EFFECT OF CULTIVAR AND SOWING DEPTH ON GROWTH AND YIELD OF SUMMER GLADIOLUS

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*This is to certify that thesis entitled, **"EFFECT OF CULTIVAR AND SOWING DEPTH ON GROWTH AND YEILD OF SUMMER GLADIOLUS"**submitted to the Department of Horticulture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE (MS) in HORTICULTURE**, embodies the result of a piece bonafide of research work carried out by, **NAHIDA AFROSE** Registration No. **10-03803** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.*

I further certify that such help or source of information, as has been availed of during the course of this investigation has duly been acknowledged.

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ABSTRACT

The experiment was conducted at the Horticultural Farm of Sher-e-Bangla Agricultural University, Dhaka during the period from April to October 2015. The experiment consisted of two factors. Factor A: three types of sowing depth: $D_{1=}$ 4cm; D_2= 8cm; D_3= 12cm and Factor B: three types of cultivar: V_1= White;V_2= Yellow;V_3= Pink gladiolus, respectively. The experiment was laid out in Randomized Complete Block Design with three replications. Depth of sowing and different cultivars showed significant variance on most of the parameters. In case of sowing depth, the highest yield of spike (3,52,593/ha) and corm (11.19 t/ha) was recorded from D_2 and the lowest yield of spike (2,52,963/ha) and corm (7.98 t/ha) from D_3. For cultivar, the highest yield of spike (3,24,938/ha) and corm (14.49 t/ha) was obtained from V_1 and lowest yield of spike (2,80,741/ha) and corm (9.29 t/ha) from V_3. For combined effect, the highest yield of spike (3,62,222/ha) and corm (10.75 t/ha) was found from D_2V_1 and the lowest spike (1,92,222/ha) and corm (7.24 t/ha) from D_1V_3. The highest benefit cost ratio (1.61) was noted from D_2V_1 and lowest (1.43) from D_3V_3. So, sowing of white cultivar in 8 cm depth was found best for growth, flowering and yield of gladiolus.

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LIST OF ABBREVIATED TERMS

ABBREVIATIONS	FULL WORD
%	Percent
@	At the rate
AEZ	Agro Ecological Zone
ANOVA	Analysis of variance
BARI	Bangladesh Agricultural Research Institute
cm	Centi-meter
CV%	Percentage of Coefficient of Variation
cv.	Cultivar (s)
df	Degrees of Freedom
DMRT	Duncan’s Multiple Range Test
et al.	And others
etc.	Etcetera
j.	Journal
LSD	Least significant difference
m2	Square meter
Max.	Maximum
ml/L	Milliliter per liter
°C	Degree Celsius
ppm	Parts Per Million
R.H	Relative Humidity
SAU	Sher-e-Bangla Agricultural University
TSP	Triple Super Phosphate
	Viz.
	Namely

CHAPTER I

INTRODUCTION

Gladiolus (*Gladiolus grandiflorus*) is a herbaceous and one of the most popular cultivated bulbous cut flower. It is also perennial and important ornamental flowering crop. It is known as "Sword Lily" for its sword like leaves structure and popularly known as gladiolus. It has more than one hundred and fifty known species and 260 genus (Negi*et al*., 1982). This cut flower is native of South Africa belongs to family Iridaceae and also found in Eurasia. It was introduced into cultivation at the end of the 16th century and mostly famous for its different colors (Parthasarathy and Nagaraju, 1999).Gladiolus occupies fourth place in the international cut-flower trade (Bhattacharjee and De, 2010). The chief producing countries are the United States, Holland, Australia, Japan, Italy, France, Iran, India, Brazil, Poland, China, Malaysia and Singapore (Memon *et al.,* 2009).

Gladiolus was introduced in Bangladesh in 1985.The agro-ecological conditions of the country are very conducive and suitable for its survival and culture as a cut flower. Gladiolus is grown as bedding flower in gardens and used as cut flower for interior decoration for its long vase life and attractiveness (Lepcha *et al*., 2007). Although it has ornamental value but also gladiolus have extensively utilized in medicines for headache, lumbago, diarrhea, rheumatism and allied pains (Bhattacharjee and De.,2010).Commercial cultivation of gladiolus is gaining popularity in Bangladesh mainly extended only in few districts such as Jessore, Jenaidah, Rajshahi, Savar and Dhaka. Khan (2009) reported that the flower production area appears to have increased significantly and estimated area of around 10,000 ha and the annual trade at wholesale level to be worth between 500-1000 million taka in Bangladesh. Momin

(2006) reported that income fromgladiolus flower production is six time higher than returns from rice and other cereal crops.

Production and supply of gladiolus flower in summer or rainy summer is very limited due to adverse weather conditions and transportation problem. But, there is a good scope of producing gladiolus flower round the year if there was maintaining the sowing depth, time and cultivar was reported by Ara *et al.* (2003).Gladiolus is mainly cultivated in winter season but quality flower and corm production are little bit difficult in summer season due to heavy rainfall as well suitable cultivar. The flower spike and corm yield in gladiolus vary according to the cultivar, corm size, sowing density and management practices etc. Gladiolus spikes take 60 to 100 days after sowing to be harvested depending upon the cultivars and time of year (Jenkins *et al.,*1970). Uddin *et. al*. (2015) studied twelve gladiolus cultivars that have yellow gladiolus cultivar was found very suitable for commercial production in Bangladesh.

The gladiolus can be propagated by seeds and corms but commercially it is grown by corms. The corm can be sown in different depth. The sowing depth depends on varieties, bulb size, depth of ploughed layer, moisture content of the soil and climatic conditions. It also influence the emergence period (Farrag, 1994). Sowing depth has also been found useful in improving the growth, flowering and quality of flowers (Hagiladi *et al*., 1992). It was reported that sowing depth for corms distance from surface to top is 3-10 cm in gladiolus while these depth will vary under different conditions of sowing time, soil type and corm size (De Hertogh and Nard, 1998). Mane *et al*. (2003) reported that the diameter of spike, number of florets per spike and length of rachis depended on the corm sowing depth.

Bhattacharjee (1981) founded the excellence of lower spikes and corms were enhanced as sowing depth increased. Feriz *et al.*(2003) considered that 8 cm sowing depth produced significantly superior results in case of growth, flowering and corms production of gladiolus.

In Bangladesh the commercial gladiolus production is limited in summer season whereas in other countries it is cultivated throughout the year. Heavy rainfall and germination failure or delay germination due to heavy rain in summer season one of the major problems of gladiolus cultivation in summer season. But the demand of cut flowers specially gladiolus is increasing day by day in summer season whereas the supply is very scanty. So there is a good scope to gladiolus production by maintaining the proper sowing depth and cultivar in summer season that improving the growth and yield of flowers and corms.

Considering the above facts, the present experiment was undertaken to find out the following objectives -

i. to find out the best cultivar and corm sowing depth for germination, growth and flowering of gladiolus;
ii. to find out the best combination of cultivar and sowing depth in summer season for ensuring the growth and yield of gladiolus.

CHAPTER II

REVIEW OF LITERATURE

2.1. Review related to different cultivarson production of gladiolus

Uddin *et al*. (2015) studied twelve gladiolus cultivars that were V1, Almond; V2, Purple; V3, Orange; V4, White; V5, Pink; V6, Orange bi-color; V7, Crimson; V8, Yellow ; V9, Red; V10, Sweet bi-color; V11, Light lavender and V12, Whitish pink gladiolus. Significant variation were found in spike length, spike diameter, chlorophyll percentage, fresh weight, number of floret, basal floret diameter, cumulative petal area, single floret weight and vase life. V8 showed the best result among all characters, except V4. V8 gladiolus cultivar was found very suitable for commercial production in Bangladesh.

Bashir (2015) evaluated the performance of four gladiolus cultivars, introduced from Egypt namely, White knight, Golden field, White prosperity and Rose supreme under Khartoum state conditions. The performance of the cultivars was evaluated in terms of vegetative characters (emergence %, days to emergence, number of leaves and leaf length), floral characters (days to flowering, length and fresh weight of inflorescence, inflorescence stalk diameter, number of florets per inflorescence and vase life of inflorescence), and reproductive characters (number and weight of corms and cormels). The cultivar White knight was superior in the vegetative characters over the other three cultivars. Better floral characters were associated with the cultivars White knight and Golden field than White prosperity and Rose supreme cultivars. The cultivar Rose supreme showed better reproductive characters than the other three cultivars. The overall performance of the cultivarsindicated that White knight was the best followed by Golden field, Rose supreme and then White prosperity.

Chourasia *et al. (*2015) studied of ten gladiolus cultivars for cultivation. Maximum plant height (122.87 cm) was recorded in ‘Poppy Tear’. ‘American Beauty’ produced maximum number of leaves per plant (11.57). Red Majesty was recorded maximum leaf length (69.33 cm). ‘White Prosperity’ recorded maximum days to sprouting of corm (26.73), leaf width (4.60 cm), spike length (99.80 cm) and rachis length (67.80 cm). ‘Red Beauty’ required maximum, number of days to first spike emergence (114.40), diameter of daughter corm (3.37 cm),weight of daughter corm (61.01 g). ‘Candiman’ was recorded the maximum spike diameter (1.230 cm), floret neck diameter (1.97 cm), diameter of floret (15.50 cm), longest duration of flowering (24.00), number of florets per spike (23.73), number of spikes per plant (1.87), number of corms per plant (1.80), number of cormels produced per plant (98.00) and weight of the cormels (96.61). It was concluded that cultivar ‘Candiman’ was found best for cultivation under Saurashtra region of Gujarat in terms of growth, flowering, spike yield and corm yield characters.

Naresh*et al.* (2015) tested of eight gladiolus hybrids as against an adopted cultivar. Plant height and leaf area at maturity was recorded at maximum in the hybrid White Prosperity as compared to other hybrids and check cultivar. White Prosperity produced the longest spikes, however per plot spike yield was highest (63.46) in the hybrid Darshan followed by White Prosperity (52.26) as against the check cultivar Dhiraj (42.93).

Priya (2014) experimented fourteen treatments (Ac No. 7, American Beauty, Arun, Arka Amar, Arka Gold, Arka Naveen, Bindya, Darshan, Dhiraj, Sadabahar, Suchitra, Swarnima, Sylvia, Tilak). Maximum leaf numbers per plant, leaf length and leaf width was recorded in cv. Bindya (9.46, 58.33 cm, 3.79 cm). Significant variations were observed for floral characters, among all cultivars, cv. Bindya (52.20,59.67, 63.67 days), Ac. No 7 (54.73, 58.53,63.80 days) and Swarnima (55.53, 60.67, 63.67, 67.73 days) were found early to spike initiation, first floret to show colour and first floret to open. Cultivars Swarnima (13.40) and Arka Amar (13.00) produced more number of florets spike. Maximum diameter of first floret was noticed in cultivar Arka Gold (12.37 cm) and Bindya (12.27 cm). With regard to corm parameters maximum number of corms plant was recorded in cultivar American Beauty (2.60) and Arka Amar (2.47) where as cultivar Arka Amar (34.33) produced more number of cormels plant followed by American Beauty (28.20). The maximum weight of corms plant and diameter of corm was observed in cv. Bindya (126.13 g, 7.71 cm respectively).The weight of cormels was highest in cultivar Sylvia (40.69 g) and Arka Amar (38.45 g).

Shaukat *et al.* (2013) evaluated five cultivars of Gladiolus namely Amsterdam, Applause, Fidelio, Peter pears and Priscilla for their adoptability and performance. Results on vegetative characteristics showed that cultivars Applause and Amsterdam took less number of days for sprouting. Results on floral characteristics showed that cultivar Applause and Peter pears were earlier for spike emergence and maximum florets, Priscilla and Peter pears took minimum days to flowering, Applause obtained maximum spike length and Peter pears remained attractive for longer time. Results on corm and cormels characteristics showed that Peter pears produced more corms, Applause produced maximum cormels and maximum corm size and weight was recorded in Fidelio. From the results concluded that keeping in view the vegetative and reproductive characteristics Applause, Peter pears and Fidelio were recommended for general cultivation.

Sankar *et al.*(2012)evaluated that Pusa Shagun' and 'Pusa Swarnima' recorded quality spikes with higher vase life, while, 'Thumbolina', 'Priscilla' and 'Candyman' were found superior in characters like corm number, corm weight and corm diameter. Taking into account various growth and floral characters, Pusa Swarnima, Pusa Shagun, Thumbolina, Priscilla and Candyman can be recommended for cut-flower production in the Eastern Ghats of Tamil Nadu.

Uddin *et al*. (2011) experimented the performance of nine different germplasm (G_1=Red,G_2=yellowish orange,G_3=Pink with white streak,G_4=Mauve violet,G_5=Red with yellow spot,G_6=Yellow with orange stripe,G_7=White,G_8=Golden Yellow and G_9=Lime Yellow) of gladiolus those are commercially cultivated in Bangladesh. Thetallest plants were produced by the G_9 (134.2cm) (Lime yellow) germplasm followed by G_8 (127.4cm) (white) and G_7 (124.7cm) (golden yellow).However, the G_7 and G_8produced the highest floret number (12.6) which was statistically identical with G_9(11.4).

Akpinar *et al*. (2011) determined the effect of plantation time (10, 20 and 30 June) on plantgrowth and floret quality of four commercial cultivars of *Gladiolus* (White Prosperity, Amsterdam, Nova Lux and Victor Gorge.As the result of the study, 20 June was found to be the most suitable plantation time when consideredsprouting and spiking time and White Prosperity was the best cultivars. The largest length belongs to White Prosperity, while the lowest was Nova Lux and plantation time did not affect plant length significantly ($p < 0.01$). White Prosperity was the best cultivar for floret number and harvesting time (84.24 days) when June 10 was considered to be the best plantation time.

Sheikh*et al*. (2011) evaluated the stability performance of (10) elite cultivars for important floral traits (floret spike and spike length) across 5 random locations (environments) revealed that mean square deviation from regression was non-significant except for 'Apple Blossom', 'Moralla' and 'Sancere' for florets, spike and for spike length in all the cultivars except 'Friendship Pink' and 'Peter Pears' and hence prediction for stability was precise and reliable. The linear regression was non-significant for floret, spike revealing that most of the cultivars except 'Apple Blossom' and 'Big Time Supreme' were average in stability. Comparing their performance with the mean it was observed that 'Jackson Villa Gold', 'Peter Pears', 'Trader Horn', 'White Prosperity' and 'Yellow Stone' were well adapted to favorable environments only.

