INFLUENCE OF CORM SIZE AND PHOSPHORUS ON GROWTH FLOWERING AND YIELD OF GLADIOLUS

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A Thesis
Submitted to the Department of Horticulture and Postharvest Technology
Sher-e-Bangla Agricultural University, Dhaka
In partial fulfillment of the requirements
for the degree
of

MASTER OF SCIENCE (MS)
IN
HORTICULTURE

SEMESTER: JANUARY-JUNE, 2008

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CERTIFICATE

This is to certify that the thesis entitled ***"Influence of Corm Size and Phosphorus on Growth Flowering and Yield of Gladiolus"*** *submitted to the Department of Horticulture and Postharvest 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* ***Md. Jamal Hossain****, Registration No.* **27446/00654** *under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.*

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

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DEDICATED
TO
MY BELOVED PARENTS

LIST OF ABBREVIATED TERMS

FULL NAME	ABBREVIATION
Agro-Ecological Zone	AEZ
and others	*et al.*
Bangladesh Bureau of Statistics	BBS
Centimeter	Cm
Degree Celsius	°C
Date After Seeding	DAS
Etcetera	etc
Food and Agriculture Organization	FAO
Gram	g
Hectare	ha
Hour	hr
Kilogram	kg
Meter	m
Millimeter	mm
Month	Mo
Murate of Potash	MP
Number	no.
Percent	%
Randomized Complete Block Design	RCBD
Sher-e-Bangla Agricultural University	SAU
Square meter	m^2
Triple Super Phosphate	TSP
United Nations Development Program	UNDP

ACKNOWLEDGEMENTS

The author first wants to express his enormous sense of gratefulness to the Almighty Allah for His countless blessing, love, support, protection, guidance, wisdom and assent to successfully complete M S degree.

The author like to express his deepest sense of gratitude sincere appreciation to his respected supervisor Prof. Md. Ruhul Amin, Chairman, Department of Horticulture and Postharvest Technology, Sher-e-Bangla Agricultural University (SAU), Dhaka, Bangladesh, for his scholastic guidance, support, encouragement and invaluable suggestions and constructive criticism throughout the study period and gratuitous labor in conducting and successfully completing the research work and in the preparation of the manuscript writing.

The author also expresses his gratefulness and best regards to respected Co-Supervisor, Professor, A. K. M. Mahatab Uddin and Associate Professor, Md.Hassanuzzaman Akand, Department of Horticulture and Postharvest technology, Sher-e-Bangla Agricultural University, Dhaka for his scholastic guidance, helpful comments and constant inspiration, inestimatable help, valuable suggestions throughout the research work and preparation of the thesis.

The author also expresses heartfelt thanks to all the teachers of the Department of Horticulture and post harvest technology, SAU, for their valuable suggestions, instructions, cordial help and encouragement during the period of the study.

The author expresses his sincere appreciation to his brother, sisters, relatives, well wishers and friends for their inspiration, help and encouragement throughout the study period.

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ABSTRACT

The study was conducted at the Horticulture Farm of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka, Bangladesh during the period from November 2006 to June 2007. The experiment consisted with two factors. Factor A: Corm size (3 levels) such as: C_1: Small size corm (10-20 g); C_2: Medium size corm (21-30 g) and C_3: Large size corm (31-40 g) and Factor B: Phosphorus (5 levels) as P_0: 0 kg (Control); P_1: 120 kg; P_2: 130 kg; P_3: 140 kg and P_4: 150 kg P_2O_5/ha, respectively. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. In case of corm size, the highest yield of corm (14.27 t/ha) and cormel (11.30 t/ha) was recorded from C_3 and the lowest yield of corm (12.13 t/ha) and cormel (9.79 t/ha) was from C_1.In case of phosphorus, the highest yield of corm (14.30 t/ha) and cormel (11.62 t/ha) was obtained from P_3 and the lowest yield of corm (11.46 t/ha) and cormel (9.24 t/ha) was from $P_{0.}$ For combind effect, the highest yield of corm (15.34 t/ha) and cormel (12.44 t/ha) was observed from C_3P_3 and the lowest yield of corm (11.00 t/ha) and cormel (8.88 t/ha) was from $C_3P_{0.}$ The highest benefit cost ratio (3.34) was attained from C_2P_3 and the lowest (2.00) was recorded from C_3P_0. It may be concluded that large corm size with 140 kg P_2O_5/ha is best for growth, flowering and yield of gladiolus.

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Chapter I

INTRODUCTION

Gladiolus (*Gladiolus grandiflorus* L.) is an herbaceous annual flower belongs to the family Iridaceae, is one of the most important cut flower in Bangladesh. Gladiolus seems to be originated in South Africa and the development of gladiolus started only at the beginning of the 18th century. It is now grown as a cut flower widely in Europe, particularly in Holland, Italy and Southern France (Butt, 2005). Gladiolus is a very popular cut flower and occupying fourth place in international cut flower trade (Bose and Yadav, 1989). In Bangladesh gladiolus was introduced from India around the year 1992 (Mollah *et al*., 2002).

Gladiolus has gained popularity in many parts of the world owing to its unsurpassed beauty and economic value (Chadha and Choudhuary, 1986). It is popular for its attractive spikes having florets of huge forms, dazzling colors, varying sizes and long durable quality as a cut flower. The aesthetic value of gladiolus in the daily life is increasing with the advancement of civilization for the spikes owing to its elegance and long vase life. Gladiolus is frequently used as cut flower in different social and religious ceremonies. It is also used as bedding flower, herbaceous borders or does quite well in pots (Bose and Yadav, 1989). Gladiolus spikes are most popular in flower arrangement and preparing high class bouquets (Mukhopadhyay, 1995).

It has recently become popular in Bangladesh and its demand in this country is increasing day by day. Commercial cultivation of gladiolus is gaining popularity due to export potentials and prevalence of favorable growing condition in different parts of the country. Planting time and fertilizer management influence the production and quality of gladiolus flower as well as its corm and cormels. Gladiolus is largely propagated by its corms and cormels. Reports indicated that growth and flowering in gladiolus are affected by various factors of which size of corm is one of the main factors (Mohanty, 1994). The diameter and weight of corm greatly influence yield and quality of cut flower in gladiolus. Size of corm influences the productions of Gladiolus. Increased flower production in case of larger corms (4.6-5.0 cm in diameter) has been reported by Mukhopadhyay and Yadav (1984). Large corms (4.6-5.0 cm in diameter) produced more flowers, corm and cormel than others (Mukhopadhyay and Yadav, 1984).

An optimum dose of application of nutrient elements will not only ensure better yield and quality of gladiolus but also lead to minimum wastage of the nutrients. Gladiolus responds greatly to major essential elements like N, P and K in respect of its growth and yield (Mital *et al.*, 1975; Singh *et al.*, 1976; Thompson and Kelly, 1988). Its production can be increased by adopting improved cultural practices. Fertilizer plays a vital role in proper growth and development of Gladiolus. Fertilizer application in appropriate time, appropriate dose and proper method is the prerequisite for its cultivation (Islam, 2003).

Phosphorus is also one of the important essential macro elements for the normal growth and development of plant. The phosphorus requirements vary depending upon the nutrient content of the soil (Bose and Som, 1986). Phosphorus restricted the plant growth (Hossain, 1990). On the other hand nutrient availability in a soil depends on some factors among them balance fertilizer is the important one. The optimum proportion of fertilizer enhances the growth and development of a crop. Again secondary mechanism of interference was the absorption of phosphorus from the soil through luxury consumption, increasing the tissue content without enhancing smooth biomass accumulation for the plant (Santos *et al.*, 2004).

There is a scope of increasing flower yield, quality of flower, corm and cormel production of gladiolus with the appropriate size of corm and optimum doses of phosphorus fertilizer. An optimum dose of application of nutrient elements will not only ensure better yield and quality of gladiolus but also led to minimum wastage of the applied nutrients. Considering the present situations and above facts the present investigation was undertaken with the following objectives-

i. To study the growth, flower yield and also corm and cormel production of gladiolus for different size of corm;

ii. To find out the optimum level of phosphorus for ensuring the production of gladiolus;

iii. To determine the growth and flowering performance of gladiolus under different combination of corm size and phosphorus;

iv. To determine the suitable combination of corm size and phosphorus in consideration of cost benefit ratio.

Chapter II

REVIEW OF LITERATURE

Gladiolus is one of the important cut flower in Bangladesh and as well as many countries of the world. A very few studies on the related to growth, flower, corm and cormel production have been carried out in our country as well as many other countries of the world. So the research work so far done in Bangladesh and is not adequate and conclusive. Nevertheless, some of the important and informative works and research findings related to the effects of corm size and levels of phosphorus on growth, flower, corm and cormel production of gladiolus reviewed under the following headings-

2.1 Effect of corm size

Generally corm and cormels are used as planting materials for propagating gladiolus. Size of corm used at planting has direct effects on flowering, corm and cormels production of gladiolus.

Paswan *et al.* (2001) was conducted a field trial in the period of 1987-88, in Assam, India, to study the effect of corm size and corm pieces on corm and cormel production of gladiolus cv. Sylvia. Corms were graded into Large-Jumbo (> 5.1 cm), Medium (3.2 to < 3.8 cm) and Small (1.9 to < 2.5 cm) based on their diameters. Corms of large and medium grades were divided into two and three pieces, except the small grade corm, which was divided into two. Large and medium sized whole corms produced more number of leaves with maximum length and breadth compared to small grade corms and all other pieced corm treatments. Among all treatments, whole corm of large and medium sizes produced the largest corms in terms of diameter and weight. Flowering grade corms were also produced by whole corms as well as corm pieces of all sizes. Although there was an apparent decrease in number of cormels per piece of corm with the increase fractionation compared to whole corms of all size grades, there was actually a substantial increase in number of cormels within the same size grade of corms.

Hatibarua and Paswan (2001), was conducted a field trial in Assam, India to study the effect of corm size and corm pieces on corm and cormel production of gladiolus cv. Sylvia. Corms were graded into Large Jumbo (> 5.1 cm), Medium (3.2 to < 3.8 cm) and Small (1.9 to < 2.5 cm) based on their diameters. Corms of large and medium grades were divided into two and three pieces, except the small grade corm, which was divided into two. Large and medium sized whole corms produced more number of leaves with maximum length and breadth compared to small grade corms and all other pieced corm treatments. Among all treatments, whole corm of large and medium sizes produced the largest corms in terms of diameter and weight. Flowering grade corms were also produced by whole corms as well as corm pieces of all sizes. Although there was an apparent decrease in number of cormels per piece of corm with the increase fractionation compared to whole corms of all size grades, there was actually a substantial increase in number of cormels within the same size grade of corms.

Singh K.P. (2000) planted corms of 6 different size grades (from >1.9-2.5 cm to >6.0-6.5 cm) in the field at a spacing of 30 × 20 cm in a trial conducted over 3 years (1995-97) at Bangalore, India with Gladiolus cv. Pink Friendship. Large corms took longer to sprout but flowered earlier; plants were taller with larger leaves and flower spikes, had more florets per spike and produced more cormels/plant, compared with medium or small corms.

Singh *et al.* (1998) was conducted a field experiment in Karnataka with gladiolus cv. Pink Friendship was conducted to examine the effects of corm size on quality of flower spike and corm development. Large-sized mother corms significantly induced earlier flowering produced longer spikes, highest florets/spike and the highest cormels and corm weight/plant compared with medium- or small-sized corms. The duration of flowering and diameter and weight of individual corm was not affected by corm size.

Singh and Singh (1998) conducted an experiment to investigate the effect of corm size on flowering and corm production of gladiolus cv. Sylavia in Himachal Prodesh, India. The three corm sizes used were large, medium and small. It was found that percentage of sprouting was highest in large corms (99.73%) compared to 81.90 and 67.60% in medium and small corms, respectively. Large corms were also superior in terms of number of spikes, number of shoots per corm, time of sprouting, plant height, spike length, number of flowers per spike (15.53, 15.51 and 9.52 for large, medium and small, respectively) and diameter of corm produced (5.98, 3.98 and 3.67 cm for large, medium and small, respectively).

Kalasareddi *et al.* (1997) carried out an experiment to study the effect of different corm size (very small, small, medium and large) on flowering of gladiolus cv. Snow White and found that corm size was significantly influenced the time taken for spike emergence, time taken for flowering, time taken for complete flowering, spike length, spike girth, number of flowers per spike and number of spikes per hectare. Large corms flowered earlier than smaller corms and produced better quality spikes. The highest yield of spikes (37333/ha in number) was obtained form large corms.

Azad (1996) carried out an experiment to investigate the effect of corm size and plant spacing on growth and flower production of gladiolus. Corms of three sizes (6.5, 16.0 or 30.0 g) were planted at the spacings of 20 × 10, 20 × 15 or 20 × 20 cm. The highest yield of mother corms (13.17 t/ha) and cormels (22.36 t/ha) were recorded form the treatment combination of close spacing (20 × 10 cm) and large corm (30.0 g).

Singh (1996) evaluated the effect of cormel size and levels of nitrogen on corm production of gladiolus cv. Pink Friendship in India. The different cormel size were 1.30 -1.90, or 1.91-2.50 cm in diameter and the rates of nitrogen were 100, 150, 200, 250, 300 or 350 kg per hectare. It was found that large cormels produced large cormels produced large corms with the highest number of cormels per plant. The best treatments for producing large corms with maximum number of cormels were the planting of large cormels fertilized with N at 200 or 250 kg per hectare.

Patil *et al*. (1995) conducted an experiment to investigate the effect of different spacing and corm size on the flower and corm production of gladiolus. Corms of 3 sizes (>4.1, 3.1-4.0 and 2.1-3.0 cm) were planted at the spacing of 30 × 20 or 30 × 30 cm. Corm size had no significant effects on spike length, floret size, number of florets per spike.

Ogale *et al*. (1995) evaluated the role of corm size on gladiolus flowering and corm yield of gladiolus and reported that young gladiolus cormels required 2-3 seasons of vegetative growth before flowering can be induced. They have observed that there was a direct correlation between corm size, flower production and final corm yield.

Mollah *et al*. (1995) carried out an experiment at Pahartali, Bangladesh to investigate the effect of cormel size and plant spacing on growth and yield of flower and corm of gladiolus. It was found that cormel of 7.0 ± 0.20 g in size with widest plant spacing (15 × 15 cm) production the longest rachis (43.5 cm), maximum number of floret per rachis (11.9), heavier corm (31.33) and highest number of cormels (21.87) per plant.

Laskar and Jana (1994) studied the effect of planting time and size of corms on plant growth, flowering and corm production of gladiolus. Corm and flower production were best with planting on 19 March (1.86-1.95) corms and 1.58-1.63 flower spikes per plant) using the largest corms (1.72-1.78 corms per plant and 1.57-1.62 flower spikes).

