EFFECT OF SPACING AND DEPTH OF PLANTING ON THE GROWTH FLOWERING AND YIELD OF GLADIOLUS

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EFFECT OF SPACING AND DEPTH OF PLANTING ON THE GROWTH FLOWERING AND YIELD OF GLADIOLUS

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This is to certify that thesis entitled, **"Effect of spacing and depth of planting on the growth, flowering and yield of Gladiolus"** Submitted to the Department of Horticulture & Post Harvest Technology, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE in HORTICULTURE,** embodies the result of a piece of bona fide research work carried out by **Sadia Afrin, Registration No. 00867** 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

A field experiment was conducted in the Horticulture Farm of Sher-e-Bangla Agricultural University, Dhaka, Bangladesh during the period from November 2006 to June 2007 to study the effect of spacing and depth of planting on the growth, flowering and yield of Gladiolus. The experiment considered 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 planting (3 levels) i.e. D_1 (5 cm), D_2 (7 cm), D_3 (9 cm). There were altogether 9 treatment combinations. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. The results of the experiment showed that the plant spacing had significant effect on plant height (30 DAP, 75 DAP), number of leaves, length of spike, weight of spike, length of rachis, number of spikelets per spike, diameter of individual corm, weight of individual corm, number of cormel per plant, weight of cormel per plant, yield of spike, yield of corm, yield of cormel except plant height (45 DAP, 60 DAP) and length of leaves. The maximum (11.40 t/ha) yield of spike was found from the closest spacing and minimum (5.83 t/ha) was recorded from widest spacing. The maximum (7.99 t/ha) yield of corm was found from the closest spacing and minimum (4.17 t/ha) was recorded from widest spacing. The maximum (6.54 t/ha) yield of cormel was found from the closest spacing and minimum (3.52 t/ha) was recorded from widest spacing. Statistically significant variation was recorded in terms of different levels of depth of planting showed on plant height (75 DAP), length of leaves (30 DAP, 45 DAP), length of spike, weight of spike, length of rachis, weight of individual corm, number of cormel per plant, weight of cormel per plant, yield of spike and yield of cormel. The maximum (8.71 t/ha) yield of spike was found 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) was found from deepest depth. There were combined effect between spacing and depth of planting recorded significant for plant height (75 DAP), length of spikes, length of rachis, weight of a single spike, weight of cormels per plant, weight of corm per plant, yield of corm per hectare and yield of cormels per hectare. The maximum (1817915 Tk/ha) gross return, maximum (1036029 Tk/ha) net return and maximum (2.33) benefit cost ratio all were found from the treatment combination of closest spacing and shallowest depth.

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ABBREVIATIONS AND ACRONYMS

AEZ	Agro Ecological Zone
BARI	Bangladesh Agricultural Research Institute
^0C	Degree Celsius
cm	Centimeter
DAP	Days After Planting
Ed.	Edited
ED.	Edition
et al.	And Others
g	Gram
Kg	Kilogram
LSD	Least Significant Difference
m	Meter
N	Nitrogen
NS	Non Significant
pH	Hydrogen Ion Concentration
ppm	Parts Per Million
RCBD	Randomized Complete Block Design
RH	Relative Humidity
SAU	Sher-e- Bangla Agricultural University
t	Ton
t/ha	Ton per hectare
TSP	Triple Super Phosphate
SRDI	Soil Resources Development Institute
ANOVA	Analysis of Variance

CHAPTER I

INTRODUCTION

Gladiolus (*Gladiolus grandiflorus* L.) is a very popular bulbous flowering plant in the world. It is usually propagated by corm and cormels. This is an herbaceous annual flower which belongs to the Iridaceae family. Gladiolus is also known as the Sword Lily, due to its sword shaped leaves.

Gladiolus is a very colorful decorative flower which is grown in herbaceous border, bed, rockery, pot and also for cut flower. Gladiolus is frequently used as cut flower in different social and religious ceremonies (Mitra, 1992). It is also used as bedding flower, herbaceous borders or does quite well in pots (Bose and Yadav, 1989). It is next to tulip in Holland in commercial importance (Negi and Raghavan, 1986). The flower vary in color with attractive shades of crimson, pink, salmon, red, scarlet, purple, apricot, cream, white or combination of two or more shades. Due to its variability in color, size, appearance and long vase life its demand is still increasing in global and local markets. Scarcity of an alternative cut-flower tuberose in winter season makes an opportunity to gladiolus to be more popular in Bangladesh.

Gladiolus has been cultivated for more than two thousand years. South Africa seems to be the origin of gladiolus. The cultivation of this flower was spread out in Europe during the 17th century. The development of gladiolus was started in Indian subcontinent in 19th century and gradually it has gained popularity in Bangladesh. The commercial cultivation of this flower has been extended widely in Jessore, Satkhira, Gazipur and Savar region in Bangladesh.

The researches on the development of gladiolus are very limited in Bangladesh. Recently small scale research has been started under the 'Horticultural Research Centre' of 'Bangladesh Agricultural Research Institute'.

Banker and Mukhopadhyay (1980) carried out an experiment to investigate the effects of corm size, depth of planting and spacing on the production of flowers and corms in gladiolus. The experiment was consisted of three depths of plantings viz.3, 5 or 7 cm and three spacing viz. 15, 20, 25 cm .It was observed that increased planting density resulted in shorter rachis (38.26) and shallow planting increased the number of cormels per plant (28.59).

Planting depth adversely affect corm and cormel production and delays flowering. Spacing also affects the flowering, corm growth and cormel production. Wider spacing showed the best flowering, corm growth and cormel production.

So, there is a scope of increasing yield and quality of flower and corm and cormel production of gladiolus by using appropriate spacing and depth of planting.

Considering the above facts, the present investigation was undertaken with the following objectives:

1. To find out the optimum plant spacing on yield of gladiolus.
2. To study the growth, flowering and yield performance of gladiolus under different depth of planting.

CHAPTER II

REVIEW OF LITERATURE

Gladiolus is one of the most popular cut flower in the world. Many research works have been conducted on various aspects of this important cut flower in different parts of the world. But limited research works have been carried out on gladiolus in Bangladesh. A review of literatures related to effects of spacing and depth of planting on growth, flowering and yield of gladiolus is given below under the following headings.

2.1. Effects of spacing

Rabbani and Azad (1996) carried out an experiment to investigate the effect of corm size and spacing on growth and flower production of gladiolus. They planted the corms at the spacing of 20 x 10, 20 x 15 or 20 x 20 cm. The highest yield of mother corm (13.17 t/ha) and cormel (22.36 t/ha) were recorded from the treatment combination of closest spacing (20 x 10 cm).

Patil *et al.* (1995) conducted an experiment to investigate the effect of different spacing and corm sizes on the flower and corm production of gladiolus in India. Gladiolus corms were planted at spacing of 30 x 10, 30 x 20 or 30 x 30 cm. The highest length of spike and more corms and cormels were obtained from closer spacing (30 x 10 cm).

Mollah *et al.* (1995) studied the effect of cormel size and spacing on growth and flower and corm of gladiolus in Bangladesh. They reported that the widest spacing (15 cm x15 cm) produced the maximum length of spike (36.34 cm) , longest rachis (11.9 cm), maximum plant height (56.60 cm) , maximum percentage of flowering plant (54.60) , heavier corm (31.33 g) and highest number of cormels (21.87) per plant.

Klasman *et al.* (1995) studied the effect of planting density on the production of gladiolus cv. Red Beauty under greenhouse condition in Argentina. They planted 15, 25, 35 or 45 corms per square meter. It was found that the best commercial quality flower (in terms of spike length and number of flowers per spike) and higher number of cormels (12.85 per plant) were obtained from the planting density of 45 corms per square meter.

Cocozza *et al.* (1994) studied the effect of planting density on flower and corm production of gladiolus cv. Victor Borge in Italy. Gladiolus cormels (<2 or 2.0-2.5 cm in circumference) were planted at the densities of 400, 600 or 800 per square meter. It was reported that corms for cut flower production and propagating material could be obtained from the highest planting density and the highest corm yield was obtained when large cormels (2.0-2.5 cm) were used as planting material.

Sciortino and Incalcaterra (1993) investigated the effect of planting density and provenance of propagation material on corm enlargement processes in different cultivars of gladiolus in Italy. They found that higher planting density gave better results in all the cultivars.

Incalcaterra (1992) carried out an experiment to investigate the effect of planting depth and density on gladiolus corm production cv. Peter Pears in Italy. The cormels were planted at the densities of 75, 100, 125 or 150 per square meter. It was found that increasing the planting density increased corm yield but reduced the corm quality. It was observed that the best yield and quality of corms were obtained from planting density of 125 cormels per square meter.

Sujata and Singh (1991) studied the effect of different planting densities on growth, flowering and corm production of gladiolus cv. Friendship in India. They used the plant densities of 15, 40, 60 or 80 corms per square meter. It was found that growth and flowering characteristics (including cut flower yields) decreased with increasing plant density. They also found that planting density had no significant effect on corm production.

Groen *et al.* (1989) investigated the effect of planting density on yield of gladiolus in the Netherlands. It was found that the optimum spacing for gladiolus cormel depends on the season, soil condition, cultivars and time of lifting.

Nilimesh and Roychowdhury (1989) carried out an experiment to investigate the effect of plant spacing and growth regulators on growth and flower yield of gladiolus cv. Psittacinus grown under polythene tunnel in India. It was found that higher planting density (33 corms per square meter) increased plant height, flower stalk length and yield of corms but decreased the number of florets per spike and flower length.

Gowda (1987) investigated the interaction effect of corm size and spacing on growth and flower production of gladiolus cv. Snow Prince. Corms were planted at a spacing of 30 x 10, 30 x 15, 30 x 20 or 30 x 25 cm. It was found that the best results were obtained from corms planted at a spacing of 30 x 25 cm.

Arora and Khanna (1987) studied the effect spacing on flowering and corm production of gladiolus cv. Sylvia in India. They planted 27, 36, 45, 54, 65, 72, or 81 corms per square meter. It was found that the number and weight of daughter corm and cormel per corm decreased at closer spacing. They also mentioned that the maximum number of daughter corms was obtained from planting 36 cormels per square meter and better flowers from 65 corms per square meter.

Syamal *et al.* (1987) studied the effect corm size, planting distance and depth of planting on growth and flowering of gladiolus cv. Happy End in India. They found that large corms (4-5 and 5-6 cm in diameter) gave earlier sprouting and increased inflorescence and stem length. On the other hand, planting distance (20 x 25, 30 x 25, or 40 x 25 cm) and depth of planting had no effect on total number and size of individual flowers. They reported that corm size, planting distance and depth of planting had no interaction effect on different parameters studied.

Sciortino *et al.* (1986) investigated the effects of size of propagating materials and planting density on the yield of corms for forced flower production in gladiolus cv. Peter Pears. They planted the cormel at the rate of 70-140 cormels per square meter. It was found that the best yield of corms increased with planting density. i.e. 140 cormels per square meter gave the best result.