2.2. Review related to corm sowing depth on production of gladiolus

Daneshvar *et al.* (2009) conducted an experiment to control the effect of sowing depth in 3 levels (7.5, 10 and 12.5 cm), corm peeling in 2 levels (with or without peeling), and the use of livestock manure in 2 levels (with or without manure), also the foliage application of micronutrients in 2 levels (with or without fertilizer) on the length and number of florets of Gladiolus cut flower. Results showed that in the first year of the culture, the number of florets moderately decreased when the peeled corms were cultured in 7.5 cm depth with micronutrients as well as livestock manure used. The highest number of florets was obtained when non-peeled corms were cultured in 10 cm depth: neither organic manure nor micronutrients were used. Also, peeled corms, with the increased sowing depth (10 and 12.5 cm) using livestock manure but not using micronutrients negatively impressed the height of flowering stem. The highest height of cut flower was detected when non-peeled corms were cultured in 7.5 cm depth, using livestock manure farther micronutrients.

Afrin *et al.* (2007) conducted the fact of spacing and depth of sowing on the improvement, flowering and yield of Gladiolus. The experiment studied of two factors. Factor A: spacing (3 levels) i.e. S_1 (25 cm x 10 cm), S_2 (25 cm x 15 cm), S_3 (25 cm x 20 cm) and Factor B: depth of sowing (3 levels) i.e. D_1 (5cm), D_2 (7 cm), D_3 (9 cm). The highest (8.71t/ha) yield of spike encounter from the deepest depth and minimum (7.96 t/ha) from intermediate depth. The maximum (5.91 t/ha) yield of corm was found from the deepest depth and minimum (5.75 t/ha) from intermediate depth. The maximum (5.75 t/ha) yield of cormel was found from the shallowest depth and minimum (3.94 t/ha) come across from deepest depth. The maximum (1817915 t/ha) gross yield, maximum (1036029 t/ha) net yield and maximum (2.33) benefit cost ratio all were found from the treatment combination of closest spacing and shallowest depth.

Peanav *et al*. (2005) carried out to identify the fact of four levels of GA_3 (0, 100, 250 and 500 ppm), three plant spacing (20 × 20, 30×20 and 40 × 20 cm) and two depths of corm sowing (5 and 10 cm) on production, flowering and corm production parameters in gladiolus cv. Candyman. Gibberellic acid @ 100 ppm, plant spacing of 30x 20 cm and sowing depth of 10 cm favor maximum plant height, number of leaves/plant, length of leaf and corm yielding.

Feriz *et al.* (2003) considered the effects of sowing depth (4, 8, 12, 16 and 20 cm) on growth, flowering and cormels production of white and pink gladiolus cultivars. Increasing sowing depth delayed sprouting and caused a significant decrease in emerging percent. The depth of sowing also affected flowering time but had no effect on stem and inflorescence length and florets numbers. A vital decrease in number of collected cormels at the end of growing season was appeared as the sowing depth increased. Considering all assessed factors the best results was obtained at the sowing depths of 8 and 12 cm.

Uddin *et al.* (2002) considered on the growth and flowering of gladiolus cv. Friendship using the combination of four corm sizes (15, 10, 5 and 3 g) and three sowing depths sowing (10.0, 7.5 and 5.0 cm). The combined effect of corm size and depth of sowing had significant effect on all the parameters considered except number of spikelets per plant. The highest plant height (97.56 cm), number of leaves (62.33), length of flower stalk (26.07 cm) and lodging of plants (33.14%) in the treatment combination of large sized corm planted at 5.0 cm depth and the lowest in the treatment partnership of very small corm with 10 cm depth.

Incalcaterra (1992) carried out the effects of specific sowing density (75, 100, 125 and 150 cormels /mq) and sowing depth (2, 4, 8, 16 and 20 cm) on corm production. Sowing depth of 16 and 20 cm had a negativepossessions on corm production. The highest yield and corms of outstanding were obtained employing sowing density of 125 cormels/mq and sowing depth of 8 cm.

Vinceljak (1990) carried out an experiment to search the effects of sowing depth and sowing density on gladiolus corm production. Cormels were seeded at a depth of 2, 4, 8, 16 or 20 cm. It was found that sowing depth of 16 and 20 cm gave noticeably decrease yields than lower sowing depth. The best practice partnership for higher yield and excel quality was sowing at a depth of 8 cm.

Syamal *et al.* (1987) considered the effect corm size, sowing distance and depth of sowing on increase and flowering of gladiolus. They initiate that large corm (4-5 and 5-6 cm in broadness) gave prior sprouting and elevated inflorescence and stem length. On the more hand, sowing separation (20 x 25, 30 x 25, or 40 x 25 cm) and depth of sowing had ineffective on equal number and size of individual flowers. They reported that corm size, sowing distance and depth of sowing had no interaction effect on original parameters thoughtful.

Mattos, *et al.* (1984) recorded that the reproduction of gladiolus approach individually depth of sowing. Sowing depth of 7.3 cm was best for mother corms for the yielding of corms over the line “Jumbo” up to type 5.They also disclosed that a depth of 5.6 cm was correct for generating massive quantities of cormels.

Mattos *et al.* (1983) implanted gladiolus corms of cultivars Hawaii, Snow Princess, Han Van Meegeren, Alfred Nobel, Aristocart, Happy End and Rosa De Lima at 5 or 15 cm depth obscure red lactose of high potency. They realized that sowing at 15 cm depth broadly gave correct results and sowing at 5 cm lead to extra lodging.

Iziro and Hori (1983) attended that at sowing depth of 15 and 30 cm, the contractiles of gladiolus prolonged on a small scale but showed a little thickening. On the alternative hand, at the rule depth of 5 cm, they expanded, thickened and contracted thoroughly. Corm improvement find planned poor at 30 cm really at 15 cm despite poor increase of contractile roots.

Bhattacharjee (1981) researched the possessions of corm size, sowing depth and spacing. Corms were implanted at a depth of 5, 7 or 9 cm. The excellence of lower spikes and corms were enhanced as sowing depth increased.

Konoshima (1980) studied the effect of sowing depth and soil shelter at original stages on the inactivity and influence of gladiolus corms in Japan. Corms at 5, 10, 15, 20 or 30 cm extent were implanted .The deeper implanted corms (20 or 30 cm) sprouted roughly 8 days preceding than the above-mentioned from the shallower implanted corms and 12 days prior than these adult outwardly. It was also build that party load of corms was heavier from deeper implanted corm than from the others.

Bankar *et al*. (1980) experimented with gladiolus cv. ‘Friendship, the originally involving 3 depths of sowings and 3 spacing, while the promote involving 3 corm sizes, 3 depth of sowings and 3 spacing. It was attended that longer corms enlarged the height of plants vastly rather. Increased sowing density bear briefer rachis, less number and small-sized florets. In one of the experiments wider distribute reorganized the agreement capacity of flowers lower field circumstances. Shallow flowering increased while deep raising diminished the number of cormels composed per flower. The communication between wider distribute and shallow flowering composed rather heavier cormels as opposed to deep sowing.

CHAPTER III

MATERIALS AND METHODS

3.1. Experimental site:

The experiment was conducted at the Horticultural farm of Sher-e-Bangla Agricultural University, Dhaka, Bangladesh during the period from April 2015 to October 2015.The location of the experiment site is situated in 23°74́ N latitude and 90°35́ E longitude. (Anon, 1989)

3.2. Climatic condition

The climate of the experimental site is subtropical. The experiment of gladiolus cultivation is characterized by three distinct seasons, the monsoon and rainy season extending from May to October, winter or dry season from November to February and the pre-monsoon period or hot season from March to April. The present study was carried out during rainy season from April to October which characterized by hot and rainy weather that were collected from the Bangladesh Meteorological Department (climate division), Agargaon, Dhaka and have been presented in Appendix I.

3.3. Soil

The soil of the experimental fields are belongs to the Madhupur Tracts under AEZ No.28. The land topography of the experimental field was medium high and soil texture was silt clay with pH 6.9. The morphological characters of the soil of the gladiolus have been presented in Appendix-II.

Plate 1. Experimental plot

3.4. Experimental details

3.4.1.Sowing material

Corms of gladiolus were used as sowing materials that were collected from Agritech Nursery, Khamarbari, Farmgate, Dhaka.

3.4.2.Treatments of the experiment

The experiment consists of two factors:

1. Factor A: Sowing depth of corm
   - Treatments: 4cm (D_1)
     8cm (D_2)
     12cm (D_3)
2. Factor B: Cultivars
   - Treatments: White flower (V_1)
     Yellow flower (V_2)
     Pink flower (V_3)

There were 9 (3×3) treatment combinations such as D_1V_1, D_1V_2, D_1V_3, D_2V_1, D_2V_2, D_2V_3, D_3V_1, D_3V_2, D_3V_3.

3.4.3. Experimental design and layout

My experiment was laid out in a Randomized Complete Block Design (RCBD) with 3 replications. Each block was divided into 9 plots. Thus, there were 27 (9×3) unit plots. Each unit plot was 15 plants. The plot size was 75cm×60cm. The plot to plot distance 50cm and block to block distance 50cm. The plots were raised up to 15cm.

3.4.4. Land preparation

The experimental plot was first ploughed by a power tiller and it was done for several times. The clods were broken until a good tilth. The weeds were collected before final landpreparation.

a **b**

c **d**

Plate 2. a) 4cm sowing depth of gladiolus b) 8 cm sowing depth of gladiolus

c) 12cm sowing depth of gladiolus d) corm sowing

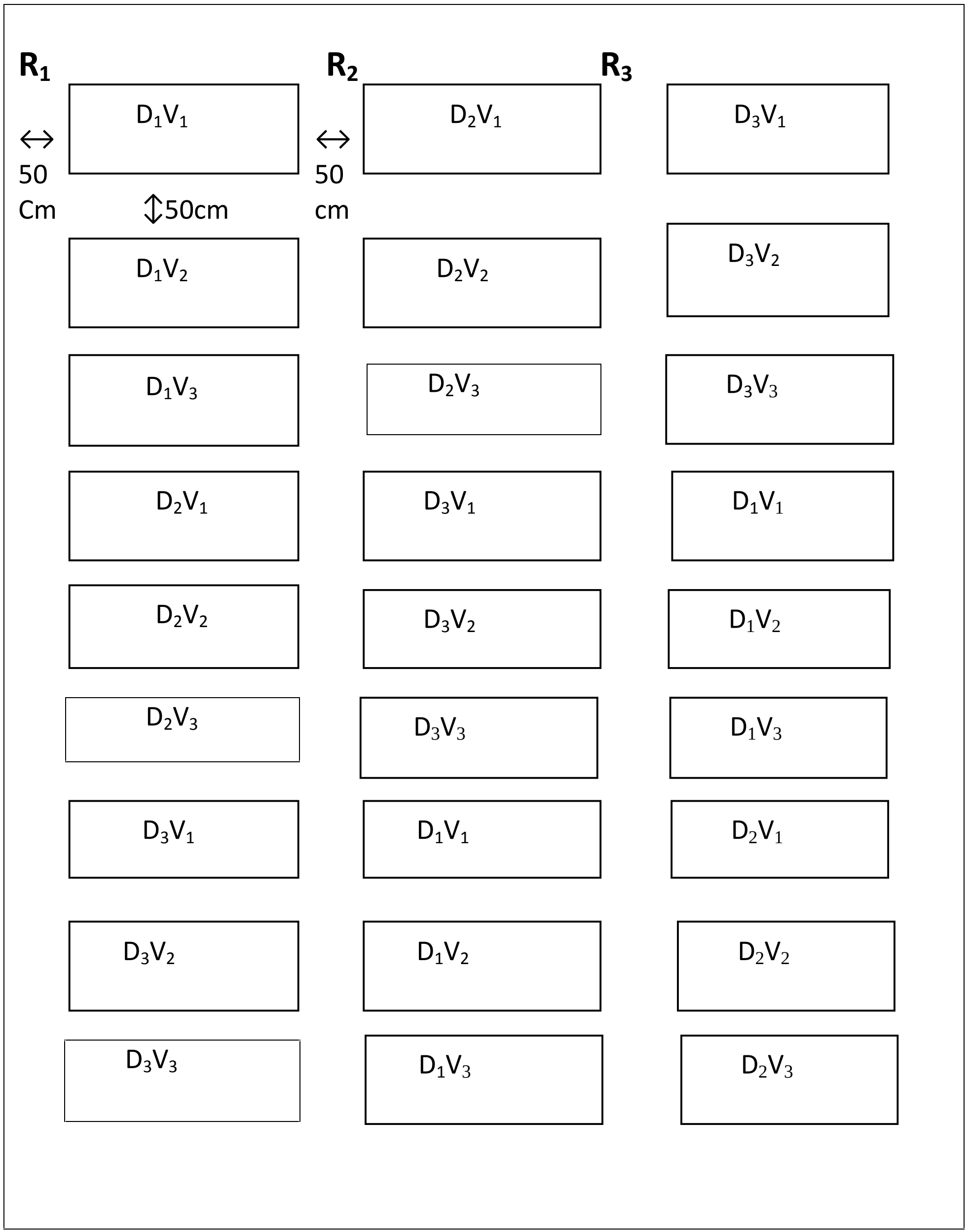
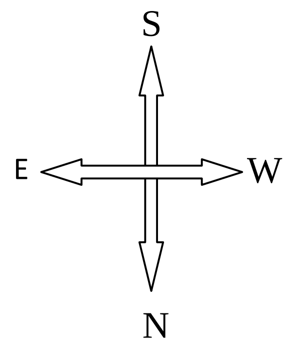


Fig 1: Layout of the experiment



Legend

Plot size=75cm×60cm

Plant-Plant distance=15cm

Row-Row distance=20cm

Block-Block distance=50cm

Plot-Plot distance=50cm

Total corm=15×27=405

Factor A:

Sowing depth of corm

4cm (D_1)

8cm (D_2)

3.4.5. Application of manure and fertilizers

The crop was fertilized with proper doses of manures and fertilizers.The following doses are recommended in areport of BARI-

Cowdung	1.5 t/ha
Urea	300kg/ha
TSP	375kg/ha
MP	300kg/ha

All amount of Cowdung and TSP were applied during final land preparation.

Urea and MP were applied in two installments at spike emergence.