Mohanty *et al.* (1994). was studied the effect of corm size and pre-planting chemical treatment of corm on growth and flowering of gladiolus cv. Vink's Beauty. They planted the corm of different sixes viz. large (2.45-2.55 cm in diameter), medium (1.25-1.30 cm) and small (0.85-0.90 cm) with soaking in solutions containing GA_3 at 50, 100 or 150 ppm and etherl at 100, 250 or 500 ppm or in distilled water for 24 hours. It was reported that taller and thicker plants with more leaves were obtained from the large corm than those from medium or small corms.

Ko *et al.* (1994) carried out an experiment to evaluate the effect of planting time and corm size on the duration of flower and corm production of gladiolus in Korea. Corms of different sizes (6-8, 8-10 or 10-12 cm) were planted on 19 May, 17 June and 15 July of 1992. It was found that earlier planting with larger corms (10-12 cm in diameter) produced longer cut stems and spikes and higher, cut flower weight, maximum number of floret (14.3), floret length and diameter and higher percentage of best quality flowers.

Hong *et al.* (1989) studied the effect of leaf remaining after cutting the flower, corm lifting date and corm size on corm production and flowering in the next crop of gladiolus at Suwon, Korea. They observed that diameter of corm and weight of corm, number and weight of cormels increased with increasing the number of leaves after cutting the flowers. They also reported that the number of daughter corms and flowering ability increased with increasing corm size up to 4-5 cm diameter.

Dod *et al.* (1989) investigated the effects of different dates of planting and corm size on growth and flower yield of gladiolus in India. They reported that the best results could be obtained from the large corms (>3.0 cm in diameter) with the earliest date of planting.

Gowda (1988) studied the effect of corm size (viz. 3.0-4.0 cm, 4.1-4.5 cm and 4.5-5.0 cm) on growth and flowering of gladiolus cv. Picardy under Bangalore conditions, India. The best result in respect of growth and flowering was found when larger corms were used as planting materials.

Gowda (1987) reported that there was an interaction effect of corm size and spacing on growth and flower production in gladiolus cv. Snow Prince. Corms of 3.0-4.0, 4.1-4.5 and 4.6-5.0 cm in diameter were planted at 30 × 10, 15, 20 or 25 cm and the effects on days to sprouting, plant height, number of leaves, and number of plantlets produced and number of flower spikes per plant were assessed. The best result was obtained by planting 4.1-4.5 cm corms.

Syamal *et al.* (1987) studied the effect of corm size, planting distance and depth of planting on growth and flowering of gladiolus cv. Happy End. They observed that large corms (4-5 and 5-6 cm in diameter) gave earlier sprouting, and deeper planting at 6 cm resulted in delayed sprouting. It was also found that increased corm size gave a significant increase in inflorescence and stem length.

Sciortino *et al.* (1986) studied the effect of size of propagating materials and plant density on the yield of corms for forced flower production in gladiolus cv. Peter Pear. They obtained higher yield with increasing cormel size (1-4 cm in circumference).

Misra *et al.* (1985) conducted an experiment to investigate the effects of different sizes of planting materials on flowering of gladiolus var. ``White Oak`` in India. They observed that the commercial grade spikes were obtained from corms of grade (1.9-2.5 cm in diameter) but acceptable quality spikes were obtained fromgrades of corms in the range of 1.3-1.9 to 0.8-1.0 cm in diameter.

Mukhopadhyay and Yadav (1984) conducted an experiment to study the effect of corm size and spacing on growth, flowering and corm production in gladiolus. They planted corms ranging in the sizes from 3.5 to 5.0 cm in diameter at 10 × 30, 15 × 30, 20 × 30 and 25 × 30 cm. It was found that large sized corms (4.5-5.0 cm) produced more flowers and corms and cormels than the other sizes.

Mckay *et al*. (1981) studied the effect of corm size and division of the mother corm in gladiolus. They used four sizes of gladiolus corms. Those were > 50 mm, 38-50 mm, 33-38 mm and 25-33 mm, 19-25 mm and 13-19 mm and were planted whole or after being cut in half. Plants from whole, large corms produced the highest inflorescence yield with better quality. For the large corms, cutting increased the yield of new corms by 93%.

Bhattacharjee (1981) observed that flower and corm production of gladiolus were influenced by corm size, planting depth and spacing. Corms of three sizes viz. 2.5-3.5, 4.0-5.0 and 5.5-6.5 cm in diameter of gladiolus cv. Friendship were planted at 3 depths viz. 5, 7 and 9 cm and 3 spacings viz. 15, 20 and 25 cm within the rows. Increasing of corm size increased the spike length, floret number, flower diameter and the size and weight of corms. Increasing in planting depth improved the quality of flower spikes as well as lifted corms.

Bankar 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 gladioulus. The experiment was consisted of three corm sizes viz. 1.5-2.5, 2.5-3.5, 3.5-

4.5 g; three depth of plating viz. 3, 5 or 7 cm and three spacings viz. 15, 20 or 25 cm. It was observed that large corms increased the height of plant (58.61 cm) highly significantly and length of spikes (101.12 cm).

Gill *et al.* (1978) in their experiment studied the effect of corm size on the quality of gladiolus flower. Corm of six sizes viz. >2, 2-10, 10-20, 20-30, 30-40 or > 40 g were used in this experiment. They observed a positive correlation between corm size and plant height, number of leaves per plant and length of flower stalk.

2.2 Effect of phosphorus

Pimpini and Zanin (2002) in 1994-95 was grown Gladiolus hybridus in 4 soil types (sandy loam, clay, sand and peaty soil) and treated with 8 fertilizer treatments: N, P, K, PK, NPK, manure (L), NPK + L, and an untreated control. The best results in terms of spike length, number of florets/spike and corm production were obtained with 50 t/ha L + 250 kg/ha N + 125 kg/ha P_2O_5 + 250 kg/ha K_2O. Treatments with NPK, L and N alone also gave better results than the control. The best results were obtained on peat soil and the poorest on sandy soil.

Mallick *et al.* (2001) was conducted a field experiment in Orissa, India from December 1997 to May 1998 to study the effect of various rates of N, P and K on gladiolus (Gladiolus grandiflorus) cv. Pink Prospector. The treatments were N at 10, 20 and 30 g/m^2, 10 and 20 g P/m^2, and 10 and 20 g K/m^2. The effect of different rate of N alone on spike length was non-significant but produced the longest spike (51.10 cm). The influence of different rates of P including K alone had significant effects on spike length (51.13 and 50.48 cm, respectively). Various combinations of N, P and K interaction rates did not show any significant differences among them. Rachis length varied significantly for all the levels of fertilizer rates. None of the NPK fertilizer rates, alone or in combinations, showed any significant differences. There was a significant difference in the length of florets with various N rates, applied alone, whereas all the other treatments were non-significant. Application of NPK at 20:10:20 rates yielded the highest floral diameter (8.13 cm).

Kawarkhe *et al.* (2001) conducted a field experiments during 1995-96, 1996-97 and 1997-98 in Akola, Maharashtra, India with 4 application rates of N (0, 40, 50 and 60 g/m^2) and P (0, 10, 20 and 30 g/m^2) fertilizers on gladiolus cv. Dabonoir. The number of spikes per plant and spike length increased with the increase in application rates of N and P fertilizers. The maximum spike length was obtained with application of N at 60 g/m^2 during 1995-96 and 1997-98, which was at par with the application of N at 50 g/m^2. The length of spikes was significantly influenced by the application of P up to 20 g P/m^2. Flowering was significantly influenced by N and P application. The maximum numbers of florets per spike were produced during 1995-96 (8.87), 1996-97 (8.88) and 1997-98 (8.88) by application of 50 g N/m^2. The interaction effects of N and P were significant. The maximum numbers of spike, spike length and number of florets per spike were influenced by the application of 50 g N/m^2 and 20 g P/m^2.

Mukesh *et al.* (2001) carried out an experiment with Gladiolus cv. Tropic Sea was supplied with different levels of N (40, 50 and 60 g/m^2) at 2 splits (3 and 6 leaf stages) as side dressing, P_2O_5 (10, 20 and 30 g/m^2) and K_2O at 20 g/m^2, in a field experiment in West Bengal, India, during 1990-93. Phosphorus at 10 g/m^2 resulted in the highest spike weight, numbers of flowers per spike, flower diameter, number of open flowers at a time, size and weight of corms, and number of corms.

Anil *et al.* (2000) was conducted a field experiment in Haryana, India, to determine the effects of N at 0, 40, 60 and 80 g/m2 with 3 levels of P (0, 10 and 20 g P_2O_5/m^2) and K

(0, 10 and 20 g K_2O/m^2) on growth, flowering and corm production in gladiolus. Growth increased with increasing N levels, but P and K did not influence growth. The tallest plants and the highest spike length and highest number of corms was recorded from P at 20 g/m^2.

Pandey *et al.* (2000) was conducted an experiment to investigate the effect of different levels of N and P on the growth of gladiolus cv. Psittacinus Hybrid, was undertaken at Agra, India. N was applied as urea at 0, 20, 40 and 60 g/m^2 and P as superphosphate at 0, 20 and 40 g P_2O_5/m^2, in all combinations. The corms were planted in the field on a sandy loam soil in early November. There were no significant differences for most of the characters recorded (plant height, leaf length, plant neck diameter, days to colour break, rachis length and number of florets/spike). Significant differences were only seen for number of leaves/clump, which was highest for and 40 g P_2O_5/m^2.

Barma *et al.* (1998) was carried out an trial to study the effect of N (0-45 g/m^2), P (0-30 g/m^2) and K (0-30 g/m^2) on enlargement and production of corms and cormels of Gladiolus cv. Psittacinus Hybrid on a sandy loam soil in Nadia, India in 1990-92. The effects of N and K were much more pronounced than those of P on number, size and weight of corms and cormels. Corm number, weight and diameter were greatest (23.60/m^2, 29.92 g and 4.20 cm, respectively) at the highest K rate (30 g/m^2), followed by the highest N rate (45 g/m^2). Cormel number and weight were greatest (82.17/m^2 and 5.53 g, respectively) at the highest N rate, followed by the highest K rate.

Jhon *et al.* (1997) was undertaken a 3 year field study to investigate the effects of N, P_2O_5 and K_2O (0, 50 and 100 kg/ha) on the growth of Gladiolus cv. Oscar on a silty loam soil at SKUAST, Shalimar Campus, India, during 1991-93 by Application of all fertilizers increased corm size, corm weight, number of cormels/plant and cormel weight.

The highest dose of N (100 kg/ha) and low doses of P_2O_5 and K_2O (50 kg/ha) produced the tallest plants with the longest spikes and most florets/spike.

Mukherjee *et al.* (1994) carried out a field trial with Gladiolus cv. Vink's Glory, N was applied at 40, 50 or 60 g/m^2 and P at 10, 20 or 30 g/m^2. K was applied to all plants at 20 g/m^2. P and K were applied in full before planting and N was applied in 2 split doses at the 3 and 6-leaf stages. The highest number of florets/spike and largest corms were produced with 50 g N/m^2 in 2 doses and 10-20 g P/m^2.

Chattopadhyay *et al.* (1992). were planted Corms of uniform size (4-4.5 cm in diameter) in a sandy loam soil at a spacing of 30 × 20 cm. A basal dressing of 10 kg cattle manure and 20 g K_2O/m^2 was applied before planting three rates of N (40, 50 and 60 g/m^2) and 3 of P_2O_5 (10, 20 and 30 g/m^2) were compared in all combinations, half the N and all the P_2O_5 being applied before planting and the remaining N 35 days after planting. Data on plant height, flower spike length, number of flowers/spike, number of days to flower, duration of flowering and size of daughter corms produced were recorded in 3 successive years. Plant height was greatest with $N_{50}P_{30}$; this treatment also resulted in longest spikes and most flowers/spike. Plants in treatments $N_{60}P_{10}$ and $N_{60}P_{30}$ flowered in the shortest time and those in treatment $N_{50}P_{20}$ were slowest to flower. The corms were smallest (though not significantly) with $N_{60}P_{20}$ and largest with $N_{50}P_{10}$.

Singh *et al.* (1990) conducted and experiment with the cormels, planted in soil low in P and of intermediate N and K content received N at 0, 20 or 40 g/m^2 and/or P_2O_5 at 0, 20 or 30 g/m^2. FYM at 3 kg/m^2 and 20 g K_2O/m^2 were applied in all cases. The N rate was split and applied one-half at the 3-leaf stage and the other half at the 6-leaf stage. A marked improvement in corm production was obtained with N at 40 g/m^2 or P_2O_5 at 20 g/m^2 but the combined N + P application had no significant effect on corm yield.

Gowda *et al*. (1988) carried out in studies with this cv. grown for cut flowers, the plants received N and P, each at 20, 30 or 40 g/m2; K at 20 g/m^2 was applied as a basal dressing. A high number of spikes/plant, a large florets diameter (9 cm), the highest number of florets/plant (14.6) and the greatest spike length (89.7 cm) were obtained with the highest N and P rates.

Chapter III

MATERIALS AND METHODS

A field experiment was conducted during the period from November, 2006 to June, 2007 to find out the effect of corm size and different levels of phosphorus on growth, flower, corm and cormel production of gladiolus. The materials and methods that were used for conducting the experiment are presented in this chapter under the following headings

3.1 Experimental site

The present experiment was conducted at the Farm of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka, Bangladesh. The location of the experimental site is situated in $23^0 74'$N latitude and $90^0 35'$E longitude (Anon, 1989).

3.2 Characteristics of soil

The experimental soil belongs to the Modhupur Tract under AEZ No. 28 (UNDP, 1988). The selected experimental plot was medium high land and the soil series was Tejgaon (FAO, 1988). The characteristics of the soil under the experimental plot were analyzed in the SRDI, Soil testing Laboratory, Khamarbari, Dhaka and presented in Appendix I.

3.3 Weather condition of the experimental site

The climate of experimental site was under the subtropical climate, characterized by three distinct seasons, the monsoon or the rainy season from November to February and the pre-monsoon period or hot season from March to April and the monsoon period from May to October (Edris *et al*., 1979). Meteorological data related to the temperature, relative humidity, rainfalls and sunshine during the period of the experiment was collected from the Bangladesh Meteorological Department, Sher-e-Bangla Nagar, Dhaka and presented in Appendix II.

3.4 Planting materials

Cormels of gladiolus were used as planting materials and they were collected from Ananda Nursery, Savar Bazar, Dhaka.

3.5 Treatment of the experiment

The experiment was carried out to find out the effects of corm size and different levels of phosphorus on growth, flower, corm and cormel production of gladiolus. The experiment considered as two factors.

