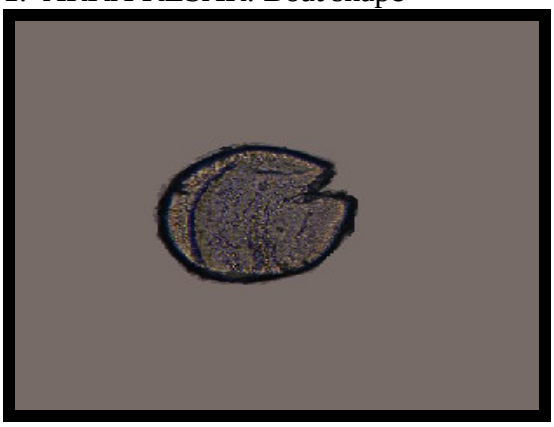
S.No.	Name of variety	Colour of filament	Colour of anther	Colour of style
1.	Classic Pink	Red group 53-A, Fan-1	Red purple group 77-A, Fan-1	Yellow group 3-D, Fan-1
2.	White Prosperity	Green- yellow Group 149-C,Fan-1	Yellow group 4-D, Fan-1	Yellow-green group 149-D, Fan-3
3.	Grock	Red group 49-D,Fan-1	Red-purple group 70-C, Fan-2	Green-yellow group 1-C,Fan1
4.	Her Majesty	Red-Purple group 69-C,Fan-2	Purple group 79-D, Fan-2	Green-yellow group 150-D, Fan-3
5.	Eurovision	Red group 51-C, Fan1	Purple -violet group 82-B, Fan-2	Yellow group3-D, Fan-1
6.	Topaz	Red-purple group 69-B, Fan-2	Violet group 83-C, Fan2	Yellow group3-D, Fan-1
7.	Rashmi	Red group 56-D, Fan-1	Red-purple group 72-A, Fan-2	Red group 56-D, Fan-1
8.	Thamboliana	Yellow group 4-D, Fan-1	Purple group 77-B, Fan-2	Yellow group 4-D, Fan-2
9.	Tropic Sea	Green-yellow group 1-D, Fan-1	Violet group 83-D, Fan-2	Red-purple group 69-C, Fan-2
10.	Parade	Yellow group 11-D, Fan-1	Red-purple group 70-A, Fan-2	Red-purple group 62-D, Fan-1
11.	Roshni	Red group 56-C, Fan-1	Red group 56-A,Fan-1	Yellow group 4-C, Fan-1
12.	Snow Princess	Red-purple group 65-D, Fan-2	Yellow-white group 158-C, Fan-4	Yellow group4-D, Fan-1
13.	Inter-Pearl	Red group 39-B, Fan-1	Red-purple group 60-C, Fan-2	Red-purple group 69-C, Fan-2
14.	Urvashi	Red group 53-A, Fan-1	Red-group 36-B, Fan-1	Orange group 27-C, Fan-1
15.	Green Woodpecker	Yellow group 2-D, Fan-1	Purple group 76-B, Fan-2	yellow group 2-D, Fan-1
16.	Friendship Pink	Yellow group 4-D, Fan-1	Red group 55-C,Fan-1	Yellow group 4-D, Fan-1
17.	Zeus	Red group 56-C , Fan-1	Red group 56-A,Fan-1	Orange group 27-C, Fan-1
18.	Priscilla	Yellow group 2-D, Fan-1	Violet-blue group 89-A, Fan-2	Red-purple group 70-D,Fan-1
19.	Neelima	Yellow group 4-D, Fan-1	Purple group 79-B, Fan-2	Yellow group 4-D, Fan-1
20.	My Love	Red-purple 62-D , Fan-2	Red-purple group 77-A, Fan-2	Purple group 75-D, Fan-2
21.	Amethyst	Yellow group 2-D, Fan-1	Yellow group 2-D, Fan-1	Yellow group 11-C, Fan-1
22.	Aldebaran	Yellow group 2-D, Fan-1	Yellow group 23-D, Fan-1	Yellow group 10-C, Fan-1
23.	Black Beauty	Red-purple group 61-B, Fan-2	Purple group 77-A, Fan-2	Yellow group 4-D, Fan-1
24.	Video	Yellow group 4-D, Fan-1	Purple group 77-A, Fan-2	Purple group 77-A, Fan-2
25.	Yellow Stone	Yellow group 2-D, Fan-1	Yellow-blue group 93-C, Fan-1	Yellow group 2-D, Fan-1
26.	Praha	Red group 36-B, Fan-1	Red-purple group 61-A, Fan-2	Yellow group 4-D, Fan-1
27.	Pacifica	Red group 49-C, Fan-1	Purple-violet group 82-A, Fan-2	Yellow group 2-B, Fan-1
28.	Regency	Red group 53-A, Fan-1	Violet group 85-A, Fan-2	Red purple group 61-A, Fan-2
29.	Picardy	Red-purple group 69-B,Fan-2	Red-purple group 72-B, Fan-2	Yellow group 2-C, Fan-1
30.	Nicole	Red group 56-B, Fan-1	Red group 55-A, Fan-1	Yellow group 4-D, Fan-1
31.	Peter Pears	Red-purple group 71-A , Fan-2	Purple group 75-A , Fan-2	Yellow group 2-D, Fan-1
32.	Summer Sunshine	Yellow group 4-D, Fan-1	Purple group 75-A , Fan-2	Green yellow group 1-C , Fan-1
33.	Arka Kesar	Yellow group 11-D, Fan-1	Red group 56-B,Fan-1	Green-yellow group 1-C , Fan-1
34.	Tiger Flame	Yellow group 2-D, Fan-1	Red group 55-C,Fan-1	Green-yellow group 1-D, Fan-1
35.	Hall Mark	Red-purple group 65-C, Fan-2	Yellow group 2-D, Fan-1	Yellow group 2-D, Fan-1



