

MORPHOLOGICAL CHARACTERIZATION AND EVALUATION OF NINETEEN GLADIOLUS GERmplasm

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Abstract

Nineteen gladiolus germplasms were characterized and evaluated in the Research Field of the Department of Horticulture, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur, during November 2017 to May 2018 for identifying suitable line(s) to release as a variety for commercial cultivation. The accession G₈ produced the highest number of shoots (3.3) and effective shoots (3.0) per hill. The accessions that produced flower stalk within 75 days of planting included BARI gladiolus- 3 (G₁, 58.7 days), G₂ (62.3 days), G₃ (65.7 days), BARI gladiolus- 5 (G₄, 61.3 days), G₅ (55.7 days), BARI gladiolus- 6 (G₇, 71.3 days), G₁₀ (74.0 days), G₁₄ (73.3 days), G₁₅ (75.0 days) and G₁₉ (67.3 days). The highest rachis length was recorded in BARI gladiolus- 3 (53.7 cm) which was statistically similar with the rachis length of G₆ (46.0 cm), G₁₀ (46.3 cm), G₁₁ (47.0 cm) and BARI gladiolus- 1 (G₁₂, 46.3 cm) but significantly differed with other accessions. Most of the accessions in general, produced more than 10 florets per spike. Vase life of the accessions varied and G₁₁ had the highest vase life of 9-11 days and this was close to 9-10 days in G₉ and 8-9 days in BARI gladiolus- 3 (G₁), G₈, G₁₀, G₁₇, G₁₈ and G₁₉. The highest number of corm per hill was recorded in G₈ (10.3) followed by G₅ (8.7), G₁₆ (8.3), G₁₇ (7.7) and BARI gladiolus- 3 (6.7). Number of cormels per hill ranged from 9.0-941.7 with an average of 237.0. Based on various plant, flower colour, corm and cormel production characters, the gladiolus accessions G₃, G₅, G₈, G₉, G₁₀, G₁₁, G₁₄, G₁₆, G₁₇, G₁₈ and G₁₉ may be considered for further study.

Keywords: Gladiolus, cormel, commercial cultivation, variety development.

Introduction

Once, only the well-off bought flowers to colour festivals. Now, even the low to mid income groups love to present flowers on beautiful moments. So, the present position of floriculture in our country is more or less uprising. About 10,000 hectares of land is now devoted to flower cultivation in Bangladesh (Rakibuzzaman *et al.*, 2018). As days go, demand for flower is increasing very rapidly. In valentines' day of 2009, flower of TK 2 crore were sold in Dhaka in 2 days (Khan, 2013).

In Bangladesh, commercial floriculture is expanding very rapidly. Today, floriculture has emerged as a lucrative profession in Bangladesh with a much higher potential for returns than most other fields and horticultural crops (Sultana, 2003). Bangladesh is well suited for cut flower and ornamental production due to the favorable climatic and other conditions like cheap land, low labour cost, relatively low capital investment and high value addition (Dadlani, 2004). Bangladesh has very good potentialities to become an important supplier of flower and ornamental

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plants for Asia, the Middle East and Europe (Momin, 2006).

Gladiolus (*Gladiolus sp*) belongs to the family Iridaceae is an important cut flower grown worldwide including Bangladesh. It is sold at almost every corner of city areas by the retailers. In our country, its demand is increasing because of its elegant spike, rich varied colours and long vase life. Now-a-days, the farmers are commercially cultivating this crop in Bangladesh (Islam and Haque, 2011). *Gladiolus* coming into play in recent times occupied the top position with a percent market share of 31.11 (Rakibuzzaman *et al.*, 2018). Presently, the Floriculture Division of BARI is conducting research on *gladiolus* along with other flower crops. They have already released 6 (six) varieties of *gladiolus* which is not sufficient and more varieties need to be released. By this time, 280 numbers of flower and ornamental germplasm including *gladiolus* are being collected from different sources (Ara *et al.*, 2010); which is not sufficient. So, to enrich the genetic resources of this crop, more germplasm from home and abroad are needed to be collected for further evaluation with a view to improvement and development of the crops. Some progressive farmers, nurserymen and private entrepreneurs have already been collected different *gladiolus* germplasm from abroad and other sources. Those genotypes need to be collected for evaluation and conservation properly to develop and enrich germplasm pool. Selection of better plant type from the collected germplasm can be of immense value for further improvement of this crop. It is, therefore considered indispensable to collect, characterize, evaluate and finally, to select the promising one(s) among the

selected materials. Hence, the present study on *gladiolus* was undertaken.

