INFLUENCE OF CORM DIVISION AND PRE-SOAKING WITH GA_3 ON GROWTH AND YIELD OF GLADIOLUS

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INFLUENCE OF CORM DIVISION AND PRE-SOAKING WITH GA_3 ON GROWTH AND YIELD OF GLADIOLUS

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CERTIFICATE

*This is to certify that thesis entitled, **"INFLUENCE OF CORM DIVISION AND PRE-SOAKING WITH GA_3 ON GROWTH AND YIELD OF GLADIOLUS"** submitted to the Department of Horticulture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE (MS) in HORTICULTURE**, embodies the result of a piece bonafide of research work carried out by, **MST. FATEMA JANNAT JOYA** Registration No. **08-2688** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.*

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

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Dedicated

to

My Beloved Parents

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ABSTRACT

The study was conducted at Horticultural farm, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh, during August 2013 to March 2014. The experiment had two factors. Factor A: Corm division such as, C_1 (whole corm), C_2 (half corm) and C_3 (quarter corm) and Factor B: Pre-soaking of corm with 100 ppm GA_3 solution at G_0 (control), G_1(12 hours) and G_2 (24 hours). The experiment was laid out in randomized complete block design with three replications. For corm division, highest no. of spike (233,300/ha) and corm yield (14 t/ha) was recorded from C_1 and lowest no. of spike (70,000/ha) and corm yield (3.7 t/ha) from C_3. For pre-soaking of corm with 100 ppm GA_3 solution, highest no. of spike (188,600/ha) and corm yield (11t/ha) was recorded from G_1 and lowest no. of spike (165,400/ha) and corm yield (9.6 t/ha) from G_2. For interaction effect, highest no. of spike (285,220/ha) and corm yield (14.7 t/ha) was recorded from C_1G_1 and lowest no. of spike (59,300/ha) and corm yield (3.4 t/ha) from C_3G_2. But C_2G_1 and C_1G_1 were similar in respect of spike and corm production. The highest benefit cost ratio (2.79) was noted from C_2G_1 and the lowest (0.68) from C_3G_2. So use of half corm presoaking with 100 ppm GA_3 for 12 hours was best for growth and yield of gladiolus.

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LIST OF ABBREVIATED TERMS

ABBREVIATIONS	FULL WORD
%	Percent
@	At the rate
Agric.	Agriculture
Agril.	Agricultural
ANOVA	Analysis of variance
BAP	Bengyl Amino Purine
BARI	Bangladesh Agricultural Research Institute
CCC	Cycocel
CRD	Completely Randomized Design
CV%	Percentage of Coefficient of Variation
cv.	Cultivar (s)
cm	Centi-meter
df	Degrees of Freedom
DMRT	Duncan's Multiple Range Test
et al.	And others
etc.	Etcetera
GA_3	Gibberellic Acid
HRC	Horticulture Research Centre
Kg	Kilogram
mm	Milimeter
m^2	Square meter
Max.	Maximum
mg/L	Miligram per Litre
MH	Maleic Hydrazid
MoP	Murate of potash
ppm	Parts per million
RCBD	Randomized Complete Block Design
SAU	Sher-e-Bangla Agricultural University
Viz.	Namely

CHAPTER I

INTRODUCTION

Gladiolus (*Gladiolus grandiflorus*) is a herbaceous, perennial, bulbous, popular and important ornamental flowering crop. It is commonly famous by the name "Sword Lily" for its sword shaped leaves. It has more than one hundred and fifty known species (Negi *et al*., 1982). This crop is native of South Africa belongs to family Iridaceae. It was introduced into cultivation at the end of the 16^{th} century (Parthasarathy and Nagaraju, 1999). The gladiolus can be grown by seed and corms but commercially it is propagated by corms.

Gladiolus being a potential cut flower has great demand and is cultivated all over the world for its attractive spikes having florets of huge forms, dazzling colors, varying sizes and long vase life (Farid Uddin *et al*., 2002). It is frequently used as cut flower in different social and religious ceremonies (Mitra, 1992). In the international cut-flower trade gladiolus occupies fourth place (Bhattacharjee and De, 2010). Gladiolus spikes are most popular in flower arrangements and for preparing attractive bouquets (Mishra *et al.*, 2006) .Gladiolus is grown as flower bed in gardens and used in floral arrangements for interior decoration as well as making high quality bouquets (Lepcha *et al*., 2007). Apart from ornamental value, gladiolus have extensively utilized in medicines for headache, lumbago, diarrhea, rheumatism and allied pains (Bhattacharjee and De, 2010). Flower and corm of some gladiolus are used as food in many countries (Khan, 2009). The chief producing countries are the United States (Florida and California), Holland, Australia, Japan, Italy, France, Poland, Iran, India, Brazil, Poland, China, Malaysia and Singapore (Memon *et al.,*2009).