Talia *et al.* (1986) studied the effect of planting density on the production of gladiolus corm cv. White Friendship, Oscar and Lavendel Puff. They observed that the higher planting density gave lower yields of large corms (12-14 and >14 cm).The cultivar Oscar gave the highest proportion (93.3%) of large corms than the other cultivars.

Koutepas (1984) conducted an experiment with planting density of 26.7, 40, or 53.3 corms per square meter using gladiolus cultivars Jessica and Peter Pears. In both the cultivars, it was observed that population density was inversely related to the number of florets per spike and spike length. It was also found that the weight of cut flower and flowering percentage decreased with increasing planting density in case of Peter Pears.

Mukhopadhyay and Yadav (1984) conducted an experiment to study the effect of corm size and spacing on growth, flowering and corm production of gladiolus. The planting spacing was 10 x 30, 15 x 30, 20 x 30, and 25 x 30. It was reported that wider spacing produced more flowers and corms and cormels than the closer spacing.

Borrelli (1984) conducted an experiment to find out the effect of planting density and nitrogen fertilization for cultivation of gladiolus cv. Peter Pears grown in an unheated glasshouse during summer and autumn. The crop was planted at the rate of 44.4, 53.5, 66.6 and 88.8 corms per square meter and it was reported that close spacing (44.4 corms per square meter) increased the yield of flower, corm and cormels.

Deswal *et al.* (1983) studied the effect of nutrients and plant population on growth and flower production of gladiolus in India. They planted the corms at 30 x 30 cm or 45 x 30 cm spacing. They found that wider spacing (45 x 30 cm) produced the tallest plant, higher number of florets per spike and cormels per plant.

Bhattacharjee (1981) investigated the effects of corm size, planting depth and spacing. Corms were planted at a spacing of 15, 20, or 25 cm. It was found that wide spacing (25 x 20 cm) was associated with the best flowering, corm weight and cormel production.

Cirrito and Vita (1980) conducted a three-year trial to study the effect of three different planting distances on the production of gladiolus corm. They planted 100, 150, or 200 corms per square meter and found that optimum size corms could be obtained from the highest planting density. They also observed that cormel production was not affected by planting density.

Grabowska (1980) studied the effect of planting density on flowering and quality of gladiolus cv. Kopernik under plastic tunnel. Corms were planted at the rate of 60, 80, or 100 per square meter. It was found that high planting density delayed flowering, reduced the number of flowering plants and decreased plant height and spike length. It was recommended that 80 plants per square meter was optimum for moderate growth and vigor of gladiolus.

Banker and Mukhopadhyay (1980) carried out an experiment to investigate the effects of corm size, depth of planting and spacing on the production of flowers and corms in gladiolus. The experiment was consisted of three spacing viz. 15, 20, 25 cm. It was observed that increased planting density resulted in shorter rachis (38.26) and shallow planting increased the number of cormels per plant (28.59).

Fernandes *et al.* (1975) carried out an experiment to investigate the effect of spacing on flowering, corm and cormel production of gladiolus cv. "Friendship". They planted 20-60 corms per square meter with constant row spacing of 60 cm. They found that decrease in spacing reduced corm weight, number of cormels and spike length.

2.2 Effects of depth of planting

Incalcaterra (1992) investigated the effect of planting depth and plant density for corm production of gladiolus. Cormels were planted at a depth of 2, 4, 8, 16 or 20 cm. It was observed that higher yield and better quality was planting at a depth of 8 cm.

Vinceljak (1990) carried out an experiment to investigate the effects of planting depth and planting density on gladiolus corm production. Cormels were planted at a depth of 2, 4, 8, 16 or 20 cm. It was found that planting depth of 16 and 20 cm gave markedly lower yields than shallower planting depth. The best treatment combination for higher yield and better quality was planting at a depth of 8 cm.

Syamal *et al.* (1987) studied the effect corm size, planting distance and depth of planting on growth and flowering of gladiolus cv. Happy End in India. They found that large corms (4-5 and 5-6 cm in diameter) gave earlier sprouting and increased inflorescence and stem length. On the other hand, planting distance (20 x 25, 30 x 25, or 40 x 25 cm) and depth of planting had no effect on total number and size of individual flowers. They reported that corm size, planting distance and depth of planting had no interaction effect on different parameters studied.

Mattos *et al.* (1984) reported that the propagation of gladiolus was influenced by the depth of planting. Planting depth of 7.3 cm was best for parent corms for the production of corms over the range "Jumbo" down to type 5.They also reported that a depth of 5.6 cm was better for producing large quantities of cormels.

Mattos *et al.* (1983) planted 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 in dark red latosol of high fertility. They observed that planting at

15 cm depth generally gave better results and planting at 5 cm led to excessive lodging.

Iziro and Hori (1983) observed that at planting depth of 15 and 30 cm, the contractiles of gladiolus elongated slightly but showed little thickening. On the other hand, at the standard depth of 5 cm, they elongated, thickened and contracted satisfactorily. Corm growth was found to be poor at 30 cm but good at 15 cm in spite of poor growth of contractile roots.

Bhattacharjee (1981) investigated the effects of corm size, planting depth and spacing. Corms were planted at a depth of 5, 7 or 9 cm. The quality of flower spikes and corms were improved as planting depth increased.

Konoshima (1980) studied the effect of planting depth and soil covering at different stages on the dormancy and weight of gladiolus corms in Japan. Corms at 0, 5, 10, 15, 20 or 30 cm depth were planted. The deeper planted corms (20 or 30 cm) sprouted about 8 days earlier than those from the shallower planted corms and 12 days earlier than those grown on the surface. It was also found that individual weight of corms was heavier from deeper planted corms than from the others.

Banker and Mukhopadhyay (1980) carried out an experiment to investigate the effects of corm size, depth of planting and spacing on the production of flowers and corms in gladiolus. The experiment was consisted of three depth of planting viz. 3, 5 or 7 cm. It was observed that shallow planting increased the number of cormels per plant (28.59).

Fodder (1976) studied the effect of soil covering and depth of planting on gladiolus corm production. The corms of gladiolus were planted at 5, 10 or 15 cm depth and soil was mulched with a 2 cm deep layer of wood shavings or was left unmulched. Planting at 5 cm depth produced the highest percentage of large (> 10 cm) corms.

Kolesnikov (1965) found that when gladiolus is grown for cormel production, it will be beneficial to plant mother corms at shallow depth. However, in light soil too much shallow planting could result in the toppling of plants. This can be prevented by staking and reducing spacing between corms within a row.

CHAPTER III

MATERIALS AND METHODS

The present experiment was conducted at the Horticulture Farm of Sher-e-Bangla Agricultural University, Dhaka during the period from November 2006 to June 2007 to investigate the effect of spacing and depth of planting on the growth, flowering and yield of Gladiolus.

3.1 Climate

The experimental area is under the sub-tropical climate 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 (Edris *et al.,* 1979). Information regarding monthly maximum and minimum temperature, rainfall, relative humidity, soil temperature as recorded by the Dhaka Meteorological Centre, Dhaka during the period of study has been presented in Appendix I.

3.2 Site and soil

The soil of the experimental area belongs to the Madhupur Tracts under AEZ No.28. The analytical data of the soil sample collected from the experimental area determined in the SRDI, Soil Testing Laboratory, Khamarbari, Dhaka has been presented in Appendix II. The experimental site was a medium high land and pH of the soil was 5.6.The morphological characters of the soil of the experimental plots are given below-

AEZ No.	- 28
Soil series	-Tejgaon
General soil	-Shallow red brown terrace soil

3.3 Treatments of the experiment

There are two factors in this experiment. The factors with their different levels are given below:

Factor A: It included three plant spacing;

1. S_1 (25 cm x 10 cm)
2. S_2 (25 cm x 15 cm)
3. S_3 (25 cm x 20 cm)

Factor B: Depth of planting;

1. D_1 (5 cm)
2. D_2 (7 cm)
3. D_3 (9 cm)

3.4 Planting materials

The corms of gladiolus were collected from Ananda Nursery, Savar Bazar, Dhaka.

3.5 Land preparation

The experimental plot was first opened by a power tiller. Land was then ploughed several times by a power tiller. The clods were broken and weeds were collected before final land preparation until good tilth. The basal doses of manures and fertilizers were applied during final land preparation.

3.6 Experimental design and layout

The two- factor experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. Each block was divided into 9 plots. Thus, there were 27 (9 x 3) unit plots in the experiments, where 9 (3 x 3) treatments were assigned at random.

The size of a unit plot was 120 cm x 100 cm. The plot to plot spacing was 50 cm in both sides. The layout of experimental plots has been shown in Fig 1.

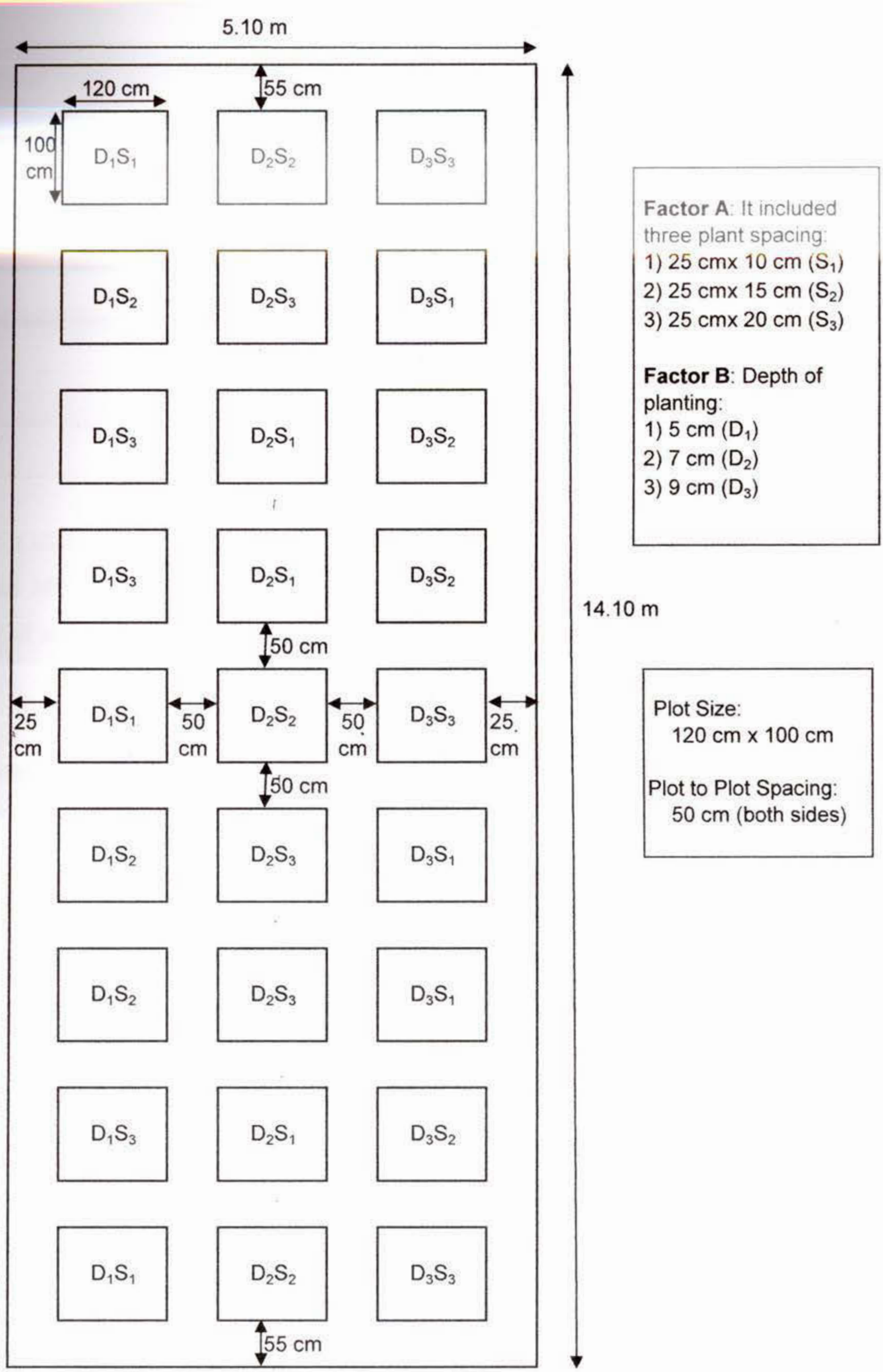

Fig 1: Field layout (Randomized Complete Block Design, RCBD)

3.7 Manure and fertilizers

Manure and fertilizers	Doses
Cowdung	100 t/ha
Urea	200 kg/ha
TSP	225 kg/ha
MP	190kg/ha

The entire amount of cow dung and TSP was applied during final land preparation. Urea and MP were applied in two equal installments at 25 and 50 days after planting of corms.

