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Impact of corm size and phosphorous on growth and floral characteristics of gladiolus (*Gladiolus grandiflorus*)

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Abstract. *Hossain TM, Pitol MNS, Mannan MA, Khan SAKU. 2021. Impact of corm size and phosphorous on growth and floral characteristics of gladiolus (*Gladiolus grandiflorus*). Asian J Agric 5: 90-97.* The present study was conducted to investigate the impact of corm size and phosphorus levels on the growth, flowering, corm, and cormel production of gladiolus (*Gladiolus grandiflorus* L.). The experiment was laid out in Randomized a Complete Block Design (RCBD) with three replications, three corm sizes, viz. S1 (31-40 g), S2 (21-30 g), S3 (10-20 g), and four phosphorus levels, viz. P0 (Control), P1 (200 kg ha^{-1} Triple Super Phosphate (TSP), P2 (300 kg ha^{-1} TSP), P3 (400 kg ha^{-1} TSP). The observations were recorded for various vegetative, floral, and corm parameters. Corm size significantly impacted plant height, number of leaves, number of tillers, size of the leaf, number of spikes, spike length, and number of florets. Corm size also significantly impacted all yield contributing characters and yield of corm and cormel. Large (S1) and medium-size (S2) corms were found superior to small-size (S3) corms concerning all the parameters. At 60 days after planting (DAP), the highest plant (83.53 cm), the maximum number of leaves (10.00), the utmost number of the tiller (3.00), the highest number of the spike (10.00), the largest spike (87.03 cm), the maximum number of floret (13.80), the greatest number of corm and cormel (154.67), the maximum size of corm (44.16 mm) and the highest weight (2,706.7 gm) of corm was obtained from the treatment combination of S1 (31-40 g) treated with P3 (400 kg ha^{-1}) TSP under this observation. The obtained result will guide the farmers on what types of planting materials and how much fertilizer to use to cultivate gladiolus commercially successfully.

Keywords: Corm, cormel, florets, floriculture, gladiolus, spike

INTRODUCTION

Floriculture is becoming a promising enterprise in Bangladesh. The economic importance of ornamentals has been increasing day by day. Gladiolus (*Gladiolus grandiflorus* L.) is an essential bulbous ornamental plant and queen amongst the flowers (Gil et al. 2000). It belongs to the family Iridaceae. It is believed to have originated in South Africa, but its cultivation in the Indian subcontinent began in the 19th century (Bose and Yadav 2003). Gladiolus occupies fourth place next to the tulips in the international cut flower trade (Ogale et al. 2005). It is highly priced for its bright, beautiful, and vivid colored flowers for garden displays such as beds, herbaceous borders, pots, and indoor ornamentation. The spike of gladiolus is viral in Bangladesh and used in different social and religious ceremonies. It has domestic and international markets, as no flower surpasses its beauty in the cut flower industry (Halevy et al. 2007). Their cultivation is getting popular for its striking colors occurring naturally in the stripes, dots, and splashed bicolored and multicolored florets. This flower has a longer shelf life than cut flowers. Their sweet inflorescence, various colors, and several pretty florets have made them gorgeous for spread use in the garden (Chandra et al. 2000). Moreover, the cut flower market continuously looks for alternatives to traditional genera such as rose, tuberose, marigold, and chrysanthemum. Bulbous flowers like gladiolus, tuberose, cyclamen, resurrection lily, spider lily, etc., make up a considerable part of the cut flower market.