Factor A: Corm size (3 levels)

i. C_1: Small size corm (10-20 g)
ii. C_2: Medium size corm (21-30 g)
iii. C_3: Large size corm (31-40 g)

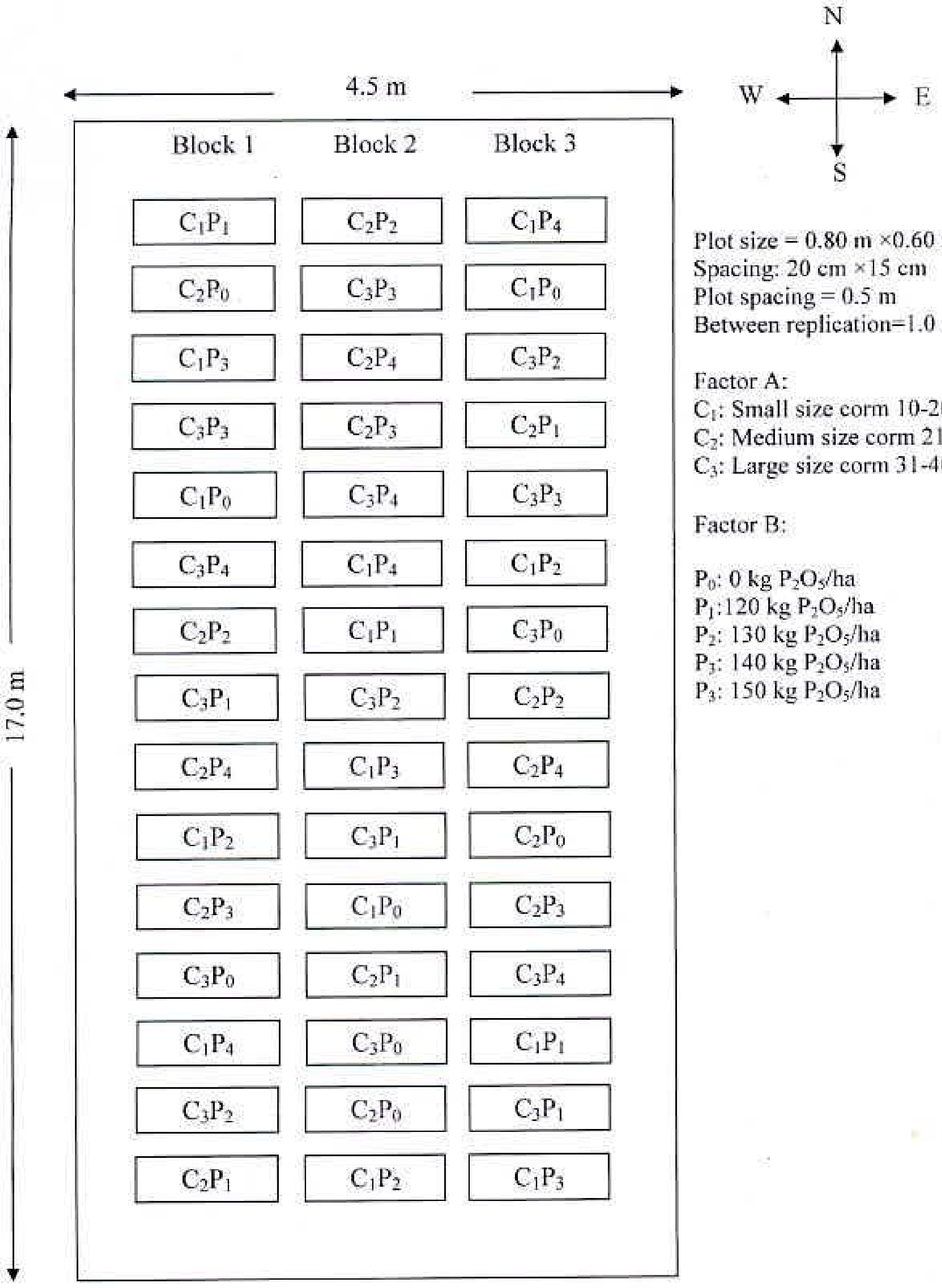
Factor B: Phosphorus (5 levels)

i. P_0: 0 kg P_2O_5/ha (Control)
ii. P_1: 120 kg P_2O_5/ha
iii. P_2: 130 kg P_2O_5/ha
iv. P_3: 140 kg P_2O_5/ha
v. P_4: 150 kg P_2O_5/ha

There were on the whole 15 (3 × 5) treatments combination such as C_1P_0, C_1P_1, C_1P_2, C_1P_3, C_1P_4, C_2P_0, C_2P_1, C_2P_2, C_2P_3, C_2P_4, C_3P_0, C_3P_1, C_3P_2, C_3P_3 and C_3P_4.

3.6 Experimental design and layout

The experiment was laid out following Randomized Complete Block Design (RCBD) with three replications. An area of 18.0 m × 6.4 m was divided into three equal blocks. Each block was divided into 15 plots where 15 treatments combination were allotted at random. There were 45 unit plots altogether in the experiment. The size of the each unit plot was 0.80 m × 0.60 m. The cormels were plunged into the soil with maintaining row to row distance at 20 cm and plant to plant at 15 cm.There were 16 plants containing in each plot. The layout of the experiment is shown in Figure 1.



Block 1	Block 2	Block 3
C_1P_1	C_2P_2	C_1P_4
C_2P_0	C_3P_3	C_1P_0
C_1P_3	C_2P_4	C_3P_2
C_3P_3	C_2P_3	C_2P_1
C_1P_0	C_3P_4	C_3P_3
C_3P_4	C_1P_4	C_1P_2
C_2P_2	C_1P_1	C_3P_0
C_3P_1	C_3P_2	C_2P_2
C_2P_4	C_1P_3	C_2P_4
C_1P_2	C_3P_1	C_2P_0
C_2P_3	C_1P_0	C_2P_3
C_3P_0	C_2P_1	C_3P_4
C_1P_4	C_3P_0	C_1P_1
C_3P_2	C_2P_0	C_3P_1
C_2P_1	C_1P_2	C_1P_3

Plot size = 0.80 m ×0.60 m
Spacing: 20 cm ×15 cm
Plot spacing = 0.5 m
Between replication=1.0 m

Factor A:
C_1: Small size corm 10-20g
C_2: Medium size corm 21-30g
C_3: Large size corm 31-40 g

Factor B:

P_0: 0 kg P_2O_5/ha
P_1:120 kg P_2O_5/ha
P_2: 130 kg P_2O_5/ha
P_3: 140 kg P_2O_5/ha
P_3: 150 kg P_2O_5/ha

Plate: 1. Field layout of two factors experiment in the Randomized Complete Block Design (RCBD)

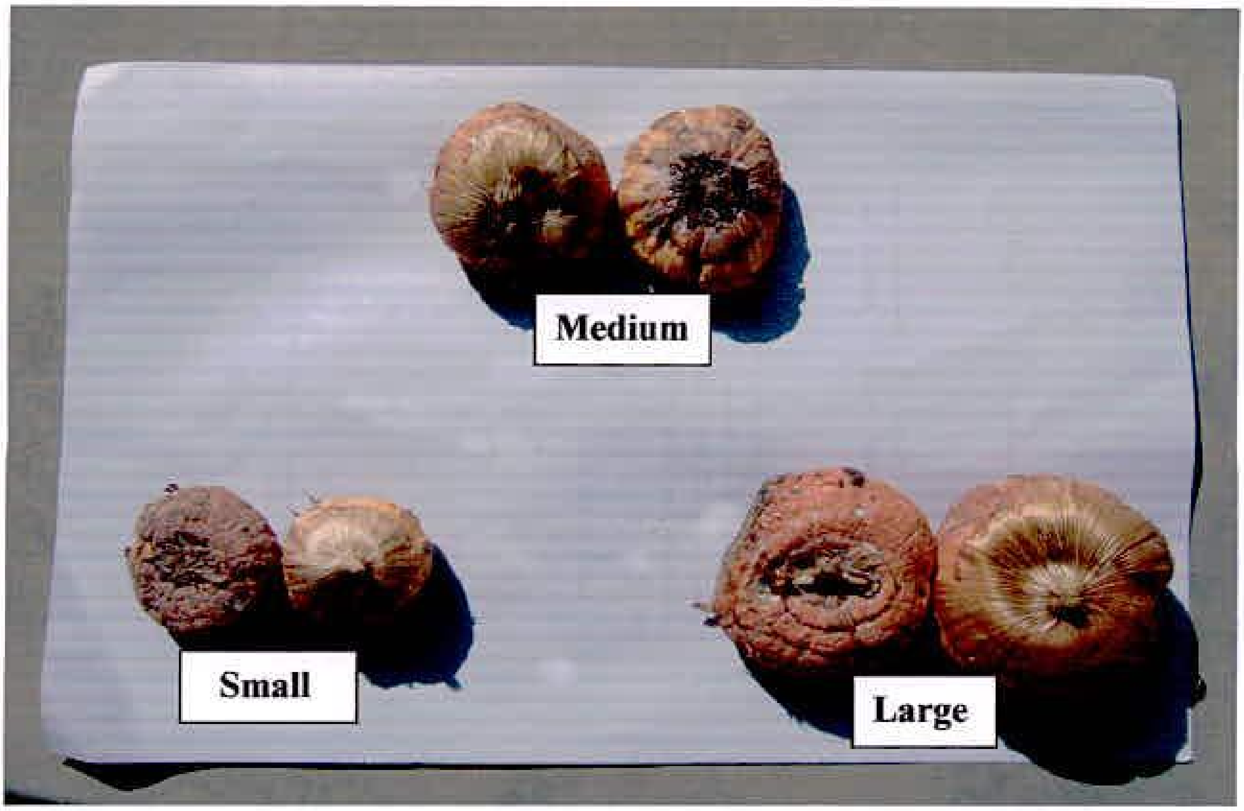


Plate 2. Different corm sizes of gladiolus used in the experiment

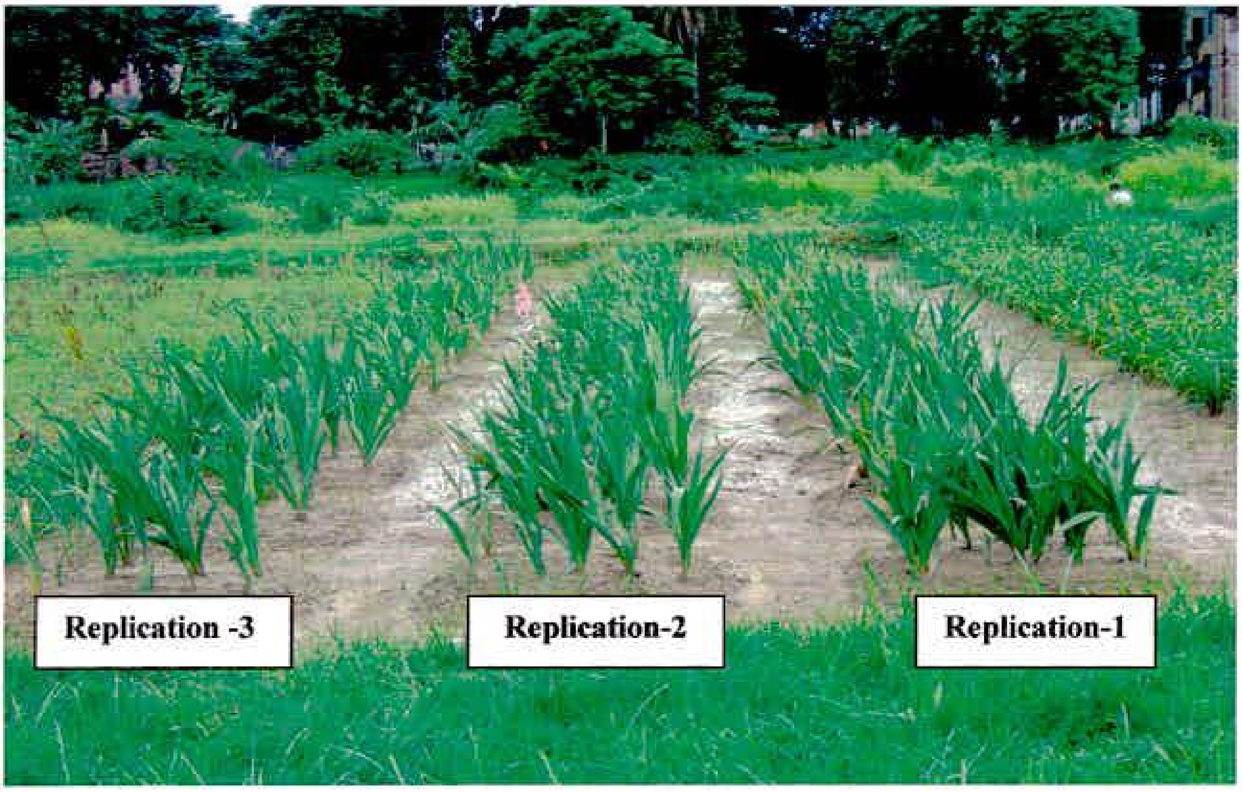


Plate 3. Experimental field of gladiolus to evaluate the effect of corm size and phosphorus on growth and flowering at Horticultural Farm, S.A.U.

3.7 Application of manure and fertilizers

The sources of N, P_2O_5, K_2O as urea, TSP and MP were applied, respectively. The entire amounts of TSP and MP were applied during the final land preparation. Nitrogen(as urea) was applied in three equal installments at 15, 30 and 45 days after sowing seeds. Well-rotten cowdung also applied during final land preparation. The following amount of manures and fertilizers were used which shown as tabular form recommended by BARI, 2002.

Table 1. Dose and method of application of fertilizers in gladiolus field

Fertilizers	Dose/ha	Application (%)			
		Basal	15 DAT	30 DAT	45 DAT
Cowdung	10 tons	100	--	--	--
Nitrogen	200 kg	--	33.33	33.33	33.33
P_2O_5 (as TSP)	As treatment	100	--	--	--
K_2O (as MP)	200 kg	100	--	--	--

3.8 Intercultural operation

When the seedlings started to emerge in the beds it was always kept under careful observation. After emergence of seedlings, various intercultural operations,like weeding, top dressing was accomplished for better growth and development of gladiolus seedlings.

3.8.1 Irrigation and drainage

Over-head irrigation was provided with a watering can to the plots once immediately after germination in every alternate day in the evening. Further irrigation was done and when needed. Stagnant water was effectively drained out at the time of heavy rains.

3.8.2 Weeding

Weeding was done to keep the plots free from weeds, easy aeration of soil, which ultimately ensured better growth and development. The newly emerged weeds were uprooted carefully after complete the emergence of gladiolus seedlings whenever it was necessary. Breaking the crust of the soil was done when needed.

3.8.3 Top Dressing

After basal dose, the remaining doses of urea were top-dressed in 3 equal installments. The fertilizers were applied on both sides of plant rows and mixed well with the soil by hand. Earthing up was done with the help of nirani immediately after top-dressing of nitrogen fertilizer.

3.9 Plant Protection

For controlling leaf caterpillars Nogos @ 1 ml/L water were applied 2 times at an interval of 10 days starting soon after the appearance of infestation. There was no remarkable attack of disease was found.

3.10 Data collection

Data were recorded on the following parameters from the sample plants during the course of experiment. Ten plants were randomly selected from each unit plot for the collection of data while the whole plot crop was harvested to record per plot data.