3.8 Sowing of corms

Uniform corms of gladiolus were selected for sowing. The corms were treated with Redomil or Bavistin. Corms were planted at a depth of 5, 7 and 9 cm in the morning on 28th November, 2006. The spacing S_1 (25 cm x 10 cm), S_2 (25 cm x 15 cm) and S_3 (25 cm x 20 cm) were given. Just after sowing a light irrigation was given with the hose pipe, so that irrigation water can not move from unit plot.

3.9 Cultural operation

Weeding and mulching

The field was weeded as and when necessary. The soil was mulched frequently after irrigation by breaking the crust for easy aeration and to conserve soil moisture.

Irrigation

The experimental plots were irrigated four times during the whole period of plant growth following flood method.

Earthing up

Earthing up was done twice during growing period. The first Earthing up was done at 25 days of planting. The 2 nd Earthing up was done after 50 days of planting.

Staking

Bamboo stick was placed for staking and spikes were tied with the stick.

3.10 Harvesting

The spikes of gladiolus were harvested from 22 February to 20 March, 2007 when the basal floret showed colour. Corms and cormels were harvested on 20 June, 2007.

3.11 Collection of data

Data were recorded from ten randomly selected plants from each unit plot for the following parameters.

3.11.1 Days required to 50% emergence of plant

It was achieved by recording the time taken to complete 50% emergence of the crop.

3.11.2 Days required to 50% emergence of inflorescence

It refers to complete 50% harvest of spikes of gladiolus in the experimental field.

3.11.3 Average plant height

Plant height refers to the length of the plant from ground level up to shoot apex of the plant. It was measured at an interval of 15 days starting from 30 days after planting (DAP) till 75 days.

3.11.4 Average number of leaves

All the leaves of plants were counted at an interval of 15 days starting from 30 days after planting (DAP) till 75 days.

3.11.5 Length of leaves

The length of all leaves of 10 randomly selected plants was measured and the mean was calculated and recorded.

3.11.6 Length of spikes

Length of spike was measured from the base to the tip of the spike.

3.11.7 Length of rachis

Length of rachis refers to the length from the axils of first floret up to the tip of the inflorescence.

3.11.8 Number of spikelet per spike

All the spike lets of the spike were counted from 10 randomly selected plants and their mean was calculated.

3.11.9 Weight of a single spike

The spike was cut from 10 randomly selected plants from each plot and the weight of spikes was recorded to calculate their mean.

3.11.10 Weight of cormels per plant

It was calculated from the weight of cormels obtained from 10 randomly selected plants and mean was found out.

3.11.11 Diameter of individual corm

A slide calipers was used to measure the diameter of the corm.

3.11.12 Number of cormels per plant

It was calculated from the number of cormels obtained from 10 randomly selected plants and mean was found out.

3.11.13 Average weight of corm per plant

It was determined by weighting the corms from 10 randomly selected plants and mean weight was calculated.

3.11.14 Yield of spike per hectare

The total weight of spike per unit plot was converted to yield of spike per hectare. It is very important how to calculate the yield. The land area is assumed to be divided into a number of plots of 120 cm x 100 cm and for both row to row and column to column 50cm interval is assumed.

3.11.15 Yield of corm per hectare

It was calculated by converting the yield of corm per plot to per hectare.

3.11.16 Yield of cormels per hectare

It was calculated by converting the yield of cormel per plot to per hectare.

3.12 Statistical analysis

The collected data for various characters were statistically analyzed by using MSTAT computer package programme. The analysis of variance of the characters under study was performed by F (variance ratio) test. The significant differences among the treatment means were evaluated by LSD test.

3.13 Economic analysis

The cost of production was analyzed in order to find out the most profitable treatment combination of spacing and planting depth. All the non material and material input cost and interest on fixed and running capital were considered for estimating the cost of production. The interest was calculated at the rate of 8% (as per Bangladesh Krishi Bank interest rate on floriculture) for the period of 9 months.

CHAPTER IV

RESULTS AND DISCUSSION

The present experiment was conducted to observe the effect of spacing and depth of planting on the growth, flowering and yield of Gladiolus. The analysis of variance (ANOVA) of the data on different yield components of gladiolus is given in Appendix III- V. The results have been presented and discussed and possible interpretations have been given under the following headings.

4.1. Plant height

At 45 DAP and 60 DAP there were no significant differences on plant height. But 30 DAP and 75 DAP plant height varied significantly due to the widest spacing (Appendix III). At 30 DAP, the tallest plant height (47.20 cm) was recorded from S_3 (25 cm x 20 cm) and shortest (44.79 cm) plant height was found from S_1 (25 cm x 10 cm). The tallest (54.49 cm) plant height was obtained from S_3 (25 cm x 20 cm) while the shortest plant height (51.54 cm) was found from S_1 (25 cm x 10 cm) at 45 DAP. At 60 DAP, the tallest (62.85 cm) plant height was obtained from S_3 (25 cm x 20 cm) while the shortest (60.01 cm) plant height was recorded from S_1 (25 cm x 10 cm) spacing. The tallest (72.42 cm) plant height was recorded from S_3 (25 cm x 20 cm) and the shortest (67.86 cm) plant height was found from the nearest spacing (25 cm x 10 cm) at 75 DAP. This might be due to the fact that plants of larger spacing can uptake comparatively larger amount of nutrients and can absorb more sunlight for photosynthesis. Mollah *et al.* (1995), Nilimesh and Roychowdhury (1989) and Deswal *et al.* (1983) also obtained maximum plant height from the widest spacing.

At 30 DAP, 45 DAP and 60 DAP there were no significant differences on plant height. But 75 DAP plant height varied significantly by depth of planting (Appendix III). At 30 DAP, the tallest plant height (47.17 cm) was recorded from D_3 (9 cm) and the shortest (45.28 cm) plant height was found from D_1 (5 cm). The tallest (53.73 cm) plant height was obtained from D_1 (5 cm) while the shortest plant height (52.37 cm) was found from D_2 (7 cm) at 45 DAP. At 60 DAP, the tallest (62.33 cm) plant height was obtained from D_1 (5 cm) while the shortest (60.42 cm) plant height was recorded from D_2 (7 cm) depth. The tallest (70.80 cm) plant height was recorded from D_3 (9 cm) and the shortest (69.79 cm) plant height was found from D_2 (7 cm).

There were no significant variation of combined effect of spacing and depth of planting on plant height at 30, 45 and 60 DAP, but at 75 DAP, the plant height showed significant variation. However, the tallest plant height was obtained from the treatment combination of S_3 D_1 (25 cm x 20 cm spacing and 5 cm depth) in all days after planting except 30 DAP. At 30 DAP, the tallest plant height was recorded from the treatment combination of S_3 D_3 (25 cm x 20 cm spacing and 9 cm depth). At 75 DAP, the tallest (73.44 cm) plant height was found from S_3 D_1 wherever, the shortest (66.21 cm) plant height was recorded from S_1 D_1 (25 cm x 10 cm and 5 cm depth) (Table 2). Syamal *et al.* (1987). stated the same trends of result in their findings.

4.2. Number of leaves per plant

Number of leaves per plant was significantly influenced by spacing (Appendix III). Number of leaves per plant was increased with the increase of spacing. At 30 DAP, the maximum (3.78) number of leaves per plant was recorded from S_3 (25 cm x 20 cm) and the minimum (3.13) number of leaves per plant was found from S_1 (25 cm x 10 cm). The maximum (5.65) number of leaves per plant was recorded from S_3 (25 cm x 20 cm) and the minimum (5.25) number of leaves per plant was obtained from S_1 (25 cm x 10 cm) at 45 DAP. At 60 DAP, the maximum (7.26) number of leaves per plant was recorded from S_3 (25 cm x 20 cm) while the minimum (6.76) number of leaves per plant was found from S_1 (25 cm x 10 cm) spacing. The maximum (8.90) number of leaves per plant was recorded from S_3 (25 cm x 20 cm) and the minimum (8.08) number of leaves per plant was obtained from S_1 (25 cm x 10 cm) at 75 DAP. This might be due to the fact that wider spacing results in less competition among the plant for sunlight, nutrients and water which ultimately contributed to produce higher number of leaves per plant. Gowda (1987) also obtained the best result for widest spacing.

Number of leaves per plant was not significantly influenced by depth of planting (Appendix III). At 30 DAP, the maximum (3.46) number of leaves per plant was recorded from D_2 (7 cm) and the minimum (3.42) number of leaves per plant was found from D_1 and D_3 (5 cm and 9 cm depth respectively).The maximum (5.51) number of leaves per plant was recorded from D_2 (7 cm) and the minimum (5.47) number of leaves per plant was obtained from D_1 and D_3 (5 cm and 9 cm depth respectively) at 45 DAP. At 60 DAP, the maximum (7.07) number of leaves per plant was recorded from D_2 (7 cm) while the minimum (7.00) number of leaves per plant was found from D_1 and D_3 (5 cm and 9 cm depth respectively). The maximum (8.56) number of leaves per plant was recorded from D_1 and D_2 (5 cm and 7 cm depth respectively) and the minimum (8.53) number of leaves per plant was obtained from D_3 (9 Cm) at 75 DAP.

Combined effect of spacing and depth of planting was found statistically non-significant on number of leaves per plant (Table 2) at 30, 45, 60 and 75 DAP. The treatment combination of S_3 D_2 (25 cm x 20 cm spacing and 7 cm depth) showed the maximum number of leaves in all days after planting except 30 DAP. However, at 75 DAP, the maximum (8.92) number of leaves gave the treatment combination of S_3 D_2, whereas, the minimum (8.07) was found from S_1 D_3 (25 cm x 10 cm spacing and 9 cm depth). Similar trend of results was obtained by Syamal *et al.* (1987).