Gladiolus is prized for its showy flowering stem and relative production case (Sarek et al. 2004). Still, Having elegance and long vase life of gladiolus, its value is increasing in our daily lives. Recently it has been viral in Bangladesh, and its demand is increasing daily. But modern technology of gladiolus production demands the production of healthy corms every year, which is essential for quality flower production. An insufficient supply of planting material is the major constraint in gladiolus farming (Malter 2005). Gladiolus is propagated mainly by its corms and cormels. The new corm produces several small cormels around it during its growth, serving as a future propagule source (Ginsburg 2003). Reports indicated that growth, flowering, and corm production in gladiolus are affected by various factors, of which size of the corm planted and chemical treatment of corms before planting essential play roles (Mohanty et al. 2004). The diameter and weight of corms have also influenced the yield and quality of cut flowers in gladiolus. Increased floret length and, thus, longer bloom life by planting large corms have been reported by Bankar and Mukhopadhyay (1980). Arora et al. (1992) reported better performance of large corms concerning corm and cormel production than smaller or medium ones. Several factors, such as agro-techniques, nutrition, phosphorus level, etc., influenced the productivity, quality of spikes, corms, and cormels production. So, it is imperative to deliver more evidence to the cultivators for higher productivity and quality. However, the number of spikes, corms, and cormels produced per plot was greatly influenced by corm size (Singh and Bijimol 2003). The growth, flowering, and yield of daughter bulbs in gladiolus have been affected by corm size. (Mukhopadhyay and Bankar 1986). The larger size of the corm benefits in obtaining good quality cut flowers and better land utilization for next crop production and quality (Sindhu and Verma 2007).

On the other hand, modification of growth and flowering of gladiolus due to phosphorous has been reported by many authors (Bose and Yadav 2003; Bleasdale 2004; Mohanty et al. 2004). The influence of corm and cormel growth by using different corms is also reported by Mukhopadhyay and Bankar (2003). Bhattacharjee (2004) observed increased vegetative growth, cormel production, and improved flowering using phosphorous. Halevy et al. (2007) and Ginsburg (2003) reported an increase in the yield and weight of corm and cormel due to phosphorous treatment. Some studies have been done in Bangladesh regarding the corm size and phosphorous effect. But research work is still lacking in the country, especially in the southwestern region. So, the present study was designed to determine the impact of corm and cormel size and phosphorous levels on gladiolus' growth and flower production.

MATERIALS AND METHODS

Field experiment

The study was conducted on the Khulna University campus, Khulna, Bangladesh, to investigate the effects of corm size and phosphorus levels on gladiolus' growth and floral characteristics. The experiment's locality has three distinct seasons: the monsoon or rainy season extending from May to October, the winter or dry season from November to February, and the pre-monsoon period or hot season from March to February April (Edris et al. 2009). The experimental plot was a medium-high land having proper drainage and irrigation facilities. The soil of the observed area was Sandy loam in texture under the Agroecological zone (AEZ) 13. The treatment details were as follows (Table 1). The two-factor experiment was laid out in Randomized Complete Block Design (RCBD) with three treatment replications.

Factor A and B expressed the corm size and phosphorus level, respectively. The land was divided into three blocks with 12 block treatment combinations at each block. The unit plot size was 1.5 m × 3.0 m, with a spacing of 50 cm × 30 cm. The corms and cormels used in the present study were collected from Gadkhali, Jhikorgacha, and Jessore.

Cultural practices

The land selected for the experiment was opened during mid-November 2016 and thoroughly prepared by several ploughings and cross ploughings with a power tiller followed by laddering to obtain a good tilth. The weeds and debris were removed from the field, and the soils were pulverized before final land preparation. The basal doses of manures and other fertilizers were applied during the final land preparation, and all types of fertilizer (Triple Super Phosphate-TSP, Mop-130 kg ha^{-1}, Zypsum-120 kg ha^{-1}, Cow dung 10 t ha^{-1}) were applied except urea. Urea was used at 30 days, 45 days, and 60 days of planting. The corms were planted at a depth of 6 cm in furrows maintaining a row-to-row distance of 50 cm and plant-to-plant distance of 30 cm. Weeding was done periodically whenever necessary. The soil was mulched with rice straw to conserve soil moisture. The experimental plots were irrigated weekly in the dry season during the plant growth following the sprinkler method. Two earthing up at 25 and 50 days of planting were done throughout the growing period. The gladiolus spikes were harvested at the tight bud stage when three basal flower buds showed color so that these may easily open indoors one by one (Bose and Yadav 2003). Corms and cormels were harvested when 25 percent of cormels had become brown, and the leaves also started yellowing (Webster 2002).