3.4.6. Sowing of corms

Corms were planted at 4cm, 8cm, 12cm depth in the plot on 23 April, 2015 with sufficient care for minimum injury of corms. The plant to plant distance 15cm and row to row distance 20cm was maintained. Total corm was 405.

3.4.7. Intercultural Operation

After emerging the seedlings in the field, it was always kept careful observation. Various interculture operations, weeding, irrigation, diseases and pest control was accomplished for better growth and development of gladiolus seedlings.

3.4.7.1. Weeding

Weeding was done to keep free the weed from field that were easy to air movement, which ensure the better growth and development. It was periodically done by hand.

3.4.7.2. Irrigation and drainage

Adequate watering in the field was depended upon the soil moisture in the plot. Stagnant water in the field was avoided and drained out the heavy rain water**.**

3.4.7.3. Disease and pest management

No pesticide was needed for diseases and pest management in the experimental plot.

3.4.8. Data collection

Data were collected in the following parameters from each plot due to the mentioned period.

3.4.8.1. Days to sprouting

It was achieved by counting the days to sprouting of plants from the sowing date of corms.

3.4.8.2. Plant height (cm)

The plant height was measured from ground level up to the tip of growing point. It was measured in centimeter(cm).Data was collected at 10 days interval from 30 days after sprouting (DAS) to 60 DAS.

3.4.8.3. Numbers of leaves per plant

All leaves were counted of each experimental plots at 10 days interval from 30 DAS to 60 DAS. Data was recorded as average of all plant leaves .

3.4.8.4. Days required to spike emergence

It was achieved by recording the days of spike emergence of gladiolus from each unit plot.

3.4.8.5. Days required to first flowering

It was achieved by recording the days of first flowering of gladiolus spike from each unit plot.

3.4.8.6. Spike length (cm)

It was measured in centimeters. Spike length was recorded from 25 cm above of the internode to fourth leaf up to the tip of spike.

3.4.8.7. Chlorophyll content (%) of leaf

Chlorophyll (%) of leaf was recorded by Spadometer.

3.4.8.8. Number of spike plant^{-1}

Number of spike was measured from each plant. Then average value was taken.

3.4.8.9. Number of spike plot^{-1}

Number of spike per plot was calculated from number of spike per plot obtained from each plot in each replication and mean value was recorded.

3.4.8.10. Number of spike ha^{-1}

Yield of spike per hectare was calculated from number of spike per plot was collected and converted in hectare.

3.4.8.11. Leaf area (cm^2)

The leaf area(cm^2) was measured byusing the CL-202 Leaf Area Meter by destructive method. Single mature leaves were randomly selected.

3.4.8.12. Cumulative petal area (cm^2)

Cumulative petal area was measured from randomly selected flower and expressed in millimeters per square.

3.4.8.13. Diameter of floret (cm)

Diameter of first floret in each spike was measured and expressed in centimeters.The average value was taken.

3.4.8.14. Number of floretspike^{-1}

Total number of floret in each gladiolus spike was counted and mean value was calculated.

3.4.8.15. Number of corm plant^{-1}

Number of corm per plant was calculated from each plant and average value were taken.

3.4.8.16. Number of corm plot^{-1}

Number of corm per plot was calculated from number of corm per plot obtained from each plot in each replication and mean value was recorded.

3.4.8.17. Individual corm weight (g)

It was determined by weighting the individual corm from each plot and mean value was calculated in gram.

3.4.8.18. Yield of corm ha^{-1}

Total yield of corm per hectare was calculated from total corm per plot was converted in kilogram and then in ton per hectare.

3.4.8.19. Number of cormel plant^{-1}

Number of cormel per plant was calculated from each plant and average value were taken.

3.4.8.20. Number of cormel plot^{-1}

Number of cormel per plot was calculated from number of cormel per plot obtained from each plot in each replication and mean value was recorded.

3.4.8.21. Individual Cormel weight (g)

It was determined by weighting the individual cormel from each plot and mean value was calculated in gram.

3.4.8.22. Yield of cormel ha^{-1}

Total yield of cormel per hectare was calculated from total cormel per plot was converted in kilogram and then in ton per hectare.

3.5. Statistical analysis

Gathered datahave been statistically analyzed by the use of Statistics-10 computer package programme. The mean value for each treatmentshave been calculated and analysis of variance for each one among characters changed into performed by way of F–test(Variance Ratio).Distinction between remedies became assessed through Least Significance Difference (LSD) test at 5% level of importance.

3.6. Economic analysis

The cost of production was turned into analyzed with the intention to discover the maximumeconomictreatment of sowing depth and cultivar. All input cost had been considered in computing the cost of production. The market price flower, corm and cormels were taken into consideration for estimating the return. The benefit cost ratio (BCR) changed into calculated as followed:

$$\text{Benefit cost ratio} = \frac{\text{Gross returns per hectare (tk)}}{\text{Total cost of production per hectare (tk)}}$$

CHAPTER IV

RESULTS AND DISCUSSION

4.1. Days to sprouting

Different kind of cultivar had not significant role of days to sprouting of gladiolus (Table 1). White cultivar(V_1) was required lowest days (13.79 days) to sprouting whereas the highestdays was required for yellow (V_2) and pink (V_3) cultivarsuch as 14.22 days and 14.44 days, respectively (Appendix III).These result is similarity with Bashir (2015) and Chourasia *et al*. (2015).

Days to sprouting was considerably influenced by 3 types sowing depth of gladiolus (Table 2). The highest days was recorded for sprouting in D_3 (17.78 days) at 12 cm depth whereas the lowest days was recorded for D_1 (10.35 days) as following as 8 cm depth D_2 (14.33 days). This result is related with Incalcaterra (1992) and Feriz *et al*. (2003) who reported that increasing sowing depth delayed sprouting and caused a significant decrease in emerging percent.

Days to sprouting wassignificantly influenced by the interaction of sowing depth and cultivar (Table 3).The highest days was 19.33 for sprouting of gladiolus that was observed in D_3V_2 where the lowest days (10.33) was recorded in $D_1V_1$and D_2V_1that is nearest to D_1V_1 (Table 3).

Table 1: Individual effect of cultivar on days to sprouting

Treatment	**Days to sprouting**
V_1	13.79 a
V_2	14.22 a
V_3	14.44 a
$LSD_{(0.05)}$	**0.67**
CV%	**4.76**

In a column, means with same letter (s) are not significantly different by LSD at 5% level of significance
V_1: White gladiolus; V_2: Yellow gladiolus; V_3: Pink gladiolus

Table 2: Individual effect of sowing depth on days to sprouting

Treatment	**Days to sprouting**
D_1	10.35 c
D_2	14.33 b
D_3	17.78 a
$LSD_{(0.05)}$	**3.51**
CV%	**4.76**

In a column, means with same letter (s) are not significantly different by LSD at 5% level of significance
D_1: Sowing depth 4cm ; D_2: Sowing depth 8cm;D_3: Sowing depth 12

Table 3: Combined effect of sowing depth and cultivar on days to Sproutingof Gladiolus

Treatment	Days to sprouting
D_1V_1	10.33 e
D_1V_2	10.37 e
D_1V_3	10.40 e
D_2V_1	13.67 d
D_2V_2	14.67 d
D_2V_3	14.67 d
D_3V_1	16.33 c
D_3V_2	19.33 a
D_3V_3	17.67 b
$LSD_{(0.05)}$	**0.67**
CV%	**4.76**

In a column, means with same letter (s) are not significantly different by LSD at 5% level of significance

D_1: Sowing depth 4cm V_1: White gladiolus

D_2: Sowing depth 8cm V_2: Yellow gladiolus

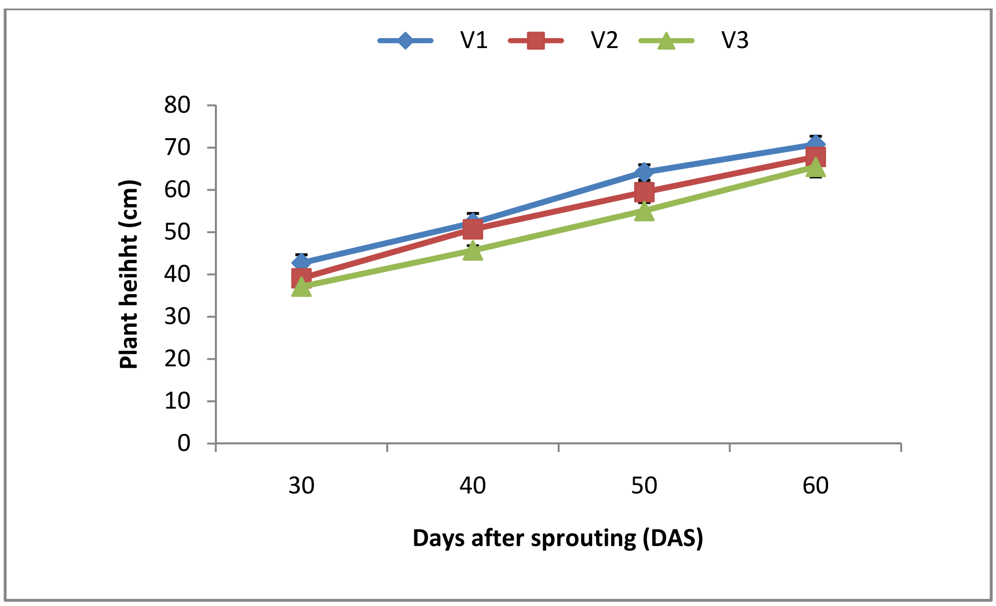
D_3: Sowing depth 12 cm V_3: Pink gladiolus

4.2. Plant height

Plant height was significantly influenced by different cultivars of gladiolus (Figure 2).Plant height was gradually increased in V_1 (42.73, 52.21, 64.14 and 70.75 cm at 30, 40, 50 and 60 DAS) cultivarwhereas the lowest height (39.07, 50.62, 59.44 and 67.74 cm at 30, 40, 50, 60 DAS) was observed in yellow (V_2) and pink (V_3) cultivar (37.10, 45.69, 55.01and 65.41 cm at 30, 40, 50, 60 DAS), respectively (Appendix III). Naresh *et al.* (2015) and Uddin*et al*. (2011) suggested that plant height of gladiolus recorded maximum in white cultivar than other cultivar.

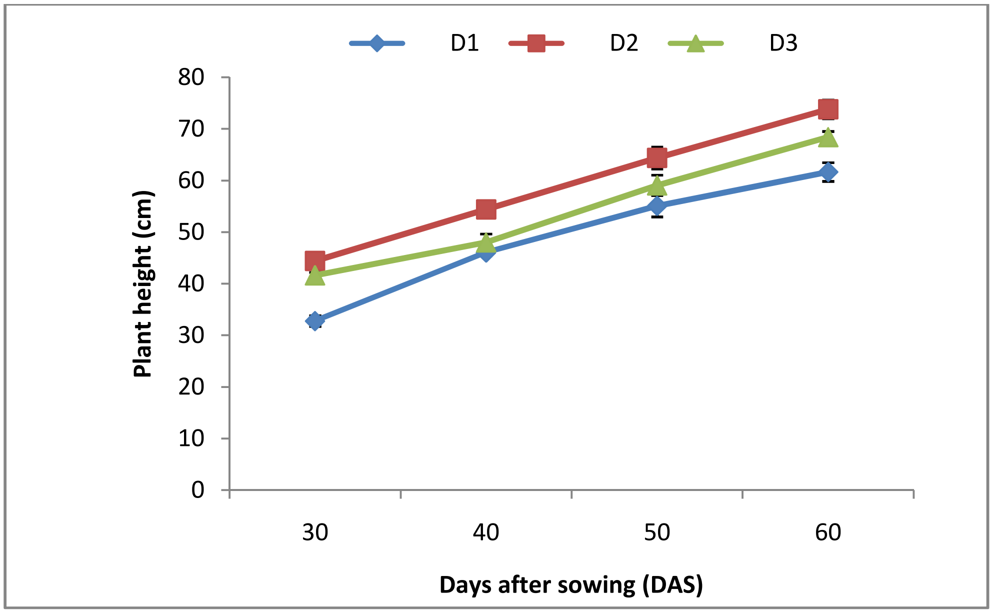
Different depth of sowing showed statistically significant variation on plant height of gladiolus at different days after sowing (Figure 3). At 60DAS, the longest plant height (73.81 cm) was observed in D_2 (8 cm sowing depth) and shortest plant height (61.67 cm) was observed in D_1 (5 cm sowing depth) that was as similar as (68.43 cm) in D_3 (12 cm sowing depth) at the same DAS, individually (Appendix III). Feriz *et al.* (2003) and Incalcaterra (1992) reported that 8 cm sowing depth gave the best result in case of plant height because it is the optimum depth.

Combined effect of different sowing depth and cultivar showed statistically significant variation in points of plant height at different days after sowing. The tallest plant height (77.23 cm) was observed in D_2V_1 at 60 DAS where the smallest plant height (58.10 cm) was observed in D_1V_3 at the same DAS, respectively(table 4).



V_1= White gladiolus, V_2= Yellow gladiolus, V_3= Pink gladiolus

Fig 2: Cultivar performance of gladiolus on plant height at different days after sowing



D_1=Sowing depth 4 cm, D_2= sowing depth 8 cm, D_3= Sowing depth 12 cm

Fig 3: Effect of sowing depth on plant height at different days after sowing

Table 4: Combined effect of sowing depth and cultivar on plant height of gladiolus at different days after sowing (DAS)

Treatment	Plant height (cm)			
	30DAS	40DAS	50DAS	60DAS
D_1V_1	36.55 e	38.77ef	60.25 bc	65.17 cd
D_1V_2	31.71 f	47.84 cd	54.61 cd	61.73 de
D_1V_3	30.15 f	45.78 de	50.48 d	58.10 e
D_2V_1	49.45 a	59.44 a	69.71a	77.23 a
D_2V_2	44.75 b	54.54 b	63.48ab	72.78 ab
D_2V_3	39.12 d	49.28 c	59.95 bc	71.40 abc
D_3V_1	42.18 c	52.58 b	62.45 abc	69.85 bc
D_3V_2	40.75 cd	49.48 c	60.21 bc	68.70 bc
D_3V_3	42.05 c	42.01 f	54.61 cd	66.73 bcd
$LSD_{(0.05)}$	**2.56**	**2.77**	**8.73**	**6.95**

CV %	3.77	3.26	8.55	5.96

In a column, means with same letter (s) are not significantly different by LSD at 5% level of significance

D_1: Sowing depth 4cm V_1: White gladiolus
D_2: Sowing depth 8cm V_2: Yellow gladiolus
D_3: Sowing depth 12 cm V_3: Pink gladiolus

4.3. Number of leaves per plant

Numbers of leaves per plant was showed statistically significant variation in points of different cultivar at different 30,40,50, 60 DAS (Figure 4). At 60 DAS, the maximum leave numbers per plant (7.32) was recorded in white cultivar (V_1), as followed as 7.16 which in yellow cultivar (V_2) and the minimum leave numbers (6.93) was recorded in pink cultivar (V_3), respectively (Appendix IV). Bashir (2015) reported that the maximum leave numbers was showed in white cultivar.