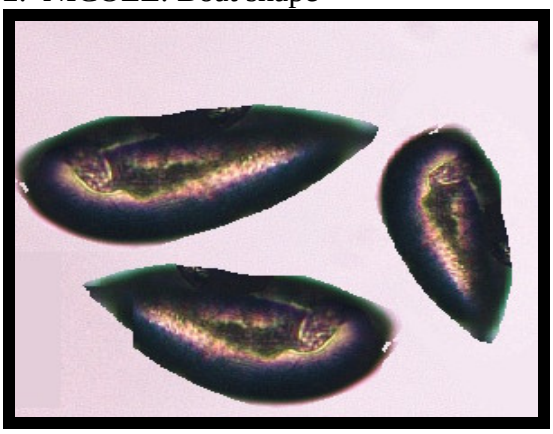
1. ARKA KESAR: Boat shape



2. NICOLE: Boat shape

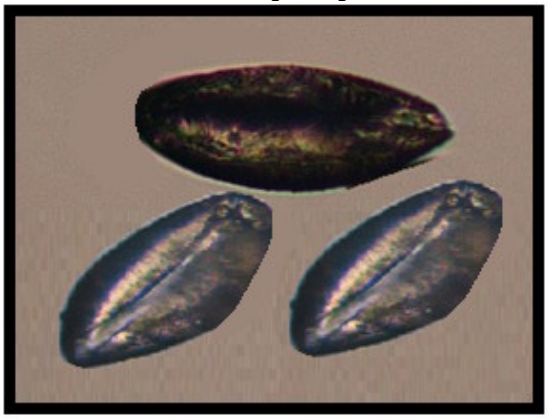


3. BLACK BEAUTY: Round shape



4. PRISCILLA: Drop shape

5. ZEUS: Elliptical shape



6. VIDEO: Oval shape

Fig.1-6 Shape of the pollens of different varieties of *Gladiolus*

The colour of the filament, anther, style and stigma lobe exhibited variability in various patterns. Out of thirty five varieties studied, twenty four had either completely coloured filament (Grock, Eurovision, Topaz, Zeus, Picardy etc.), two or more colours on filament (Video, Inter-Pearl, Neelima, Amethyst etc.) while eleven were with colourless filaments (Thamboliana, Aldebaran, Green Woodpecker etc). The anther colour of all the varieties studied and ranged from light (White Prosperity), single colour (Classic Pink, Eurovision, Topaz etc.) to dark (Black Beauty, Regency), double colours (Video, Tropic Sea, Neelima, Amethyst, Aldebaran, Summer Sunshine etc.) to dark colour lobed (Grock, Tropic Sea, Praha etc). The similar findings were observed by Roy (2003). The pollens observed under microscope (20x to 40x) exhibited five categories of pollen shapes (table 4) and all pollen had smooth exine. Out of 35 varieties studied for pollen shape, oval (17 varieties) ruled over Boat shape (7 varieties) followed by round shape (4 varieties), Elliptical (4 varieties) and Drop (3 varieties) (Fig. 1-6). The above colour patterns of style, stigma and shape of pollen were due to type character of each genotype and its interaction with environment.

The reproductive structure of the flowers of gladiolus showed great variation with regard to length of androceium, filaments, anther, style, stigma lobe, angle of filament to anther, pollen size, pollen shape, anther colour, androceium and gynoceium colour. There was significant difference amongst the characters as well as varieties. Similarly, pollens morphology comprising size and shape also varied from one variety to other. It may be concluded that the varieties studied were heterozygous in nature. This resulted significant variation on palynological as well as structural part of the flowers.

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