Data collection

Data on the following parameters were recorded from ten randomly selected plants as representatives of a unified plot and yield per plot where all the plants were considered. All the data were recorded at an interval of 15 days, from 15 days after planting (DAP) to 60 days after planting. Plant height was determined from the ground level to the large leaf's apex and expressed in centimeters. All the leaves, spikes, florets per spike and tillers were counted. The total number of corm and cormel was counted after harvest, and the mean was calculated at 180 DAP. The length and breadth of leaves, spikes, corms, and cormels were measured, and the means were calculated (at cm). The total weight of the corm and cormel per plot was calculated at 180 DAP, while the mean was in kilogram (kg).

Table 1. Treatments and combinations

Treatment	Combination	Treatment	Combination	Treatment	Combination
T1	S1 and P0	T5	S2 and P0	T9	S3 and P0
T2	S1 and P1	T6	S2 and P1	T10	S3 and P1
T3	S1 and P2	T7	S2 and P2	T11	S3 and P2
T4	S1 and P3	T8	S2 and P3	T12	S3 and P3

Note: S1 (31-40 g), S2 (21-30 g), S3 (10-20 g), P0 (Control), P1 (200 kg ha^{-1} (TSP), P2 (300 kg ha^{-1} TSP), P3 (400 kg ha^{-1} TSP)

Statistical analysis

The collected data for various characters were statistically analyzed using Statistical Tool for Agricultural Research (STAR) computer package program. The mean for all the treatments was calculated, and the F-test analyzed variance for each character. Duncan's New Multiple Range Test (DMRT) evaluated the difference between the treatment means at 1% or 5% probability wherever applicable.

RESULT AND DISCUSSION

Impact of corm size and phosphorous levels on plant height of gladiolus

Plant height was significantly influenced by corm size but no significant variation between the phosphorus level and the combination treatment of corm size with a phosphorous level regarding plant height. At different DAP, the taller plant (80.60 cm) was obtained from S1 (31-40 g), and the shorter plant (60.43 cm) was observed from S3 (10-20 g) (Table 2). That might be because the early emergence of the crop from a large corm and higher reserve food resulted in better growth and ultimately gave maximum plant height compared to the small corm. Similar results were found by Bankar and Mukhopadhyay (1980), Misra et al. (1985), Azad (1996), Gil et al. (2000), Singh et al. (2000), and Hossain et al. (2011) from their earlier experiments. However, the taller plant (70.87 cm and 83.53 cm) at 60 DAP was obtained from P3 (400 kg ha^{-1}) and S1xP3 (31-40 g with 400 kg ha^{-1}), where the shorter plant (68.67 cm and 59.73 cm) was obtained from the control (P0) and S3xP0 (10-20 g with 0 kg ha^{-1}) respectively (Table 2). Rabbani and Azad (1996) stated that large and medium corms were superior to small ones. Anil et al. (2000) and Bazwaja et al. (2001) reported that growth increased with increasing phosphorous doses.

Impact of corm size and phosphorus levels on the number of leaves of gladiolus

The number of leaves was significantly influenced by corm size, and there was no significant variation among the phosphorus level and combination treatments. The highest number of the leaf (9.83) was obtained from the plant grown from S1 (31-40 g), and the lower number (5.91) was recorded from S3 (10-20 g) (Table 3). Similar results were found by Gowda (1987), Mohanty et al. (1994), Kalasareddi et al. (1997), and Hossain et al. (2011). However, the highest number of the leaf at (8.33 and 10.00) was obtained from P3 (400 kg ha^{-1} TSP) and S1xP3 (31-40 g with 400 kg ha^{-1}). In contrast, the lower number of the leaf (7.56 and 5.67) at 60 DAP was obtained from P0 (the control) and S3xP0 (10-20 g with 0 kg ha^{-1}), respectively (Table 3).