Materials and Methods

The experiment was conducted at the research field of the Department of Horticulture, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur from November 2017 to May 2018. Nineteen *gladiolus* germplasm were previously collected from farmer's field and nurseries of Godkhali, Benapole, Jessore, Bogra, Savar areas through direct visit and were included in the experiment. Cut flower stick of all collected germplasm are presented in Plate 1 and 2. The germplasm were numbered as G₁, G₂, G₃, G₄, G₅, G₆, G₇, G₈, G₉, G₁₀, G₁₁, G₁₂, G₁₃, G₁₄, G₁₅, G₁₆, G₁₇, G₁₈ and G₁₉. Out of these germplasm, G₁, G₄, G₇ and G₁₂ has already been released by the Bangladesh Agricultural Research Institute as BARI *gladiolus*- 3, BARI *gladiolus*- 5, BARI *gladiolus*- 6 and BARI *gladiolus*- 1, respectively. The unit plot size was 1.2 m X 1.2 m. Medium sized (3.5-4.5 cm) corms of different *gladiolus* germplasm were planted at about 6-9 cm depth in the plot maintaining a spacing of 30 cm X 15 cm. The experiment was set up on November 12, 2017 following Randomized Complete Block Design (RCBD) with 3 replications. Manures and fertilizers were applied at the rate of cowdung- 10 t/ha, Urea- 300 kg/ha, TSP- 375 kg/ha, MoP- 300 kg/ha, Boric acid- 12.0 kg/ha and Zinc sulphate- 8.0 kg/ha (Azad, 2017). Entire quantity of manures and fertilizers except urea were applied during final land preparation and mixed with soil. Half of urea was top dressed after 25 days of planting and rest half was applied during spike initiation stage. Different intercultural operations like irrigation,

weeding, earthing up, stacking, pesticide and fungicide application were performed as needed. The spikes were cut when lower one or two florets showed color but still in tight bud stage. The cut spikes were kept into water to study the vase life. Corms and cormels were harvested only when the leaves turned into brown colour (Mukhopadhyay, 1995). The collected data were statistically analyzed using computer MSTAT-C program. Mean separation was done by Duncan's Multiple Range Test (DMRT).

Results and Discussion

Plant characteristics of 19 germplasm have been presented in Table 1. Results revealed that base colour of the germplasm were either green or tan (pale brown) or light tan or light pink. Number of leaf was found to be varied significantly. The highest number of leaves per plant was recorded in G₁₅ (11.7) which was statistically similar to G₃ (11.3). The lowest number of leaves per plant (8.0) was recorded in G₅, G₈, G₁₀ and G₁₃. This result was in agreement with the findings of Hossain *et al.* (2011), who found it ranged from 8.50-12.25. Number of shoot per hill varied significantly, which ranged from 1.0-3.3 with an average of 2.1. Likewise, significant variation was found in number of effective shoot per hill which varied from 1.0-3.0 with an average of 1.5. The accession G₈ produced the highest number of shoot (3.3) and effective shoots (3.0) per hill. It indicated that all the shoots of gladiolus did not effectively produce inflorescence. Variation was observed as to the days to flower spike initiation. The accession G₁₆ took the highest time (81.3 days) for spike initiation; whereas, G₅ took the lowest (55.7 days). Days to spike initiation is very

important as it determines the earliness or lateness of the flower crop. The accessions that produced flower stalk within 75 days of planting included BARI Gladiolus- 3 (58.7 days), G₂ (62.3 days), G₃ (65.7 days), BARI Gladiolus- 5 (61.3 days), G₅ (55.7 days), BARI Gladiolus- 6 (71.3 days), G₁₀ (74.0 days), G₁₄ (73.3 days), G₁₅ (75.0 days) and G₁₉ (67.3 days). Tirkey *et al.* (2018) reported to have spikes of gladiolus after 53.4-67.0 days of planting. Variation in days to spike initiation seem to be genetically controlled as reported by Pragya *et al.* (2010) in gladiolus. Regarding diseases, leaf blight was found to infect in BARI Gladiolus- 3 (G₁), G₆, G₁₃ and G₁₅; whereas, cut worm infestation was found in BARI Gladiolus- 3 (G₁), G₂, BARI Gladiolus- 5 (G₄) and G₁₅ (Table 1).