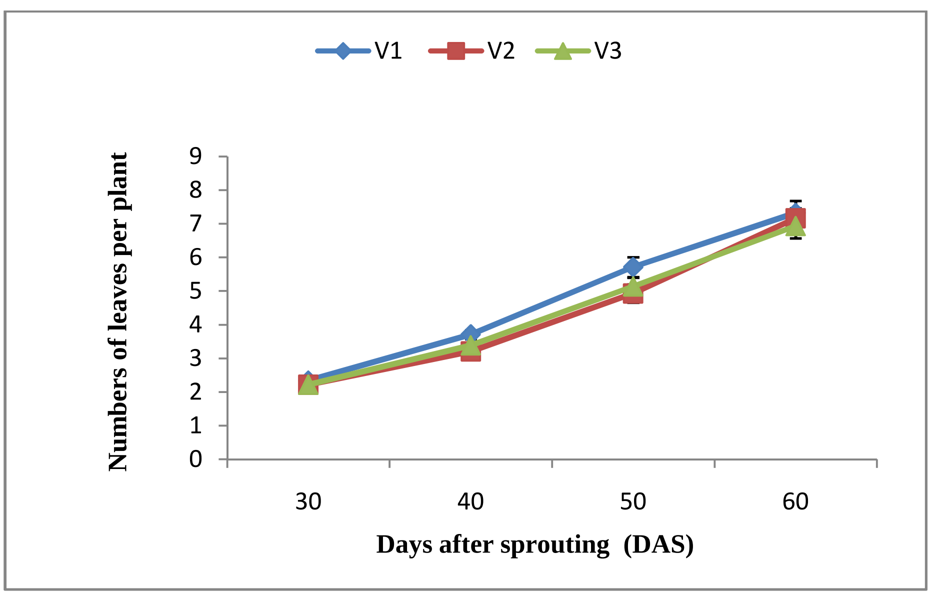
Statistically significant variation was showed in terms of numbers of leaves per plant at different days after sowing (Figure 5). The maximum leaves numbers (8.08) was counted in D_2 (8 cm sowing depth) at 60 DAS, which was followed (7.37) by D_3 and the minimum leaves number (5.96) was counted by D_1 at the same 60 DAS. Afrin (2007) did not agree with the result of the present findings.

Combined effect between sowing depth and cultivar showed statistically significant variation in terms of numbers of leaves per plant of gladiolus at 30,40,50,60 DAS (Table 5). The maximum leave numbers per plant (8.25) was recorded from D_2V_1 at 60DAS, whereas the minimum numbers (5.90) was found from D_1V_1 and D_1V_3 at same DAS, respectively (Appendix IV).

4.4. Days required to spike emergence

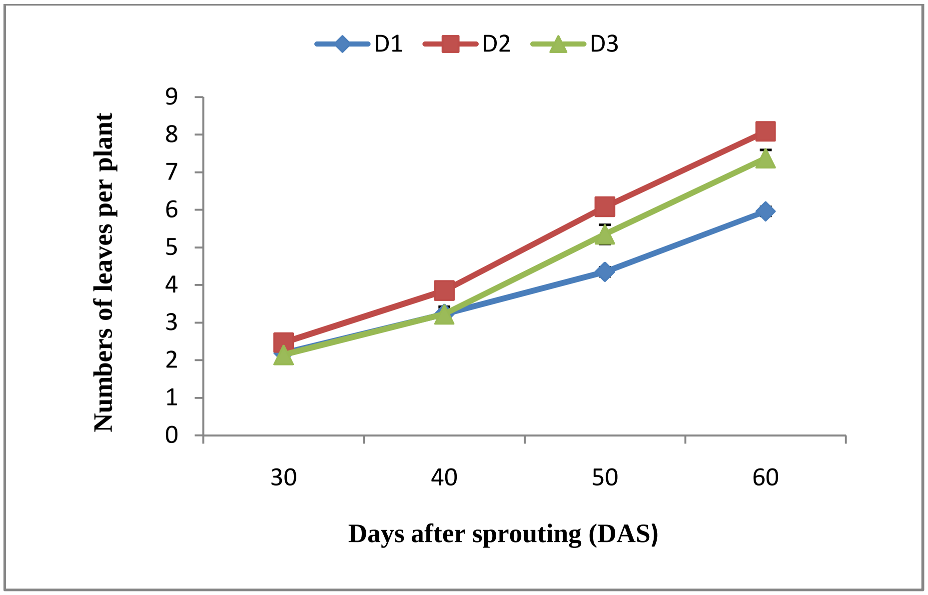
Statistically significant variation was showed in terms of days from sowing to emergence of spike of gladiolus due to different cultivar (Table 6). The maximum days (37.78) was recorded for spike emergence of gladiolus in pink cultivar (V_3), as followed as (36.33) in yellow cultivar (V_2) and the minimum days (34.88) was recorded in white cultivar (V_1) (Appendix IV). These results similar of Akpinar*et al*. (2011) who also observed that sowing tospike emergence required minimum days in white cultivar.

Days required from sowing to emergence of spike of gladiolus showed statistically significant variation for different sowing depth (Table 7). The maximum days (38.88) was required for sowing to emergence of spike from D_1, which was statistically similar (37.11) with D_3 and the minimum days (33.00) was found from D_2 (Appendix IV). Vinceljak (1990) reported that 8 cm sowing depth of corm given the early spike emergence of gladiolus.



V_1= White gladiolus, V_2= Yellow gladiolus, V_3= Pink gladiolus

Fig 4: Cultivar performance of gladiolus on numbers of leaves per plant at different days after sowing



D_1= sowing depth 4cm, D_2= sowingdepth 8 cm, D_3= Sowingdepth 12 cm

Fig 5: Effect of sowing depth on numbers of leaves per plant at different days after sowing

Table 5: Combined effect of sowing depth and cultivars on numbers of leaves per plant of gladiolus at different days after sowing (DAS)

Treatment	Numbers of leaves per plant			
	30DAS	**40DAS**	**50DAS**	**60DAS**
D_1V_1	2.07 b	3.13 c	4.09 f	5.90 d
D_1V_2	2.20 b	3.17 c	4.25 ef	6.07 d
D_1V_3	2.29 b	3.38 c	4.70 d	5.90 d
D_2V_1	2.80 a	4.53 a	6.30a	8.25 a
D_2V_2	2.13 b	3.30 c	5.98 b	8.13 a
D_2V_3	2.12 b	3.20 c	6.13 ab	7.87a
D_3V_1	2.17 b	3.87 b	5.20 c	6.63c
D_3V_2	2.33 b	3.16 c	4.56 de	7.29b
D_3V_3	2.27 b	3.17 c	6.12 ab	8.18a
$LSD_{(0.05)}$	**0.31**	**0.37**	**0.31**	**0.42**
CV%	**8.05**	**6.37**	**3.44**	**3.45**

In a column, means with same letter (s) are not significantly different by LSD at 5% level of significance

D_1: Sowing depth 4cm V_1: White gladiolus
D_2: Sowing depth 8cm V_2: Yellow gladiolus
D_3: Sowing depth 12 cm V_3: Pink gladiolus

Combined effect of sowing depth and cultivar showed statistically significant variation in points of days required from sowing to emergence (Table 8). The maximum days (39.67) required in D_1V_3 from sowing to emergence of gladiolus and the minimum days (31.00) required for D_2V_1, respectively (Appendix IV).

4.5. Days required to first flowering

Statistically significant variation was observed for first flowering due to different cultivar (Table 6). The longest days (43.56) was required for first flowering of gladiolus in V_3 (pink cultivar) and the shortest days (41.00) was recorded for first flowering in V_1 (white cultivar) that was as similar as (42.11) in V_2 (yellow cultivar) (Appendix IV).Bashir (2015) who evaluated that white cultivar superior to the floral characters of gladiolus.

In terms of days to first flowering, gladiolus showed statistically significant variation due to different sowing depth (Table 7). The shortest days (38.33) was observed for first flowering in 8cm sowing depth (D_2) while the longest days (47.00) was observed in 4 cm sowing depth (D_1) for first flowering that was similar to (41.33) 12 cm sowing depth (D_3) (Appendix IV). Feriz *et al.* (2003) suggested that sowing depth effected the flowering time of gladiolus.

Combined effect between different sowing depth and cultivar showed statistically significant variation for first flowering of gladiolus. They are not statistically similar (Table 8). The highest days (48.67) was observed in D_1V_3 for first flowering and the lowest days (37.00) was observed in D_2V_1, respectively (Appendix IV).

Table 6: Cultivar performance on days required to spike emergence, days required to first flowering and spike length of gladiolus at different days after sowing (DAS)

Treatment	Days required to spike emergence	Days required to first flowering	Spike length(cm)
V_1	34.88 b	41.00 b	81.75 a
V_2	36.33 ab	42.11 b	78.14 b
V_3	37.78 a	43.56 a	75.43 c
$LSD_{(0.05)}$	**2.33**	**1.34**	**1.03**
CV%	**6.49**	**3.22**	**1.32**

In a column, means with same letter (s) are not significantly different by LSD at 5% level of significance
V_1: White gladiolus; V_2: Yellow gladiolus; V_3: Pink gladiolus

Table 7: Effect of sowing depth on days required to spike emergence, days required to first flowering and spike length of gladiolus at different days after sowing (DAS)

Treatment	Days required to spike emergence	Days required to first flowering	Spike length(cm)
D_1	38.88 a	47.00 a	69.52 c
D_2	33.00 b	38.33 c	88.06 a
D_3	37.11 a	41.33 b	77.73 b
$LSD_{(0.05)}$	**2.33**	**1.35**	**1.03**
CV%	**6.49**	**3.22**	**1.32**

In a column, means with same letter (s) are not significantly different by LSD at 5% level of significance
D_1: Sowing depth 4cm; D_2: Sowing depth 8cm; D_3: Sowing depth 12 cm

Table 8: Combined effect of sowing depth and cultivars on days required to spike, emergence, days required to first flowering and spike length of gladiolus at different days after sowing (DAS)

Treatment	Days required to spike emergence	Days required to first flowering	Spike length(cm)
D_1V_1	38.00 ab	45.00 b	73.12 f
D_1V_2	39.00 ab	47.33 ab	69.26 g
D_1V_3	39.67 a	48.67 a	66.20 h
D_2V_1	31.00 d	37.00 e	92.19 a
D_2V_2	33.00 cd	38.00 de	87.98b
D_2V_3	35.00 bcd	40.00 cd	84.02 c
D_3V_1	35.67 abc	41.00 c	79.95 d
D_3V_2	37.00 abc	41.00 c	77.17 e
D_3V_3	38.67 ab	42.00 c	76.06 e
$LSD_{(0.05)}$	**4.04**	**2.33**	**1.78**
CV%	**6.49**	**3.22**	**1.32**

In a column, means with same letter (s) are not significantly different by LSD at 5% level of significance

D_1: Sowing depth 4cm	V_1: White gladiolus
D_2: Sowing depth 8cm	V_2: Yellow gladiolus
D_3: Sowing depth 12 cm	V_3: Pink gladiolus

4.6. Spike length (cm)

Spike length of gladiolus was statistically significant with the cultivar (Table 6). The longest spike (81.75 cm) was observed in V_1 (white cultivar) and the shortest spike (75.43 cm) was founded in V_3 (pink cultivar) (Appendix IV). The result found under the present study was similar with the findings of Naresh *et al.*(2015).

The effect of sowing depth on spike length of gladiolus showed statistically significant influence (Table 7). The maximum spike length (88.06 cm) was recorded in D_2 (8 cm), whereas the minimum spike length (69.52 cm) was recorded in D_1 (4 cm) (Appendix IV). Daneshvar (2009) and Afrin (2007) suggested the sowing depth of gladiolus corm 7.5cm or 7cm that is nearest to 8cm where Uddin *et al.* (2002) not agreed with this kind of sowing depth.

Combinedeffect between sowing depth and cultivar of gladiolus showed statistically significant influenced for spike length of gladiolus (Table 8 and plate 6). The highest spike height (92.19cm) was found in D_2V_1 combination whereas the lowest spike height (66.20 cm) was found in D_1V_3 combination(Appendix IV).

4.7. Chlorophyll content (%) of leaf

Significant differences were noticed on chlorophyll content (%) of leaf by using different cultivar (Appendix IV). The highest chlorophyll content (%) of leaf (56.13) was recorded in V_1 (white cultivar) and the lowest chlorophyll content (%) of leaf (48.44) was found in V_3 (pink cultivar) that was similar (50.53) in V_2 (yellow cultivar) (Table 9). Bashir (2015) suggested that white cultivar superior for chlorophyll content (%) of leaf.

The sowingdepth of corm showed significant variation on chlorophyll content (%) of leaf (Table 10). The higher chlorophyll content (%) of leaf (60.27) was recorded in 8 cm sowing depth of corm (D_2) and the lower chlorophyll content (%) of leaf (45.36) was recorded in 4 cm sowing depth (D_1) that was statistically similar (49.48) (Appendix IV).Feriz *et al*. (2003) agreed with this result.

Combined effect between sowing depth and cultivar of gladiolus was statistically significant on the basis of chlorophyll content (%) on leaf (Table 11). The highest chlorophyll content (%) (70.52) was in D_2V_1 and the lowest chlorophyll content (%) (44.57) was in D_1V_3, (Appendix IV).

73.12 69.26 66.20 92.19 87.98 84.02 79.95 77.17 76.06

D_1V_1 D_1V_2 D_1V_3 D_2V_1 D_2V_2 D_2V_3 D_3V_1 D_3V_2 D_3V_3

Plate 3.Influence of Sowing depth and cultivar onspike length of gladiolus

4.8. Spikes plant^{-1}

Number of spikes per plant of gladiolus showed statistically significant variation due different cultivar of gladiolus (Appendix V).The highest spikes per plant (1.03) was observed and the lowest spikes per plant (0.87) was observed in V_3 (Table 9).Chourasia *et al. (*2015) agreed with the result.