Table 2. Impact of corm size and phosphorous levels on plant height of gladiolus

Corm size (cm)	Plant height(cm) at			
	15 DAP	30 DAP	45 DAP	60 DAP
S1	41.60 a	55.91 a	66.53 a	80.60 a
S2	34.09 b	43.50 b	54.53 b	67.03 b
S3	30.50 c	38.67 c	50.41 c	60.43 c
Level of significance	**	**	**	**
Level of phosphorous (kg ha^{-1})				
P0	34.66	45.31	56.87	68.67
P1	35.57	46.39	57.35	68.92
P2	35.64	46.60	57.38	68.88
P3	35.92	46.80	57.42	70.87
Level of significance	NS	NS	NS	NS
Treatment combination				
S1 P0	40.53	55.06	66.20	79.93
S1 P1	41.83	57.16	66.80	80.43
S1 P2	41.36	54.80	66.20	79.53
S1 P3	42.67	56.60	66.90	83.53
S2 P0	34.63	44.67	55.06	66.36
S2 P1	34.76	43.67	53.80	65.13
S2 P2	34.30	41.00	54.53	66.76
S2 P3	36.30	44.67	54.70	69.86
S3 P0	25.80	34.67	49.00	59.73
S3 P1	30.10	38.33	50.00	60.47
S3 P2	30.67	41.00	51.33	59.99
S3 P3	40.80	41.67	51.33	60.20
Level of significance	NS	NS	NS	NS
CV	9.41	7.76	3.78	4.02

Note: **: Significance 0.01, NS: non-Significant

Table 3. Impact of corm size and phosphorus levels on the number of leaves of gladiolus

Corm size (cm)	Number of the leaf at			
	15 DAP	**30 DAP**	**45 DAP**	**60 DAP**
S1	8.59 a	9.25 a	9.83 a	9.83 a
S2	7.00 b	7.58 b	7.83 b	7.91 b
S3	6.33 c	5.75 c	5.75 c	5.91 c
Level of significance	**	**	**	**
Level of phosphorous (kg ha^{-1})				
P0	6.77	7.11	7.44	7.56
P1	7.44	7.22	7.55	7.67
P2	7.44	7.77	8.00	8.00
P3	7.55	8.00	8.22	8.33
Level of significance	NS	NS	NS	NS
Treatment combination				
S1 P0	9.00	9.66	9.67	9.67
S1 P1	9.00	9.33	10.00	10.00
S1 P2	8.33	9.00	9.67	9.67
S1 P3	8.33	9.00	10.00	10.00
S2 P0	7.67	8.33	8.33	8.33
S2 P1	7.67	8.00	8.67	8.67
S2 P2	6.67	6.67	7.00	7.33
S2 P3	6.00	7.33	7.33	7.33
S3 P0	5.31	5.33	5.33	5.67
S3 P1	5.67	6.00	6.00	6.33
S3 P2	5.33	5.67	5.67	6.67
S3 P3	5.31	5.33	5.33	6.67
Level of significance	NS	NS	NS	NS
Cv	12.70	9.37	7.86	9.53

Note: **: Significance 0.01, NS: non-Significant

Impact of corm size and phosphorus levels on tiller number of gladiolus

Plants grown from large corms had the highest number of tiller (3.0), and the lowest number of tiller (1.92) was observed from small corms used as planting material (Table 4). That might be because the large corms were about four times larger than the small corm having more reserve food, which enhanced the vegetative growth quickly and resulted in a maximum number of tillers. Similar results were reported by Vinceljak-Toplak (1990). However, a highest number of tillers (2.44 and 3.00) was obtained from the P3 (400 kg ha^{-1} TSP) and S1xP3 (31-40 g with 400 kg ha^{-1}). In contrast, the lower number of tillers (2.22 and 1.67) was obtained from P0 (the control) and S3xP0 (10-20 g with 0 kg ha^{-1}) at 60 DAP, respectively (Table 4).

Impact of corm size and phosphorus levels on the number of spike gladiolus

The number of spikes was significantly influenced by corm size. At different DAPs, the highest (43.75) and lowest (23.00) number of the spike was obtained from the treatment S1 (31-40 g) and S3 (10-20 g), respectively (Table 5). Similar results were reported by Mukhopadhyay and Bankar (2003). At all the growth stages, the number of spikes increased with time advancement. However, a highest number of spikes (8.33 and 10.00) was obtained from P3 (400 kg ha^{-1} TSP) and S1xP3 (31-40 g with 400 kg ha^{-1}). In contrast, the lower number of spikes (7.56 and 5.67) were obtained from P0 (the control) and S3xP0 (10-20 g with 0 kg ha^{-1}) at 60 DAP, respectively (Table 5).