Plant height in gladiolus is important as it determines lodging of the crop. Longer plant tends to be lodged and needs to be staked. Plant height in different accessions found to be varied (Fig. 1). The longest plant was observed in the accession BARI gladiolus- 5 (92.3 cm), which was statistically different from all other accessions. The accession G₂ had a plant height of 76.3 cm and it was similar to the plant height of BARI gladiolus- 3 (65.0 cm), G₃ (74.3 cm) and G₁₆ (72.7 cm) but significantly differed from rest of the accessions. The shortest plant (42.0 cm) was observed in G₁₃. The accessions G₅ (51.7 cm), G₆ (54.0 cm), BARI gladiolus- 6 (60.0 cm), G₈ (53.7 cm), G₉ (55.3 cm), G₁₀ (59.0 cm), G₁₁ (54.3 cm), BARI gladiolus- 1 (52.7 cm), G₁₄ (59.7 cm), G₁₇ (59.3 cm), G₁₈ (58.7 cm) and G₁₉ (56.7 cm) produced medium sized plants, where the plant height ranged from 50-60 cm (Fig. 1). Hossain *et al.* (2011) recorded more or less similar range of 46.52-58.65 cm plant

Table 1. Plant characteristics of nineteen gladiolus germplasm

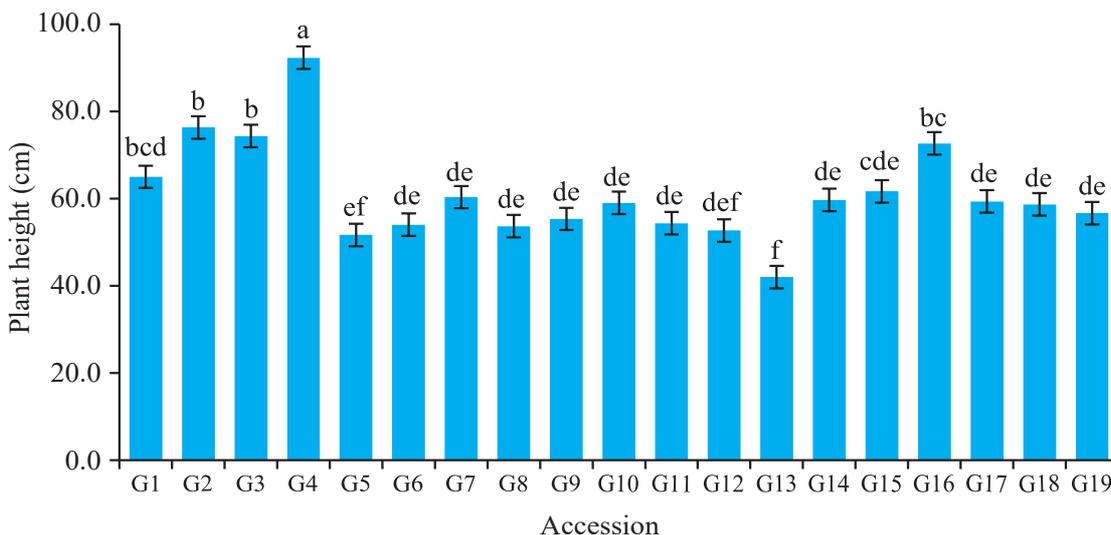
Accession	Base colour of plant	Number of leaves / Plant	Number of shoot/hill	Number of effective shoot/hill	Days to 1 st spike initiation	Disease	Insect
G ₁	Green	10.0 cd	1.0 d	1.0 d	58.7 hi	LB	Cut worm
G ₂	Tan	10.0 cd	1.3 cd	1.0 d	62.3 fgh	None	Cut worm
G ₃	Tan	11.3 ab	1.3 cd	1.0 d	65.7 fg	None	None
G ₄	Light tan	9.3 cde	1.7 bcd	1.7 bcd	61.3 gh	None	Cut worm
G ₅	Light pink	8.0 f	3.0 ab	1.7 bcd	55.7 i	None	None
G ₆	Tan	10.0 cd	3.0 ab	1.7 bcd	78.3 abc	LB	None
G ₇	Tan	8.3 ef	2.3 a-d	1.7 bcd	71.3 de	None	None
G ₈	Light tan	8.0 f	3.3 a	3.0 a	76.0 a-d	None	None
G ₉	Tan	8.7 ef	2.0 a-d	1.3 cd	78.0 abc	None	None
G ₁₀	Light tan	8.0 f	2.3 a-d	1.0 d	74.0 bcd	None	None
G ₁₁	Green	8.3 ef	1.3 cd	1.0 d	78.7 abc	None	None
G ₁₂	Green	10.3 bc	1.0 d	1.0 d	80.0 a	None	None
G ₁₃	Tan	8.0 f	2.7 abc	2.3 abc	78.0 abc	LB	None
G ₁₄	Green	10.0 cd	1.0 d	1.0 d	73.3 cd	None	None
G ₁₅	Tan	11.7 a	2.3 a-d	1.0 d	75.0 b-d	LB	Cut worm
G ₁₆	Light tan	9.0 def	3.3 a	1.7 bcd	81.3 a	None	None
G ₁₇	Light tan	9.0 def	3.3 a	2.7 ab	78.0 abc	None	None
G ₁₈	Tan	10.3 bc	1.3 cd	1.0 d	79.3 ab	None	None
G ₁₉	Light tan	8.7 ef	2.3 a-d	1.3 cd	67.3 ef	None	None
Mean	-	9.3	2.1	1.5	72.3	-	-
CV (%)	-	7.06	17.43	13.48	4.20	-	-