3.10.1 Plant height

The height of plant was recorded in centimeter (cm) at 30, 45, 60 and 75 days after planting (DAP) in the experimental plots. The height was measured from the attachment of the ground level up to the tip of the growing point.

3.10.2 Number of leaves per plant

All the leaves of ten plants were counted at an interval of 15 days at 30, 45, 60 and 75 days after planting (DAP) in the experimental plots.

3.10.3 Days required for 50% emergence of spike

It was achieved by recording the days taken for 50% emergence of spike from each unit plot.

3.10.4 Days required for 80% emergence of spike

It was achieved by recording the days taken for 80% emergence of spike from each unit plot..

3.10.5 Percentage of flowering plant

It was calculated by counting the numbers of plants bearing flowers in each unit plot divided by the number of plants emerged and converted to percentage.

3.10.6 Length of flower stock at harvest

Length of flower stalk was measured from the base to the tip of the spike and expressed in centimeter.

3.10.7 Length of rachis at harvest

Length of rachis refers to the length from the axil of first floret upto the tip of the inflorescence and expressed in centimeter.

3.10.8 Number of spikelet per spike

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

3.10.9 Number of spike per plot

It was calculated from the number of spike per plot obtained from counting all spike in a plot in each replication and mean was recorded.

3.10.10 Number of spike/ha ('000)

Number of spikes per hectare was computed from numbers of spikes per plot and converted to hectare.

3.10.11 Individual corm thickness

Corms were separated from the plant and the thickness of corms was taken by a slide calipers and expressed in centimeter.

3.10.12 Individual corm weight

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

3.10.13 Individual corm diameter

A slide calipers was used to measure the diameter of the corm and expressed in centimeter.

3.10.14 Number of cormel per plant

It was calculated from the number of cormels obtained from ten randomly selected plants and mean was recorded.

3.10.15 Weight of cormel

Individual weight of cormel was recorded from the mean weight of ten randomly selected sample cormels and expressed in gram.

3.10.16 Diameter of cormel

A slide calipers was used to measure the diameter of the cormel and expressed in centimeter.

3.10.17 Corm yield per plot

Total corm yield per plot was recorded by adding the total harvested corm in a plot and expressed in kilogram.

3.10.18 Cormel yield per plot

Total cormel yield per plot was recorded by adding the total harvested corm in a plot and expressed in kilogram.

3.10.19 Corm yield per hectare

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

3.10.20 Cormel yield per hectare

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

3.11 Statistical Analysis

The data obtained for different parameters were statistically analyzed to find out the significance difference at corm size and levels of phosphorus on flowering, corm and cormel production of gladiolus. The mean values of all the characters were calculated and analysis of variance was performing by the 'F' (variance ratio) test. The significance of the difference among the treatment combinations means was estimated by the Duncan's Multiple Range Test (DMRT) at 5% level of probability.

3.12 Economic analysis

The cost of production was analyzed in order to find out the most economic treatment of corm size and phosphorus. All input cost were considered in computing the cost of production. The market price of spike, corm and cormel was considered for estimating the return. The benefit cost ratio (BCR) was calculated as follows:

$$\text{Benefit cost ratio} = \frac{\text{Gross return per hectare (Tk.)}}{\text{Total cost of production per hectare (Tk.)}}$$

Chapter IV

RESULTS AND DISCUSSION

The present study was conducted to find out the effect of corm size and different level of phosphorus on growth and yield contributing character, spike, corm and cormel yield of gladiolus. Data on different characters were recorded to find out the optimum corm size and phosphorus on gladiolus. The analysis of variance (ANOVA) of the data on different yield components and yield are given in Appendix III-V. The results have been presented, discussed, and possible interpretations given under the following headings

4.1 Plant height

Corm size significantly influenced on plant height of gladiolus at different days after planting (DAP) under the present trial (Appendix III). At 30 DAP the tallest plant (41.67 cm) was recorded from C_3 (Large size corm) which was statistically identical (40.49 cm) to C_2 (Medium size corm), and the shortest (37.79 cm) was recorded from C_1 (Small size corm). The tallest plant (61.13 cm) was recorded from C_3 which was statistically similar (59.80 cm) to C_2, while the shortest plant (53.20 cm) was obtained from C_1 at 45 DAP. At 60 DAP the tallest plant (71.40 cm) was found from C_3 which was closely followed (67.89 cm) by C_2 and the shortest (60.78 cm) was recorded from C_1. At 75 DAP the tallest plant (77.03 cm) was recorded from C_3 which was closely followed (72.44 cm) with C_2, and the shortest (65.07 cm) was obtained from C_1 (Table 2). The results indicated that the large size corm produced the highest plant height starting from 30 DAP to 75 DAP for ensured the supply of all macro and micro nutrient elements adequately for newly emerge plants. Singh K.P. (2000) found taller plants with using larger corms in earlier expeiment. Azad (1996), Mohanty *et al.* (1994), Bankar and Mukhopadhyay (1984) obtained similar result from their earlier experiment.

Table 2. Influence of corm size and phosphorus on plant height and number of leaves per plant at different days after planting (DAP) of gladiolus

Treatment	Plant height (cm) at				Number of leaves per plant at			
	30 DAP	45 DAP	60 DAP	75 DAP	30 DAP	45 DAP	60 DAP	75 DAP
Corm size								
C$_1$	37.79 b	53.20 b	60.78 c	65.07 c	2.63 b	4.79 b	7.55 c	9.27 c
C$_2$	40.49 a	59.80 a	67.89 b	72.44 b	2.83 a	5.39 a	8.43 b	10.31 b
C$_3$	41.67 a	61.13 a	71.40 a	77.03 a	2.96 a	5.49 a	8.85 a	10.99 a
LSD$_{(0.05)}$	2.208	2.301	2.204	2.129	0.150	0.197	0.269	0.312
Level of Phosphorus								
P$_0$	31.96 d	50.32 d	57.63 d	61.97 d	2.24 d	4.51 d	7.13 d	8.82 d
P$_1$	38.61 c	56.70 c	65.55 c	70.56 c	2.71 c	5.09 c	8.16 c	10.02 c
P$_2$	41.51 b	59.50 bc	68.50 b	73.36 b	2.89 bc	5.36 b	8.49 bc	10.47 b
P$_3$	44.76 a	62.86 a	71.69 a	76.83 a	3.13 a	5.67 a	8.89 a	10.93 a
P$_4$	43.08 ab	60.86 ab	70.07 ab	74.85 ab	3.04 ab	5.49 ab	8.71 ab	10.69 ab
LSD$_{(0.05)}$	2.850	2.970	2.846	2.748	0.193	0.254	0.347	0.403
CV(%)	7.38	5.30	9.42	6.98	7.15	5.01	8.34	7.10

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability

C$_1$: Small size corm (10-20 g)
C$_2$: Medium size corm (21-30 g)
C$_3$: Large size corm (31-40 g)

P$_0$: 0 kg P$_2$O$_5$/ha
P$_1$: 120 kg P$_2$O$_5$/ha
P$_2$: 130 kg P$_2$O$_5$/ha
P$_3$: 140 kg P$_2$O$_5$/ha
P$_4$: 150 kg P$_2$O$_5$/ha

Plant height of gladiolus showed significant variations at different days after planting (DAP) for different level of phosphorus (Appendix III). At 30 DAP the tallest plant (44.76 cm) was obtained from P_3 (140 kg P_2O_5/ha) which was statistically similar (43.08 cm) to P_4 (150 kg P_2O_5/ha) and closely followed (41.51 cm) by P_2 (130 kg P_2O_5/ha), and the shortest (31.96 cm) was found from P_0 (0 kg P_2O_5/ha) which was closely followed (38.61 cm) by P_1 (120 kg P_2O_5/ha). At 45 DAP the tallest plant (62.86 cm) was recorded from P_3 which was statistically identical (60.86 cm) to P_4 and closely followed (59.50 cm) by P_2, and the shortest (50.32 cm) was obtaineded from P_0 which was closely followed (56.70 cm) by P_1. The tallest plant (71.69 cm) was recorded from P_3 which was statistically identical (70.07 cm) to P_4 and closely followed (68.50 cm) by P_2, and the shortest (57.63 cm) was recorded from P_0 which was closely followed (65.55 cm) by P_1 at 60 DAP. At 75 DAT the tallest plant (76.83 cm) was recorded from P_3 which was statistically identical (74.85 cm) with P_4 and closely followed (73.36 cm) by P_2, and the shortest (61.97 cm) was recorded from P_0 which was closely followed (70.56 cm) by P_1 (Table 2). Probably, phosphorus helps to make available other nutrients elements of soil which also ensures the advanced growth of gladiolus plants.Anil *etal.* (2000) reported that growth increased with increasing phosphorus levels.Bazwaja *etal.* (2001) also found same result.

Combined effect of corm size and different levels of phosphorus showed significant differences in terms of plant height of gladiolus (Appendix III). At 30 DAP the tallest plant (47.17 cm) was recorded from C_3P_3 (Large size corm + 140 kg P_2O_5/ha) which was statistically similar (46.69 cm) to C_2P_3 (Medium size corm + 140 kg P_2O_5/ha), while the shortest (30.08 cm) was found from the treatment combination of C_3P_0 (Large size corm + 0 kg P_2O_5/ha) which was statistically identical (30.39 cm) to C_2P_0 (Medium size corm + 0 kg P_2O_5/ha). The tallest plant (67.22 cm) was obtained from C_3P_3 which was statistically similar (65.22 cm) to C_2P_3, while the shortest plant (48.95 cm) was recorded from C_3P_0

which was closely followed (49.13 cm) by C_1P_0 at 45 DAP. At 60 DAP the tallest plant (76.91 cm) was recorded from C_3P_3 which was statistically similar (74.74 cm) to C_2P_3, while the shortest (55.21 cm) was obtained from C_2P_0 which was closely followed (57.85 cm) by C_1P_0. At 75 DAP the tallest plant (82.90 cm) was recorded from C_3P_3 which was statistically similar (80.13 cm and 80.12 cm) to C_3P_2 and C_3P_4, respectively and the shortest (59.47 cm) was found from C_2P_0 which was closely followed (61.09 cm) by C_1P_0 (Table 3).

4.2 Number of leaves per plant

Significant variation was recorded for corm size in leaves per plant of gladiolus at different days after planting (DAP) under the present trial (Appendix III). At 30 DAP the highest (2.96) number of leaves per plant was recorded from C_3 (large size corm) which was statistically similar (2.83) to C_2 (medium size corm), and the lowest (2.63) was recorded from C_1 (small size corm). The highest (5.49) number of leaves per plant was obtained from C_3 which was statistically similar (5.39) to C_2, while the lowest (4.79) number of leaves per plant was recorded from C_1 at 45 DAP. At 60 DAP the highest (8.85) number of leaves per plant was found from C_3 which was closely followed (8.43) by C_2 and the lowest (7.55) was recorded from C_1. At 75 DAP the highest (10.99) number of leaves per plant was recorded from C_3 which was closely followed (10.31) by C_2, and the lowest (9.27) was recorded from C_1 (Table 2). Paswan *et al.* (2001) found maximum number of leaves in using large corms of their experiment. Mohanty *et al.* (1994) and Gowda (1987) also reported the similar findings.

Table 3. Combined effect of corm size and phosphorus on plant height and number of leaves per plant at different days after planting (DAP) of gladiolus

Treatment	Plant height (cm) at				Number of leaves per plant at			
	30 DAP	45 DAP	60 DAP	75 DAP	30 DAP	45 DAP	60 DAP	75 DAP
C_1P_0	35.41 ef	49.13 hi	57.85 fg	61.09 gh	2.47 fg	4.47 gh	7.20 ef	8.67 hi
C_1P_1	35.25 ef	51.67 ghi	58.41 efg	62.90 fgh	2.47 fg	4.60 fgh	7.27 ef	8.93 ghi
C_1P_2	37.95 de	54.27 fghi	61.12 ef	65.75 efg	2.60 ef	4.87 efg	7.53 e	9.40 fgh
C_1P_3	40.43 cde	56.13 defg	63.41 de	68.19 de	2.80 def	5.07 cdef	7.87 de	9.73 ef
C_1P_4	39.92 cde	54.81 efgh	63.10 def	67.44 def	2.80 def	4.93 defg	7.87 de	9.60 efg
C_2P_0	30.39 f	52.89 fghi	55.21 g	59.47 h	2.13 g	4.73 efgh	6.80 f	8.40 i
C_2P_1	39.45 cde	57.91 cdef	67.51 cd	72.13 cd	2.73 ef	5.20 cde	8.40 cd	10.20 de
C_2P_2	41.51 bcd	60.06 bcde	69.60 bc	74.21 c	2.87 cde	5.40 bcd	8.67 bc	10.60 cd
C_2P_3	46.69 ab	65.22 ab	74.74 ab	79.39 ab	3.27 ab	5.87 ab	9.27 ab	11.33 abc
C_2P_4	44.43 abc	62.95 abc	72.41 abc	77.00 bc	3.13 abcd	5.73 ab	9.00 abc	11.00 abc
C_3P_0	30.08 f	48.95 i	59.85 efg	65.36 efg	2.13 g	4.33 h	7.40 ef	9.40 fgh
C_3P_1	41.12 cd	60.51 bcd	70.75 bc	76.66 bc	2.93 bcde	5.47 bc	8.80 bc	10.93 bc
C_3P_2	45.08 abc	64.16 ab	74.77 ab	80.13 ab	3.20 abc	5.80 ab	9.27 ab	11.40 ab
C_3P_3	47.17 a	67.22 a	76.91 a	82.90 a	3.33 a	6.07 a	9.53 a	11.73 a
C_3P_4	44.90 abc	64.83 ab	74.71 ab	80.12 ab	3.20 abc	5.80 ab	9.27 ab	11.47 ab
$LSD_{(0.05)}$	4.936	5.144	4.929	4.760	0.335	0.439	0.601	0.698
CV(%)	7.38	5.30	9.42	6.98	7.15	5.01	8.34	7.10

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability

C_1: Small size corm (10-20 g)	P_0: 0 kg P_2O_5/ha
C_2: Medium size corm (21-30 g)	P_1: 120 kg P_2O_5/ha
C_3: Large size corm (31-40 g)	P_2: 130 kg P_2O_5/ha
	P_3: 140 kg P_2O_5/ha
	P_4: 150 kg P_2O_5/ha

Different level of phosphorus showed a significant difference on number of leaves per plant of gladiolus at different days after planting (DAP) under the present trial (Appendix III). At 30 DAP the highest (3.13) number of leaves per plant was recorded from P_3 (140 kg P_2O_5/ha) which was statistically similar (3.04) to P_4 (150 kg P_2O_5/ha) and closely followed (2.89) by P_2 (130 kg P_2O_5/ha), and the lowest (2.24) was obtained from P_0 (0 kg P_2O_5/ha) which was closely followed (2.71) by P_1 (120 kg P_2O_5/ha). At 45 DAP the highest (5.67) number of leaves per plant was recorded from P_3 which was statistically identical (5.49) with P_4 and closely followed (5.36) by P_2, and the lowest (4.51) was recorded from P_0 which was closely followed (5.09) by P_1. The highest (8.89) number of leaves per plant was recorded from P_3 which was statistically identical (8.71) to P_4 and the lowest (7.13) was recorded from P_0 which was closely followed (8.16) by P_1 at 60 DAP. At 75 DAT the highest (10.93) number of leaves per plant was recorded from P_3 which was statistically identical (10.69) with P_4 and closely followed (10.47) by P_2, and the lowest (8.82) was obtained from P_0 (Table 2).

