

## PERFORMANCE OF BARI-RELEASED GLADIOLUS VARIETIES UNDER THE CLIMATIC CONDITIONS OF YOUNG BRAHMAPUTRA AND JAMUNA FLOODPLAIN

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### Abstract

The experiment was conducted in the farmers' field at the Farming System Research and Development site (FSRD), Atia, Delduar, Tangail during the Rabi season of 2018-19 and 2019-20 to evaluate the performance of BARI released gladiolus varieties and popularize these varieties among the farmers of Tangail region. BARI developed three varieties of gladiolus, namely BARI Gladiolus-3, BARI Gladiolus-4, and BARI Gladiolus-5. Among the three varieties, BARI Gladiolus-4 performed the best in terms of the spike (191009 piece ha<sup>-1</sup>) and corm (254322 piece ha<sup>-1</sup>) production from the average of 2018-19 and 2019-20. Though BARI Gladiolus-4 performed the best in terms of yield, the maximum economic return was obtained from BARI Gladiolus-5 due to a higher spike in demand and market price compared to the other two varieties. The highest gross return (Tk.2406215 ha<sup>-1</sup>), gross margin (Tk. 1402546 ha<sup>-1</sup>), as well as BCR (2.40), were also recorded in BARI Gladiolus-5 followed by BARI Gladiolus-4. The lowest gross return (Tk. 1837608 ha<sup>-1</sup>), gross margin (Tk. 833939 ha<sup>-1</sup>) as well as BCR (1.83), were obtained from BARI Gladiolus-3. The farmers under the AEZ-8 areas can become economically benefitted by the production of BARI Gladiolus-5 and BARI Gladiolus-4.

**Keywords:** AEZ-8, Bulbour flower, Corn yield, Cut flower, Gladiolus, Varieties

### Introduction

Gladiolus (*Gladiolus* sp.) is one of the most popular commercial flowers in Bangladesh as well as throughout the world. Gladiolus is popularly known as Sword Lily which is an ornamental plant under the monocot family Iridaceae (Sumi *et al.*, 2021). Among bulbous crops, gladiolus occupies an apex position among commercial cut flower crops due to high demand in both domestic and international markets. It is called the queen of bulbous flowers for its excellent aesthetic value and shelf life (Bhattacharjee and De, 2005). It is believed that gladiolus has been originated in South Africa (Sumi *et al.*, 2021). Gladiolus is mainly cultivated for cut flowers because of its elegant appearance and prolonged vase life. Gladiolus spikes are most popular in flower arrangements and for preparing attractive bouquets. Its magnificent inflorescence with

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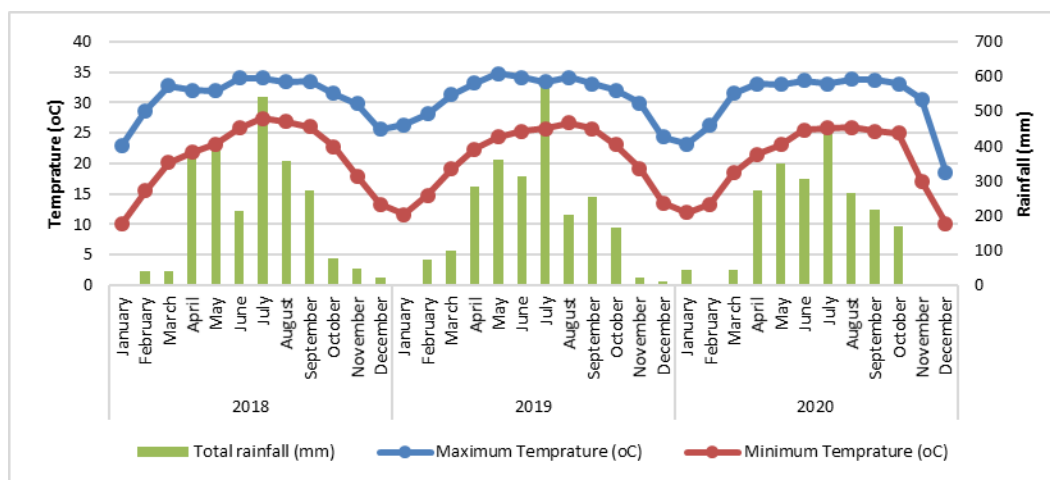
various colors has made it attractive for use in landscaping as an herbaceous border, bedding, rockeries, pots, and cut flowers (Singh *et al.*, 2020). In addition, along with ornamental value, gladiolus has medicinal use to cure headaches, lumbago, diarrhea, rheumatism, and allied pains (Bose *et al.*, 2003). Some of the gladiolus varieties of flowers and corms are consumed as food in many countries of the world. The agroecological conditions of Bangladesh, are very suitable for the cultivation of gladiolus. In Bangladesh commercial floriculture is expanding rapidly. Now a days, floriculture has emerged as a lucrative profession with a higher potential for returns than most other fields and horticultural crops in Bangladesh (Sultana, 2003). In a study, conducted by Momin (2006) it was found that gladiolus flower production is six times higher than the returns from rice. Gladiolus production technology is comparatively easy. In Bangladesh, the major growing area of gladiolus is Jessore (Sadar, Sharsha, Chowgacha upazila), Kushtia, Chuadanga, Chattogram, Mymensingh, Dhaka, Savar, and Gazipur. At present, the production area of gladiolus has been started on a small scale. The total production of gladiolus was 4159.54 M. Ton from 382 ha of land (BBS, 2022). It has great economic value as a cut flower and its cultivation is easy. The agroecological conditions of Tangail are conducive to the survival and culture of gladiolus. Bangladesh Agricultural Research Institute has developed some promising, high-yielding gladiolus varieties. There is a great scope to introduce these varieties among the farmers of the Tangail region. Through the cultivation of BARI gladiolus varieties, farmers will be economically benefitted. Considering the popularity of the gladiolus flower, it deserves before the dissemination of BARI gladiolus varieties it is very important to find out a suitable gladiolus variety and popularize that among the farmers of Tangail.