Tan= Pale brown and LB= Leaf blight

G₁= BARI gladiolus- 3, G₄= BARI gladiolus- 5, G₇= BARI gladiolus- 6 and G₁₂= BARI gladiolus- 1.

height in the studied genotypes of gladiolus; whereas, Singh *et al.* (2017) recorded a range from 80.3-134.7 cm plant height with a mean of 112.0 cm in ten hybrids of gladiolus. As the genotypes of present study has been collected from farmers field and they are hopefully open pollinated; so, the variation in plant height of different gladiolus genotypes might be due to the genetic difference as well as growing environment and management practices.

The spike length, rachis length, number of side spike and number of floret per spike varied significantly among the germplasm. The longest spike was found in BARI gladiolus- 3 (72.0 cm) which was statistically similar to G₁₀ (69.7 cm) but differed from rest of the accessions. In majority of the accessions, spike length was recorded as more than 50.0 cm. Rachis length differed from 19.0 cm to 53.7 cm with an average of 36.4



G₁= BARI gladiolus- 3, G₄= BARI gladiolus- 5, G₇= BARI gladiolus- 6 and G₁₂= BARI gladiolus- 1.

Fig. 1. Plant height (cm) at spike initiation stage influenced by gladiolus germplasm.

cm. The highest rachis length was recorded in BARI gladiolus- 3 (53.7 cm) which was statistically similar to the rachis length of G₆ (46.0 cm), G₁₀ (46.3 cm), G₁₁ (47.0 cm) and BARI gladiolus- 1 (46.3 cm) but significantly differed from other accessions. Tirkey *et al.* (2018) recorded a variable rachis length in six gladiolus genotypes that ranged from 37.3 cm to 62.7 cm. The variation in different characters among varieties might be due to variation of genetic traits and the effect of prevailing environmental conditions (Kumar, 2015). Regarding number of side spike, only 5 accessions produced side spikes and majority of the accessions had no side spikes.

Significant variation was found regarding number of floret per spike, which ranged from 7.0-15.7. The highest number of florets per spike was recorded in G₁₁ (15.7) followed by G₁₀ (14.8), BARI gladiolus- 3 (14.0) and G₂ (13.7). The accession G₁₃ (7.0) had the

lowest number of florets per spike (Fig. 2). In general, most of the accession produced more than 10 florets per spike. Hossain *et al.* (2011) reported a range of 8.4-14.3 florets per spike, while studied with five different genotypes of gladiolus. Whereas, Tirkey *et al.* (2018) recorded to have 11.2- 15.0 florets per spike, while working with six genotypes of gladiolus and Rashmi (2006) obtained 14.1- 16.7 florets per spike while working with 11 genotypes of gladiolus.

Variable flower characters were observed and recorded in the studied accessions (Table 3). Nineteen accessions had different floret colour and marking (Plate 1 and Plate 2). Although, BARI gladiolus- 3 (G₁) and G₆ produced white coloured floret but they differed regarding floret marking. The florets of BARI gladiolus- 3 (G₁) had pink scar inside; while, the florets of G₆ had red butterfly scar inside. The accession BARI gladiolus- 5 (G₄) and