Combined effect of corm size and levels of phosphorus showed significant differences in terms of number of leaves per plant of gladiolus (Appendix III). At 30 DAP the highest (3.33) number of leaves per plant was recorded from C_3P_3 (Large size corm + 140 kg P_2O_5/ha) which was statistically similar (3.27) to C_2P_3 (medium size corm + 140 kg P_2O_5/ha), while the lowest (2.13) was recorded from C_3P_0 and C_2P_0 (large size corm + 0 kg P_2O_5/ha and medium size corm + 0 kg P_2O_5/ha). The highest (6.07) number of leaves per plant was recorded from C_3P_3 which was statistically similar (5.87) to C_2P_3, while the lowest (4.33) was found from C_3P_0 which was closely followed (4.47) by C_1P_0 at 45 DAP. At 60 DAP the highest number of leaves per plant (9.53) was obtained from C_3P_3 which was statistically similar (9.27) to C_2P_3, C_3P_2 and C_3P_4, while the lowest (6.80) was recorded from C_2P_0 which was closely followed (7.20) by C_1P_0. At 75 DAP the highest number of leaves per plant (11.73) was recorded from C_3P_3 which was statistically similar (11.47 and 11.40) with C_3P_4 and C_3P_2, respectively and the lowest (8.40) was found from the treatment combination of C_2P_0 (Table 3).

4.3 Days required for 50% emergence of spike

Corm size significantly varied on days required for 50% emergence of spike under the present trial (Appendix IV). The maximum (82.67) days required for 50% emergence of spike was recorded from C_1 (small size corm) which was statistically similar (81.67 days) with C_2 (medium size corm), and the minimum (78.47 days) was recorded from C_1 (small size corm) under the present trial (Table 4).

Days required for 50% emergence of spike of gladiolus showed significant differences for different level of phosphorus (Appendix IV). The maximum (84.33) days required for 50% emergence of spike was recorded from P_0 (0 kg P_2O_5/ha) which was statistically similar (82.11 days) to P_1 (120 kg P_2O_5/ha) and closely followed (80.89 days) by P_2 (130 kg P_2O_5/ha), and the minimum (78.00 days) was obtained from P_3 (140 kg P_2O_5/ha) which was statistically similar (79.33 days) to P_4 (150 kg P_2O_5/ha) (Table 4).

Corm size and levels of phosphorus showed significant combined effect in terms of days required for 50% emergence of spike of gladiolus (Appendix IV). The maximum (87.67) days required for 50% emergence of spike was recorded from C_1P_0 (Small size corm + 0 kg P_2O_5/ha) which was statistically similar (85.00 days) with C_1P_1 (Small size corm + 120 kg P_2O_5/ha), while the minimum (77.00 days) was recorded from the treatment combination of C_3P_3 (large size corm + 140 kg P_2O_5/ha (Table 5).

4.4 Days required for 80% emergence of spike

Days required for 80% emergence of spike of gladiolus was significantly influenced by corm size (Appendix IV). The maximum days required for 80% emergence of spike was (95.87) recorded from C_1 (small size corm) which was statistically similar (95.60 days) with C_2 (medium size corm), and minimum (92.40 days) was recorded from C_1 (small size corm) under the present trial (Table 4). Large sized corm initially helps the plant for growth and development with supplying storage nutrients in the corm which is the ultimate results of minimum days for 80% emergence of spike.

Days required for 80% emergence of spike of gladiolus showed significant differences for different level of phosphorus (Appendix IV). The maximum (97.33) days required for 80% emergence of spike was recorded from P_0 (0 kg P_2O_5/ha) which was statistically similar (95.78 days and 94.78 days) to P_1 (120 kg P_2O_5/ha) and P_2 (130 kg P_2O_5/ha), and the minimum (92.00 days) was noted from P_3 (140 kg P_2O_5/ha) which was statistically similar (93.22 days) to P_4 (150 kg P_2O_5/ha) (Table 4).

Combined effect of corm size and levels of phosphorus showed statistically significant variation for days required for 80% emergence of spike of gladiolus (Appendix IV). The maximum (98.67) days required for 80% emergence of spike was recorded from C_1P_0 (small size corm + 0 kg P_2O_5/ha) which was statistically similar (98.33 days) to C_2P_0 (medium size corm + 0 kg P_2O_5/ha), while the minimum (90.67 days) was obtained from the treatment combination of C_3P_3 (large size corm + 140 kg P_2O_5/ha (Table 5).

Table 4. Effect of corm size and phosphorus on days required for 50% and 80% emergence of spike, percentage of lodging and flowering plant, length of flower stalk and rachis, number of spikelet per spike and number of spike per plot and hectare of gladiolus

Treatment	Days required for 50% emergence of spike	Days required for 80% emergence of spike	Percentage of flowering plant	Length of flower stock at harvest (cm)	Length of rachis at harvest (cm)	Number of spikelet per spike	Number of spike per plot
C_1	82.67 a	95.87 a	87.27 b	62.93 c	33.26 c	11.84 b	28.33 b
C_2	81.67 a	95.60 a	90.07 a	69.93 b	37.02 b	12.74 a	32.00 a
C_3	78.47 b	92.40 b	91.20 a	74.21 a	39.22 a	13.06 a	32.40 a
$LSD_{(0.05)}$	2.162	1.932	1.968	2.038	1.160	0.541	1.083
Level of Phosphorus							
P_0	84.33 a	97.33 a	81.78 c	59.93 c	31.59 c	10.44 c	26.00 d
P_1	82.11 ab	95.78 ab	88.33 b	68.21 b	36.07 b	12.11 b	29.44 c
P_2	80.89 bc	94.78 ab	91.00 a	70.90 a	37.54 ab	13.08 a	31.22 b
P_3	78.00 c	92.00 c	93.67 a	73.64 a	38.99 a	13.67 a	34.11 a
P_4	79.33 bc	93.22 bc	92.78 a	72.43 a	38.31 a	13.43 a	33.78 a
$LSD_{(0.05)}$	2.791	2.494	2.541	2.631	1.498	0.698	1.399
CV(%)	10.57	9.73	12.94	5.95	8.25	5.76	9.69

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability

C_1: Small size corm (10-20 g)	P_0: 0 kg P_2O_5/ha
C_2: Medium size corm (21-30 g)	P_1: 120 kg P_2O_5/ha
C_3: Large size corm (31-40 g)	P_2: 130 kg P_2O_5/ha
	P_3: 140 kg P_2O_5/ha
	P_4: 150 kg P_2O_5/ha

Table 5. Combined effect of corm size and phosphorus on days required for 50% and 80% emergence of spike and flowering plant, length of flower stalk and rachis, number of spikelet per spike and number of spike per plot and hectare of gladiolus

Treatment	Days required for 50% emergence of spike	Days required for 80% emergence of spike	Percentage of flowering plant	Length of flower stock at harvest (cm)	Length of rachis at harvest (cm)	Number of spikelet per spike	Number of spike per plot
C_1P_0	87.67 a	98.67 a	85.00 g	59.01 fg	31.08 fg	11.08 ef	25.33 gh
C_1P_1	85.00 ab	97.67 ab	85.00 g	60.96 efg	32.15 efg	11.15 def	26.67 fgh
C_1P_2	82.33 abcd	96.67 abc	87.67 fg	63.42 ef	33.65 ef	11.96 cde	28.33 def
C_1P_3	78.33 cd	92.33 cd	89.00 fg	65.89 de	34.84 de	12.56 c	30.67 cd
C_1P_4	80.00 bcd	94.00 abcd	89.67 defg	65.36 de	34.58 de	12.45 cd	30.67 cd
C_2P_0	84.67 ab	98.33 a	80.33 h	57.52 g	30.32 g	10.16 f	27.67 efg
C_2P_1	83.33 abc	97.33 ab	89.33 efg	69.59 cd	36.81 cd	12.25 cde	30.00 cde
C_2P_2	81.67 bcd	95.33 abcd	91.00 bcdef	71.85 bc	37.96 bc	13.08 abc	31.67 bc
C_2P_3	78.67 cd	93.00 bcd	95.67 ab	76.39 ab	40.63 ab	14.33 a	35.67 a
C_2P_4	80.00 bcd	94.00 abcd	94.00 abcde	74.29 abc	39.38 abc	13.90 ab	35.00 a
C_3P_0	80.67 bcd	95.00 abcd	80.00 h	63.26 ef	33.36 ef	10.09 f	25.00 h
C_3P_1	78.00 cd	92.33 cd	90.67 cdef	74.09 abc	39.24 abc	12.94 bc	31.67 bc
C_3P_2	78.67 cd	92.33 cd	94.33 abcd	77.44 a	41.01 a	14.20 ab	33.67 ab
C_3P_3	77.00 d	90.67 d	96.33 a	78.63 a	41.51 a	14.12 ab	36.00 a
C_3P_4	78.00 cd	91.67 cd	94.67 abc	77.65 a	40.96 a	13.96 ab	35.67 a
$LSD_{(0.05)}$	4.834	4.320	4.400	4.557	2.594	1.210	2.423
CV(%)	10.57	9.73	12.94	5.95	8.25	5.76	9.69

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability

C_1: Small size corm (10-20 g)
C_2: Medium size corm (21-30 g)
C_3: Large size corm (31-40 g)

P_0: 0 kg P_2O_5/ha
P_1: 120 kg P_2O_5/ha
P_2: 130 kg P_2O_5/ha
P_3: 140 kg P_2O_5/ha
P_4: 150 kg P_2O_5/ha

4.5 Percentage of flowering plant

Corm size showed statistically significantly variation on percentage of flowering plants of gladiolus (Appendix IV). The highest(91.20%) of flowering plant was found from C_3 (large size corm) which was statistically similar (90.07%) to C_2 (medium size corm) and the lowest (87.27%) was recorded from C_1 (small size corm) under the present trial (Table 4). This might be due to higher food reserve in large corm. Similar trend of results have also been reported by Mollah *et al.* (1995), Singh and Singh (1998) and Ko *et al.* (1994).

Percentage of flowering plants of gladiolus showed significant variations for different level of phosphorus under the present trial (Appendix IV). The highest (93.67%) flowering plant was counted from P_3 (140 kg P_2O_5/ha) which was statistically similar (92.78% and 91.00%) to P_4 and P_2 (150 kg P_2O_5/ha and 130 kg P_2O_5/ha, respectively), and the lowest (81.78%) was noted from P_0 (0 kg P_2O_5/ha) which was closely followed (88.33%) by P_1 (120 kg P_2O_5/ha) (Table 4).

Corm size and levels of phosphorus showed significant combined effect for percentage of flowering plants of gladiolus (Appendix IV). The highest (96.33%) flowering plant was recorded from C_3P_3 (Large size corm + 140 kg P_2O_5/ha) which was statistically similar (95.67%) with C_2P_3 (Medium size corm + 140 kg P_2O_5/ha), while the lowest (80.00%) was recorded from C_3P_0 (Large size corm + 0 kg P_2O_5/ha) (Table 5).

4.6 Length of flower stalk at harvest

Corm size significantly influenced on length of flower stalk at harvest of gladiolus (Appendix IV). The maximum (74.21 cm) length of flower stalk at harvest was obtained from C_3 (large size corm) which was closely followed (69.93 cm) by C_2 (medium size corm) and the minimum (62.93 cm) was found from C_1 (small size corm) under the present trial (Table 4). This might be due to the use of higher amount of stored food material from large corm. Similar results were also reported by Bhattacharjee (1981) and Dod *et al.* (1989).

Length of flower stalk at harvest of gladiolus showed significant variations for different level of phosphorus (Appendix IV). The maximum (73.64 cm) length of flower stalk at harvest was recorded from P_3 (140 kg P_2O_5/ha) which was statistically similar (72.43 cm and 70.90 cm) to P_4 and P_2 (150 kg P_2O_5/ha and 130 kg P_2O_5/ha, respectively), and the minimum (59.93 cm) was found from P_0 (0 kg P_2O_5/ha) which was closely followed (68.21 cm) by P_1 (120 kg P_2O_5/ha) (Table 4). Kawarkhe *et al.* (2001) reported that number of spikes per plant and spike length increased with the increase in application rates P fertilizers.

Combined effect of corm size and levels of phosphorus showed significant differences in terms of length of flower stalk at harvest of gladiolus (Appendix IV). The maximum (78.63 cm) length of flower stalk at harvest was recorded from C_3P_3 (large size corm + 140 kg P_2O_5/ha) which was statistically similar (77.65 cm and 77.44 cm) to C_3P_4 and C_3P_2 (Large size corm + 150 kg P_2O_5/ha and large size corm + 130 kg P_2O_5/ha), while the minimum (59.01 cm) length of flower stalk was recorded from C_1P_0 (small size corm + 0 kg P_2O_5/ha) (Table 5).

4.7 Length of rachis at harvest

Corm size significantly differs on length of rachis at harvest of gladiolus under the present trial (Appendix IV). The maximum (39.22 cm) length of rachis at harvest was recorded from C_3 (large size corm) which was closely followed (37.02 cm) by C_2 (medium size corm) and the minimum (33.26 cm) was recorded from C_1 (small size corm) under the present trial (Table 4). The increased rachis length from large corm was probably due to the presence of higher food materials in the large corm which resulted in better vegetative and reproductive growth of the plant. Uddin (1998) found maximum rachis length in larger corms.

Length of rachis at harvest of gladiolus showed statistically significant differences for different level of phosphorus (Appendix IV). The maximum (38.99 cm) length of rachis at harvest was recorded from P_3 (140 kg P_2O_5/ha) which was statistically similar (38.31 cm and 37.54 cm) to P_4 and P_2 (150 kg P_2O_5/ha and 130 kg P_2O_5/ha, respectively), and the minimum (31.59 cm) was found from P_0 (0 kg P_2O_5/ha) which was closely followed (36.07 cm) by P_1 (120 kg P_2O_5/ha) (Table 4).

Combined effect of corm size and levels of phosphorus varied significantly for length of rachis at harvest of gladiolus (Appendix IV). The maximum (41.51 cm) length of rachis at harvest was recorded from C_3P_3 (large size corm + 140 kg P_2O_5/ha) which was statistically similar (41.01 cm and 40.96 cm) to C_3P_2 and C_3P_4 (large size corm + 130 kg P_2O_5/ha and Large size corm + 150 kg P_2O_5/ha), while the minimum (31.08 cm) was obtained from C_1P_0 (small size corm + 0 kg P_2O_5/ha) (Table 5).