Statistically significant variation was recorded in number of spikes per plant of gladiolus due to different sowing depth of corm (Appendix V). The maximum number of spikes per plant (1.06) was recorded in D_2 and the minimum number of spikes per plant (0.80) was found in D_3 (Table 10). Bhattacharjee (1981) researched spike excellence enhanced with the sowing depth increased.

Combined effect of sowing depth and different cultivar of corm showed statistically significant variation in terms of spike per plant (Table 11).The maximum spikesper plant (1.09) was observed in D_2V_1 whereas the minimum spikes (0.58) was recorded in D_3V_3 per plant (Appendix V).

Table 9: Cultivar performance on chlorophyll content (%), spikes plant^{-1}, spikes plot^{-1}, spikes ha^{-1} of gladiolus at different days after sowing (DAS)

Treatment	Chlorophyll content(%) of leaf	Spikes plant^{-1}	Spikes plot^{-1}	Spikes ha^{-1}
V_1	56.13 a	1.03 a	14.62 a	324938 a
V_2	50.53 b	0.97 b	14.53 a	322963 a
V_3	48.44 b	0.87 c	12.63 b	280741 b
$LSD_{(0.05)}$	**2.94**	**0.05**	**0.79**	**17707**
CV%	**5.75**	**4.93**	**5.78**	**5.78**

In a column, means with same letter (s) are not significantly different by LSD at 5% level of significance
V_1: White gladiolus; V_2: Yellow gladiolus; V_3: Pink gladiolus

Table 10: Effect of sowing depth on chlorophyll content(%),spikesplant^{-1}, spikes plot^{-1},spikes ha^{-1}ofgladiolus at different days after sowing (DAS)

Treatment	Chlorophyll content(%) of leaf	Spikes plant^{-1}	Spikes plot^{-1}	Spikes ha^{-1}
D_1	45.36 c	1.00b	14.54b	323086b
D_2	60.27 a	1.06 a	15.87 a	352593a
D_3	49.48 b	0.80 c	11.38c	252963c
$LSD_{(0.05)}$	**2.94**	**0.05**	**0.79**	**17707**
CV%	**5.75**	**4.93**	**5.78**	**5.78**

In a column, means with same letter (s) are not significantly different by LSD at 5% level of significance
D_1: Sowing depth 4cm; D_2: Sowing depth 8cm; D_3: Sowing depth 12 cm

Table 11: Combined effect of sowing depth and cultivars on chlorophyll content (%), spikes plant^{-1}, spikes plot^{-1}, spikes ha^{-1} of gladiolus at different days after sowing (DAS)

Treatment	Chlorophyll content(%) of leaf	Spikes plant^{-1}	Spikes plot^{-1}	Spikes ha^{-1}
D_1V_1	46.00 de	1.00 b	14.57 bc	323704 bc
D_1V_2	45.50 de	1.02 ab	15.25 ab	338889ab
D_1V_3	44.57 e	1.00 b	13.80 cd	306667 cd
D_2V_1	70.52 a	1.09 a	16.30 a	362222a
D_2V_2	56.10 b	1.06 ab	15.85 ab	352222ab
D_2V_3	54.20 bc	1.03 ab	15.45 ab	343333ab
D_3V_1	51.87 bc	1.00 b	13.00 c	288889 d
D_3V_2	50.00 cd	0.83 c	12.50 d	277778d
D_3V_3	46.57 de	0.58 d	8.65 e	192222 e
$LSD_{(0.05)}$	**5.09**	**0.08**	**1.38**	**30670**
CV%	**5.75**	**4.93**	**5.78**	**5.78**

In a column, means with same letter (s) are not significantly different by LSD at 5% level of significance
D_1: Sowing depth 4cm V_1: White gladiolus
D_2: Sowing depth 8cm V_2: Yellow gladiolus
D3: Sowing depth 12 cm V_3: Pink gladiolus

4.9. Spikes plot^{-1}

The effect of cultivar on number of spike per plot of gladiolus was statistically influenced (Appendix V). The maximum spike number per plot (14.62) was observed in white cultivar; V_1 that was similar (14.53) with yellow cultivar; V_2 and the minimum number of spike per plot (12.63) was observed in pink cultivar; V_3 (Table 9).But Uddin *et al*. (2015) not agreed with this findings.

Statistically significant variation was observed on number of spikes per plot due to different depth of sowing (Table 10). The maximum spike per plot of gladiolus (15.87) was counted in D_2 which was statistically different (14.54) with $D_1$and the minimum spike number per plot (11.38) was counted in D_3, respectively (Appendix V).

Combined effect between depth of sowingof corm and cultivar of gladiolus corm showed statistically significant differences on number of spikes per plot among the treatments (Table 11). The maximum number of spike per plot (16.30) was observed from D_2V_1 and the minimum number of spike per plot (8.65) was observed from D_3V_3 (Appendix V).

4.10. Spikes ha^{-1}

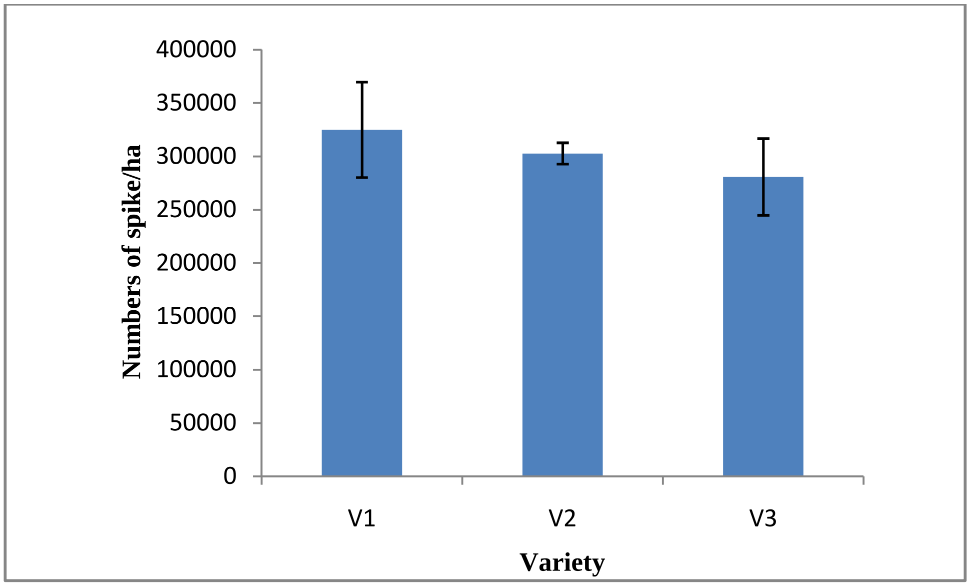
The effect of cultivar on spikes per hectare of gladiolus was statistically influenced (Table 9). The maximum number of spikes per hectare (3,24,938) was recorded in white cultivar; V_1 which was followed (3,22,963) by yellow cultivar; V_2 whereas the minimum number of spikes per hectare (2,80,741) was recorded in pink cultivar; V_3 (Table 9 and appendix V).Naresh *et al.* (2015) showed that white cultivar give highest yield.

Statistically significant variations were recorded in points of number of spikes per hectare due to different sowing depth of corm (Table 10). The highest number of spikes per hectare (3,52,593) was found from D_2 which was statistically different (3,23,086) by D_1 whereas, the lowest numbers of spikes per hectare (252963) was found from D_3, (Table 10 and appendix V). Bhattacharjee (1981) showed that spike yield increased with sowing depth.

Combined effect between sowing depth and cultivar of gladiolus corm showed significant differences on number of spike per hectare (Table 11).The results of number of spike per hectare ranged from 3,62,222 to 1,92,222.It was observed that the maximum number of spike/ha (3,62,222) was recorded in D_2V_1 which was statistically similar with D_2V_2. On the other hand, the minimum number of spike/ha (1,92,222) was recorded with D_3V_3(Appendix V).The results obtained from all other treatment combinations were significantly different compared to highest and lowest peduncle height of gladiolus plant.

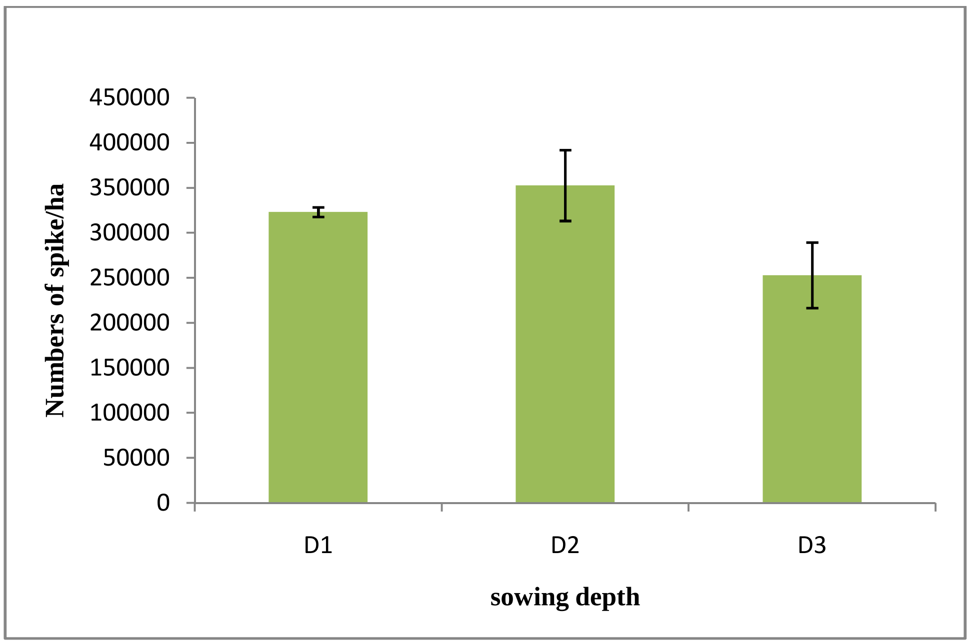
4.11. Leaf area (cm^2)

Non-Significant differences were noticed on leaf area when different cultivar of gladiolus corm used (Appendix V). Largest leaf area were recorded 37.26 cm^2 and 36.79 cm^2in V_1 and V_2 and smallest leaf area (35.42cm^2) was recorded in V_3, (Table 12).Bashir (2015) suggested that leaf area are different with cultivar



V_1= White gladiolus, V_2= Yellow gladiolus, V_3= Pink gladiolus

Fig 6: Cultivar performance of gladiolus on numbers of spike/ha at different days after sowing



D_1= Sowing depth 4 cm, D_2= sowing depth 8 cm, D_3= Sowing depth 12 cm

Fig 7: Effect of sowing depth on numbers of spike/ha at different days after sowing

The different sowing depth showed non-significant variation with respect to leaf area of gladiolus (Appendix V).The highest leaf area were found in D_2 and D_3 that were 37.95cm^2 and 36.68cm^2 and the lowest leaf area was 34.89cm^2 in D_1 (Table 13). Vinceljak (1990) suggested that 8 cm sowing depth give the excellent quality of leaves.

Combined effect between sowing depth and cultivar on leaf area was showed statistically non-significant differences (Appendix V). The largest leaf area (38.67cm^2) was showed in D_2V_1 and D_3V_1 and the smallest leaf area (34.67cm^2) was showed in D_1V_1, (Table 14).

4.12. Petal area(cm^2)

The use of different cultivar of gladiolus showed non-significant difference on petal area (cm^2) (Appendix V). The largest size petal area (203.17cm^2) was found andthe smallest petal area (200.22cm^2) was found in V_3 followed by 202.09cm^2 (Table 12). This type experiment is similar with the findings of Shaukat *et al*. (2013).

Statistically significant variation was noticed due to different sowing depth of gladiolus on petal area (cm^2) (Appendix V). The largest petal area (205.98cm^2) was found in D_2whereas the smallest petal area (199.44cm^2) was found in D_3 followed by 200.06cm^2 (Table 13).

Combined effect between sowing depth and different cultivar showed significant differences on petal area of gladiolus among the treatments (Appendix V). It was observed that the largest petal area (208.67 cm^2) was recorded in $D_2V_1$and the smallest petal area (197.67 cm^2) was recorded in D_3V_3, (Table 14).

Table 12: Effect of cultivars on leaf area(cm^2), petal area(cm^2),diameter of floret(cm), number of floret $spike^{-1}$ of gladiolus at different days after sowing (DAS)

Treatment	Leaf area(cm^2)	Petal area(cm^2)	Diameter of floret(cm)	Number of floret $spike^{-1}$
V_1	37.26 a	203.17a	9.89 a	13.02 a
V_2	36.79 a	202.09a	9.67 ab	12.56 ab
V_3	35.42a	200.22a	8.78 b	12.11 b
$LSD_{(0.05)}$	**4.01**	**4.17**	**0.89**	**0.99**
CV%	**11.09**	**2.09**	**9.56**	**7.92**

In a column, means with same letter (s) are not significantly different by LSD at 5% level of significance
V_1: White gladiolus; V_2: Yellow gladiolus; V_3: Pink gladiolus

Table 13: Effect of sowingdepth on leaf area(cm^2), petal are (cm^2), diameter of floret(cm), number of floret $spike^{-1}$ of gladiolus at different days after sowing(DAS)

Treatment	Leaf area(cm^2)	Petal area(cm^2)	Diameter of floret(cm)	Number of floret $spike^{-1}$
D_1	34.89 a	200.06b	8.56 b	11.44 c
D_2	37.95 a	205.98a	10.67 a	13.00 a
D_3	36.68 a	199.44b	9.11 b	12.56 b
$LSD_{(0.05)}$	**4.01**	**4.17**	**0.89**	**0.99**
CV%	**11.09**	**2.09**	**9.56**	**7.92**

In a column, means with same letter (s) are not significantly different by LSD at 5% level of significance
D_1: Sowing depth 4cm; D_2: Sowing depth 8cm; D_3: Sowing depth 12 cm

Table 14: Combined effect of sowing depth and cultivars on leaf area(cm^2), petal area(cm^2),diameter of floret(cm), number of floretspike^{-1} of gladiolus at different days after sowing (DAS)

Treatment	Leaf area(cm^2)	Petal area(cm^2)	Diameter of floret(cm)	Number of floret spike^{-1}
D_1V_1	34.67 a	201.50abc	9.00 bcd	12.00 c
D_1V_2	35.34 a	198.33c	8.67 bcd	12.00 c
D_1V_3	34.68 a	200.33bc	8.67 d	10.33 d
D_2V_1	38.67 a	208.67a	11.00 a	13.00 a
D_2V_2	38.44a	206.60ab	11.00 a	12.67 b
D_2V_3	36.74 a	202.67abc	10.00 ab	12.00 c
D_3V_1	38.67 a	199.33c	9.67 abc	12.67 b
D_3V_2	36.36 a	201.33bc	9.33 bcd	12.20 bc
D_3V_3	35.00 a	197.67c	8.33 cd	12.00 c
$LSD_{(0.05)}$	**6.94**	**7.22**	**1.55**	**1.72**
CV%	**11.09**	**2.09**	**9.56**	**7.92**

In a column, means with same letter (s) are not significantly different by LSD at 5% level of significance

D_1: Sowing depth 4cm V_1: White gladiolus
D_2: Sowing depth 8cm V_2: Yellow gladiolus
D_3: Sowing depth 12 cm V_3: Pink gladiolus

4.13. Diameter of floret(cm)

The largest floret diameter (9.89cm) was found in V_1 that was statistically different with the cultivarV_3. V_1 was statistically identical with V_2.The smallest floret diameter (8.78cm) was recorded in V_3, (Table 12).White cultivar observed largest floret diameter that is similar with Bashir (2015).