4.3. Length of leaves

Length of leaves per plant was not significantly influenced by spacing at all days after planting (Appendix III and Table 1.A). At 30 DAP, the maximum (39.72 cm) length of leaves was found from S_3 (25 cm x 20 cm, widest spacing) and the minimum (37.66 cm) was recorded from S_1 (25 cm x 10 cm). The maximum (47.24 cm) length of leaves was obtained from S_2 (intermediate spacing, 25 cm x 15 cm) whereas, the minimum (45.48 cm) was recorded from S_1 (closest spacing, 25 cm x 10 cm) at 45 DAP. Intermediate spacing (S_2, 25 cm x 15 cm) showed the maximum (52.88 cm) length of leaves while the widest spacing (S_3, 25 cm x 20 cm) gave the minimum (51.18 cm) at 60 DAP. But at 75 DAP, the maximum (57.55 cm) leaf length was found from the intermediate spacing (S_2, 25 cm x 15 cm) and the minimum (56.46 cm) was obtained from the widest spacing (S_3, 25 cm x 20 cm).

Effect of depth on length of leaves of plant was found statistically significant for 30 and 45 DAP, but it was non significant for 60 and 75 DAP (Appendix III and Table 1.B). At 30 DAP, the maximum (42.30 cm) length of leaves was recorded from D_1 (5 cm) and the minimum (35.43 cm) was found from D_2 (7 cm).The maximum (48.00 cm) length of leaves was obtained from D_1 (5 cm) and the minimum (43.76 cm) was recorded from D_2 (7 cm) at 45 DAP. At 60 DAP, the maximum (53.43 cm) length of leaves was recorded from D_3 (9 cm) while the minimum (50.80 cm) was found from D_2 (7 cm). The maximum (58.49 cm) length of leaves was obtained from D_3 (9 cm) and the minimum (56.03 cm) was found from D_2 (7 Cm) at 75 DAP. Allover the vegetative period length of leaves for intermediate depth (7 cm) was found minimum.

Combined effect of spacing and depth of planting was found statistically non-significant length of leaves (Table 2) at 30, 45, 60 and 75 DAP. The treatment combination of S_2 D_1 (25 cm x 15 cm spacing and 5 cm depth) showed the maximum length of leaves in all days after planting except 75 DAP. However, at 75 DAP, the maximum (59.05 cm) length of leaves gave the treatment combination of S_3 D_3 (25 cm x 20 cm spacing and 9 cm depth), whereas, the minimum (54.57 cm) was found from S_3 D_2 (25 cm x 20 cm spacing and 7 cm depth). Similar trend of results was obtained by Syamal *et al.* (1987).

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Table 1.A. Individual effect of spacing on plant height, number of leaves, length of leaves at different days after planting (DAP)

Treatment	Plant height (cm)				Number of leaves per plant				Length of leaves (cm)			
Spacing	30DAP	45DAP	60DAP	75DAP	30DAP	45DAP	60DAP	75DAP	30DAP	45DAP	60DAP	75DAP
25 cm x 10 cm (S_1)	44.79	51.54	60.01	67.86	3.13	5.25	6.76	8.08	37.66	45.48	51.65	56.97
25 cm x 15 cm (S_2)	46.15	53.75	62.15	70.60	3.38	5.54	7.06	8.67	39.39	47.24	52.88	57.55
25 cm x 20 cm (S_3)	47.20	54.49	62.58	72.42	3.78	5.65	7.26	8.90	39.72	46.23	51.18	56.46
$LSD_{(0.05)}$	2.785	--	--	2.352	0.363	0.212	0.197	0.232	--	--	--	--
Level of significance	**	NS	NS	**	**	**	**	**	NS	NS	NS	NS

Table 1.B. Individual effect of depth of planting on plant height, number of leaves, length of leaves at different days after planting (DAP)

Treatment	Plant height (cm)				Number of leaves per plant				Length of leaves (cm)			
Depth	30DAP	45DAP	60DAP	75DAP	30DAP	45DAP	60DAP	75DAP	30DAP	45DAP	60DAP	75DAP
5 cm (D_1)	45.28	53.73	62.33	70.29	3.42	5.47	7.00	8.56	42.30	48.00	51.49	56.46
7 cm (D_2)	45.70	52.37	60.42	69.79	3.46	5.51	7.07	8.56	35.43	43.76	50.80	56.03
9 cm (D_3)	47.17	53.69	61.99	70.80	3.42	5.47	7.00	8.53	39.04	47.20	53.43	58.49
$LSD_{(0.05)}$	--	--	--	2.324	--	--	--	--	3.584	3.996	--	--
Level of significance	NS	NS	NS	**	NS	NS	NS	NS	**	**	NS	NS

** Significant at 1% level of probability, NS: Non Significant

Table 2. Combined effect of spacing and depth of planting on plant height, number of leaves, length of leaves at different days after planting (DAP)

Treatment		Plant height (cm) at				Number of leaves per plant				Length of leaves (cm)			
Spacing (cm x cm)	Depth (cm)	30DAP	45DAP	60DAP	75DAP	30DAP	45DAP	60DAP	75DAP	30DAP	45DAP	60DAP	75DAP
25 x 10 (S_1)	5 (D_1)	43.27	50.63	58.93	66.21	3.01	5.21	6.75	8.08	40.63	46.13	49.62	54.74
	7 (D_2)	44.80	52.50	60.53	68.92	3.23	5.30	6.78	8.10	35.52	45.12	52.57	57.99
	9 (D_3)	46.30	51.50	60.56	68.45	3.16	5.25	6.74	8.07	36.83	45.19	52.75	58.19
25 x 15 (S_2)	5 (D_1)	45.96	54.67	63.71	71.21	3.41	5.56	7.02	8.70	43.90	50.15	54.29	58.87
	7 (D_2)	45.30	52.12	60.33	69.57	3.36	5.51	7.10	8.67	35.08	43.86	50.35	55.54
	9 (D_3)	47.20	54.46	62.41	71.02	3.38	5.56	7.06	8.64	39.19	47.70	54.00	58.24
25 x 20 (S_3)	5 (D_1)	46.61	55.89	64.34	73.44	3.85	5.63	7.22	8.90	42.37	47.71	50.55	55.76
	7 (D_2)	47.00	52.49	60.39	70.89	3.78	5.72	7.34	8.92	35.70	42.29	49.47	54.57
	9 (D_3)	48.00	55.10	63.00	72.94	3.72	5.60	7.21	8.88	41.10	48.70	53.53	59.05
$LSD_{(0.05)}$		--	--	--	1.157	--	--	--	--	--	--	--	--
Level of significance		NS	NS	NS	**	NS	NS	NS	NS	NS	NS	NS	NS
CV (%)		3.88	5.16	4.09	0.95	5.84	2.91	1.73	1.78	6.11	4.74	4.88	4.09

** Significant at 1% level of probability
NS: Non Significant

4.4. Days required to 50% emergence of plant

Days required to 50% emergence of plant were significantly influenced by spacing (Appendix IV). Wider spacing resulted shorter time for emergence and vice versa. The maximum (7.29) days and the minimum (5.69) days were counted for the spacing of S_1 (25 cm x 10 cm) and S_3 (25 cm x 20 cm) respectively (Table 3.A).

Days required to 50% emergence of plant were also significantly influenced by depth of planting (Appendix IV). Increase in depth results a decrease in day's requirement for emergence. The maximum (8.07) days were required for D_3 (9 cm) and the minimum (5.20 days) for D_1 (5 cm) (Table 3.B). The present finding is in agreement with the findings of Konoshima (1980).

Combined effect of spacing and depth of planting was found also statistically significant on days required to 50% emergence of plant (Table 4). The treatment combination of S_1 D_3 (25 cm x 10 cm spacing and 9 cm depth) took the maximum (10.29) days and minimum (4.97) days were needed for the treatment combination of S_3 D_1 (widest spacing, 25 cm x 20 cm and shallowest depth, 5 cm).

4.5. Days required to 50% emergence of inflorescence

Days required to 50% emergence of inflorescence were significantly influenced by spacing (Appendix IV). The maximum (66.67) days were required for the spacing of S_1 (25 cm x 10 cm) and the minimum (63.89) days were required for the widest spacing at 25 cm x 20 cm (Table 3.A). The present finding is in agreement with the findings of Mukhopadhyay and Yadav (1984).

Days required to 50% emergence of inflorescence were also significantly influenced by depth of planting (Appendix IV). Increase in depth results a decrease in day's requirement for emergence. The maximum (69.97) days were required for D_3 (9 cm) depth of planting and the minimum (60.78) days were needed for D_1 (5 cm) depth of planting (Table 3.B).

The combined effect of spacing and depth of planting was not statistically significant (Table 4).The maximum (71) days were required for the treatment combination of 25 cm x 10 cm spacing (closest) with 9 cm depth (deepest) and the minimum (59.33) days were counted for the combination of 25 cm x 20 cm spacing and 5 cm depth (Table 4). Similar trend of results was obtained by Syamal *et al.* (1987).

4.6. Length of spikes at harvest

Length of spikes of plant at harvest was significantly influenced by spacing (Appendix IV). The maximum (85.68 cm) length of spike was found from the widest spacing of 25 cm x 20 cm and the minimum (74.41 cm) was recorded from the closest spacing of 25 cm x 10 cm (Table 3.A and Plate 1). The present finding is in agreement with the findings of Mollah *et al.* (1995) and Banker and Mukhopadhyay (1980).

Length of spike was also significantly influenced by different depth of planting (Appendix IV). The maximum (82.56 cm) length of spike was found from 9 cm (deepest) depth of planting and the minimum (76.61 cm) was recorded from 7 cm (intermediate) depth (Table 3.B).

Combined effect of spacing and depth of planting was also found statistically significant on length of spike of plant (Table 4). The treatment combination of S_3 D_3 (widest spacing, 25 cm x 20 cm and deepest depth, 9 cm) gave the maximum (89.67 cm) length of spike and the minimum (74.21 cm) was measured from the combination of S_1 D_3 (closest spacing, 25 cm x 10 cm and deepest depth, 9 cm).

4.7. Weight of spikes at harvest

Weight of spike was also varied significantly with plant spacing (Appendix IV). The maximum (73.43 gm) weight was found from the widest spacing of 25 cm x 20 cm and the minimum (56.12 gm) was recorded from the closest spacing of 25 cm x 10 cm (Table 3.A). As wider spacing provided opportunity to absorb more sunlight and ensure less competition in uptaking nutrients and water from soil, relatively larger weighted spikes were produced for wider spacing. Similar trend of results was obtained by Bhattacharjee (1981).

Weight of spikes showed also statistically significant variation due to the effect of planting depth (Appendix IV). Increase in depth not resulted a linear variance in order either positively or negatively but it was found that the maximum (69.04 gm) weight was obtained from 9 cm (deepest depth of planting) and the minimum (61.83 gm) was found from 7 cm (intermediate depth) which was closely followed by 65.45 gm for 5 cm (shallowest depth) (Table 3.B).