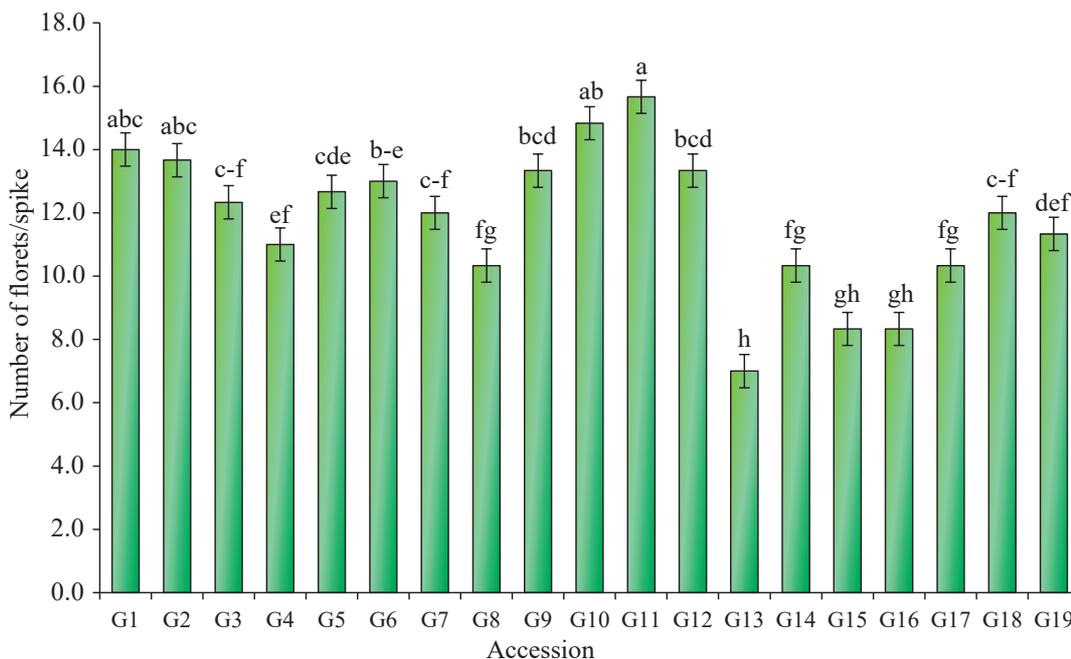
Table 2. Flowering characteristics of nineteen gladiolus germplasm

Accession	Spike length (cm)	Rachis length (cm)	Number of side spike
G ₁	72.0 a	53.7 a	1.0 b
G ₂	55.3 cd	39.0 b-e	0.0 c
G ₃	66.0 b	43.0 bc	0.0 c
G ₄	61.7 bc	41.7 bc	0.0 c
G ₅	53.7 cd	40.7 bcd	1.0 b
G ₆	53.3 cd	46.0 ab	0.0 c
G ₇	42.3 ef	36.7 c-f	0.0 c
G ₈	40.6 ef	27.8 g	0.0 c
G ₉	51.0 d	38.7 b-e	0.0 c
G ₁₀	69.7 ab	46.3 ab	2.0 b
G ₁₁	57.0 cd	47.0 ab	0.0 c
G ₁₂	61.7 bc	46.3 ab	0.7 bc
G ₁₃	37.7 f	25.3 gh	0.7 bc
G ₁₄	54.3 cd	31.0 efg	0.0 c
G ₁₅	41.0 ef	28.3 fg	0.0 c
G ₁₆	47.7 de	29.0 fg	0.0 c
G ₁₇	52.7 cd	33.0 d-g	0.0 c
G ₁₈	38.7 ef	19.3 h	0.0 c
G ₁₉	38.7 ef	19.0 h	0.0 c
Mean	52.4	36.4	0.3
CV (%)	9.40	12.61	15.80

G₁= BARI gladiolus- 3, G₄= BARI gladiolus- 5, G₇= BARI gladiolus- 6 and G₁₂= BARI gladiolus- 1.

G₈ had also produced similar colour (yellow) of florets but they also differed in floret marking. The floret colour of the accessions G₃, G₅, G₈, G₉, G₁₀, G₁₁, G₁₄, G₁₆, G₁₇, G₁₈ and G₁₉ was very attractive. Floret breadth and length in the studied accessions also varied. The highest breadth (12.0 cm) and length (12.2 cm) were recorded in G₁₅, indicated the largest flower size. The accession G₁₁ produced the smallest sized florets among

the accessions with a breadth and length of 6.5 cm and 6.2cm, respectively (Table 3). Bhat *et al.* (2017) recorded a breadth range of 6.0-12.0 cm in fifty studied genotypes of gladiolus, which supported the present study. Vase life in the accessions varied and G₁₁ had the highest vase life (9-11 days) followed by G₉ (9-10 days), BARI gladiolus- 3 (8-9 days), G₈ (8-9 days), G₁₀ (8-9 days), G₁₇ (8-9 days), G₁₈ (8-9 days) and G₁₉ (8-9 days).



G₁= BARI gladiolus- 3, G₄= BARI gladiolus- 5, G₇= BARI gladiolus- 6 and G₁₂= BARI gladiolus- 1.

Fig. 2. Number of florets/spike in different gladiolus germplasm.