### **Materials and Methods**

The experiment was conducted at the Farming System Research and Development site (FSRD), Atia, Delduar, Tangail under Agroecological Zone-8 during the Rabi seasons of 2018-2019 and 2019-2020. The geographical coordinates of the experimental location were 24.160152 North Latitude and 89.897974 East Longitude at 16 m above sea level. The maximum, minimum temperature ( $^{\circ}\text{C}$ ), and total rainfall (mm) of the experimental field are presented in Figure 1 (BMD, 2020). The highest (576.1 mm) and the lowest rainfall (0 mm) were observed in January 2018-2019 and 2019-20, respectively. The average maximum temperature ( $34.79^{\circ}\text{C}$ ) was observed in May 2019 whereas the minimum ( $10.0^{\circ}\text{C}$ ) was in January 2018. The experimental plot was prepared 15 days before sowing. Before planting the corms of gladiolus were soaked in 0.2% Diathen M-45 (Mancozeb) for 30 minutes and air-dried in shade. The land was fertilized with 138-75-150-18-2-2 kg NPKSZnB  $\text{ha}^{-1}$  and 5 t  $\text{ha}^{-1}$  cowdung. Total amount of cowdung, Triple Superphosphate, Muriate of Potash, Boric acid, Zinc Sulphate, and Gypsum was applied during the final land preparation and mixed with the soil thoroughly.

The total amount of urea was divided into two parts. The first part of urea was applied 25 days after corm sowing and the second part was top-dressed during the spike development (Azad *et al.*, 2017). The corms were sown on 7 November and 30 October in 2018-19 and 2019-20, respectively. Two irrigation was provided. Two-hand weeding

was also provided for the proper growth and development of the plant. BARI Gladiolus-3, BARI Gladiolus-4, and BARI Gladiolus-5 were considered planting materials. The spike colors of BARI Gladiolus-3, BARI Gladiolus-4, and BARI Gladiolus-5 were white, pink, and yellow, respectively. The planting materials (corn) of different gladiolus varieties were collected from Horticultural Research Centre, Bangladesh Agricultural Research Institute, Gazipur. Unit plot size was 5 m x 4 m with Randomized Complete Block Design with six replications. The spacing was 25 cm x 15 cm. Harvesting was done starting from the second week of January to the first week of February in both years. The gross economic return was calculated based on the prevailing market price of the commodity. Data on the yield and yield contributing characters were collected and statistically analyzed following the R Project for Statistical Computing Software Version 4.1.1 (R Core Team, 2021). 10 m<sup>2</sup> area was selected and harvested for collecting spike, corn, and corn yield data when lower 1-2 florets started to open. Mean separation was done by the Least Significant Difference (LSD) at 5% level of significance.