Effect of corm size and phosphorous levels on spike length of gladiolus

At 60 DAP, the large corm produced the highest spike length (84.80cm.), and the small corm produced the lowest spike (66.38) (Table 6). Similar results, i.e., the increased spike length due to large corm, were reported by Dod et al. (2007). However, no significant effect was observed due to the variation in phosphorus level. At all the stages of growth, spike length was increased with the advancement of time. Numerically, the longest spike (76.10cm) was obtained from P3 (400 kg ha^{-1} TSP). At the same time, the shortest spike (73.34cm) was obtained from P0 (the control) at 90 DAP. However, the maximum spike length (87.03cm) was observed in the treatment combination of large corms with 400 Kg/ha TSP, and the minimum spike (65.46cm) was obtained from the most undersized corms treated with the control (Table 6). Gil et al. (2000), Bhattacharjee (2001), and Makay et al. (2001) stated that spike length, floret number, flower diameter, and size and weight of corms increased with the increase in corm size.

Table 4. Impact of corm size and phosphorous levels on the number of tillers of gladiolus

Corm size (cm)	Number of the tiller at			
	15 DAP	30 DAP	45 DAP	60 DAP
S1	3.00 a	3.00 a	3.00 a	3.00 a
S2	2.00 b	2.00 b	2.08 b	2.08 b
S3	1.92 c	1.91 c	1.92 c	1.92 c
Level of significance	**	**	**	**
Phosphorous (kg ha^{-1})				
P0	2.22	2.22	2.22	2.22
P1	2.22	2.22	2.33	2.33
P2	2.33	2.33	2.33	2.33
P3	2.44	2.44	2.44	2.44
Level of significance	NS	NS	NS	NS
Treatment combination				
S1 P0	3.00	3.00	3.00	3.00
S1 P1	3.00	3.00	3.00	3.00
S1 P2	3.00	3.00	3.00	3.00
S1 P3	3.00	3.00	3.00	3.00
S2 P0	2.33	2.33	2.33	2.33
S2 P1	2.00	2.00	2.00	2.00
S2 P2	2.00	2.00	2.00	2.00
S2 P3	2.00	2.00	2.00	2.00
S3 P0	1.67	1.67	1.67	1.67
S3 P1	2.00	2.00	2.00	2.00
S3 P2	2.00	2.00	2.00	2.00
S3 P3	2.00	2.00	2.00	2.00
Level of significance	NS	NS	NS	NS
CV	12.89	12.89	10.55	10.55

Note: **: Significance 0.01, NS: non-Significant

Table 5. Impact of corm size and phosphorous levels on the number of spikes of gladiolus

Corm size (cm)	Number of the spike at			
	45 DAP	60 DAP	75 DAP	90 DAP
S1	10.00 a	26.33 a	38.17 a	43.75 a
S2	2.92 b	11.67 b	22.08 b	27.00 b
S3	2.42 c	9.83 c	18.08 c	23.00 c
Level of significance	**	**	**	**
Phosphorous (kg ha^{-1})				
P0	5.33	13.56	23.67	29.33
P1	5.33	15.67	24.78	29.89
P2	5.55	16.78	27.67	32.66
P3	6.22	17.77	28.33	33.11
Level of significance	NS	NS	NS	NS
Treatment combination				
S1 P0	9.33	21.33	33.33	40.33
S1 P1	6.67	25.67	37.33	43.00
S1 P2	10.67	27.00	38.67	43.33
S1 P3	13.33	31.33	43.33	48.33
S2 P0	4.67	10.00	19.67	25.33
S2 P1	3.33	13.33	22.67	27.00
S2 P2	2.97	12.00	23.67	28.33
S2 P3	2.83	11.33	22.33	27.33
S3 P0	2.89	9.33	18.00	22.33
S3 P1	2.00	8.00	14.33	19.67
S3 P2	2.07	11.33	20.67	26.33
S3 P3	1.97	10.67	19.33	25.67
Level of significance	NS	NS	NS	NS
CV	48.96	35.69	26.79	20.84