Corms and cormels characteristics of nineteen gladiolus accessions are presented in Table 4. The highest number of corms was recorded in G₈ (10.3), which differed statistically from other accessions. The accessions G₉, G₁₁ and G₁₄ produced the lowest number of corms per hill (1.3). Number of corms per hill is very important in gladiolus as the corms are the sources of seed for the following years. Weight of individual corm was also found to be varied significantly among the accessions. The highest corm weight was

obtained from in BARI gladiolus- 5 (75.7 g) and the lowest in G₁₈ (12.3 g). Likewise, the diameter of large corm was observed the highest (6.6 cm) in BARI gladiolus- 5 (G₄) and the lowest (3.6 cm) in G₁₀ and G₁₈ (Table 4). Number of cormels per hill was also varied widely among the accessions and ranged from 9.0-941.7 with an average of 237.0. Individual weight of cormels in the accessions was also varied and ranged from 0.1 -1.1 g. The accession G₆ produced the largest cormel (Table 4).

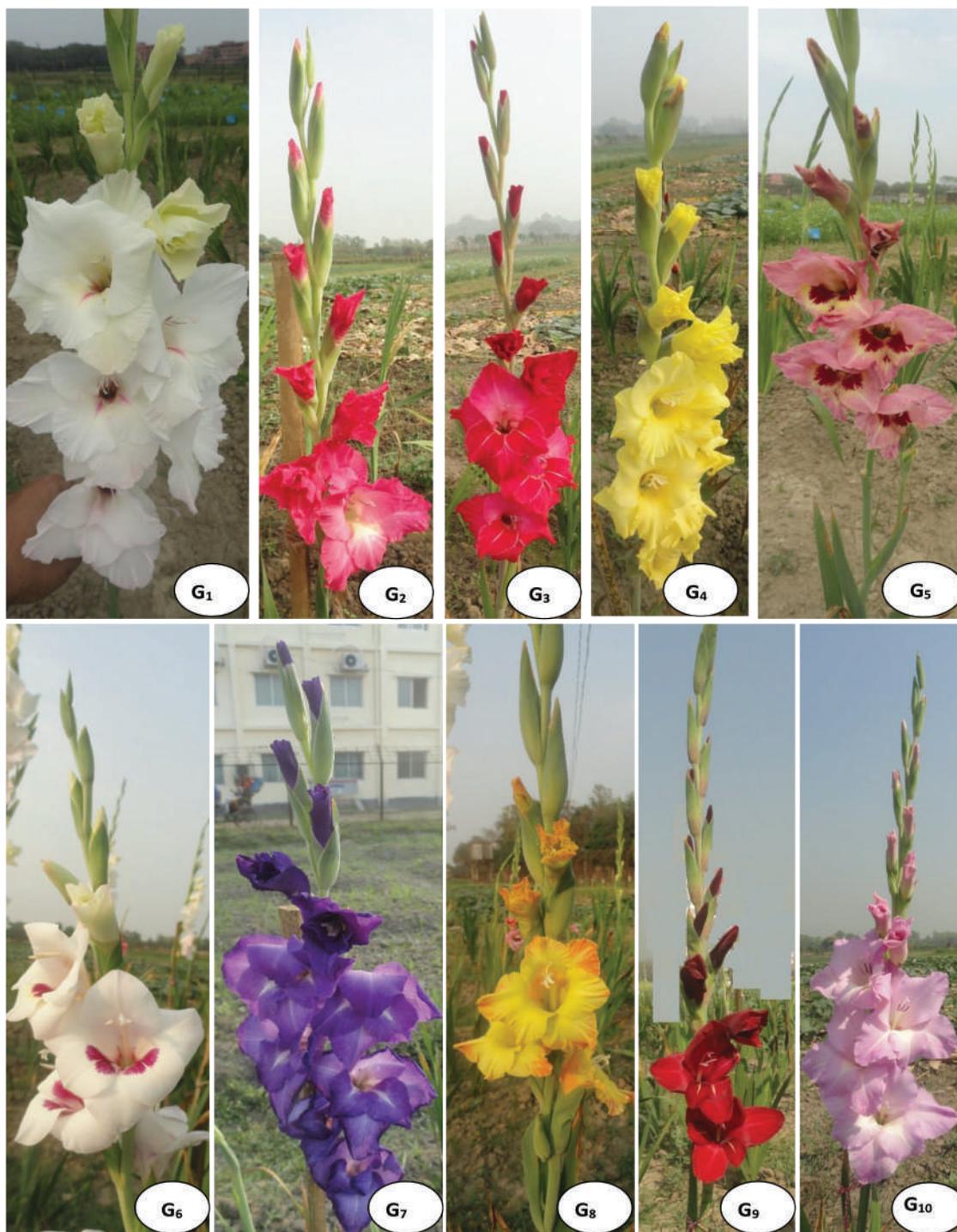


Plate 1. Flower spikes of different gladiolus germplasm (G₁-G₁₀).