Combined effect of spacing and depth of planting was also found statistically significant on weight of spike of plant (Table 4). The treatment combination of S_3 D_3 (widest spacing, 25 cm x 20 cm and deepest depth, 9 cm) showed the maximum (79.94 gm) weight of spike and the minimum (52.86 gm) was found from the combination of 25 cm x 10 cm spacing (closest) and 5 cm depth (shallowest).

4.8. Length of rachis at harvest

Variation of length of rachis was highly significant with the use of different spacing (Appendix IV) and ranged from 37.83 cm to 47.65 cm which were recorded from the closest spacing (25 cm x 10 cm) and the widest spacing (25 cm x 20 cm) respectively (Table 3.A and Plate 2). The results showed the positive variation in length of rachis with the increase in spacing. This result recorded may be due to the fact that wider spacing results in less competition among the plant for sunlight, nutrients and water. The present finding is in agreement with the findings of Banker and Mukhopadhyay (1980).

Length of rachis was also significantly influenced by different depth of planting (Appendix IV). The maximum (44.88 cm) length of rachis was found from 5 cm (shallowest) depth of planting and the minimum (41.52 cm) was recorded from 7 cm (intermediate) depth which was closely followed by 42.63 cm found from 9 cm (deepest) depth (Table 3.B and Plate 3).

Combined effect of spacing and depth of planting was also found statistically significant on length of rachis of plant (Table 4). The treatment combination of widest spacing (25 cm x 20 cm) and shallowest depth (5 cm) showed the maximum (49.35 cm) length of rachis at harvest while the minimum (36.92 cm) was recorded from the treatment combination of the closest spacing (25 cm x 10 cm) with the deepest (9 cm) depth of planting.

4.9. Number of spikelets per spike

Number of spikelets per spike was significantly influenced by spacing (Appendix IV). Number of spikelets per spike was increased with the increase of spacing. It was found that the maximum (12.71) number of spikelets per spike from the widest spacing of 25 cm x 20 cm and the minimum (9.99) from the closest spacing of 25 cm x 10 cm (Table 3.A and Plate 4). This might be due to the fact that wider spacing results in less competition among the plant for sunlight, nutrients and water which ultimately contributed to produce higher number of spikelets per spike. The present finding is in agreement with the findings of Nilimesh and Roychowdhury (1989) and Mukhopadhyay and Yadav (1984).

Number of spikelts per spike was not significantly influenced by depth of planting (Appendix IV). Number of spikelets per spike was almost same with the different spacing of 5 cm, 7 cm and 9 cm. At harvest, the maximum (11.61) number of spikelets per spike was found from 5 cm depth and the minimum (11.27) was recorded from 7 cm depth of planting (Table 3.B and Plate 5).

Combined effect of spacing and depth of planting was found statistically non-significant on number of spikelets per spike (Table 4) at harvest. The treatment combination of S_3 D_1 (widest spacing, 25 cm x 20 cm and shallowest depth, 5 cm) showed the maximum (12.88) number of spikelets per spike while the minimum (9.75) number of spikelets per spike was found from the treatment combination of 25 cm x 10 cm spacing (closest) and 9 cm depth (deepest). Similar trend of results was obtained by Syamal *et al.* (1987).

Table 3.A. Individual effect of spacing on days required to 50% emergence of plant, days required to 50% emergence of inflorescence, length of spike at harvest, wt. of spike at harvest, length of rachis at harvest, number of spikelets per spike of gladiolus

Treatment	Days required to 50% emergence of plant	Days required to 50% emergence of inflorescence	Length of spike at harvest (cm)	Wt. of spike at harvest (gm)	Length of rachis at harvest (cm)	Number of spikelets per spike
Spacing						
25 cm x 10 cm (S_1)	7.29	66.67	74.41	56.12	37.83	9.99
25 cm x 15 cm (S_2)	6.14	65.22	80.75	66.77	43.55	11.58
25 cm x 20 cm (S_3)	5.69	63.89	85.68	73.43	47.65	12.71
$LSD_{(0.05)}$	1.479	1.424	4.414	6.011	3.320	1.514
Level of significance	**	**	**	**	**	**

Table 3.B. Individual effect of depth of planting on days required to 50% emergence of plant, days required to 50% emergence of inflorescence, length of spike at harvest, wt. of spike at harvest, length of rachis at harvest, number of spikelets per spike of gladiolus

Treatment	Days required to 50% emergence of plant	Days required to 50% emergence of inflorescence	Length of spike at harvest (cm)	Wt. of spike at harvest (gm)	Length of rachis at harvest (cm)	Number of spikelets per spike
Depth						
5 cm (D_1)	5.20	60.78	81.68	65.45	44.88	11.61
7 cm (D_2)	5.86	65.33	76.61	61.83	41.52	11.27
9 cm (D_3)	8.07	69.67	82.56	69.04	42.63	11.40
$LSD_{(0.05)}$	1.325	1.638	4.330	6.154	3.399	--
Level of significance	**	**	**	**	**	NS

** Significant at 1% level of probability, NS: Non Significant

Table 4. Combined effect of spacing and depth of planting on days required to 50% emergence of plant, days required to 50% emergence of inflorescence, length of spike at harvest , wt. of spike at harvest, length of rachis at harvest, number of spikelets per spike of gladiolus

Treatment		Days required to 50% emergence of plant	Days required to 50% emergence of inflorescence	Length of spike at harvest (cm)	Wt. of spike at harvest (gm)	Length of rachis at harvest (cm)	Number of spikelets per spike
Spacing (cm x cm)	Depth (cm)						
25 x 10 (S_1)	5 (D_1)	5.38	62.33	74.67	52.86	38.04	9.96
	7 (D_2)	6.21	66.67	74.35	56.46	38.54	10.27
	9 (D_3)	10.29	71.00	74.21	59.04	36.92	9.75
25 x 15 (S_2)	5 (D_1)	5.24	60.67	82.87	70.09	47.24	12.00
	7 (D_2)	6.01	65.33	75.60	62.09	41.17	11.17
	9 (D_3)	7.17	69.67	83.79	68.14	42.23	11.57
25 x 20 (S_3)	5 (D_1)	4.97	59.33	87.50	73.41	49.35	12.88
	7 (D_2)	5.37	64.00	79.88	66.94	44.86	12.38
	9 (D_3)	6.74	68.33	89.67	79.94	48.75	12.87
$LSD_{(0.05)}$		0.05474		1.445	2.026	1.789	
Level of significance		**	NS	**	**	**	NS
CV (%)		0.35	1.49	1.04	1.79	2.4	7.84