4.8 Number of spikelet per spike

Number of spikelet per spike of gladiolus varied significantly by corm size (Appendix IV). The highest (13.06) number of spikelet per spike was recorded from C_3 (large size corm) which was statistically similar (12.74) to C_2 (medium size corm) and the lowest (11.84) was recorded from C_1 (small size corm) under the present trial (Table 4). Bhattacharjee (1981) obtained maximum number of spikelet per spike with large corms. Singh.K.P. (2000), Singh and Singh (1984), Kalasareddi (1997) and Ko *et al.* (1994) found similar result from their earlier experiment.

Number of spikelet per spike of gladiolus performed significant variations for different level of phosphorus (Appendix IV). The highest (13.67) number of spikelet per spike was obtained from P_3 (140 kg P_2O_5/ha) which was statistically similar (13.43 and 13.08) with P_4 and P_2 (150 kg P_2O_5/ha and 130 kg P_2O_5/ha, respectively), and the lowest (10.44) was recorded from P_0 (0 kg P_2O_5/ha) which was closely followed (12.11) by P_1 (120 kg P_2O_5/ha) (Table 4). Kawarkhe *et al.* (2001) reported that the maximum number of florets per spike was influenced by the application of 20 g P/m^2.

Combined effect of corm size and different levels of phosphorus showed significant differences on number of spikelet per spike of gladiolus (Appendix IV). The highest (14.33) number of spikelet per spike was recorded from C_2P_3 (medium size corm + 140 kg P_2O_5/ha) which was statistically similar (14.20 and 14.12) to C_3P_2 and C_3P_3 (large size corm + 130 kg P_2O_5/ha and large size corm + 140 kg P_2O_5/ha), while the lowest (11.08) was obtained from C_1P_0 (small size corm + 0 kg P_2O_5/ha) (Table 5).

4. 9 Number of spike per plot

Corm size significantly influenced number of spike per plot of gladiolus (Appendix IV). The highest (32.40) number of spike per plot was recorded from C_3 (Large size corm) which was statistically similar (32.00) to C_2 (medium size corm) and the lowest (28.33) was recorded from C_1 (small size corm) under the present trial (Table 4).

Number of spike per plot of gladiolus showed significant variations for different level of phosphorus (Appendix IV). The highest (34.11) number of spike per plotwas recorded from P_3 (140 kg P_2O_5/ha) which was statistically similar (33.78) to P_4 (150 kg P_2O_5/ha) and closely followed (31.22) by P_2 (130 kg P_2O_5/ha), the lowest (26.00) was obtained from P_0 (0 kg P_2O_5/ha) which was closely followed (29.44) by P_1 (120 kg P_2O_5/ha) (Table 4).

Combined effect of corm size and different levels of phosphorus showed significant differences for number of spike per plot of gladiolus (Appendix IV). The highest (36.00) number of spike per plot was recorded from C_3P_3 (large size corm + 140 kg P_2O_5/ha) which was statistically similar (35.67 and 35.00) to C_3P_4, C_2P_3 and C_2P_4 (large size corm + 150 kg P_2O_5/ha, medium size corm + 140 kg P_2O_5/ha and Medium size corm + 150 kg P_2O_5/ha), while the lowest (25.00) was noted from C_3P_0 (large size corm + 0 kg P_2O_5/ha) (Table 5).

4.10 Number of spike/ha ('000)

Number of spike in thousand per hectare of gladiolus varied significantly for corm size (Appendix IV). The highest (675.07/ha) number of spike was recorded from C_3 (large size corm) which was statistically similar (666.60/ha) to C_2 (medium size corm) and the lowest (590.40/ha) number of spike was recorded from C_1 (Small size corm) under the present trial.

Number of spike in thousand per hectare of gladiolus showed significant differences for different levels of phosphorus (Appendix IV). The highest (710.67/ha) number of spike was recorded from P_3 (140 kg P_2O_5/ha) which was statistically similar (703.67/ha) to P_4 (150 kg P_2O_5/ha) and closely followed (650.44/ha) by P_2 (130 kg P_2O_5/ha), and the lowest (541.89/ha) was recorded from P_0 (0 kg P_2O_5/ha) which was closely followed (613.44/ha) by P_1 (120 kg P_2O_5/ha). Singh *et al.* (1976) and Mukesh *et al.* (2001) reported that the highest level of phosphorus increased the number of spike.

Combined effect of corm size and levels of phosphorus showed significant variation for number of spike in thousand per hectare of gladiolus (Appendix IV). The highest (750.00/ha) number of spike was recorded from C_3P_3 (large size corm + 140 kg P_2O_5/ha) which was statistically similar (743.00/ha and 729.00/ha) to C_3P_4, C_2P_3 and C_2P_4 (large size corm + 150 kg P_2O_5/ha, medium size corm + 140 kg P_2O_5/ha and medium size corm + 150 kg P_2O_5/ha), while the lowest (521.33/ha) was obtained from C_2P_0 (medium size corm + 0 kg P_2O_5/ha).

4.11 Individual corm thickness

Corm size significantly influenced on individual corm thickness of gladiolus (Appendix V). The maximum (6.12 cm) individual corm thickness was recorded from C_3 (large size corm) which was statistically identical (5.83 cm) to C_2 (medium size corm) and the minimum (5.43 cm) was noted from C_1 (small size corm) under the present trial (Table 6).

Individual corm thickness of gladiolus showed significant variations due to different level of phosphorus (Appendix V). The maximum (6.41 cm) corm thickness was recorded from P_3 (140 kg P_2O_5/ha) which was statistically similar (6.32 cm) to P_4 and the minimum (4.65 cm) was recorded from P_0 (0 kg P_2O_5/ha) which was closely followed (5.62 cm) by P_1 (120 kg P_2O_5/ha) (Table 6).

Combined effect of corm size and different levels of phosphorus showed significant differences in terms of individual corm thickness of gladiolus (Appendix V). The maximum (6.83 cm) individual corm thickness was recorded from C_3P_3 (large size corm + 140 kg P_2O_5/ha) which was statistically similar (6.65 cm and 6.64 cm) to C_2P_3 and C_3P_4 (Medium size corm + 140 kg P_2O_5/ha and large size corm + 150 kg P_2O_5/ha), while the minimum (4.42 cm) was recorded from C_2P_0 and C_3P_0 (Medium size corm + 0 kg P_2O_5/ha and large size corm + 0 kg P_2O_5/ha) (Table 7).

Table 6. Effect of corm size and phosphorus on height of corm thickness, weight and diameter, individual cormel number, weight and diameter and yield per plot of corm and cormel of gladiolus

Treatment	Individual corm			Individual cormel			Yield (kg/plot)	
	Thickness (cm)	Weight (g/corm)	Diameter (cm)	Number of corm per plant	Weight (g/cormel)	Diameter (cm)	Corm	Cormel
Corm size								
C_1	5.43 b	24.11 b	2.24 b	19.17 c	11.79 c	1.16 b	0.58 c	0.47 b
C_2	5.83 a	26.09 a	2.52 a	21.44 b	12.79 b	1.31 a	0.65 b	0.53 a
C_3	6.12 a	27.14 a	2.58 a	22.85 a	13.44 a	1.33 a	0.69 a	0.54 a
LSD$_{(0.05)}$	0.327	1.090	0.089	0.638	0.551	0.047	0.023	0.023
Level of Phosphorus								
P_0	4.65 c	21.21 d	2.10 d	18.25 d	10.36 c	1.06 c	0.55 c	0.44 c
P_1	5.62 b	24.73 c	2.38 c	20.84 c	12.29 b	1.21 b	0.63 b	0.50 b
P_2	5.99 ab	26.73 b	2.51 b	21.73 b	13.09 a	1.27 b	0.65 ab	0.53 ab
P_3	6.41 a	28.30 a	2.63 a	22.76 a	13.84 a	1.40 a	0.69 a	0.56 a
P_4	6.32 a	27.93 ab	2.60 ab	22.19 ab	13.78 a	1.38 a	0.68 a	0.55 a
LSD$_{(0.05)}$	0.422	1.408	0.114	0.824	0.712	0.061	0.031	0.031

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability

C_1: Small size corm (10-20 g)
C_2: Medium size corm (21-30 g)
C_3: Large size corm (31-40 g)

P_0: 0 kg P_2O_5/ha
P_1: 120 kg P_2O_5/ha
P_2: 130 kg P_2O_5/ha
P_3: 140 kg P_2O_5/ha
P_4: 150 kg P_2O_5/ha

Table 7. Combined effect of corm size and phosphorus on height of corm thickness, weight and diameter, individual cormel number, weight and diameter and yield per plot of corm and cormel of gladiolus

Treatment	Individual corm			Individual cormel			Yield (kg/plot)	
	Thickness (cm)	Weight (g/corm)	Diameter (cm)	Number of corm per plant	Weight (g/cormel)	Diameter (cm)	Corm	Cormel
C_1P_0	5.10 ef	22.32 ef	2.05 g	17.71 g	10.81 fg	1.02 g	0.55 gh	0.44 fg
C_1P_1	5.11 ef	22.79 ef	2.17 fg	18.57 fg	11.16 efg	1.09 fg	0.56 fgh	0.45 efg
C_1P_2	5.40 de	24.44 de	2.25 efg	19.42 ef	11.78 def	1.15 def	0.58 fgh	0.48 defg
C_1P_3	5.75 cde	25.56 d	2.38 def	20.30 de	12.55 cd	1.26 bcd	0.61 efg	0.50 cde
C_1P_4	5.82 bcde	25.44 d	2.36 def	19.84 def	12.68 cd	1.26 bcd	0.61 def	0.49 cdef
C_2P_0	4.42 f	20.69 f	2.21 fg	17.47 g	10.06 g	1.13 efg	0.53 h	0.47 efg
C_2P_1	5.66 de	24.96 de	2.43 de	21.16 cd	12.42 cde	1.23 cde	0.65 cde	0.51 cde
C_2P_2	5.95 bcd	26.72 bcd	2.52 cd	22.05 bc	13.02 bcd	1.29 bc	0.67 bcd	0.53 bcd
C_2P_3	6.65 ab	29.16 ab	2.75 ab	23.60 a	14.28 ab	1.46 a	0.72 ab	0.58 ab
C_2P_4	6.49 abc	28.93 abc	2.68 abc	22.92 ab	14.15 ab	1.43 a	0.70 abc	0.58 ab
C_3P_0	4.42 f	20.63 f	2.05 g	19.57 ef	10.22 g	1.03 g	0.57 fgh	0.43 g
C_3P_1	6.08 abcd	26.46 cd	2.55 bcd	22.80 ab	13.31 abc	1.31 bc	0.68 bc	0.54 abc
C_3P_2	6.62 ab	29.03 abc	2.75 ab	23.71 a	14.48 a	1.36 ab	0.72 ab	0.57 ab
C_3P_3	6.83 a	30.18 a	2.78 a	24.37 a	14.69 a	1.48 a	0.74 a	0.60 a
C_3P_4	6.64 ab	29.40 ab	2.77 ab	23.81 a	14.52 a	1.46 a	0.72 ab	0.58 ab
LSD$_{(0.05)}$	0.731	2.438	0.198	1.427	1.232	0.106	0.053	0.053
CV(%)	7.55	5.65	8.75	10.03	5.82	6.92	8.94	10.76

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability

C_1: Small size corm (10-20 g)
C_2: Medium size corm (21-30 g)
C_3: Large size corm (31-40 g)

P_0: 0 kg P_2O_5/ha
P_1: 120 kg P_2O_5/ha
P_2: 130 kg P_2O_5/ha
P_3: 140 kg P_2O_5/ha
P_4: 150 kg P_2O_5/ha

4.12 Individual corm weight

Individual corm weight of gladiolus varied significantly due to corm size that was used as planting material (Appendix V). The maximum (27.14 g) individual corm weight was obtained from C_3 (large size corm) which was statistically identical (26.09 g) to C_2 (medium size corm) and the minimum (24.11 g) was recorded from C_1 (small size corm) under the present trial (Table 6).

Individual corm weight of gladiolus showed significant differences due to application of different level of phosphorus (Appendix V). The maximum (28.30 g) individual corm weight was noted from P_3 (140 kg P_2O_5/ha) which was statistically similar (27.93 g) to P_4 (150 kg P_2O_5/ha) and closely followed (26.73 g) by P_2 (130 kg P_2O_5/ha), and the minimum (21.21 g) was obtaind from P_0 (0 kg P_2O_5/ha) which was closely followed (24.73 g) by P_1 (120 kg P_2O_5/ha) (Table 6). Mukesh *et al.* (2001) reported that phosphorus at 10 g/m^2 resulted in the highest size and weight of corms, and number of corms.

Combined effect of corm size and different levels of phosphorus showed significant differences in terms of individual corm weight of gladiolus (Appendix V). The maximum (30.18 g) individual corm weight was recorded from C_3P_3 (large size corm + 140 kg P_2O_5/ha) which was statistically similar (29.40 g) to C_3P_4 (large size corm + 150 kg P_2O_5/ha), while the minimum (20.63 g) was recorded from the treatment of C_2P_0 (medium size corm + 0 kg P_2O_5/ha) (Table 7).

4.13 Individual corm diameter

Corm size significantly influenced on individual corm diameter of gladiolus (Appendix V). The maximum (2.58 cm) individual corm diameter was recorded from C_3 (large size corm) which was statistically identical (2.52 cm) to C_2 (medium size corm) and the minimum (2.24 cm) was obtained from C_1 (small size corm) under the present trial (Table 6).

Individual corm diameter of gladiolus showed significant variations due to application of different levels of phosphorus (Appendix V). The maximum (2.63 cm) individual corm diameter was obtained from P_3 (140 kg P_2O_5/ha) which was statistically similar (2.60 cm) to P_4 (150 kg P_2O_5/ha) where as the minimum (2.10 cm) was recorded from P_0 (0 kg P_2O_5/ha) which was closely followed (2.38 cm) by P_1 (120 kg P_2O_5/ha) (Table 6).

Combined effect of corm size and different levels of phosphorus showed significant differences in terms of individual corm diameter of gladiolus (Appendix V). The maximum (2.78 cm) individual corm diameter was recorded from C_3P_3 (large size corm + 140 kg P_2O_5/ha) which was statistically identical (2.77 cm and 2.75 cm) to C_3P_4, C_3P_2 and C_2P_3 (large size corm + 150 kg P_2O_5/ha, large size corm + 130 kg P_2O_5/ha and medium size corm + 140 kg P_2O_5/ha), while the minimum (2.05 cm) was obtained from C_2P_0 and C_3P_0 (medium size corm + 0 kg P_2O_5/ha and large size corm + 0 kg P_2O_5/ha) (Table 7).