Note: **: Significance 0.01, NS: non-Significant

Table 6. Impact of corm size and phosphorous rate on spike length of gladiolus

Corm size (cm)	Spike length (cm)
	90 DAP
S1	4.80 a
S2	2.77 b
S3	6.38 c
Level of significance	**
Phosphorous (kg ha^{-1})	
P0	73.34
P1	74.16
P2	74.99
P3	76.10
Level of significance	NS
Treatment combination	
S1 P0	85.06
S1 P1	84.53
S1 P2	82.57
S1 P3	87.03
S2 P0	72.70
S2 P1	71.40
S2 P2	72.00
S2 P3	74.97
S3 P0	65.46
S3 P1	66.57
S2 P2	66.46
S3 P3	66.30
Level of significance	NS
CV	74.65

Note: **: Significance 0.01, NS= non-Significant

Effect of corm size and phosphorous levels on the number of florets of gladiolus

At 90 DAP, the highest (13.30) and lowest (10.39) number of floret was obtained from S1 (31-40 g) and S3 (10-20 g), respectively (Table 7). The present results are in agreement with the findings of Bhattacharjee (2001), Dod et al. (2007), and Gowda (2008), who obtained a highest number of florets per spike in plants grown from a large corm. At all the stages of growth, the number of florets increased with time. However, numerically the maximum number of floret (11.83) was obtained from the P3 (400 kg ha^{-1}). On the other hand, the minimum number of floret (11.41) was obtained from P0 (the control). Moreover, the combined effect of corm size and phosphorus level was insignificant.

Effect of corm size and phosphorous levels on the number of corm and cormel of gladiolus

The corm size significantly influenced the number of corm and cormel. At 180 DAP, the highest (144.50) and lowest (77.17) number of corm and cormel were observed from the treatment of S1 and S3, respectively (Table 8). The present finding is in agreement with the reports of Hong et al. (1989), Vincetjak-Toplak (1990), and Ogale et al. (2005). However, the result showed that the highest number of corm and cormel (113.11, 154.67) was obtained from the P3 (400 kg ha^{-1} TSP) and S1xP3 (31-40 g with 400 kg ha^{-1}) where the lowest (83.22, 67.33) were obtained from P0 (the control) and S3xP0 (10-20 g with 0 kg ha^{-1}) at 180 DAP, respectively (Table 8).

Table 7. Impact of corm size and phosphorous levels on the number of florets of gladiolus

Corm size (cm)	Number of florets at
	90 DAP
S1	3.30 a
S2	1.17 b
S3	0.39 c
Level of significance	**
Phosphorous (kg ha^{-1})	
P0	11.41
P1	11.53
P2	11.69
P3	11.83
Level of significance	NS
Treatment combination	
S1 P0	13.80
S1 P1	13.20
S1 P2	12.97
S1 P3	13.80
S2 P0	11.00
S2 P1	11.10
S2 P2	11.06
S2 P3	11.50
S3 P0	10.20
S3 P1	10.73
S3 P2	10.20
S3 P3	10.20
Level of significance	NS
CV	5.52

Note: **: Significance 0.01, NS: non-Significant

Table 8. Impact of corm size and phosphorous on the number of corm and cormel

Corm size (cm)	Number of corm and cormel at
	180 DAP
S1	44.50 a
S2	0.67 b
S3	7.17 c
Level of significance	**
Phosphorous (kg ha^{-1})	
P0	83.22
P1	98.78
P2	108.00
P3	113.11
Level of significance	NS
Treatment Combination	
S1 P0	151.67
S1 P1	133.67
S1 P2	138.00
S1 P3	154.67
S2 P0	72.00
S2 P1	48.67
S2 P2	82.00
S2 P3	106.00
S3 PO	67.33
S3 P1	67.33
S3 P2	76.33
S3 P3	78.67
Level of significance	NS
CV	42.22

Note: **: Significance 0.01, NS: non-Significant

Table 9. Impact of corm size and phosphorous rate on the size of corm of gladiolus