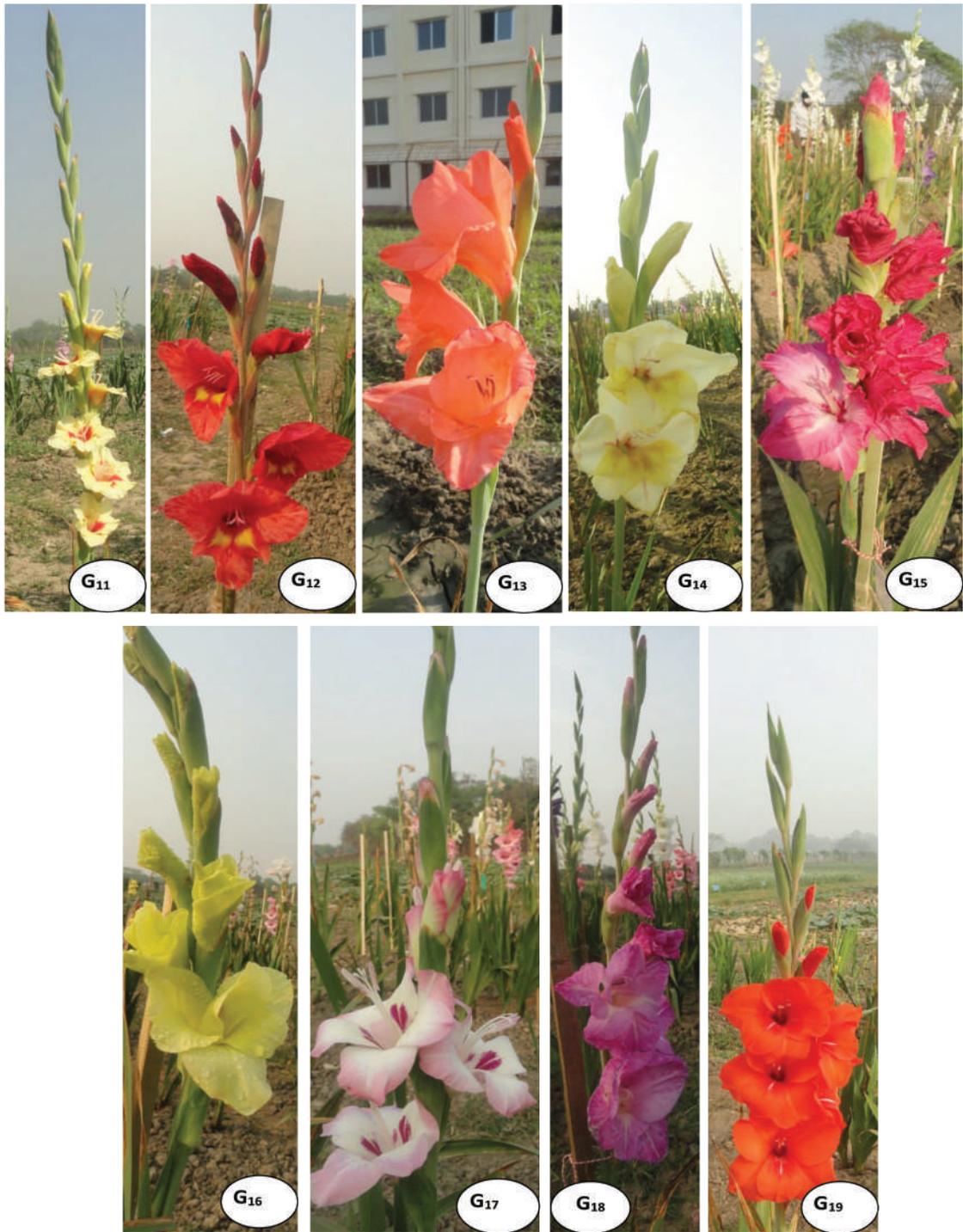


Plate 2. Flower spikes of different gladiolus germplasm (G₁₁-G₁₉).