** Significant at 1% level of probability
NS: Non Significant

Plate-1: Effect of spacing on length of spike

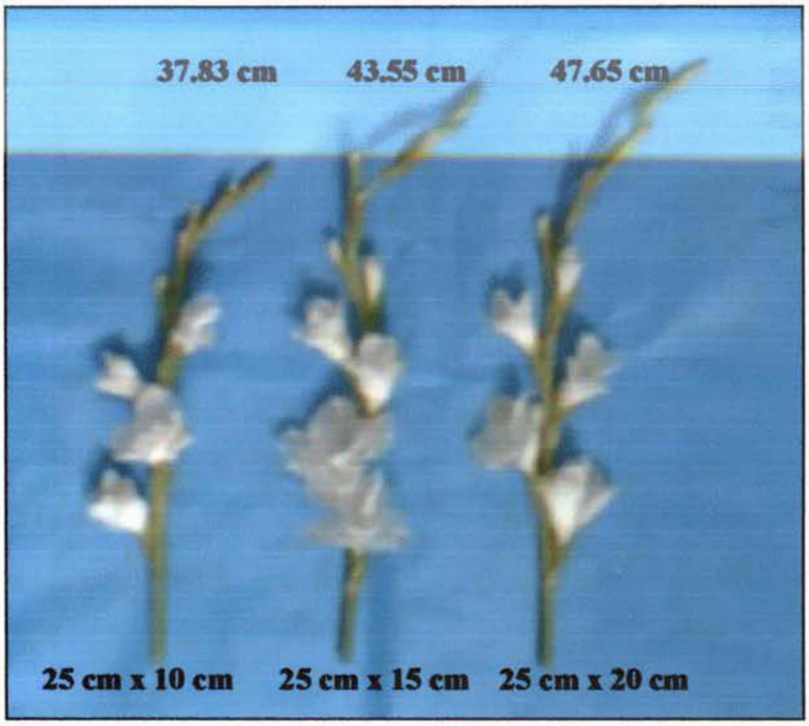

Plate-2: Effect of spacing on length of rachis

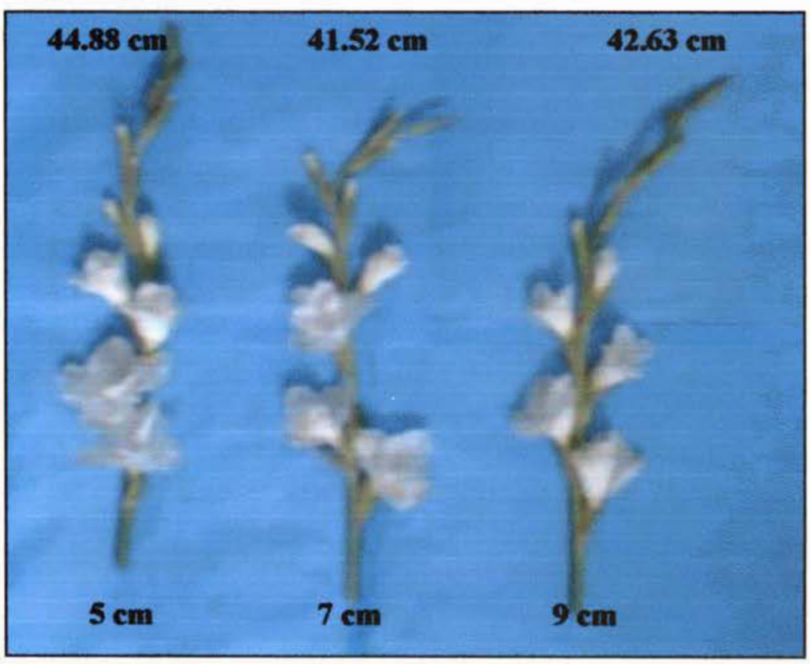

Plate-3: Effect of depth on length of rachis

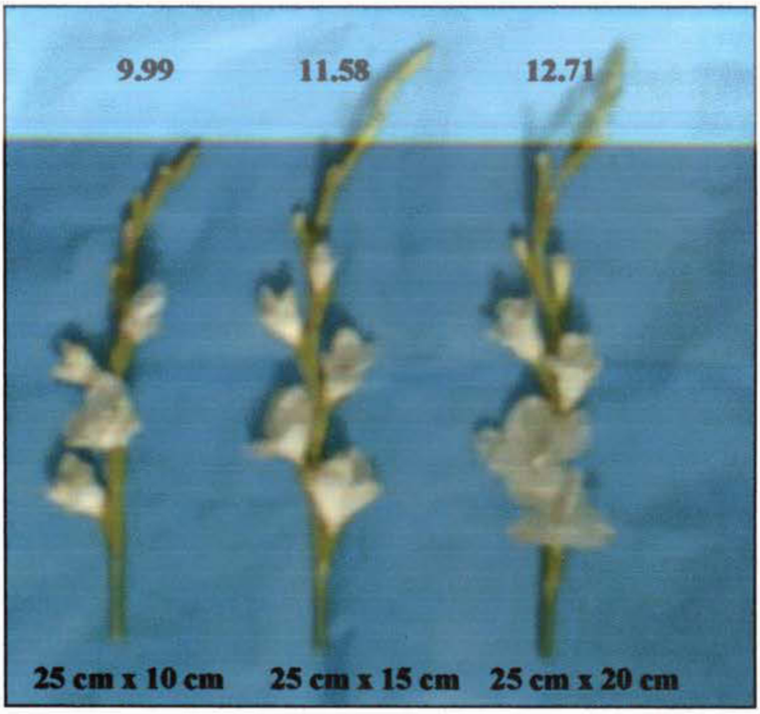

Plate-4: Effect of spacing on number of spikelets per spike

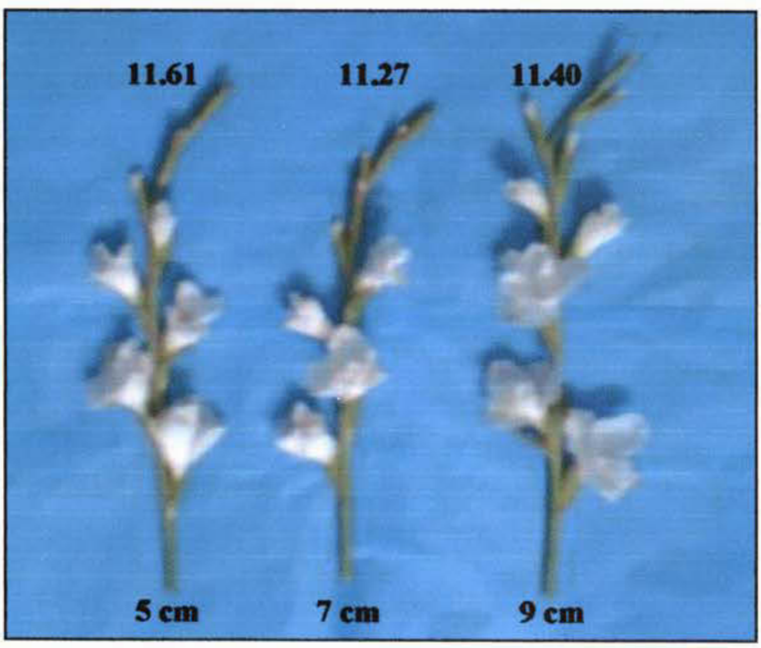

Plate-5: Effect of depth on number of spikelets per spike

4.10. Diameter of individual corm (cm)

Diameter of individual corm was significantly influenced by different plant spacing (Appendix V) and ranged from 4.80 cm to 5.42 cm which are recorded from the closest spacing and the widest spacing respectively. Corm diameter showed positively significant variation with the increase of spacing (Table 5.A). This result recorded may be due to the fact that wider spacing results in less competition among the plant for sunlight, nutrients and water. The present finding is in agreement with the findings of Incalcaterra (1992).

Diameter of individual corm was not significantly influenced by different depth of planting (Appendix V). The maximum (5.23 cm) diameter of corm was found from 5 cm (shallowest) depth of planting and the minimum (5.00 cm) was recorded from 7 cm (intermediate) depth (Table 5.B).

Combination of spacing and depth of planting has no statistically significant effect on diameter of individual corm (Table 6). The maximum (5.50 cm) diameter of corm was found from the treatment combination of 25 cm x 20 cm spacing (widest) and 5 cm depth (shallowest) and the minimum (4.68 cm) was measured from the treatment combination of 25 cm x 10 cm spacing (closest) and 7 cm depth (intermediate). Similar trend of results was obtained by Syamal *et al.* (1987).

4.11. Weight of individual corm

As same of diameter of individual corm, weight of corm also varied significantly with plant spacing (Appendix V). Weight of individual corm increased with the increase in spacing. The maximum (52.56 gm) weight was found from the widest spacing of 25 cm x 20 cm and the minimum (39.31 gm) was recorded from the closest spacing of 25 cm x 10 cm (Table 5.A). As wider spacing provided opportunity to absorb more sunlight and ensure less competition in uptaking nutrients and water from soil, relatively larger weighted corm were produced for wider spacing. Similar trend of results was obtained by Mollah *et al.* (1995) and Bhattacharjee (1981).

Weight of individual corm showed statistically significant effect for different planting depth (Appendix V). The maximum (46.75 gm) weight was from 9 cm (deepest depth of planting) and the minimum (45.62 gm) was from 5 cm (shallowest depth) (Table 5.B). The present finding is in agreement with the findings of Bhattacharjee (1981) and Konoshima (1980).

Combined effect of spacing and depth of planting was also found statistically significant on weight of individual corm (Table 6). The maximum (54.19 gm) weight of corm was found from the treatment combination of 25 cm x 20 cm spacing (widest) and 9 cm depth (deepest) and the minimum (36.76 gm) was measured from the treatment combination of 25 cm x 10 cm spacing (closest), and 7cm depth(intermediate depth).

4.12. Number of cormel per plant

Number of cormel per plant was significantly influenced by spacing (Appendix V). It was increased with the increase of spacing. However, the maximum (38.05) number of cormels per plant was found from the widest spacing of 25 cm x 20 cm and the minimum (28.68) was obtained from the closest spacing of 25 cm x 10 cm (Table 5.A). Wider spacing resulted in less competition among the plant for sunlight, nutrients which eventually formed larger number of cormel per plant. This result is in agreement with the finding of Mollah *et al.* (1995).

Number of cormel per plant was also significantly influenced by depth of planting (Appendix V). The result of this experiment concluded that shallower depth of planting results the highest number of cormels per plant. It was found that the maximum (38.43) number of cormels was obtained from 5 cm (shallowest) depth and the minimum (29) was found from 9 cm (deepest) depth (Table 5.B). The present finding is in agreement with the findings of Banker and Mukhopadhyay (1980).

Although spacing and depth of planting has significant effect individually on the number of cormel produced per plant but it was found that their combined effect had no statistically significant effect on number of cormels per plant (Table 6). The maximum (43.23) number of cormels per plant was counted from the treatment combination of 25 cm x 20 cm spacing (widest) and 5 cm depth (shallowest) and the minimum (24.16) was counted from the treatment combination of 25 cm x 10 cm spacing (closest) and 9 cm depth (deepest). Similar trend of results was obtained by Syamal *et al.* (1987).

4.13. Weight of cormel per plant

The weight of cormels was varied significantly with plant spacing (Appendix V). The maximum (44.39 gm) weight was found from the widest spacing of 25 cm x 20 cm and the minimum (32.20 gm) was recorded from the closest spacing of 25 cm x 10 cm (Table 5.A). This result is in agreement with the findings of Arora and Khanna (1987).

Weight of cormels per plant showed also statistically significant variance due to the effect of planting depth (Appendix V). Increase in depth resulted a negative variance in order with depth of planting. It was found that the maximum (45.71 gm) weight was found from 5 cm (shallowest depth of planting) and the minimum (31.46 gm) was obtained from 9 cm (deepest depth) (Table 5.B).

The combined effect of spacing and depth of planting had statistically significant effect on weight of cormels per plant (Table 6).The maximum (52.36 gm) weight was found from the treatment combination of 25 cm x 20 cm spacing (widest) and 5 cm depth (shallowest) and the minimum (26.13 gm) was measured from the treatment combination of 25 cm x 10 cm spacing (closest) with 9 cm depth (deepest).

4.14. Yield of spike (t/ha)

Effect of spacing on yield of spike was found highly significant (Appendix V). Wider spacing produced smaller yield as number of plant i.e. number of spike decreased with the increase of spacing. The maximum (11.40 t/ha) yield of spike was found from the closest spacing of 25 cm x 10 cm and the minimum (5.83 t/ha) was recorded from the widest spacing of 25 cm x 20 cm (Table 5.A). This result is in agreement with the finding of Borrelli (1984).

Depth of planting showed significant variation on yield of spike. However, the maximum (8.71 t/ha) yield of spike was found from 9 cm (deepest) depth of planting and the minimum (7.96 t/ha) was obtained from 7 cm depth of planting (Table 5.B).

Combination of spacing and depth of planting had no statistically significant effect on yield of spike (Table 6). The maximum (12.00 t/ha) yield was found from the treatment combination of 25 cm x 10 cm spacing (closest) with 9 cm depth (deepest) and the minimum (5.31 t/ha) was measured from the treatment combination of 25 cm x 20 cm spacing (widest) with 7 cm depth (intermediate). Similar trend of results was obtained by Syamal *et al.* (1987).

4.15. Yield of corm (t/ha)

Yield of corm was significantly influenced by different plant spacing (Appendix V). Yield increased with the decrease of spacing as closer spacing results higher number of corm. The maximum (7.99 t/ha) yield of corm was found from the closest spacing of 25 cm x 10 cm and the minimum (4.17 t/ha) was recorded from the widest spacing of 25 cm x 20 cm (Table 5.A). Similar trend of results was obtained by Rabbani and Azad (1996), Nilimesh and Roychowdhury (1989), Talia *et al.* (1986) and Borrelli (1984).

The maximum (5.91 t/ha) yield of corm was found from 9 cm depth of planting and the minimum (5.75 t/ha) was obtained from 7 cm depth of planting and that effect was non significant (Appendix V and Table 5.B).

Combined effect of spacing and depth showed statistically significant influence on yield of corm (Table 6). The maximum (8.29 t/ha) yield of corm was found the treatment combination of 25 cm x 10 cm spacing (closest) with 5 cm depth (shallowest) and the minimum (4.02 t/ha) was measured from the treatment combination of 25 cm x 20 cm spacing (widest) and 5 cm depth (shallowest).

4.16. Yield of cormel (t/ha)

Effect of spacing on yield of cormel was found highly significant (Appendix V). Wider spacing produced minimum yield as number of plant decreased with the increase of spacing. The maximum (6.54 t/ha) yield of cormel was found from the closest spacing of 25 cm x 10 cm and the minimum (3.52 t/ha) was recorded from the widest spacing of 25 cm x 20 cm (Table 5.A). This result is in agreement with the findings of Rabbani and Azad (1996).

A significant variation was found on yield of cormel (Appendix V). The maximum (5.75 t/ha) yield of cormel was found from 5 cm depth while the minimum (3.94 t/ha) was obtained from 9 cm depth (Table 5.B).

Combination of spacing and depth of planting had statistically significant effect on yield of cormel production (Table 6). The maximum (7.81 t/ha) yield was found from the treatment combination of 25 cm x 10 cm spacing (closest) and 5 cm depth (shallowest) and the minimum (2.94 t/ha) was measured from the treatment combination of 25 cm x 20 cm spacing (widest) and 9 cm depth (deepest).