Floret diameter (cm) was statistically significant with different sowing depth of corm (Appendix V). The largest floret diameter (10.67cm) was observed in D_2 and the smallest floret diameter (8.56cm) was recorded in D_1 whereas 9.11cm floret diameter was showed D_3 (Table 13).

The maximum floret diameter (11.00cm) was recorded in D_2V_1 and D_2V_2 whereas the minimum floret diameter (8.33cm) was recorded in D_3V_3,(Table 14).

4.14. Florets spike^{-1}

Significant variations was found in different cultivar of gladiolus in points of floret number/spike (Appendix V). The highest number of florets per spike (13.02) was found in V_1 and the lowest number of floret/spike (12.11) was found in V_3 which was statistically similar (12.56) with V_2 (Table 12).Chourasia *et al.* (2015) was conformity with this result.

The effect of different sowing depth of corm showed significant variations in terms of floret number/spike of gladiolus (Appendix V). The maximum florets per spike (13.00) was found in 8 cm sowing depth of corm (D_2),while the minimum florets per spike (11.44) was found in 4 cm sowing depth (D_1) (Table 13). Bankar *et al*. (1980) experimented that floret number is not depended with sowing depth.

Combined effect of different sowing depth and cultivar of gladiolus showed significant differences due to florets per spike (Appendix V and plate 7). The highest number of floret per spike (13.00) was found in D_2V_1 where the lowest floret number/spike (10.33) was found in D_1V_3, (Table 14).

12 12 10.33 13 12.67 12 12.67 12.20 12

D_1V_1 D_1V_2 D_1V_3 D_2V_1 D_2V_2 D_2V_3 D_3V_1 D_3V_2 D_3V_3

Plate 4.Influence of Sowing depth and cultivar on floret no. per spike of gladiolus

4.15. Corms plant^{-1}

Significant variations were noticed when different cultivar were used with respect to number of corm/plant (Appendix VI). The maximum number of corms per plant (1.71) was recorded in V_1 and the minimum number of corms/plant (1.17) was recorded in V_3 which was similar (1.28) with V_2 (Table 15).Chourasia *et al. (*2015) reported that corm number best in white cultivar.

The use of different sowing depth of gladiolus corm showed significant differences with respect to number of corm per plant (Appendix VI). The higher number of corms per plant (1.68) was observed in D_2 and lower number of corm per plant (1.14) was observed in D_1 which was not similar (1.34) with D_3 (Table 16). Bhattacharjee (1981) agreed with this sowing depth.

The combined effect of sowing depth and cultivar of gladiolus showed significant effect on number of corms/plant (Appendix VI). It was observed that the maximum number of corms/plant (2.10) were found in D_2V_1 and minimum number of corms/plant (1.03) were produced by D_3V_3 (Table 17).

4.16. Corms plot^{-1}

The effect of cultivar of corm numbers/plot showed significant variances (Appendix VI). The highest number of corm/plot (25.68) was recorded in V_1 and the minimum corm number/plot (17.58) was produced by in V_3 whereas 19.18 corm numbers/plot was counted in V_2, (Table 15). Sankar *et al.*(2012) suggested that corm number may be varying with the cultivar.

Table 15: Effect of cultivarscorms plant^{-1},corms plot^{-1},Individualcorm Weight(g) and yield of corms(t/ha) of gladiolus atdifferent days after sowing(DAS)

Treatment	Corm plant^{-1}	Corm plot^{-1}	Individual corm weight(g)	Yield of corms(t/ha)

V_1	1.71 a	25.68 a	24.91 a	14.49 a
V_2	1.28 b	19.18 b	23.62 b	10.21 b
V_3	1.17 b	17.58 b	23.56 b	9.29 b
$LSD_{(0.05)}$	**0.16**	**2.36**	**0.47**	**1.34**
CV%	**11.46**	**11.46**	**1.96**	**11.92**

In a column, means with same letter (s) are not significantly different by LSD at 5% level of significance
V_1: White gladiolus; V_2: Yellow gladiolus; V_3: Pink gladiolus

Table 16: Effect of sowing depth on corms plant^{-1},corms plot^{-1}, Individual corm weight (g) and yield of corms(t/ha) of gladiolus at different days after sowing(DAS)

Treatment	Corms plant^{-1}	Corms plot^{-1}	Individual corm weight (g)	Yield of corms(t/ha)
D_1	1.14 c	17.03 c	21.04 c	10.83 b
D_2	1.68 a	25.25 a	26.90 a	11.19 a
D_3	1.34 b	20.17 b	24.14 b	7.98 c
$LSD_{(0.05)}$	**0.16**	**2.36**	**0.47**	**1.34**
CV%	**11.46**	**11.46**	**1.96**	**11.92**

In a column, means with same letter (s) are not significantly different by LSD at 5% level of significance
D_1: Sowing depth 4cm; D_2: Sowing depth 8cm; D_3: Sowing depth 12 cm

Table 17: Combined effect of sowing depth and cultivars on corms plant^{-1}, corms plot^{-1},Individual corm weight (g) and yield of corms(t/ha) of gladiolus at different days after sowing(DAS)

Treatment	Corms plant^{-1}	Corms plot^{-1}	Individual corm weight(g)	Yield of corms(t/ha)
D_1V_1	1.24 de	18.55 de	22.06 d	9.09 c
D_1V_2	1.10 e	16.55 e	20.69 e	7.61 c

D_1V_3	1.07 e	16.00 e	20.37 e	7.24 c
D_2V_1	2.10 a	31.50 a	28.24 a	10.75 a
D_2V_2	1.53 bc	23.00 bc	26.36 b	10.49 b
D_2V_3	1.42 cd	21.25 cd	26.11 b	10.33 b
D_3V_1	1.80 b	27.00 b	24.42 c	10.64 b
D_3V_2	1.20 de	18.00 de	23.80 c	9.52 c
D_3V_3	1.03 e	15.50 e	24.19 c	8.33 c
$LSD_{(0.05)}$	**0.27**	**4.09**	**0.82**	**2.32**
CV%	**11.46**	**11.46**	**1.96**	**11.92**

In a column, means with same letter (s) are not significantly different by LSD at 5% level of significance

D_1: Sowing depth 4cm V_1: White gladiolus

D_2: Sowing depth 8cm V_2: Yellow gladiolus

D3: Sowing depth 12 cm V_3: Pink gladiolus

Significant differences were noticed for number of corms per plot in different sowing depth of corm (Appendix VI). The maximum number of corms/plot (25.25) was counted from D_2 and minimum number of corms/plot (17.03) was counted from D_1 whereas 20.17 corms/plot was counted from D_3 (Table 16). Bhattacharjee (1981) agreed with this result.

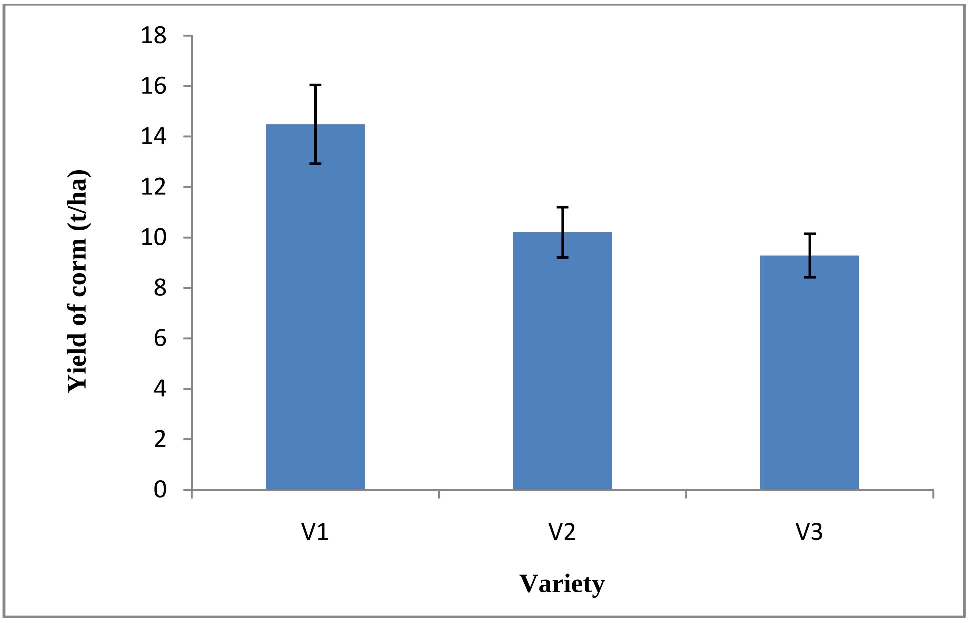
Combined effect between sowing depth and cultivarshowed significant variances in terms of number of corms/plot (Appendix VI). The maximum number of corms/plot (31.50) was showed in D_2V_1 and the minimum number of corms/plot (15.50) was showed in D_3V_3 (Table 17).

4.17.Individual corm weight (g)

Significant corm weight (g) were noticed in different cultivar of gladiolus (Appendix VI). The highest corm weight (24.91 g) was recorded in V_1 and the lowest corm weight (23.56 g) was recorded in V_3 that was statistically as similar as (23.62 g) with V_2 (Table 15).Bashir (2015) agreed with this result.

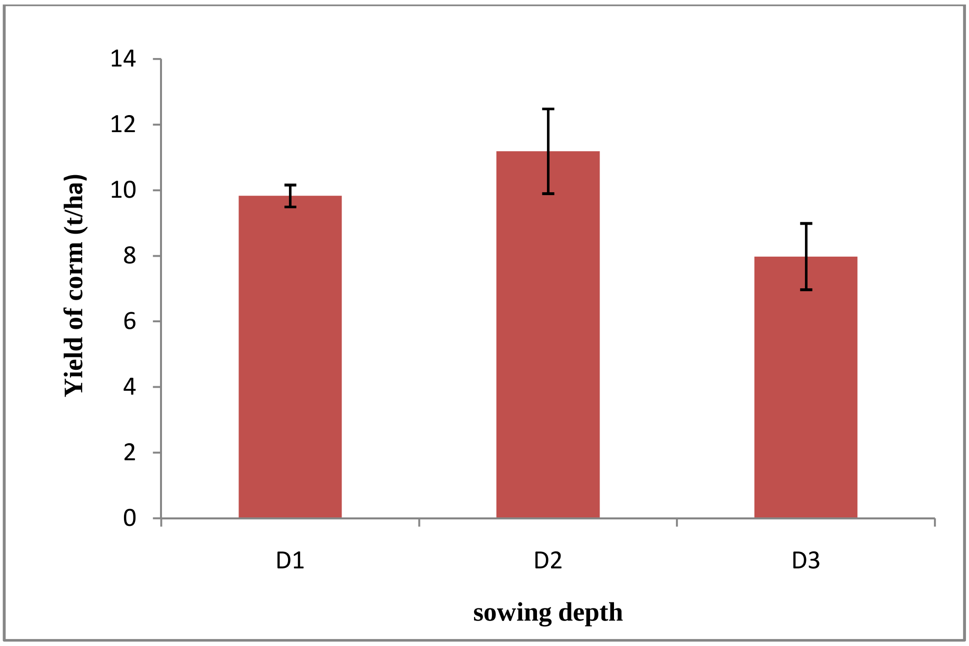
Significant differences were noticed among the different sowing depth of corm for individual corm weight (g) (Appendix VI). The higher corm weight (26.90 g) was estimated in D_2 and lower corm weight (21.04 g) was estimated in D_1 whereas 24.14 g corm weight was estimated in D_3 (Table 16).Konoshima (1980) reported that intermediate sowing depth gave the heavier corms.

Combined effect between sowing depth and cultivar was significant influenced on individual corm weight (g) (Appendix VI). The highest corm weight (28.24 g) was recorded in D_2V_1 and the lowest corm weight (20.37 g) was recorded by D_1V_3 (Table 17).



V_1= White gladiolus, V_2= Yellow gladiolus, V_3= Pink gladiolus

Fig 8: Cultivar performance of gladiolus on yield of corm (t/ha) at different days after sowing



D_1= Sowing depth 4 cm, D_2= sowing depth 8 cm, D_3= Sowing depth 12 cm

Fig 9: Effect of sowing depth on yield of corm (t/ha) at different days after sowing

4.18. Yield of corms(t/ha)

Significant differences were recorded by on different cultivar on corm yield (t/ha) (Appendix VI and figure 8). The higher corm yield (14.49 t/ha) was recorded in V_1 and lower corm yield (9.29 t/ha) was recorded in V_3 which was statistically similar (10.21t/ha) with V_2 (Table 15).Bashir (2015) agreed with my present experiment.

Significant variations were recorded by sowing depth on yield of corm (t/ha) (Appendix VI and figure 9).The highest corm yield (11.19 t/ha) was recorded by D_2 and the lowest corm yield (7.98 t/ha) was recorded in D_3 (Table 16). Incalcaterra (1992) suggested that highest yield obtained from 8 cm sowing depth.