4.14 Number of cormel per plant

Corm size should significant variation on number of cormel per plant of gladiolus (Appendix IV). The highest (22.85) number of cormel per plant was recorded from C_3 (large size corm) and the lowest (19.17) was recorded from C_1 (small size corm) under the present trial (Table 6). Generally large sized corm ensured the proper growth and development of gladiolus and the ultimate results is the highest number of cormel/plant. The result is in agreement with the findings of Mollah *et al.* (1995).

Number of cormel per plant of gladiolus showed significant variations due to application of different level of phosphorus (Appendix IV). The highest (22.76) number of cormel per plant was recorded from P_3 (140 kg P_2O_5/ha) which was statistically similar (22.19) to P_4 (150 kg P_2O_5/ha)

Plate 4. Influence of corm size on spike length of gladiolus

Plate 5. Influence of Phosphorus on spike length of gladiolus

and closely followed (21.73) by P_2 (130 kg P_2O_5/ha) and the lowest (18.25) was recorded from P_0 (0 kg P_2O_5/ha) number of cormel which was closely followed (20.84) by P_1 (120 kg P_2O_5/ha) (Table 6).

Corm size and different levels of phosphorus showed statistically significant variation due to combined effect on number of cormel per plant of gladiolus (Appendix IV). The highest (24.37) number of cormel per plant was recorded from C_3P_3 (large size corm + 140 kg P_2O_5/ha) which was statistically similar (23.81, 23.71 and 23.60) to C_3P_4 C_3P_2 and C_2P_3 (large size corm + 150 kg P_2O_5/ha, large size corm + 130 kg P_2O_5/ha and medium size corm + 140 kg P_2O_5/ha), while the lowest (17.47) was recorded from C_2P_0 (medium size corm + 0 kg P_2O_5/ha) (Table 7).

4.15 Weight of cormel

Corm size significantly influenced individual cormel weight of gladiolus (Appendix V). The maximum (13.44 g) individual cormel weight was found from C_3 (large size corm) and the minimum (11.79 g) was recorded from C_1 (small size corm) under the present trial (Table6).

Individual cormel weight of gladiolus showed significant variations due to application of different level of phosphorus (Appendix V). The maximum (13.84 g) individual cormel weight was recorded from P_3 (140 kg P_2O_5/ha) which was statistically similar (13.78 g and 13.09 g) to P_4 (150 kg P_2O_5/ha) and P_2 (130 kg P_2O_5/ha) and the minimum (10.36 g) was recorded from P_0 (0 kg P_2O_5/ha) which was closely followed (12.29 g) by P_1 (120 kg P_2O_5/ha) (Table 6).

Combined effect of corm size and different levels of phosphorus showed significant differences in terms of individual cormel weight of gladiolus (Appendix V). The maximum (14.69 g) individual cormel weight was recorded from C_3P_3 (large size corm + 140 kg P_2O_5/ha) which was statistically similar (14.52 g and 14.48 g) to C_3P_4 (large size corm +

150 kg P_2O_5/ha) and C_3P_2 (large size corm + 130 kg P_2O_5/ha), while the minimum (10.06 g) was recorded from C_2P_0 (Medium size corm + 0 kg P_2O_5/ha) (Table 7).

4.16 Diameter of cormel

Cormel diameter of gladiolus varied significantly for corm size (Appendix V). The maximum individual cormel diameter (1.33 cm) was recorded from C_3 (large size corm) which was statistically identical (1.31 cm) with C_2 (medium size corm) and the minimum (1.16 cm) was obtained from C_1 (small size corm) under the present trial (Table 6).

Individual cormel diameter of gladiolus showed significant variations for different level of phosphorus (Appendix V). The maximum individual cormel diameter (1.40 cm) was recorded from P_3 (140 kg P_2O_5/ha) which was statistically similar (1.38 cm) to P_4 (150 kg P_2O_5/ha) and closely followed (1.27 cm) by P_2 (130 kg P_2O_5/ha) and the minimum (1.06 cm) was noted from P_0 (0 kg P_2O_5/ha) which was closely followed (1.21 cm) by P_1 (120 kg P_2O_5/ha) (Table 6).

Combined effect of corm size and different levels of phosphorus showed significant differences in terms of individual cormel diameter of gladiolus (Appendix V). The maximum (1.48 cm) individual cormel diameter was recorded from C_3P_3 (large size corm + 140 kg P_2O_5/ha) which was statistically similar (1.46 cm and 1.43 cm) to C_3P_4, C_2P_3 and C_2P_4 (large size corm + 150 kg P_2O_5/ha, medium size corm + 140 kg P_2O_5/ha and medium size corm + 150 kg P_2O_5/ha), while the minimum (1.02 cm) was found from C_1P_0 (small size corm + 0 kg P_2O_5/ha) (Table 7).

4.17 Corm yield per plot

In the present experiment corm size significantly influenced on corm yield per plot of gladiolus (Appendix V). The highest (0.69 kg/plot) corm yield was recorded from C_3 (large size corm) and the lowest (0.58 kg/plot) yield per plot was found from C_1 (Small size corm) under the present trial (Table 6).

Corm yield per plot of gladiolus showed significant variations due to application of different level of phosphorus (Appendix V). The highest (0.69 kg/plot) corm yield was obtained from P_3 (140 kg P_2O_5/ha) which was statistically similar (0.68 kg/plot and 0.65 kg/plot) to P_4 (150 kg P_2O_5/ha) and P_2 (130 kg P_2O_5/ha) and the lowest (0.55 kg/plot) was recorded from P_0 (0 kg P_2O_5/ha) (Table 6). Mukesh *et al*. (2001) reported that phosphorus at 10 g/m^2 resulted in the highest size and weight of corms.

Combined effect of corm size and levels of phosphorus showed significant differences in terms of corm yield per plot of gladiolus (Appendix V). The highest(0.74 kg/plot) corm yield was recorded from C_3P_3 (large size corm + 140 kg P_2O_5/ha) which was statistically similar (0.72 kg/plot) with C_3P_4 (large size corm + 150 kg P_2O_5/ha), and C_3P_2 (large size corm + 130 kg P_2O_5/ha) and C_2P_3 (medium size corm + 140 kg P_2O_5/ha), while the lowest (0.53 kg/plot) was recorded from the treatment combination of C_2P_0 (medium size corm + 0 kg P_2O_5/ha) (Table 7).

4.18 Cormel yield per plot

Corm size significantly influenced cormel yield per plot of gladiolus (Appendix V). The highest cormel yield (0.54 kg/plot) was noted from C_3 (large size corm) which was statistically similar (0.53 kg/plot) to C_2 (medium size corm) and the lowest (0.47 kg/plot) was recorded from C_1 (small size corm) under the present trial (Table 6).

Cormel yield per plot of gladiolus showed significant variations due to application of different levels of phosphorus (Appendix V). The highest (0.56 kg/plot) cormel yield was recorded from P_3 (140 kg P_2O_5/ha) which was statistically similar (0.55 kg/plot) to P_4 (150 kg P_2O_5/ha) and the lowest (0.44 kg/plot) was found from P_0 (0 kg P_2O_5/ha) (Table 6).

Combined effect of corm size and levels of phosphorus showed significant differences in terms of cormel yield per plot of gladiolus (Appendix V). The highest (0.60 kg/plot) cormel yield was recorded from C_3P_3 (large size corm + 140 kg P_2O_5/ha) which was statistically similar (0.58 kg/plot) with C_3P_4 (large size corm + 150 kg P_2O_5/ha), while the lowest (0.43 kg/plot) cormel yield was recorded from C_3P_0 (Medium size corm + 0 kg P_2O_5/ha) (Table7).

4.19 Corm yield per hectare

Corm yield per hectare of gladiolus differ significantly for corm size (Appendix V). The highest corm yield (14.27 t/ha) was recorded from C_3 (Large size corm) which was statistically similar (13.59 t/ha) with C_2 (Medium size corm) and the lowest (12.13 t/ha) was recorded from C_1 (Small size corm) under the present trial (Figure 5).

Different level of phosphorus showed significant variations for corm yield per hectare of gladiolus (Appendix V). The highest (14.30 t/ha) corm yield was recorded from P_3 (140 kg P_2O_5/ha) which was statistically similar (14.15 t/ha) with P_4 (150 kg P_2O_5/ha) and (13.64 t/ha) P_2 (130 kg P_2O_5/ha), while the lowest (11.46 t/ha) was recorded from P_0 (0 kg P_2O_5/ha) which was closely followed (13.09 t/ha) by P_1 (120 kg P_2O_5/ha).

A statistically significant combined effect of corm size and levels of phosphorus was recorded in terms of corm yield per hectare of gladiolus (Appendix V). The highest corm yield (15.34 t/ha) was recorded from C_3P_3 (Large size corm + 140 kg P_2O_5/ha) which was statistically similar (15.08 t/ha) with C_3P_4 (Large size corm + 150 kg P_2O_5/ha), while the lowest (11.00 t/ha) was recorded from C_2P_0 (Medium size corm + 0 kg P_2O_5/ha) (Figure 7).

Plate 6. Influence of corm size on rachis length of gladiolus

Plate 7. Influence of phosphorus on rachis length of gladiolus

4.20 Cormel yield per hectare

Statistically significant variation was recorded for corm size for cormel yield per hectare of gladiolus (Appendix V). The highest (11.30 t/ha) cormel yield was recorded from C_3 (large size corm) which was statistically similar (11.14 t/ha) with C_2 (medium size corm) and the lowest (9.79 t/ha) cormel yield was recorded from C_1 (small size corm) under the present trial.

In the present experiment cormel yield per hectare of gladiolus showed significant differences for different level of phosphorus (Appendix V). The highest cormel yield (11.62 t/ha) was recorded from P_3 (140 kg P_2O_5/ha) which was statistically similar (11.44 t/ha) with P_4 (150 kg P_2O_5/ha) and closely followed (10.44 t/ha) by P_2 (130 kg P_2O_5/ha) and the lowest (9.24 t/ha) was recorded from P_0 (0 kg P_2O_5/ha) which was closely followed (10.44 t/ha) by P_1 (120 kg P_2O_5/ha).

Combined effect of corm size and levels of phosphorus showed significant differences in terms of cormel yield per hectare of gladiolus (Appendix V). The highest cormel yield (12.44 t/ha) was recorded from C_3P_3 (Large size corm + 140 kg P_2O_5/ha) which was statistically similar (12.09 t/ha) with C_2P_3 (Medium size corm + 140 kg P_2O_5/ha), while the lowest (8.88 t/ha) was recorded from C_2P_0 (Medium size corm + 0 kg P_2O_5/ha) (Figure 10).

Plate 8. Influence of corm size on number of floret/spike of gladiolus

Plate 9. Influence of Phosphorus on number of floret/spike of gladiolus

Table 8. Cost and return of gladiolus cultivation as influenced by corm size and phosphorus

Treatment	Cost of production (Tk./ha)	Yield of corm (t/ha)	Price of corm (Tk.)	Yield of cormel (t/ha)	Price of cormel	Total Spike (‘000)	Price of cut flower	Gross return (Tk./ha)	Net return (Tk./ha)	Benefit cost ratio
C_1P_0	211,489	11.44	114,400	9.10	72,800	528.00	528,000	715,200	503,711	2.38
C_1P_1	214,247	11.66	116,600	9.43	75,440	555.67	555,670	747,710	533,463	2.49
C_1P_2	214,476	12.15	121,500	9.93	79,440	590.33	590,330	791,270	576,794	2.69
C_1P_3	214,936	12.66	126,600	10.34	82,720	639.00	639,000	848,320	633,384	2.95
C_1P_4	214,706	12.74	127,400	10.16	81,280	639.00	639,000	847,680	632,974	2.95
C_2P_0	224,258	11.00	110,000	9.74	77,920	576.33	576,330	764,250	539,992	2.41
C_2P_1	227,016	13.51	135,100	10.66	85,280	625.00	625,000	845,380	618,364	2.72
C_2P_2	227,245	13.86	138,600	11.09	88,720	659.67	659,670	886,990	659,745	2.90
C_2P_3	227,705	14.91	149,100	12.09	96,720	743.00	743,000	988,820	761,115	3.34
C_2P_4	227,475	14.65	146,500	12.11	96,880	729.00	729,000	972,380	744,905	3.27
C_3P_0	237,027	11.94	119,400	8.88	71,040	521.33	521,330	711,770	474,743	2.00
C_3P_1	239,785	14.09	140,900	11.23	89,840	659.67	659,670	890,410	650,625	2.71
C_3P_2	240,014	14.91	149,100	11.92	95,360	701.33	701,330	945,790	705,776	2.94
C_3P_3	240,474	15.34	153,400	12.44	99,520	750.00	750,000	1002,920	762,446	3.17
C_3P_4	240,244	15.08	150,800	12.05	96,400	743.00	743,000	990,200	749,956	3.12

Market price of corm @ Tk. 10000/t and cormel Tk. 8000/t
Price of cut flower @ Tk 1/spike

C_1: Small size corm (10-20 g)	P_0: 0 kg P_2O_5/ha
C_2: Medium size corm (21-30 g)	P_1: 120 kg P_2O_5/ha
C_3: Large size corm (31-40 g)	P_2: 130 kg P_2O_5/ha
	P_3: 140 kg P_2O_5/ha
	P_4: 150 kg P_2O_5/ha

4.21 Economic analysis

The economic analysis was calculated to find out the gross and net return and the benefit cost ratio in the present experiment and presented under the following headings-

4.21.1 Gross return

In the combination of corm size and different level of phosphorus the highest gross return (Tk. 1,002,920) was obtained from the treatment combination of large size cor phosphorus with 140 kg P_2O_5/ha and the second highest gross return (Tk. 990200/ha) was obtained in large size corm and phosphorus at 150 kg P_2O_5/ha. The lowest gross return (Tk. 711770/ha) was obtained from C_3P_0 in the large size corm with no phosphorus fertilizer (Table 8).

4.21.2 Net return

In case of net return different treatment combination showed different types of net return. In the combination of different corm size and different levels phosphorus highest net return (Tk. 762,446) was obtained from the treatment combination of large size corm and phosphorus with 140 kg P_2O_5/ha and the second highest net return (Tk. 761,115) was noted from medium size corm and 140 kg P_2O_5/ha. The lowest net return (Tk. 503,711) was obtained from the small size corm and no phosphorus (Table 8).

4.21.3 Benefit cost ratio

In the combination of different corm size and levels of phosphorus the highest benefit cost ratio (3.34) was attained from the treatment combination of medium size corm and phosphorus at 140 kg P_2O_5/ha and the second highest benefit cost ratio (3.27) was estimated in medium size corm and phosphorus at 150 kg P_2O_5/ha. The lowest benefit cost ratio (2.00) was obtained in large size corm and no phosphorus (Table 8).