**Fig. 1.** Monthly record of air maximum, minimum temperature (°C), and total rainfall (mm) of the experimental site during the period from January 2018 to March 2020.

## Results and Discussion

### Vegetative and floral characteristics of gladiolus varieties

The leaf length of different gladiolus varieties varied significantly. Leaf length was affected by genotypes and varied from 39.8 to 47.1 cm (Table 1). The highest leaf length was observed in BARI Gladiolus-4 (47.14 cm). On the other hand, the lowest is BARI Gladiolus-3 (39.8 cm). These findings are at par with Hossain *et al.*, 2011. Leaf breadth was not varied significantly among the tested varieties of gladiolus. Among the tested varieties, the leaf breadth range was 2.55 to 3.35 cm in the two consecutive years. The highest leaf breadth was observed in BARI Gladiolus-4 (3.35 cm) followed by BARI Gladiolus-5 (3.05 cm) whereas the lowest was in BARI Gladiolus-3 (2.55 cm). Hossain *et*

*al.*, 2011 reported that the leaf breadth of different gladiolus cultivars ranged from 1.65-3.05 cm. The plant height among the different varieties showed no significant difference which varied from 59.21 to 100.05 cm. The highest plant height 100.05 cm was produced by BARI Gladiolus-5 whereas the lowest was 59.2 in BARI Gladiolus-3 (Table 1). Variations in vegetative attributes may be due to their genetic makeup as well as varietal differences and environmental effects. Similar, results were observed by Pragya *et al.*, (2010) and Neha *et al.*, (2012) in gladiolus. The number of leaves showed no significant difference among the varieties from the average of two years. The highest number of leaves was produced by BARI Gladiolus-5 (8.38) whereas the lowest was (7.15) in BARI Gladiolus-4 (Table 1). Variation in the number of leaves per plant in gladiolus was also reported by Padma and Kumar (2004). The variation might be due to genotype as well as some known and/ or unknown environmental factors (Hossain *et al.*, 2011).

**Table 1.** Average vegetative and flowering parameters of three gladiolus varieties during the Rabi seasons of 2018-19 and 2019-20 at farm level

Variety	Leaf length (cm)	Leaf breadth (cm)	Plant height (cm)	Leaves at flowering (no.)	Spike length (cm)	Rachis length (cm)	Floret spike <sup>-1</sup> (number)	Weight of single spike (g)	Spike yield (piece ha <sup>-1</sup> )	Vase life (days)
BARI Gladiolus-3	39.75 b	2.55 a	59.21 b	7.73 a	79.25 a	47.05 a	11.82 a	78.65 b	174477 a	8 a
BARI Gladiolus-4	47.14 a	3.35 a	97.95 a	7.15 a	71.25 b	38.85 a	11.13 a	66.7 c	191009 a	9 a
BARI Gladiolus-5	45.85 a	3.05 a	100.05a	8.38 a	83.35 a	56.47 a	9.54 a	93.65 a	181655 a	7 a
Level of significance	*	NS	*	NS	*	NS	NS	*	NS	NS
CV (%)	6.65	11.21	6.83	6.75	8.35	11.62	1.35	9.37	6.58	3.15

In a column, means having similar letter(s) are statistically similar and those having a dissimilar letter(s) differ significantly as per 0.05 level of probability; \*significant at p=0.05; NS = Non Significant

Statistically, a non-significant difference was observed in spike length. The highest spike length was observed in BARI Gladiolus-5 (83.5). On the contrary, the lowest spike length was found in BARI Gladiolus-4 (71.25 cm) (Table 1). In a varietal evaluation conducted by Bhagur (1989), it was recorded that spike length ranged from 50-120 cm in gladiolus. The variation in spike length in different varieties may be due to the influence of genetic and environmental factors. Similar observations were reported by Singh *et al.*, (2017) and Mushtaq *et al.*, (2018). Considering the rachis length, it was observed that there was no significant difference among the varieties. The longest rachis (56.5 cm) was found in BARI Gladiolus-5 whereas the shortest rachis length in BARI Gladiolus-4 (38.9 cm) (Table 1). Anuradha and Gowda (1994) found the highest rachis length in gladiolus about 50 cm. The variation in rachis and spike lengths might be attributed to the inherent genetic characteristics associated with genotypes. Similar observations were recorded by Krishan *et al.*, (2005); Manjunath and Jankiram (2006), and Neha *et al.*, (2012).