The combined effect of sowing depth and cultivar showed significant differences on corm yield (t/ha) (Appendix VI). The highest corm yield (10.75 t/ha) was recorded in D_2V_1 and the lowest corm yield (8.33 t/ha) was recorded in D_3V_3 (Table 17).

4.19. Cormels plant^{-1}

The effect of different cultivar showed significant variances in terms of cormel numbers/plant (Appendix VI). The top cormel numbers/plant (3.26) was noticed in V_1 and low cormel numbers/plant (2.49) was noticed in V_3 that was similar (2.63) with V_2, (Table 18).Chourasia *et al. (*2015) evaluated that cormel numbers varied with different cultivar.

Significant differences showed for cormels per plant when corms were sown in different depth (Appendix VI). The maximum cormel numbers per plant (3.77) was recorded in D_2 and the minimum cormel numbers/plant (1.76) was recorded in D_3 while 2.86 cormel numbers/plant showed in D_1 (Table 19).Bankar *et al*. (1980) showed that cormel numbers decreased with respect of deep sowing.

Combine effect between sowing depth and cultivarshowed significant variances in points of cormel numbers/plant (Appendix VI). The highest cormel numbers/plant (4.17) was noticed in D_2V_1 and lowest cormel numbers/plant (1.27) was noticed in D_3V_3, (Table 20).

4.20. Cormels plot^{-1}

Statistically significant variances were showed by different cultivar with respect of cormel numbers/plot (Appendix VI). The higher cormels (38.50) /plot was counted from V_1 and lower cormels (32.22)/plot was counted from V_3 that was similar (33.17) with V_2 (Table 18).

Significant differences were showed by the number of cormels/plot in different sowing depth (Appendix VI). The highest cormel numbers/plot (39.29) was recorded in D_2 which was statistically similar 38.50 and the lowest cormel numbers/plot (26.11) was recorded in D_3(Table 19). But Mattos *et al.* (1984) disagreed with this sowing depth for cormel quantities.

Combined effect of sowing depth and cultivar were showed statistically insignificant differences with respect of cormel numbers/plot (appendix VI). The higher cormel numbers (39.50) /plot was found in D_2V_1 and lower cormel numbers (18.33)/plot was found in D_3V_3(Table 20).

Table 18: Effect of cultivars on cormels plant^{-1}, cormelsplot^{-1}, Individual cormel weight(g) and yield of cormels(t/ha) of gladiolus at different days after sowing(DAS)

Treatment	Cormels plant^{-1}	Cormels plot^{-1}	Individual cormel weight(g)	Yield of cormels(t/ha)
V_1	3.26 a	38.50 a	11.62 a	9.89 a
V_2	2.63 b	33.17 b	11.06 ab	8.18 b
V_3	2.49 b	32.22 b	10.50 b	7.66 b
$LSD_{(0.05)}$	**0.23**	**2.96**	**0.99**	**0.68**
CV%	**8.41**	**8.64**	**9.06**	**7.97**

In a column, means with same letter (s) are not significantly different by LSD at 5% level of significance
V_1: White gladiolus; V_2: Yellow gladiolus; V_3: Pink gladiolus

Table 19: Effect of sowing depth on cormels plant^{-1},cormels plot^{-1}, Individual cormel weight (g) and yield of cormels(t/ha) of gladiolus at different days after sowing(DAS)

Treatment	cormels plant^{-1}	Cormels plot^{-1}	Individual cormel weight(g)	Yield of cormels(t/ha)
D_1	2.86 b	38.50 a	11.74 a	9.95 a
D_2	3.77 a	39.29 a	12.12 a	10.45 a
D_3	1.76 c	26.11 b	9.32 b	5.33 b
$LSD_{(0.05)}$	**0.23**	**2.96**	**0.99**	**0.677**
CV%	**8.41**	**8.64**	**9.06**	**7.97**

In a column, means with same letter (s) are not significantly different by LSD at 5% level of significance
D_1: Sowing depth 4cm; D_2: Sowing depth 8cm; D_3: Sowing depth 12 cm

Table 20: Combined effect of sowing depth and cultivars on cormels plant^{-1},cormels plot^{-1}, Individual cormel weight(g) and yield of cormels(t/ha) gladiolus at different days after sowing(DAS)

Treatment	Cormels plant^{-1}	Cormels plot^{-1}	Individual cormel weight(g)	Yield of cormels(t/ha)
D_1V_1	3.17 bc	39.40 a	12.19 ab	9.77 b
D_1V_2	2.53 de	37.67 a	11.45 b	10.60 ab
D_1V_3	2.87 cd	38.33 a	11.58 ab	10.32 ab
D_2V_1	4.17 a	39.50 a	13.20 a	11.47 a
D_2V_2	3.80 a	38.33 a	12.29 ab	9.56 b
D_2V_3	3.33 b	37.00 a	10.87 bc	9.48 b
D_3V_1	2.43 e	36.50 a	9.47 cd	7.61 c
D_3V_2	1.57 f	23.50 b	9.44 cd	4.73 d
D_3V_3	1.27 f	18.33 c	9.05 d	3.64 d
$LSD_{(0.05)}$	**0.40**	**5.13**	**1.72**	**1.17**
CV%	**8.41**	**8.64**	**9.06**	**7.97**

In a column, means with same letter (s) are not significantly different by LSD at 5% level of significance

D_1: Sowing depth 4cm V_1: White gladiolus

D_2: Sowing depth 8cm V_2: Yellow gladiolus

D3: Sowing depth 12 cm V_3: Pink gladiolus

4.21. Individual cormelweight(g)

Statistically significant variations were recorded in terms of weight ofcormel (g) due to different cultivar of gladiolus (Appendix VI). The highest individual cormel weight (11.62 g) was recorded in V_1 that was statistically similar with V_2(11.06 g) and the lowest individual cormel weight (10.50 g) was recorded in V_3, (Table 18). Bashir (2015) reported cormel weight may be fluctuated with the cultivar.

Weight of individual cormel showed statistically significant differences with respect of different sowing depth (Appendix VI). The highest cormel weight (12.12 g) was found in D_2 that was similar with D_1(11.74 g) and the lowest cormel weight (9.32 g) was found in D_3, (Table 19).

Interaction effect between sowing depth and cultivarshowed significant variances with respect of cormel weight of gladiolus (Appendix VI). The highest cormel weight of gladiolus (13.20 g) was found in D_2V_1 and lowest was found in D_3V_3(9.05 g), respectively (Table 20).

4.22. Yield of cormel(t/ha)

Different cultivar showed significant variances on yield of cormel (t/ha) (Appendix VI). The highest yield (9.89 t/ha) of cormel was found in V_1 and the lowest cormel yield (7.66 t/ha) was found in V_3 while 8.18 t/ha was found in V_2, (Table 18). This type result of Bashir (2015) findings.

Different sowing depth of corm showed significant variances on yield of cormels/ha (Appendix VI). The highest cormels yield (10.45 t/ha) was recorded in D_2 that was statistically similar (9.95 t/ha) with D_1 and lowest cormels yield (5.33 t/ha) was recorded in D_3, (Table 19).Vinceljak (1990) noticed 8 cm is the best sowing depth.

combined effect of different sowing depth of corm and cultivar showed significant differences on cormels yield (t/ha) (Appndix VI). The highest cormels yield (11.47t/ha) was counted in D_2V_1 and lowest cormels yield (3.64 t/ha) was counted in D_3V_3, (Table 20).

4.23. Economic analysis

Economic analysis from land preparation to harvesting of gladiolus spike, corm and cormel was done according to the procedure of Alam *et al*. (1989). Input cost (material and non-material) and fixed cost including to the marketable price of spike and corm were recorded for unit plot and then converted to hectare basis. The economic analysis was done under the following basis-

4.23.1. Gross return

The combination of sowing depth and cultivar showed different gross return. The highest gross return (3,23,500) was obtained from D_2V_1 and the lowest gross income (1,49,800) was obtained from D_3V_3 (Table 21).

4.23.2. Net return

In case of net return for different treatment combinations showed different net return. The highest net return (2,15,935) was observed in D_2V_1 and the lowest net return (42,235)was showed in D_3V_3 (Table 21).

4.23.3. Benefit cost ratio

In combination of sowing depth and cultivarof gladiolus, the highest benefit cost ratio (2.89) was noted in D_2V_1 and the lowest benefit cost ratio (1.39) was obtained in D_3V_3 (Table 21). From economic point of view, it was decided from the above result that the white cultivar with 8 cm sowing depth was more profitable than other combinations.

CHAPTER V

SUMMARY AND CONCLUSION

5.1. Summary

My present experiment was entitled "Effect of sowing depth of corm on growth and flowering of gladiolus in summer" that was conducted at the Horticultural Farm of Sher-e-Bangla Agricultural University, Dhaka during the period from April 2015 to October 2015. The experiment consisted of two factors. Factor A: Three types of sowing depth: D_1-4 cm,D_2- 8 cm, D_3- 12 cm and Factor B: Three types of cultivar: V_1- White, V_2- Yellow, V_3- Pink, respectively. There were on the 9 (3×3) treatments combinations. The experiment was laid out in Randomized Complete Block Design with three replications.The results thus obtained are summarized below:

The results under the present study concluded that, there was significant effect in case of days to sprouting with the interaction of the sowing depth and cultivar.It was observed that the lowest days required for sprouting (10.35) in D_1whereas the highest days required (17.78) for sprouting in D_3.Again, white cultivar (V_1) showed the lowest days (13.79) for sprouting while highest days (14.44) required for pink cultivar (V_3). On the other hand, the lowest days to sprouting (10.33) was observed in the combination of 4 cmsowing depth and yellowcultivar (D_1V_2) where highest days (19.33) was counted for sprouting in12 cm sowing depth and yellow cultivar (D_3V_2).

The sowing depth variances on plant height, number of leaves/plant,days required to spike emergence, days required to first flowering had significant effect. The results showed that the highest plant height (73.81 cm), numbers of leaves/plant (8.08) was observed in 8 cm sowing depth, D_2 where the lowest plant height (61.67 cm), numbers of leaves/plant (5.96) was observed in 4 cm sowing depth, D_1.On the other hand, the lowest days required for spike emergence (33.00) and first flowering (38.33) was showed in D_2 where highest days required for spike emergence (38.88) and first flowering (47.00) was observed in D_1.The highest spike length (88.06 cm), chlorophyll content (%) (60.27), number of spike per plant (1.06), plot (15.87) and yield (3,52,593/ha), leaf area (37.95cm^2), petal area (205.98cm^2), diameter of floret (10.67cm) and number per spike (13.89), weight of corm (26.90 gm) and cormel (12.12 gm), number of corm and cormel per plant (1.68 and 3.77), plot (25.25 and 39.29)and yield (11.19 t/ha and 10.45 t/ha)was noticed significant variances that was observed in 8 cm sowing depth, D_2. And the lowest spike length (69.52 cm),chlorophyll content (%) (45.36),number of spike per plant (1.00), leaf area (34.89cm^2),diameter of floret (8.56cm) and number per spike (11.44),weight of corm (21.04 gm) and cormel (9.32 gm),number of corm and cormel per plant (1.14 and 2.86),number of corm per plot (17.03 and) was showed significant in 4 cm sowing depth, D_1;but number of spike per plot (11.38) and yield (252963/ha), petal area (199.44cm^2), corm yield (7.98 t/ha) , cormel per plot (26.11) and yield (5.33 t/ha) was observed in 12 cm sowing depth, D_3.

Cultivar performance of plant height, number of leaves/plant, days required to spike emergence, days required to first flowering had significant effect. The results showed that the highest plant height (70.75 cm), numbers of leaves/plant (7.32) was observed in white cultivar, V_1 where the lowest plant height (65.41cm), numbers of leaves/plant (6.93) was observed in pink cultivar, V_3. On the other hand, the lowest days required for spike emergence (34.88) and first flowering (41.00) was showed in white cultivar, V_1 where highest days required for spike emergence (37.78) and first flowering (43.56) was observed in pink cultivar, V_3.The highest spike length (81.75 cm), chlorophyll content (%) (56.13), number of spike per plant (1.03), plot (14.62) and yield (3,24,938/ha), leaf area (37.26 cm^2), petal area (203.17cm^2), diameter of floret (9.89cm) and number per spike (13.22), weight of corm (24.91 gm) and cormel (11.62 gm), number of corm and cormel per plant (1.71 and 3.26), plot (25.68 and 38.50) and yield (14.49 t/ha and 9.89 t/ha) was noticed significant variances that was observed in white cultivar, V_1. And the lowest spike length (75.43 cm), chlorophyll content (%) (48.44), number of spike per plant (0.87), plot (12.63) and yield (2,80,741/ha), leaf area (35.42cm^2), petal area (200.22cm^2), diameter of floret (8.78cm) and number per spike (12.11), weight of corm (23.56 gm) and cormel (10.50 gm), number of corm and cormel per plant (1.17 and 2.49), plot (17.58 and 32.22) and yield (9.29 t/ha and 7.66 t/ha) was noticed significant variances in pink cultivar, $V_{3.}$

Different growth and flowering of gladiolus parameters were also significantly influenced by interaction effect of sowing depth and cultivar.

Results showed that the highest plant height (77.23 cm), numbers of leaves per plant (8.25), spike length (92.19cm),chlorophyll content (%) (70.52), number of spike per plant (1.09), plot (16.30)andyield (3,62,222/ha),leaf area (38.67cm^2),petal area (208.67 cm^2), diameter of floret (11.00cm) and number per spike (13.00),weight of corm (28.24 gm)and cormel (13.20 gm), number of corm and cormel per plant (2.10 and 4.17),plot (31.50 and 39.50)and yield(10.75 t/ha and 11.47 t/ha) were obtained from 4 cm sowing depth and white cultivarcombination (D_2V_1).Where the lowest plant height (58.10 cm), numbers of leaves per plant (5.90), spike length (66.20 cm), chlorophyll content (%) (44.57)and number per spike (10.33),weight of corm (20.37gm)were obtained from 4cm sowing depth and pink cultivar combination (D_1V_3). But lowest number of spike per plant (0.58), plot (8.65) and yield (1,92,222/ha), petal area (197.67 cm^2),leaf area (34.67cm^2),diameter of floret (8.33cm) and number per spike (10.33),weight of cormel (9.05 gm), number of corm and cormel per plant (1.03 and 1.27),plot (15.50 and 18.33)and yield (8.33 t/ha and 3.64 t/ha) were found in 12 cm sowing depth and pink cultivar combination (D_3V_3). And in case of minimum days required to spike emergence (31.00) and first flowering (37.00) was in 8 cm sowing depth and white cultivar (D_2V_1) where maximum days required for spike emergence (39.67) and first flowering (48.67) in 8 cm sowing depth and pink cultivar combination (D_2V_3).