Chapter V

SUMMARY AND CONCLUSION

The study was conducted at the Horticulture Farm of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka, Bangladesh during the period from November, 2006 to June, 2007 to find out the effect of corm size and different levels of phosphorus on growth, flower, corm and cormel production of gladiolus. The experiment considered as two factors. Factor A: Corm size (3 levels) such as: C_1: Small size corm (10-20 g); C_2: Medium size corm (21-30 g) and C_3: Large size corm (31-40 g) and Factor B: Phosphorus (5 levels) as P_0: 0 kg (Control); P_1: 120 kg; P_2: 130 kg; P_3: 140 kg and P_4: 150 kg P_2O_5/ha, respectively. There were on the whole 15 (3 × 5) treatments combinations. The experiment was laid out following Randomized Complete Block Design (RCBD) with three replications. Data were recorded on yield contributing characters and yield of gladiolus.

At 75 DAP the tallest plant (77.03 cm) was obtained from C_3 and the shortest (65.07 cm) was recorded from C_1. At 75 DAP the highest number of leaves per plant (10.99) was found from C_3 and the lowest (9.27) was recorded from C_1. The maximum (95.87) days required for 80% emergence of spike was counted from C_1 and the minimum (92.40 days) was recorded from C_1. The highest (91.20%) of flowering plant was recorded from C_3 and the lowest (87.27%) was noted from C_1. The maximum length of flower stalk at harvest (74.21 cm) was obtained from C_3 and the minimum (62.93 cm) was recorded from C_1. The highest number of spike (675.07/ha) was recorded from C_3 and the lowest number of spike (590.40/ha) was found from C_1. The maximum individual corm thickness (6.12 cm) was found from C_3 and the minimum (5.43 cm) was recorded from C_1. The maximum (27.14 g) individual corm weight was recorded from C_3 and the minimum (24.11 g) was obtained from C_1. The highest (22.85) number of cormel per plant was obtained from C_3 and the lowest (19.17) was recorded from C_1. The maximum (13.44 g) individual cormel weight was recorded from C_3 (large size corm) and the minimum (11.79 g) was recorded from C_1. The highest corm yield (14.27 t/ha) was recorded from C_3 and the lowest (12.13 t/ha) was found from C_1. The highest (11.30 t/ha) cormel yield was obtained from C_3 and the lowest (9.79 t/ha) cormel yield was recorded from C_1.

At 75 DAT the tallest plant (76.83 cm) was recorded from P_3 and the shortest (61.97 cm) was found from P_0. At 75 DAT the highest number of leaves per plant (10.93) was noted from P_3 and the lowest (8.82) was recorded from P_0. The maximum (97.33) days required for 80% emergence of spike was recorded from P_0 and the minimum (92.00 days) was obtained from P_3. The highest flowering plant (93.67%) was obtained from P_3 and the lowest (81.78%) was noted from P_0. The maximum (73.64 cm) length of flower stalk at harvest was recorded from P_3 and the minimum (59.93 cm) was found from P_0. The highest number of spike (710.67/ha) was recorded from P_3 and the lowest (541.89/ha) was recorded from P_0. The maximum (6.41 cm) corm thickness was obtained from P_3 and the minimum (4.65 cm) was recorded from P_0. The maximum (28.30 g) individual corm weight was recorded from P_3 and the minimum (21.21 g) was recorded from P_0. The highest number of cormel per plant (22.76) was recorded from P_3 and the lowest (18.25) was recorded from P_0. The maximum (13.84 g) individual cormel weight was recorded from P_3 and the minimum (10.36 g) was recorded from P_0. The highest corm yield (14.30 t/ha) was recorded from P_3, while the lowest (11.46 t/ha) was found from P_0. The highest cormel yield (11.62 t/ha) was recorded from P_3 and the lowest (9.24 t/ha) was recorded from P_0.

At 75 DAP the tallest plant (82.90 cm) was noted from C_3P_3 and the shortest (59.47 cm) was recorded from C_2P_0. At 75 DAP the highest number of leaves per plant (11.73) was obtained from C_3P_3 and the lowest (8.40) was recorded from C_2P_0. The maximum (98.67) days required for 80% emergence of spike was recorded from C_1P_0, while the minimum

(90.67 days) was obtained from C_3P_3. The highest flowering plant (96.33%) was found from C_3P_3, while the lowest (80.00%) was recorded from C_3P_0. The maximum length of flower stalk at harvest (78.63 cm) was noted from C_3P_3, while the minimum (59.01 cm) was recorded from C_1P_0. The highest number of spike (750.00/ha) was recorded from C_3P_3, while the lowest (521.33/ha) was obtained from C_2P_0. The maximum individual corm thickness (6.83 cm) was recorded from C_3P_3, while the minimum (4.42 cm) was recorded from C_2P_0 and C_3P_0. The maximum individual corm weight (30.18 g) was recorded from C_3P_3, while the minimum (20.63 g) was found from C_2P_0. The highest number of cormel per plant (24.37) was recorded from C_3P_3, while the lowest (17.47) was found from C_2P_0. The maximum individual cormel weight (14.69 g) was noted from C_3P_3, while the minimum (10.06 g) was recorded from C_2P_0. The highest corm yield (15.34 t/ha) was recorded from C_3P_3, while the lowest (11.00 t/ha) was found from C_2P_0. The highest cormel yield (12.44 t/ha) was recorded from C_3P_3, while the lowest (8.88 t/ha) was obtained from C_2P_0. The highest benefit cost ratio (3.34) was attained from C_2P_3 and the lowest (2.00) was obtained from the treatment combination of C_3P_0. It may be concluded that large corm size with140 kg P_2O_5 /ha is best for growth, flowering and yield of gladiolus.

Considering the situation of the present experiment, further studies in the following areas may be suggested:

1. Such study is needed in different agro-ecological zones (AEZ) of Bangladesh for regional compliance and other performance.
2. Another experiment may be carried out with other size of corm for maximizing highest benefit.
3. Phosphorus fertilizer had significant influence on the growth and yield of gladiolus. So, further study in needed to specify the level.

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APPENDICES

Appendix I. Characteristics of Horticulture Farm soil is analyzed by Soil Resources Development Institute (SRDI), Khamarbari, Farmgate, Dhaka.

A. Morphological characteristics of the experimental field

Morphological features	Characteristics
Location	Horticulture Garden , SAU, Dhaka
AEZ	Madhupur 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	Winter Vegetable – Summer Vegetable

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

* **Source:** SRDI

Appendix II. Monthly record of air temperature, rainfall, relative humidity, soil temperature and Sunshine of the experimental site during the period from November 2006 to June/07

Year	Month	*Air temperature (°c)		*Relative humidity (%)	*Rain fall (mm) (total)	*Sunshine (hr)
		Maximum	Minimum			
2006	November	21.4	13.4	65	00	6.2
	December	20.6	12.5	66	00	6.5
2007	January	24.5	12.4	68	00	5.7
	February	27.1	16.7	67	30	6.7
	March	31.4	19.6	54	11	8.2
	April	33.6	23.6	69	163	6.4
	May	34.7	25.9	70	185	7.8
	June	32.4	25.5	81	628	5.7

* Monthly average,

* Source: Bangladesh Meteorological Department (Climate and weather division) Agargoan, Dhaka - 1212

Appendix III. Analysis of variance of the data on plant height and number of leaves per plant at different days after sowing (DAS) of gladiolus as influenced by corm size and phosphorus

Source of variation	Degrees of freedom	Mean square							
		Plant height (cm) at				Number of leaves per plant at			
		30 DAS	45 DAS	60 DAS	75 DAS	30 DAS	45 DAS	60 DAS	75 DAS
Replication	2	2.208	0.659	4.800	2.939	0.012	0.014	0.067	0.056
Corm size (A)	2	59.347**	270.631**	439.438**	546.186**	0.422**	2.178**	6.665**	11.256**
Phosphorus (B)	4	227.388**	212.999**	276.674**	303.126**	1.114**	1.822**	4.344**	6.248**
Interaction (A×B)	8	24.541*	17.502*	28.332**	23.512**	0.129**	0.184*	0.477**	0.463*
Error	28	8.711	9.461	8.685**	8.100	0.040	0.069	0.129	0.174

**: Significant at 0.01 level of probability: *: Significant at 0.05 level of probability:

Appendix IV. Analysis of variance of the data on days required for 50% and 80% emergence of spike, percentage of lodging and flowering plant, length of flower stalk and rachis, number of spikelet per spike and number of spike per plot and hectare of gladiolus as influenced by corm size and phosphorus

Source of variation	Degrees of freedom	Mean square								
		Days required for 50% emergence of spike	Days required for 80% emergence of spike	Percentage of lodging of plants	Percentage of flowering plant	Length of flower stock at harvest (cm)	Length of rachis at harvest (cm)	Number of spikelet per spike	Number of spike per plot	Number of spike/ha ('000)
Replication	2	8.067	16.289	0.590	0.089	4.124	1.194	1.130	0.289	126.489
Corm size (A)	2	72.200**	55.822**	13.620**	61.489**	486.581**	135.988**	6.055**	75.356**	32616.42**
Phosphorus (B)	4	54.256**	39.478**	3.036**	205.533**	269.699**	78.542**	15.642**	100.856**	43664.41**
Interaction (A×B)	8	15.672**	1.961**	1.617*	23.267**	20.654*	5.992*	1.528*	5.272*	2269.978*
Error	28	8.352	6.670*	0.704	6.922	7.423	2.406	0.523	2.098	911.132

**: Significant at 0.01 level of probability: *: Significant at 0.05 level of probability:

Analysis V. Analysis of variance of the data on height of corm thickness, weight and diameter, individual cormel number, weight and diameter and yield per plot and hectare of corm and cormel of gladiolus as influenced by corm size and phosphorus

Source of variation	Degrees of freedom	Mean square									
		Individual corm			Individual cormel			Yield (kg/plot)		Yield (t/ha)	
		Thickness (cm)	Weight (g/corm)	Diameter (cm)	Number per plant	Weight (g/cormel)	Diameter (cm)	Corm	Cormel	Corm	Cormel
Replication	2	0.139	4.535	0.0001	0.211	0.816	0.003	0.0001	0.0001	0.215	0.111
Corm size (A)	2	1.774**	35.493**	0.479**	51.857**	10.317**	0.131**	0.041**	0.024**	17.923**	10.338**
Phosphorus (B)	4	4.586**	76.113**	0.415**	28.071**	18.591**	0.173**	0.027**	0.019**	11.883**	8.233**
Interaction (A×B)	8	0.530	6.234*	0.033*	1.721*	1.457*	0.008*	0.002*	0.002**	1.066*	0.826**
Error	28	0.191	2.125	0.014	0.728	0.543	0.004	0.001	0.001	0.433	0.261

**: Significant at 0.01 level of probability: *: Significant at 0.05 level of probability:

Appendix VI. Production cost of gladiolus per hectare

A. Input cost

Treatment	Labour cost	Ploughing cost	Corm Cost	Irrigation Cost	Insecticides	Pesticides	Manure and fertilizers				Sub Total (A)
							Cowdung	Urea	TSP	MP	
C_1P_0	25000.00	6000.00	35000.00	3000.00	2000.00	1000.00	20000.00	1600.00	0.00	3000.00	96600.00
C_1P_1	25000.00	6000.00	35000.00	3000.00	2000.00	1000.00	20000.00	1600.00	2160.00	3000.00	98760.00
C_1P_2	25000.00	6000.00	35000.00	3000.00	2000.00	1000.00	20000.00	1600.00	2340.00	3000.00	98940.00
C_1P_3	25000.00	6000.00	35000.00	3000.00	2000.00	1000.00	20000.00	1600.00	2520.00	3000.00	99120.00
C_1P_4	25000.00	6000.00	35000.00	3000.00	2000.00	1000.00	20000.00	1600.00	2700.00	3000.00	99300.00
C_2P_0	25000.00	6000.00	45000.00	3000.00	2000.00	1000.00	20000.00	1600.00	0.00	3000.00	106600.00
C_2P_1	25000.00	6000.00	45000.00	3000.00	2000.00	1000.00	20000.00	1600.00	2160.00	3000.00	108760.00
C_2P_2	25000.00	6000.00	45000.00	3000.00	2000.00	1000.00	20000.00	1600.00	2340.00	3000.00	108940.00
C_2P_3	25000.00	6000.00	45000.00	3000.00	2000.00	1000.00	20000.00	1600.00	2520.00	3000.00	109120.00
C_2P_4	25000.00	6000.00	45000.00	3000.00	2000.00	1000.00	20000.00	1600.00	2700.00	3000.00	109300.00
C_3P_0	25000.00	6000.00	55000.00	3000.00	2000.00	1000.00	20000.00	1600.00	0.00	3000.00	116600.00
C_3P_1	25000.00	6000.00	55000.00	3000.00	2000.00	1000.00	20000.00	1600.00	2160.00	3000.00	118760.00
C_3P_2	25000.00	6000.00	55000.00	3000.00	2000.00	1000.00	20000.00	1600.00	2340.00	3000.00	118940.00
C_3P_3	25000.00	6000.00	55000.00	3000.00	2000.00	1000.00	20000.00	1600.00	2520.00	3000.00	119120.00
C_3P_4	25000.00	6000.00	55000.00	3000.00	2000.00	1000.00	20000.00	1600.00	2700.00	3000.00	119300.00

C_1: Small size corm (10-20 g)
C_2: Medium size corm (21-30 g)
C_3: Large size corm (31-40 g)

P_0: 0 kg P_2O_5/ha
P_1: 120 kg P_2O_5/ha
P_2: 130 kg P_2O_5/ha
P_3: 140 kg P_2O_5/ha
P_4: 150 kg P_2O_5/ha

Appendix VI. Contd.

B. Overhead cost (Tk./ha)

Treatment Combination	Cost of lease of land for 12 months (13% of value of land Tk. 6,00000/year	Miscellaneous cost (Tk. 5% of the input cost	Interest on running capital for 12 months (Tk. 13% of cost/year	Sub total (Tk) (B)	Total cost of production (Tk./ha) [Input cost (A)+ overhead cost (B)]
C_1P_0	78000	12558	24331	114889	211489
C_1P_1	78000	12839	24648	115487	214247
C_1P_2	78000	12862	24674	115536	214476
C_1P_3	78000	12886	24701	115586	214706
C_1P_4	78000	12909	24727	115636	214936
C_2P_0	78000	13858	25800	117658	224258
C_2P_1	78000	14139	26117	118256	227016
C_2P_2	78000	14162	26143	118305	227245
C_2P_3	78000	14186	26170	118355	227475
C_2P_4	78000	14209	26196	118405	227705
C_3P_0	78000	15158	27269	120427	237027
C_3P_1	78000	15439	27586	121025	239785
C_3P_2	78000	15462	27612	121074	240014
C_3P_3	78000	15486	27639	121124	240244
C_3P_4	78000	15509	27665	121174	240474

C_1: Small size corm (10-20 g)
C_2: Medium size corm (21-30 g)
C_3: Large size corm (31-40 g)

P_0: 0 kg P_2O_5/ha
P_1: 120 kg P_2O_5/ha
P_2: 130 kg P_2O_5/ha
P_3: 140 kg P_2O_5/ha
P_4: 150 kg P_2O_5/ha