Table 3. Floret characteristics of nineteen gladiolus germplasm

Accession	Colour of florets	Floret marking	Floret length (cm)	Floret breadth (cm)	Vase life (days)
G ₁	White	Pink scar inside	11.3 ab	11.7 a	8-9
G ₂	Light red	White scar inside	10.7 bc	10.0 b	6-7
G ₃	Deep red	White scar inside	10.7 bc	10.1 b	7-8
G ₄	Yellow	None	10.8 bc	10.1 b	6-8
G ₅	Light pink	Deep red butterfly scar inside	10.2 c	10.0 b	7-9
G ₆	White	Red butterfly scar inside	8.3 efg	8.2 d	5-7
G ₇	Violet	White scar inside	7.8 fg	8.3 d	7-8
G ₈	Yellow	Orange scar on side of petal	7.5 gh	6.8 gh	8-9
G ₉	Tan	Velvety, white scar inside	8.5 ef	8.0 de	9-10
G ₁₀	Light violet	White scar inside	8.0 fg	7.3 efg	8-9
G ₁₁	Light yellow	Deep red butterfly scar inside	6.2 i	6.5 h	9-11
G ₁₂	Brick Red	Yellow butterfly scar inside	8.5 ef	8.0 de	7-8
G ₁₃	Light orange	None	6.8 hi	7.2 fgh	6-7
G ₁₄	Cream	Yellow scar inside	8.7 ef	8.5 cd	7-8
G ₁₅	Red	White scar inside	12.2 a	12.0 a	6-7
G ₁₆	Light yellow (Biscuit color)	None	9.9 cd	9.2 c	7-8
G ₁₇	Light pink	Inside white with red butterfly scar	6.8 hi	6.8 gh	8-9
G ₁₈	Pink	White scar inside	9.1 de	8.5 cd	8-9
G ₁₉	Orange	White scar inside	8.0 fg	7.8 def	8-9
Mean	-	-	9.0	8.7	-
CV (%)	-	-	5.88	5.03	-

G₁= BARI gladiolus- 3, G₄= BARI gladiolus- 5, G₇= BARI gladiolus- 6 and G₁₂= BARI gladiolus- 1.

Table 4. Corms and cormels characteristics of nineteen gladiolus germplasm

Accession	Number of corms/hill	Weight of individual corm (g)	Diameter of the largest corm (cm)	Number of cormels/hill	Weight of cormel/hill (g)	Weight of individual cormel (g)
G ₁	6.7 cd	46.5 cd	5.8 bc	941.7 a	266.9 a	0.3
G ₂	5.7 de	20.4 ij	4.5 f-i	451.3 b	117.2 bc	0.3
G ₃	5.3 def	55.0 b	6.2 ab	213.3 cde	90.5 cd	0.4
G ₄	5.3 def	75.7 a	6.6 a	146.7 d-g	85.2 d	0.6
G ₅	8.7 b	34.8 ef	5.3 cde	398.3 b	131.5 b	0.3
G ₆	3.3 hi	24.9 ghi	3.9 ij	9.0 g	9.5 g	1.1
G ₇	3.7 ghi	20.3 ij	4.1 g-j	38.7 fg	17.4 g	0.4
G ₈	10.3 a	40.5 de	5.1 def	316.7 bc	94.9 cd	0.3
G ₉	1.3 j	20.1 ij	4.7 efg	43.7 fg	22.0 fg	0.5
G ₁₀	4.3 e-h	12.4 k	3.6 j	337.7 bc	51.7 e	0.2
G ₁₁	5.0 efg	22.0 hi	4.6 fgh	70.7 efg	16.3 g	0.2
G ₁₂	2.3 ij	14.1 jk	3.9 j	38.7 fg	86.5 d	2.2
G ₁₃	5.7 de	28.5 fgh	5.1 def	418.3 b	109.5 bcd	0.3
G ₁₄	1.3 j	22.3 hi	4.0 hij	27.0 fg	8.1 g	0.3
G ₁₅	1.3 j	21.5 hi	4.7 fg	311.3 bc	116.8 bc	0.4
G ₁₆	8.3 b	47.6 c	5.8 bcd	229.0 cd	57.5 e	0.3
G ₁₇	7.7 bc	31.1 fg	4.9 ef	185.0 c-f	48.2 ef	0.3
G ₁₈	3.3 hi	12.3 k	3.6 j	226.3 cd	33.8 efg	0.1
G ₁₉	4.0 fgh	38.9 e	5.6 bcd	100.0 d-g	18.8 g	0.2
Mean	4.9	31.0	4.9	237.0	72.8	0.3
CV (%)	15.53	12.25	7.35	14.96	20.83	-

G₁= BARI gladiolus- 3, G₄= BARI gladiolus- 5, G₇= BARI gladiolus- 6 and G₁₂= BARI gladiolus- 1.

Conclusions

The collected gladiolus germplasm varied in different characters with released varieties. Based on flower colour and other characters, the gladiolus accessions G₃, G₅, G₈, G₉, G₁₀, G₁₁, G₁₄, G₁₆, G₁₇, G₁₈ and G₁₉ may be considered for further study.

Acknowledgements

The authors acknowledge the Research Management wing (RMW) of BSMRAU to offer fund for conducting the experiment

and successful implementation of the project activities.

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