Corm size (cm)	Size of corm (cm) at	
	Length	Breath
S1	2.83 a	0.90 a
S2	6.90 b	3.95 b
S3	5.93 c	3.58 c
Level of significance	**	**
Phosphorous (kg ha^{-1})		
P0	39.27	37.36
P1	38.83	36.22
P2	38.42	35.54
P3	37.70	35.44
Level of significance	NS	NS
Treatment combination		
S1 P0	44.16	42.40
S1 P1	42.93	41.57
S1 P2	42.57	40.27
S1 P3	41.67	39.37
S2 P0	33.90	31.80
S2 P1	35.47	32.23
S2 P2	37.50	34.63
S2 P3	40.87	37.13
S3 P0	33.77	37.90
S3 P1	34.70	32.83
S3 P2	35.30	31.43
S3 P3	33.97	32.16
Level of significance	NS	NS
CV	9.67	9.95

Note: **: Significance 0.0, NS: non-Significant

Table 10. Impact of corm size and phosphorous levels on the weight of corm of gladiolus

Corm size (cm)	Weight of corm (gm) at
	180 DAP
S1	2505.80 a
S2	1287.50 b
S3	1162.5 c
Level of significance	**
Phosphorous (kg ha^{-1})	
P0	1316.70
P1	1594.40
P2	1846.70
P3	1850.00
Treatment combination	
S1 P0	2583.30
S1 P1	2333.30
S1 P2	2400.00
S1 P3	2706.7
S2 P0	1266.7
S2 P1	750.20
S2 P2	1333.3
S2 P3	1800
S3 P0	866.7
S3 P1	1006.87
S3 P2	1050.00
S3 P3	1033
Level of significance	NS
CV	44.96

Note: **: Significance 0.01, NS: non-Significant

Effect of corm size and phosphorous rate on the size of corm of gladiolus

Corm size significantly influenced the size of the corm. The longest number of sizes of corm (42.83 mm) was found in the plant grown from a large corm. On the other hand, the shortest corm size (35.93 mm) was discovered when a small corm was used as planting material (Table 9). The present experimental results regarding the size of the corm agree with the findings of Singh and Singh (1998). However, there was no significant variation between the phosphorus level and the combined treatment regarding the size of the corm.

Effect of corm size and phosphorous levels on the weight of corm of gladiolus

Corm size significantly influenced the weight of the corm. At 180 DAP, the maximum weight of the corm (2,505.80 g) was obtained from the plant grown from a large corm. On the other hand, the minimum weight of the corm (1,162.50 g) was observed when a small corm was used as planting material (Table 10). The increased weight of corms from large corms was probably due to the stored food materials present during planting, which contributed towards better vegetative growth and higher corm weight. Misra et al. (1985) also reported similar results. However, the highest weight of the corm (1,850 gm) was obtained from the treatment P3 (400 kg ha^{-1}). In contrast, the lowest weight of the corm (1,316 .80 gm) was obtained from the P0. Moreover, the maximum weight of corm (2706.7 gm) was observed in the treatment combination of large corm treated with 400 Kg/ha TSP, and the minimum weight of corm (866.7 gm) was obtained from the most undersized corms treated with the control (Table 10). Prakash et al. (2008) found the maximum production using phosphorus in 500 kg/ha, whereas Auge (1982) found 300 Kg/ha TSP and 600 Kg/ha TSP by Roychoudhuri et al. (1985). Mukhopadhyay and Bankar (1986) and Nilimesh and Roychowdhury (1989) obtained tremendous results from 500 Kg/ha TSP.

In conclusion, the experiment results revealed that corm size significantly influenced all parameters studied, and no significant effect was observed due to variation in phosphorus level and combined treatment. Plant height, spike length, and the number of leaves, florets, tillers, corm, and cormel were significantly increased with the increase in the size of the corm and the advancement of time. This result will be helpful for those farmers who are interested in plants gladiolus for commercial cultivation. However, there are some significant limitations to our study. We did not consider how production changes with temperature, rainfall, and seasonal changes. More extensive research is needed to successfully obtain the desired results from the commercial cultivation of gladiolus.

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