Table 5.A. Individual effect of spacing on diameter of individual corm, weight of individual corm, number of cormel per plant, weight of cormel per plant, yield of spike, yield of corm and yield of cormel of gladiolus

Treatment	Diameter of individual corm (cm)	Wt. of individual corm (gm)	Number of cormel per Plant	Wt. of cormel per plant (gm)	Yield of spike (t/ha)	Yield of corm (t/ha)	Yield of cormel (t/ha)
Spacing							
25 cm x 10 cm (S_1)	4.8	39.31	28.68	32.2	11.4	7.99	6.54
25 cm x 15 cm (S_2)	5.15	46.63	33.29	38.38	7.63	5.33	4.39
25 cm x 20 cm (S_3)	5.42	52.56	38.05	44.39	5.83	4.17	3.52
$LSD_{(0.05)}$	0.461	3.589	1.209	1.745	1.134	0.6312	0.6902
Level of significance	**	**	**	**	**	**	**

Table 5.B. Individual effect of depth of planting on diameter of individual corm, weight of individual corm, number of cormel per plant, weight of cormel per plant, yield of spike, yield of corm and yield of cormel of gladiolus

Treatment	Diameter of individual corm (cm)	Wt. of individual corm (gm)	Number of cormel per Plant	Wt. of cormel per Plant (gm)	Yield of spike (t/ha)	Yield of corm (t/ha)	Yield of cormel (t/ha)
Depth							
5 cm (D_1)	5.23	45.62	38.43	45.71	8.19	5.83	5.75
7 cm (D_2)	5.00	46.14	32.60	37.79	7.96	5.75	4.76
9 cm (D_3)	5.14	46.75	29.00	31.46	8.71	5.91	3.94
$LSD_{(0.05)}$	--	3.581	1.314	1.823	1.178	--	0.6704
Level of significance	NS	**	**	**	*	NS	**

** Significant at 1% level of probability, * Significant at 5% level of probability, NS: Non Significant

Table 6. Combined effect of spacing and depth of planting on diameter of individual corm, weight of individual corm, number of cormel per plant, weight of cormel per plant, yield of spike, yield of corm and yield of cormel of gladiolus

Treatment		Diameter of individual corm (cm)	Wt. of individual corm (gm)	Number of cormel per Plant	Wt. of cormel per Plant (gm)	Yield of spike (t/ha)	Yield of corm (t/ha)	Yield of cormel (t/ha)
Spacing (cm x cm)	Depth (cm)							
25 x 10 (S_1)	5 (D_1)	4.85	40.80	33.87	38.45	10.74	8.29	7.81
	7 (D_2)	4.68	36.76	28.02	32.01	11.47	7.47	6.50
	9 (D_3)	4.88	40.38	24.16	26.13	12.00	8.20	5.31
25 x 15 (S_2)	5 (D_1)	5.33	45.45	38.19	46.32	8.01	5.19	5.29
	7 (D_2)	5.02	48.77	32.24	37.59	7.10	5.57	4.30
	9 (D_3)	5.11	45.67	29.45	31.22	7.79	5.22	3.57
25 x 20 (S_3)	5 (D_1)	5.50	50.62	43.23	52.36	5.83	4.02	4.16
	7 (D_2)	5.31	52.88	37.54	43.78	5.31	4.20	3.47
	9 (D_3)	5.44	54.19	33.39	37.04	6.34	4.30	2.94
$LSD_{(0.05)}$		0.525	1.159	1.240	1.435		0.424	0.536
Level of significance		NS	**	NS	*	NS	**	*
CV (%)		5.92	1.45	2.15	2.16	6.94	4.21	6.44

** Significant at 1% level of probability
* Significant at 5% level of probability
NS: Non Significant

4.17. Economic analysis

The details of economic analysis have been provided in Appendix VI.A, VI.B and Table 7.

4.17.1. Production cost

Among the combinations of different spacing and depth of planting, the maximum (781885 Tk/ha) cost was found from the closest spacing of 25 cm x 10 cm and the minimum (415460 Tk/ha) was found from the widest spacing of 25 cm x 20 cm. Practically depth of planting had no significant effect in production cost, so production cost may be considered as only a function of spacing where different spacing demands different number of corms i.e. variable production cost. (Appendix . VI.A. & VI.B.).

4.17.2. Gross return

Different combinations of spacing and depth of planting result variable yield and quality of spike, corm and cormel. Market price of spike varies on its quality that depends on the number of spikelets per spike, length of spike and length of rachis. Price of corm also varies with its size, weight and how many corms are contained by unit mass. But cormel price doesn't change with its size and weight and it has been considered 75 Tk/kg as per recent (2007) market price. So, variable gross returns are achieved from variable combinations of spacing and depth of planting. The maximum gross return (1817915 Tk/ha) was found from the treatment combination of 25 cm x 10 cm (closest) spacing and 5 cm (shallowest) depth and the minimum (843093 Tk/ha) was found from the treatment combination of 25 cm x 20 cm (widest) spacing and 7 cm (intermediate) depth.

4.17.3. Net return

Net return is just the difference of gross return and production cost. The maximum net return (1036029 Tk/ha) was found from the treatment combination of 25 cm x 10 cm (closest) spacing with shallowest depth (5 cm) and the minimum (427633 Tk/ha) was found from the treatment combination of 25 cm x 20 cm spacing and intermediate depth (7 cm).

4.17.4. Benefit cost ratio

Benefit cost ratio is calculated simply divided the gross return by the total cost of production. It was found that the maximum (2.33) benefit cost ratio was found from the treatment combination of 25 cm x 10 cm (closest) spacing with shallowest depth (5 cm) and the minimum (2.03) was found from the treatment combination of 25 cm x 20 cm spacing and intermediate depth (7 cm).

Table-7: Cost and return of gladiolus cultivation influenced by spacing and depth of planting

Treatment	Combina - tion	Yield of corm	Price of corm (Tk/t)	Price of corm	Yield of cormel	Price of cormel	Yield of spike	Price per spike (tk)	Price of spike	Gross return	Total production cost	Net return	Benefit cost ratio
Spacing (cm x cm)	Depth of planting (cm)	(t/ha)	(variation due to variable corm size)	(Tk/ha)	(t/ha)	(Tk/ha)	(No./ha)	(variation due to quality of spike)	(Tk/ha)	(Tk/ha)	(Tk/ha)	(Tk/ha)	(BCR)
25 x 10 (S_1)	5 (D_1)	8.29	49020	406373	7.81	585750	275264	3.00	825792	1817915	781885	1036029	2.33
	7 (D_2)	7.47	57127	426741	6.50	487500	275264	3.25	894608	1808849	781885	1026964	2.31
	9 (D_3)	8.20	54482	446756	5.31	398250	275264	3.00	825792	1670798	781885	888913	2.14
25 x 15 (S_2)	5 (D_1)	5.19	50605	262640	5.29	396750	154836	3.50	541926	1201316	518824	682492	2.32
	7 (D_2)	5.57	47160	262682	4.30	322500	154836	3.25	503217	1088399	518824	569575	2.10
	9 (D_3)	5.22	54741	285746	3.57	267750	154836	3.50	541926	1095422	518824	576598	2.11
25 x 20 (S_3)	5 (D_1)	4.02	51363	206480	4.16	312000	107525	4.00	430100	948580	415460	533119	2.28
	7 (D_2)	4.20	49168	206505	3.47	260250	107525	3.50	376338	843093	415460	427633	2.03
	9 (D_3)	4.30	49825	214246	2.94	220500	107525	4.00	430100	864846	415460	449386	2.08

Cormel: Recent (2007) market price is 75000 Tk/ton.

CHAPTER V

SUMMARY AND CONCLUSION

A field experiment was conducted in the Horticulture Farm of Sher-e-Bangla Agricultural University, Dhaka, Bangladesh during the period from November 2006 to June 2007 to study the effect of spacing and depth of planting on the growth, flowering and yield of Gladiolus. The experiment considered 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 planting (3 levels) i.e. D_1 (5 cm), D_2 (7 cm), D_3 (9 cm). There were altogether 9 treatment combinations. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. After emergence of seedlings, various intercultural operations were accomplished for better growth and development of gladiolus. Data were collected in respect of gladiolus growth characters and yield of spike, corm and cormels of gladiolus. The collected data were statistically analyzed.

Statistically significant variation was recorded in terms of different spacing for all the characters except plant height (45 DAP, 60 DAP) and length of leaves and different levels of depth of planting applied under the present experiment showed statistically significant effect except plant height (30 DAP, 45 DAP, 60 DAP), number of leaves, length of leaves (60 DAP, 75 DAP), number of spikelets per spike, diameter of individual corm and yield of corm.

At 75 DAP, the tallest (72.42 cm) plant height was obtained from the widest spacing and the shortest (67.86 cm) plant height was recorded from the closest spacing. On the other hand, the tallest (70.8 cm) plant height was obtained from the deepest depth and the shortest (69.79 cm) was found from intermediate depth.

At 75 DAP, the maximum (8.90) number of leaves was found from the widest spacing and the minimum (8.08) was recorded from the closest spacing. On the other hand, the maximum (8.56) number of leaves was found from both the shallowest and intermediate depth and the minimum (8.53) was found from the deepest depth.

At 75 DAP, the maximum (57.55 cm) length of leaves was found from intermediate spacing and the minimum (56.46 cm) was recorded from the widest spacing. On the other hand, the maximum (58.49 cm) length of leaves was found from the deepest depth and the minimum (56.03 cm) was found from intermediate depth.

The maximum (7.29) days were required (50% emergence of plant) from the closest spacing and the minimum (5.69) were required from the widest spacing. On the other hand, the maximum (8.07) days were required from the deepest depth and the minimum (5.20) were required from the shallowest depth.

The maximum (66.67) days were required (50% emergence of inflorescence) from the closest spacing and the minimum (63.89) were required from the widest spacing. On the other hand, the maximum (69.67) days were required from the deepest depth and the minimum (60.78) were required from the shallowest depth.

The maximum (85.68 cm) length of spikes was found from the widest spacing and the minimum (74.41 cm) was recorded from the closest spacing. On the other hand, the maximum (82.56 cm) length of spikes was found from the deepest depth and the minimum (76.61 cm) was recorded from intermediate depth.

The maximum (73.43 gm) weight of spike was found from the widest spacing and the minimum (56.12 gm) was recorded from the closest spacing. On the other hand, the maximum (69.04 gm) weight of spikes was obtained from the deepest depth and the minimum (61.83 gm) from intermediate depth.

The maximum (47.65 cm) length of rachis was recorded from the widest spacing and the minimum (37.83 cm) was obtained from the closest spacing. On the other hand, the maximum (44.88 cm) length of rachis was found from the shallowest depth and the minimum (41.52 cm) was recorded from intermediate depth.

The maximum (12.71) number of spikelets per spike was found from the widest spacing and the minimum (9.99) was obtained from the closest spacing. On the other hand, the maximum (11.61) number of spikelets per spike was found from the shallowest depth and the minimum (11.27) from intermediate depth.