A non-significant difference was observed among the varieties for the number of florets in the spike. The highest number of florets spike<sup>-1</sup> was observed in BARI Gladiolus-3 (11.82) followed by BARI Gladiolus-4 (11.1) whereas the lowest in BARI Gladiolus-5 (9.54) (Table 1). The number of florets per spike varied from 7-17 as reported by Negi *et al.*, (1982) and Lal and Plant (1989). Producing spike with more florets happens because of less competitiveness among plants to obtain water, minerals, nutrients, and light (Azimi and Banijamali, 2019). A significant difference was observed in spike weight among the gladiolus varieties. The highest single spike weight 93.65 g was observed in BARI Gladiolus-5 followed by BARI Gladiolus-3 (78.65 g) whereas the lowest was in BARI Gladiolus-4 (66.7 g) (Table 1). In a previous trial conducted in Tista Meander Floodplain the spike weights of the BARI-released gladiolus ranged from 94.67-160 (Islam *et al.*, 2017). There was a non-significant difference observed for spike yield among the varieties of gladiolus. Though the yield of tested gladiolus varieties was high yielding, the maximum spike yield was found in BARI Gladiolus-4 (191009 piece spike ha<sup>-1</sup>) whereas the minimum spike yield from BARI Gladiolus-3 (174477 piece spike ha<sup>-1</sup>) (Table 1). The yield of different BARI gladiolus varieties varied from 175000-200000 sticks ha<sup>-1</sup> (Azad *et al.*, 2020). Ornamental plants show considerable diversity in their growth habits, colors, blooming structure, flower shape, and size (Pasha *et al.*, 2016).

Among the varieties, vase life varied from 7 to 9 days which was statistically non-significant. The maximum vase life (9 days) was observed in BARI Gladiolus-4 whereas the minimum vase life of 7 days was observed in BARI Gladiolus-5 during the growing period of 2018-19 and 2019-20 (Table 1). The results are in conformity with the findings of Singh *et al.*, (2018) and Azad *et al.*, (2020). The variation in vase life might be due to senescing behavior by producing higher amounts of ACC, ethylene-forming enzymes, and ethylene along with the genetic makeup of different varieties (Singh *et al.*, 2020).

### **Corm and cormel characteristics in gladiolus genotype**

The average data of the year 2018-19 and 2019-20 on corm production of three BARI-released gladiolus varieties are presented in Table 2. A statistically significant difference was observed in corm production. The number of corms produced per plant was the highest in BARI Gladiolus-4 (1.33). The lowest number of corms per plant 1.11 was found in BARI Gladiolus-5 (Table 2). The variation observed in corm production among the varieties might be due to differences in genetic construction as well as environmental variation (1.1-2.5 corm plant<sup>-1</sup>) was observed by Hossain *et al.*, 2011 in some genotypes. The breadth of corm showed significant differences among the gladiolus varieties which ranged from 18.33 to 23.21 cm. The highest corm diameter was observed in BARI Gladiolus-5 (23.31 cm) whereas the lowest was in BARI Gladiolus-4 (18.33) (Table 2). Similar findings were also reported by Kumar (2009) and Nalage *et al.*, 2019, who reported significant varietal differences in corm diameter in different genotypes of gladiolus.

**Table 2.** Average corm and cormel production as influenced by three gladiolus varieties (average of 2018-19 and 2019-20) at farm level

Variety	Corm plant <sup>-1</sup> (No.)	Breadth of corm (cm)	Wt. of corm (g)	Cormel plant <sup>-1</sup> (No.)	Wt. of single Cormel plant <sup>-1</sup> (g)	Corm yield (No. ha <sup>-1</sup> )
BARI Gladiolus-3	1.12 b	19.47 ab	69.44 c	76.83 a	15.01 b	205423 b
BARI Gladiolus-4	1.33 a	18.33 b	72.95 b	60.01 b	22.74 b	254322 a
BARI Gladiolus-5	1.11 b	23.31 a	81.71 a	78.75 a	45.35 a	211693 b
Level of significance	*	*	*	*	*	*
CV (%)	3.61	6.05	3.35	8.13	17.02	6.61

In a column, means having similar letter(s) are statistically similar and those having a dissimilar letter(s) differ significantly as per 0.05 level of probability; \*significant at p=0.05; NS = Non Significant