Gladiolus was introduced in Bangladesh in 1985.The agro-ecological conditions of the country are very conducive for its survival and culture as a crop. Commercial cultivation of gladiolus is gaining popularity in Bangladesh mainly concentrated only in few districts such as Jessore, Jenaidah, Rajshahi and Dhaka. Khan (2009) reported that the area of flower production appears to have increased significantly and estimated area of around 10,000 ha and the annual trade at wholesale level to be worth between 500-1000 million taka in Bangladesh. Momin (2006) reported that income from gladiolus flower production is six time higher than returns from rice.

The size of corms highly influences the growth and development of gladiolus including flowers and corms production (Bose *et al*., 2003). For commercial cultivation, conventional methods of propagation are insufficient to meet the demand for planting material. To increase the number of planting units, corms of different sizes are cut into pieces and the number of divisions from one corm depends on the number of buds present on the corm (Gromov 1972). Commercial producers may be able to cut large corms instead of using whole corms for corm and cormel production (N. Menon *et. al.;* 2009). Due to unavailability of corms in sufficient quantity cost is increased. In that case by using of corm division for planting material cost of production can be reduced.

Gibberellic acid (GA_3) enhance the growth, development and yield of gladiolus at different concentrations (Vijai *et al*. 2007). GA_3 solution increases the photosynthetic and metabolic activities of gladiolus causing more transport and utilization of photosynthetic products resulting early flowering in gladiolus (Sudhakar and Kumar 2012). According to Suresh *et al*. 2009, gladiolus corms of cultivar American Beauty dipped in the solution of GA_3 at 125 ppm sprouted with less number of days (17 days) and 50% sprouting in 29 days.Pre-plant dipping of gladiolus corms in a GA_3 solution is now becoming a popular method among commercial growers (Schnelle *et al*., 2005). Soaking of corms in solution of GA_3 has been used for comercial purpose (Larson *et al*., 1987).

There is a scope of increasing yield of gladiolus with proper size of corm and pre-soaking of corms with GA_3 at right concentration. In Bangladesh, conventional propagation methods are unable to supply the corm in large scale. Considering above facts, the experiment was carried out with the following objectives-

i. To study the growth, flowering and yield of gladiolus utilizing different size corms as planting material.
ii. To find out the optimum concentration of GA_3 for enhancing the growth and yield of gladiolus.
iii. To select the best combination of corm size and GA_3 concentration for ensuring the higher growth and yield of gladiolus.

CHAPTER II
REVIEW OF LITERATURE

One of the major constrains in commercial cultivation of gladiolus is non-availability of a large quantity of propagules. However, the standardized conventional propagationmethods can play major role in this regard. Information regarding the effect of corm division and different cultivars on the performance of gladiolus is very scanty. Here, an attempt has been made to review the available literatures which are relevant with this investigation.

2.1 Review related to corm division on production of gladiolus

Noor-ul-amin *et al.*, (2013) evaluated the effect of different cormel sizes on the growth and development of gladiolus corms in the city of Peshawar, Khyber Pakhtunkhwa, Pakistan. The current study was undertaken at Ornamental Horticulture Nursery, Department of Horticulture, the Agriculture University, Peshawar during 2009. Three different cormel sizes (C1 = >1.5 cm and < 2 cm, C2 = >1.0 cm and < 1.5 cm and C3 = >0.5 cm and < 1 cm of gladiolus cultivar "white Friendship". were planted and the effect of cormel size on growth was assessed. Cultivar white Friendship; has white colour, 30–45cm spikes length, bearing 18–20 florets around 9.5–10.5cm size and at average each corm produces 15–20 cormels (AgrihortiCo: Dissemination of Horticultural information).Number of studies indicated that cormel sizes significantly influence consequent growth and development of corms. In the present study, it was observed that corm and cormel size positively effects on various parameters and the highest values were obtained from large size cormels for sprouting percentage (70.40), number of leaves per plant (6.77), survival percentage (77.46), leaf area (61.14 cm2), plant height (61.25 cm), diameter of corms (3.18 cm), corms weight (9.616 g) and maximum numbers of cormels per plant (4.74). Earliest sprouting was observed in large size cormels (21.5

days), whereas maximum percent increase in cormel size (186.16) was obtained from small size cormels.