The maximum (5.42 cm) diameter of individual corm was found from the widest spacing and the minimum (4.80 cm) was recorded from the closest spacing. On the other hand, the maximum (5.23 cm) diameter of individual corm was found from the shallowest depth and the minimum (5.00 cm) was recorded from intermediate depth.

The maximum (52.56 gm) weight of corm was found from the widest spacing and the minimum (39.31 gm) was recorded from the closest spacing. On the other hand, the maximum (46.75 gm) weight of corm was found from the deepest depth and the minimum (45.62 gm) was recorded from the shallowest depth.

The maximum (38.05) number of cormel per plant was found from the widest spacing and the minimum (28.68) was found from the closest spacing. On the other hand, the maximum (38.43) number of cormel per plant was found from the shallowest depth and the minimum (29.00) was obtained from the deepest depth.

The maximum (44.39 gm) weight of cormel was found from the widest spacing and the minimum (32.20 gm) was recorded from the closest spacing. On the other hand, the maximum (45.71 gm) weight of cormel was found from the shallowest depth and the minimum (31.46 gm) was recorded from the deepest depth.

The maximum (11.40 t/ha) yield of spike was found from the closest spacing and the minimum (5.83 t/ha) was recorded from the widest spacing. On the other hand, the maximum (8.71 t/ha) yield of spike was found from the deepest depth and the minimum (7.96 t/ha) was recorded from intermediate depth.

The maximum (7.99 t/ha) yield of corm was found from the closest spacing and the minimum (4.17 t/ha) was recorded from the widest spacing. On the other hand, the maximum (5.91 t/ha) yield of corm was found from the deepest depth and the minimum (5.75 t/ha) was recorded from intermediate depth.

The maximum (6.54 t/ha) yield of cormel was found from the closest spacing and the minimum (3.52 t/ha) was recorded from the widest spacing. On the other hand, the maximum (5.75 t/ha) yield of cormel was obtained from the shallowest depth and the minimum (3.94 t/ha) was found from the deepest depth.

There were combined effect between spacing and depth of planting recorded significant for plant height (75 DAP), length of spikes and rachis, weight of a single spike, cormels and corm per plant, yield of corm and cormels per hectare except others.

The maximum (1817915 Tk/ha) gross return and the maximum net return (1036029 Tk/ha) was found from the treatment combination of closest spacing and shallowest depth while the minimum (843093 Tk/ha) gross return and the minimum (427633 Tk/ha) net return was found from the treatment combination of widest spacing and intermediate depth. The maximum (2.33) benefit cost ratio was found from the treatment combination of closest spacing and shallowest depth and the minimum (2.03) was found from the treatment combination of widest spacing and intermediate depth.

Conclusion

The widest spacing produced tallest plant, maximum number of leaves, tallest spike of maximum weight, superior quality of rachis of maximum length and spikelets, maximum weight of individual corm and cormel per plant, whether maximum yield of spike, corm and cormel was obtained from the closest spacing. Similarly the shallowest depth of planting produced maximum weight and number of cormel whether the deepest depth produced tallest and heaviest spike. The maximum (2.33) benefit cost ratio was found from the treatment combination of closest spacing and shallowest depth.

Considering all the circumstances further recommendation may be suggested on the following areas-

1. This experiment should be performed for regional compliance in different Agro- Ecological Zones (AEZ) of Bangladesh.
2. This experiment should be performed for different varieties and sizes of corm.

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APPENDIX

Appendix I: Monthly recorded of air temperature, rainfall, relative humidity and sunshine hours during the period from November 2006 to June 2007

Year	Month	Average air temperature (^0C)			Total rainfall	Average relative humidity (%)	Total sunshine
		Maximum	Minimum	Mean	(mm)		(hrs)
2006	November	29.67	19.86	24.43	4	71.00	188.00
	December	27.21	15.40	21.34	0	62.00	222.00
2007	January	24.46	13.10	18.22	0	60.12	170.30
	February	31.20	18.90	24.15	0	62.41	182.34
	March	33.47	22.55	28.04	2	56.34	219.14
	April	34.89	24.16	29.87	145	72.10	225.40
	May	34.27	24.58	29.12	301	74.28	231.61
	June	34.18	25.03	30.44	271	78.22	90.50

Source: Dhaka Meteorology Centre

Appendix II: Soil Characteristics of Horticulture Farm of SAU analyzed by Soil Resources Development Institute (SRDI), Khamar Bari, Farmgate, Dhaka

A. Morphological characteristics of the experimental field

Morphological features	Characteristics
Location	Horticulture Farm, SAU, Dhaka
AEZ	Madhupur Tract(28)
General Soil Type	Shallow red brown terrace soil
Land type	High
Soil series	Tejgaon
Topography	Fairly leveled
Flood level	Above flood level
Drainage	Well drained

B. Physical and chemical properties of the initial soil

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 (%)	20.00
Exchangeable K (meq/100 g soil)	0.10
Available S (ppm)	45

Source: SRDI, 2006

APPENDIX III. Analysis of variance of the data on plant height, number of leaves, length of leaves at different days after planting (DAP) influenced by spacing and depth of planting

Source of variation	Degrees of freedom	Mean square											
		Plant height				No. of leaves				Length of leaves			
		30DAP	45DAP	60DAP	75DAP	30DAP	45DAP	60DAP	75DAP	30DAP	45DAP	60DAP	75DAP
Replication	2	0.838	5.267	3.98	0.545	0.017	0.045	0.001	0.042	1.231	1.76	3.248	3.272
Factor A (Spacing)	2	13.075**	20.07	16.67	47.484**	0.968**	0.338**	0.568**	1.553**	10.978	6.964	6.944	2.676
Factor B (Depth)	2	7.378	4.991	9.22	2.296**	0.004	0.005	0.016	0.017	106.138**	45.949**	16.72	15.568
AB	4	0.957	6.305	7.033	5.944**	0.024	0.007	0.003	0.008	5.49	10.613	10.127	10.614
Error	16	3.203	7.536	6.344	0.447	0.04	0.026	0.015	0.023	5.649	4.83	6.407	5.439

** Significant at 1% level of probability

APPENDIX IV. Analysis of variance of the data on days required to 50% emergence of plant, days required to 50% emergence of inflorescence, length of spike at harvest, wt. of spike at harvest, length of rachis at harvest, number of spikelet per spike of gladiolus influenced by spacing and depth of planting

Source of variation	Degrees of freedom	Mean square					
		Days required to 50% emergence of plant	Days required to 50% emergence of inflorescence	Length of spike at harvest	Wt. of spike at harvest	Length of rachis at harvest	Number of spikelets per spike
Replication	2	0.003	0.293	2.923	3.524	3.634	1.646
Factor A (Spacing)	2	6.135**	17.397**	287.446**	686.161**	218.909**	16.775**
Factor B (Depth)	2	20.304**	177.86**	92.754**	116.965**	26.264**	0.265
AB	4	2.917**	0.036	23.554**	45.446**	12.58**	0.349
Error	16	0.001	0.948	0.697	1.37	1.068	0.803

** Significant at 1% level of probability

APPENDIX V. **Analysis of variance of the data on diameter of individual corm, wt. of individual corm, number of cormel per plant, weight of cormel per plant, yield of spike, yield of corm and yield of cormel of gladiolus influenced by spacing and depth of planting**

Source of variation	Degrees of freedom	Mean square						
		Diameter of individual corm	Wt. of individual corm	Number of cormel per plant	Wt. of cormel per plant	Yield of spike	Yield of corm	Yield of cormel
Replication	2	0.056	1.63	1.6	0.753	0.223	0.052	0.058
Factor A (Spacing)	2	0.851**	396.451**	197.56**	334.727**	72.864**	34.421**	21.896**
Factor B (Depth)	2	0.115	2.846**	203.811**	458.565**	1.326*	0.058	7.417**
AB	4	0.012	16.04**	0.446	2.312*	0.673	0.372**	0.315*
Error	16	0.092	0.448	0.513	0.687	0.331	0.06	0.096

* Significant at 5% level of probability

** Significant at 1% level of probability

Appendix VI. Production cost of gladiolus per hectare

A. Input cost

Treatment	Combina - tion	Labour	Ploughing	Cost of manure and fertilizers (Tk/ha)				Irrigation	Insecticide	Pesticide	Corm	Miscellaneous	Sub-total
Spacing (cm x cm)	Depth of planting (cm)	cost (Tk/ha)	cost (Tk/ha)	Cowdung	Urea	TSP	MP	cost (Tk/ha)	cost (Tk/ha)	cost (Tk/ha)	cost (Tk/ha)	cost (Tk/ha)	(Tk/ha)
25 x 10 (S_1)	5 (D_1)	30000	5000	50000	1600	3375	2280	3000	2000	1000	561533	8500	668288
	7 (D_2)	30000	5000	50000	1600	3375	2280	3000	2000	1000	561533	8500	668288
	9 (D_3)	30000	5000	50000	1600	3375	2280	3000	2000	1000	561533	8500	668288
25 x 15 (S_2)	5 (D_1)	30000	5000	50000	1600	3375	2280	3000	2000	1000	315862	6000	420117
	7 (D_2)	30000	5000	50000	1600	3375	2280	3000	2000	1000	315862	6000	420117
	9 (D_3)	30000	5000	50000	1600	3375	2280	3000	2000	1000	315862	6000	420117
25 x 20 (S_3)	5 (D_1)	30000	5000	50000	1600	3375	2280	3000	2000	1000	219349	5000	322604
	7 (D_2)	30000	5000	50000	1600	3375	2280	3000	2000	1000	219349	5000	322604
	9 (D_3)	30000	5000	50000	1600	3375	2280	3000	2000	1000	219349	5000	322604

Recent (2007) market price:

Cowdung:	100 t/ha 500 Tk/t 50000Tk/ha	Urea:	200 kg/ha 12 Tk/kg 2400 Tk/ha	TSP:	225 kg/ha 18 Tk/kg 4050Tk/ha	MP:	190 kg/ha 17 Tk/kg 3230 Tk/ha

Corm: 55555 Tk/t

10.11, 5.69 and 3.95 ton corm are required for 25 cm x 10 cm, 25 cm x 15 cm and 25 cm x 20 cm spacing respectively

Appendix VI. Production cost of gladiolus per hectare

B. Overhead cost

Treatment	Combination	Cost of lease of land for 9 months	Interest on running capital	Sub-total	Total cost
Spacing (cm x cm)	Depth of planting (cm)	(14% of land value 700000 Tk/ha)	(8% for 9 months)	(Overhead cost)	Input cost+ overhead cost)
25 x 10 (S_1)		73500	40097	113597	781885
	5 (D_1)	73500	40097	113597	781885
	7 (D_2)	73500	40097	113597	781885
25 x 15 (S_2)	9 (D_3)	73500	25207	98707	518824
	5 (D_1)	73500	25207	98707	518824
	7 (D_2)	73500	25207	98707	518824
25 x 20 (S_3)	9 (D_3)	73500	19356	92856	415460
	5 (D_1)	73500	19356	92856	415460
	7 (D_2)	73500	19356	92856	415460
	9 (D_3)				

Note: 8% annual interest has been considered as per recent (2007) bank rate of interest providing for floriculture by 'Bangladesh Krishi Bank'.