The combination of sowing depth and cultivar of gladiolus the highest gross income (3,23,500) was obtained in D_2V_1 and lowest (1,49,800) was obtained in D_3V_3.The highest net return (2,15,935) was found in D_2V_1 and lowest (42,235) was found in D_3V_3. The highest benefit cost ratio (2.89) was noted from D_2V_1 and lowest (1.39) from D_3V_3.

5.2. Conclusion

Considering the above discussion it may be concluded that

i. Sowing in 8 cm depth of corm gave the better performance than other sowing depth.
ii. White cultivar was more suitable than other cultivar.

iii. During the investigation, 8 cm sowing depth with white cultivar was found best growth, flowering and yield of gladiolus.

5.3. RECOMMENDATIONS

Based on the results and discussions following recommendations are to be suggested:

i. Other different combinations of sowing depth with cultivar of gladiolus may be investigated.

ii. Considering the situation of the present investigation, further studies might be conducted in different agro-ecological zone (AEZ) of Bangladesh for regional adaptability and other performances.

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APPENDICES

Appendices I. Monthly record of air temperature, rainfall, relative humidity, Sunshine of the experimentalsite during the period fromApril to October 2015

Month (2015)	Air temperature(ºc)		*Relative humidity (%)	*Rain fall(mm) (total)	*Sunshine (hr)
	Maximum	Minimum			
April	37	26	62	430	8.3
May	38	28	66	150	7.7
June	36	27	72	324	4.2
July	33	28	80	484	3.1
Auguest	34	27	78	307	4.0
Septemb er	36	28	73	204	4.4
October	34	25	69	39	4.6

* Monthly average,

Source: Bangladesh Meteorological Department (Climate & weather division) Agargoan, Dhaka – 1212

Appendices II: Characteristics of experimental soil.

A. Morphological characteristics of the experimental field

Morphological features	Characteristics
Location	Agronomy Farm, SAU, Dhaka
AEZ	Modhupur Tract (28)
General Soil Type	Shallow red brown terrace soil
Land type	High land
Soil series	Tejgaon
Topography	Fairly leveled
Flood level	Above flood level
Drainage	Well drained
Cropping pattern	Not Applicable

Source: Soil Resource Development Institute (SRDI)

B. Physical and chemical soil properties of experimental plot.

Characteristics	Value
Partical size analysis	

% Sand	27
% Silt	43
% Clay	30
Textural class	Silty-clay
pH	5.6
Organic carbon (%)	0.45
Organic matter (%)	0.78
Total N (%)	0.03
Available P (ppm)	20.00
Exchangeable k(me/100g soil)	0.10
Available S (ppm)	45

Source: Soil Resource Development Institute (SRDI)

AppendicesIII : Analysis of variance (ANOVA) for Days to sowing, Plant height.

Source of variance	Degrees of freedom	Mean square				
		Days to sprouting	Plant height (cm)			
			30 DAS	40 DAS	50 DAS	60 DAS
Depth	2	124.50*	332.21*	171.56*	194.49	332.98*
Cultivar	2	0.99*	73.26*	104.10*	187.29	64.48*
Depth*Cultivar	4	3.39*	21.16*	35.00*	3.52	4.15
Error	18	0.45	2.33	2.60	25.89	16.43

* Significant at 5% level of significance

AppendicesIV : Analysis of variance (ANOVA) for Numbers of leaves per Plant,Days required to spike emergence,Days required to first flowering, Spike length (cm), Chlorophyll content (%).

Source of variance	Degrees Of freedom	Mean square							
		Numbers of leaves per plant				Days required to Spike emergence	Days required to first flowering	Spike length (cm)	Chlorophyll content (%) of leaf
		30DAS	40DAS	50DAS	60DAS				
Depth	2	0.28*	1.18*	6.79*	10.51*	82.11*	174.33*	776.7*	534.12*

Cultivar	2	0.04*	0.57*	1.48*	0.34*	18.78*	14.78*	90.62*	142.09*
Depth* Cultivar	4	0.12*	0.46*	0.59*	0.80*	1.068	1.78*	3.76*	60.06
Error	18	0.03	0.05	0.03	0.06	5.56	1.85	1.08	8.82

* Significant at 5% level of significance

Appendices V: Analysis of variance (ANOVA) for of Number of spike plant^{-1}, Number of spike plot^{-1}, Number of spike ha^{-1}, Leaf area (cm^2), Petal area (cm^2), Diameter of floret (cm), Number of floret spike^{-1}

Source of variance	Degrees Of freedom	Mean square						
		Number of spike plant^{-1}	Number of spike plot^{-1}	Number of spike ha^{-1}	Leaf area (cm^2)	Petal area (cm^2)	Diameter of floret (cm)	Number of floret spike^{-1}
Depth	2	0.162*	47.73*	2.36*	21.16*	117.19*	10.78*	13.48*
Cultivar	2	0.06*	11.36*	5.61*	7.72*	19.97*	3.11*	2.81*
Depth* Cultivar	4	0.04*	3.88*	1.92*	3.19	12.85	0.06*	2.43*
Error	18	0.01	0.65	3.19	16.38	17.73	0.81	1.00

* Significant at 5% level of significance

Appendices VI: Analysis of variance (ANOVA) for Number of corm plant^{-1}, Number of corm plot^{-1}, Corm weight (gm), Yield of corm ha^{-1}, Number of cormel plant^{-1}, Number of cormel plot^{-1}, Cormel weight (gm), Yield of cormel ha^{-1}

Source of variance	Degrees of freedom	Mean square							
		Number of corm plant^{-1}	Number of corm plot^{-1}	Corm weight (gm)	Yield of corm ha^{-1}	Number of cormel plant^{-1}	Number of cormel plot^{-1}	cormel weight (gm)	Yield of cormel ha^{-1}

Depth	2	0.69*	154.76*	77.46*	118.70*	9.13*	491.18*	20.74*	71.84*
Cultivar	2	0.74*	165.63*	5.24*	69.31*	1.49*	103.12*	2.83*	12.27*
Depth* Cultivar	4	0.09*	19.86*	0.77*	7.56*	0.22*	82.26	0.97*	2.04*
Error	18	0.03	5.69	0.22	1.83	0.06	8.95	1.00	0.47

* Significant at 5% level of significance

Appendices VII. Per hectare production cost of gladiolus

A. Input cost

Treatment combination	Labour cost	Ploughing cost	Corm cost	Irrigation cost	Insecticides	Manure and fertilizer				Sub total (A)
						cowdung	Urea	TSP	MP	
D_1V_1	15,000	12,000	15,000	10,000	6,000	7,000	1,000	2000	1,500	69500
D_1V_2	15,000	12,000	15,000	10,000	6,000	7,000	1,000	2000	1,500	69500

D_1V_3	15,000	12,000	15,000	10,000	6,000	7,000	1,000	2000	1,500	69500
D_2V_1	15,000	12,000	15,000	10,000	6,000	7,000	1,000	2000	1,500	69500
D_2V_2	15,000	12,000	15,000	10,000	6,000	7,000	1,000	2000	1,500	69500
D_2V_3	15,000	12,000	15,000	10,000	6,000	7,000	1,000	2000	1,500	69500
D_3V_1	15,000	12,000	15,000	10,000	6,000	7,000	1,000	2000	1,500	69500
D_3V_2	15,000	12,000	15,000	10,000	6,000	7,000	1,000	2000	1,500	69500
D_3V_3	15,000	12,000	15,000	10,000	6,000	7,000	1,000	2000	1,500	69500

B. Overhead cost (Tk./ha)

Treatment combination	Cost of lease of land for 6 month (11% of value of land Tk. 4,00,000/year)	Miscellaneous cost (Tk. 5% of the input cost)	Interest on running capital for 12 months	Subtotal (Tk) (B)	Total cost of production (Tk./ha)[input cost(A)+Overhead cost(B)]
D_1V_1	28,000	3,475	6,590	38,065	1,07,565
D_1V_2	28,000	3,475	6,590	38,065	1,07,565
D_1V_3	28,000	3,475	6,590	38,065	1,07,565
D_2V_1	28,000	3,475	6,590	38,065	1,07,565
D_2V_2	28,000	3,475	6,590	38,065	1,07,565

D_2V_3	28,000	3,475	6,590	38,065	1,07,565
D_3V_1	28,000	3,475	6,590	38,065	1,07,565
D_3V_2	28,000	3,475	6,590	38,065	1,07,565
D_3V_3	28,000	3,475	6,590	38,065	1,07,565

Table 21. Effect of cultivarand sowing depth of gladiolus on economic point of view showing gross return, net return

and BCR

Treatment combination	Cost of production (Tk/ha)	Yield of corm (t/ha)	Price of corm (t/ha)	Yield of spike (thousand/ ha^{-1})	Price of cut flower	Gross return (Tk/ha)	Net return (Tk/ha)	Benefit cost ratio
D_1V_1	1,00,000	9.09	90,900	3.2	90,000	1,80,000	95,335	1.47
D_1V_2	1,00,000	7.61	73,100	3.4	95,000	1,68,100	87,535	1.59
D_1V_3	1,00,000	7.24	72,400	3.1	88,500	1,60,900	73,335	1.58
D_2V_1	1,00,000	10.75	1,04,000	3.6	99,000	2,03,000	2,15,935	1.61
D_2V_2	1,00,000	10.49	1,02,900	3.5	98,500	2,01,400	1,07,562	1.60
D_2V_3	1,00,000	10.33	1,00,300	3.4	95,000	1,95,300	1,19,000	1.59
D_3V_1	1,00,000	10.64	1,03,400	2.9	80,500	1,83,900	1,40,335	1.55
D_3V_2	1,00,000	9.52	95,200	2.8	78,000	1,73,200	85,635	1.50
D_3V_3	1,00,000	8.33	78,300	1.9	65,500	1,43,800	42,235	1.43

V_1=White, V_2= Yellow and V_3 = PinkD_1 = 4cm, D_2 = 8cm and D_3 = 12cm,

Gross return = Price of corm (t/ha) + Price of cut flower (thousand/ ha^{-1})

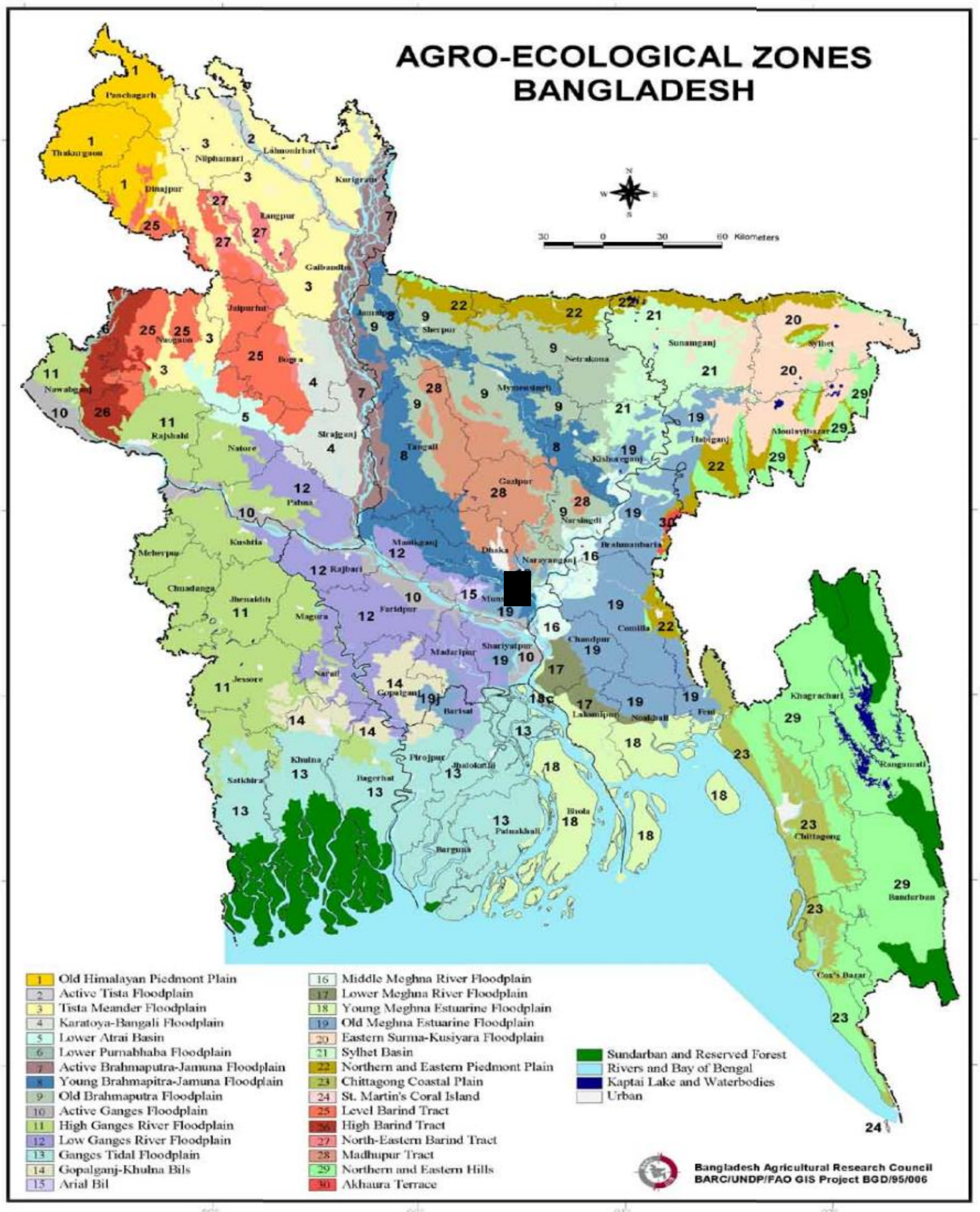
Net return = Gross return - Total cost of production

Benefit cost ratio = Gross return / Total cost of production

Price of spike @ 4tk/piece

Price of corm @ 5000 tk/ton

Appendices VIII: Map showing the experimental site under study



■ **Experimental site**