Laishram *et al.,* (2011) evaluated six cut corm treatments. These treatment were small whole corm (10-16 g), large corm cut into two pieces (23-27 g), medium corm cut into two pieces (19-22 g), large corm cut into three pieces (15-18 g), medium corm cut into three pieces (12-15 g), small corm cut into two pieces (5-8 g). Among the six treatments the solid corm and large corm cut into two pieces give significally higher shoot emergence (16.8 days and 17.9 days respectively) while small corm cut into two pieces took the maximum time (24.4 days). Large corm cut into two pieces showed maximum plant height (117.7 cm) whereas small corm cut into two pieces showed minimum (75.1 cm). Solid corm took a minimum of 59.6 days and was significantly earlier than all other treatments while small corm cut into two pieces resulted in delayed emergence (66.1 days). Medium corm cut into two and three pieces and small solid corms cut into two pieces produced earliest opening of first floret (70.0 to 70.4 days) which were statistically similar with one another. Large corm cut into two pieces produced highest number of florets per spike (14.7) followed by medium corm cut into two pieces (14.3). Significantly longer spikes (106.0 cm) were obtained from large corm cut into two pieces followed by medium corm cut into two pieces (91.5 cm). Significantly larger florets were recorded on spikes produced by large (11.5 cm), medium corm cut into two pieces (11.4 cm) and small solid corm (11.3 cm). Solid corm resulted in maximum corm (1.3/plant) as compared to other treatments. Large corm cut into two pieces produced significantly heavier corm (49.9 g) at lifting. Large corm cut into two pieces produced significantly large daughter corms (59.5 mm diameter) followed by large corm cut into three pieces (57.4 mm). The maximum cormel production was recorded in case of large corms cut into two and three pieces (15.8 and 16.0 per plant). Large and medium corm cut into two and three pieces showed a significantly longer vase life (13.8 days).

Ahmad *et al.,* (2009) observed the effect of different bulb size on growth, flowering and bulblet production of tuberose (*Polianthestuberosa* L.) cv. Single under agro-ecological conditions of Faisalabad country during 2005-06 so as to explore the best bulb size for the best quality flower spikes production as well as maximum bulb and bulblet production. It was observed that large bulb size resulted in vigorous growth, maximum yield and more number of bulblet as compared to small and medium sized bulbs.

N. Memon *et al.,* (2009) the gladiolus (*Gladiolus* spp.) industry is based on its flower and also its corm production. However, commercial cultivation is limited by the low multiplication rate of corms. This field study was conducted over 2 consecutive years (2006–07) to explore the possibility of increasing propagation rates by using half corms in comparison with whole corms along with various leaf and flower spike clippings. It involved a factorial combination of three varieties of gladiolus (viz. 'Traderhorn', 'White friendship', and 'Peter pears') and five treatments in a split-plot design and with 3-fold replication. The treatment of clipping three leaves with the flower spike, exhibited the best response in both years in all three varieties, producing the highest mean collective total weight of corms and cormels (136.59 g/plant). This production was 20.16% higher than in the untreated control. The advantage of this treatment was also apparent from the increase in the mean number of corms (27.86%) and cormels (17.47%) per plant. Comparison of the variety means shows that the variety 'Peter pears' yielded a significantly higher weight of single corm(62.35 g/plant), total corms (90.57 g/plant), and total corm+cormel weight (121.07 g/plant) than either of the other two varieties. On a unit stock basis, the yield of new corms was economically increased by planting half corms instead of whole corms, the increase being 64% in 'Traderhorn', 36%in 'White friendship', and 37% in 'Peter pears'. All corms and cormels were graded into large and small sized corms on the basis of their diameter when categorised according to the North American Gladiolus Council. It is concluded that corm and cormel production can be maximised by the clippingof three leaves along with the flower spike, and that rapid propagation of new planting material can be successfully and economically achieved by using half corms instead of whole corm.