A statistically significant difference was observed among the gladiolus varieties in corm weight. The highest corm weight was found in BARI Gladiolus-5 (81.7 g) which was followed by BARI Gladiolus-4 (72.9 g) whereas the lowest in BARI Gladiolus-3 (69.44 g) (Table 2). The corm weight varied from 30-60 g in a varietal trail of gladiolus conducted in India (Sharma and Sharma, 1984) in consonance with the present investigation. The number of cormels plant<sup>-1</sup> showed a wide range (60.0 to 78.8) of variability. The highest number of cormels per plant was obtained from BARI Gladiolus-5 (78.8) which was closely followed by BARI Gladiolus-3 (76.8) whereas the lowest in BARI Gladiolus-4 (60.0). Difference in the number of cormels plant<sup>-1</sup> in gladiolus. A statistically significant difference was observed among the gladiolus varieties in the weight of a single cormel which ranged from (15.0 to 45.4 g). The maximum weight of a single cormel was observed in BARI Gladiolus-5 (45.4 g) (Table 2). Negi *et al.*, (1982) reported that cormel weight in gladiolus genotypes ranged from 5.2 to 17.0 g. A significant difference was observed among the gladiolus varieties for corm yield. The highest average corm yield of 2018-19 and 2019-20 was observed from BARI Gladiolus-4 (254322 piece ha<sup>-1</sup>) whereas the lowest (205423 piece ha<sup>-1</sup>) was in BARI Gladiolus-3 (Table 2). In an investigation, Khan *et al.*, 2012 mentioned that the corm yield of BARI Gladiolus-1 was 75000-120000 ha<sup>-1</sup>.

### Cost and return analysis

The cost and return of BARI-released gladiolus varieties were estimated from the average of two years' spike and corm yield considering the market values (Table 3). The highest total gross return (Tk. 2406215 ha<sup>-1</sup>), gross margin (Tk. 1402546 ha<sup>-1</sup>), as well as BCR (2.40), were observed in BARI Gladiolus-5 and the lowest gross return (Tk. 1837608 ha<sup>-1</sup>), gross margin (Tk. 833939 ha<sup>-1</sup>) as well as BCR (1.83) in BARI Gladiolus-3. Though the yield of BARI Gladiolus-5 was statistically similar to BARI Gladiolus-4, a higher gross return was found in BARI Gladiolus-5 due to the higher demand and market price of the flowering spike. Gross margin Tk. 216844-1005144 ha<sup>-1</sup> was found by Islam *et al.*, (2017) in a performance trial of different BARI-released gladiolus varieties.

**Table 3.** Cost and return analysis for cultivation of BARI Gladiolus varieties (average of 2018-19 and 2019-20) at farm level

Variety	Average spike yield (no. ha <sup>-1</sup> )	Average corm yield (no. ha <sup>-1</sup> )	Return (Tk. ha <sup>-1</sup> )		Total gross return (Tk. ha <sup>-1</sup> )	Variable cost (Tk. ha <sup>-1</sup> )	Gross margin (Tk. ha <sup>-1</sup> )	BCR
			Spike	Corm				
BARI Gladiolus-3	174477	205423	1221339	616269	1837608	1003669	833939	1.83
BARI Gladiolus-4	191009	254322	1623576	762966	2386542	1003669	1382873	2.38
BARI Gladiolus-5	181655	211693	1771136	635079	2406215	1003669	1402546	2.40

Market price: BARI Gladiolus-3 @ Tk. 7 spike<sup>-1</sup>, BARI Gladiolus-4 @ Tk .8.5 spike<sup>-1</sup>, and BARI Gladiolus-5 @ Tk. 9.75 spike<sup>-1</sup>, corm @ 3 Tk. piece<sup>-1</sup> (Islam *et al.*, 2017 reported the price of gladiolus varied from 2-6 Tk. spike<sup>-1</sup>).

## Conclusion

The results of the study over two years showed that BARI Gladiolus-4 provided the best spike and corm yield but the highest gross return and gross margin was observed in BARI Gladiolus-5 due to higher market price of spikes compared to other gladiolus varieties. The farmers of the Young Brahmaputra and Jamuna Floodplain in Bangladesh can be socio-economically benefited through the production of BARI Galdiolus-5 and BARI Galdiolus-4.

## Conflicts of Interest

The authors declare no conflicts of interest regarding publication of this paper.

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