N.Memon *et al.,* (2009) evaluated gladiolus cultivars (Tradehorn, White Friendship and Peter Pears) with 5 treatments. The treatments were: whole corms, simple half corms with bud, removal of three leaves, half corms treated with activated charcoal, and removal of three leaves plus flower spike. The treatment of clipping three leaves with the flower spike produced the highest mean collective total weight of corm and cormels (136.6 g/plant). This production was 20.2 % higher than in the untreated control. This treatment also increased the mean number of corms (27.9 %) and cormels (17.5 %) per plant. The yield of new corms was economically increased by planting half corms instead of whole corms, the increase being 64% in Tradehorn, 36 % in White Friendship and 37% in Peter Pears.

Barman *et al.*, (2006) conducted an experiment to study the effect of excised corm on corm and cormel production in cv. Jester and found a gradual decrease in spike length with increasing division of corms. Largest diameter of corm was obtained from the whole corms, thereafter it decreased with subsequent division of corms. A similar pattern of variation was also recorded in case of number of floret per spike.

Ramachandradu and Thangam (2006) cut Jumbo sized corms into 3 pieces and compared the performance with different grades of whole corms. They noticed that whole corms gave the maximum vegetative growth as compared to cut corms. However, cut corms of Jumbo grade (>5.1 cm) produced daughter corms with greater corm diameter and weight than whole corms of Jumbo and No. 1 grade.

Singh and Dohare (1994) reported that due to low rate of multiplication and high percentage of spoilage o f corms during storage, supply of planting material was insufficient. Maximization of corm and cormel production was reported in three cultivars (Pusa Suhagin, Mayur and Melody) of Gladiolus using various improved cultural techniques. From the experiment it was obtained that maximum number and weight of corms and cormels per plant in response to manual removal of two central apical buds. However, there reduction in weight and number of corms and cormels was observed in response to half corms and quarter corms. When translated in terms of yield of corms per unit stock, plantation with quarter corms, showed maximum increase in yield over control (no improved cultural technique), followed by that with half corms.

Singh and Singh (1998) studied the effect of corm size on flowering and corm production of gladiolus cv. Sylvia in Himachal Pradesh, India. Corms of three different sizes, viz. large (6.0 + 0.15 cm), medium (4.2 + 0.15 cm) and small (3.3 + 0.15 cm) were planted in November. They found that the percentage of sprouting was the 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 to harvest, plant height, spike length, number of flowers per spike (15.33, 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 corms respectively.

Ogale *et al.,* (1995) studied the role of corm size on flowering and corm yield of gladiolus at Mumbai, India. Flowering behavior and final corm yields from corms of 6 different sizes (<1-35 g) at different stages of developmental maturity were studied in cultivars Happy End and Apricot. In both the cultivars they found a direct correlation between corm size, flower production and final corm yield.

Laskar and Jana (1994) studied the effect of planting time and size of corms on plant growth, flowering and corm production of gladiolus in India. Gladiolus corms of different sizes (1.5, 3.0 or 4.5 cm in diameter) were planted on 7 February, 27 February, 19 March or 8 April of 1989 and 1990. It was observed that the best flowering spikes and corms were obtained from large corm (1.86-1.95 corms and 1.58-1.63 flower spikes per plant).

Hatibarua (1989) reported that initial plant growth was delayed with increase in number of splits. Corms of all sizes produced flowering grade corms. Splitting of corms into 2 halves increased the number of corms over whole corms of all sizes. Substantial increase in number of cormels was also reported with the increase in number of cormels was also reported with the increase in number of corm splitting within the same size of corm in cv. Sylvia. MacKay *et al*. (1981) was of the opinion that flowering percentage was increased by cutting the large corm of Jumbo, No.1 and No.2 grades into two pieces but reduced by cutting the smaller corms (No. 4 and No. 5 grade). Inflorescence quality was also reduced by cutting the corms. The yield of new corms was however increased by cutting of large and medium sized corms.

Lopez Oliveras *et al*., (1984) suggested that splitted and treated corms should be planted on well prepared warm and moist soil media. Corm of cultivar Peter Pears when divided into 4 or 8 sections and planted in 50% peat and 50% perlite substrate produce large number of grade 1 corms (4.8 cm diameter) while soaking of corms for 24 hours in 900 ppm GA_3 solution increased the cormel production.

Gromov (1972) reported that commercial producers may be able to cut large corms instead of using whole corms for getting maximum corm and cormel production. The corm division is usually based on the size of the corm and number of buds existing on the corm. It was found that small corms are divided into 3-4 parts, large into 7-10 and very large ones may be divided into 12-15 parts depending on the number of the buds. Each division should have a bud and a portion of root zone. It was also reported that cutting of corms markedly increased the growth of the filial corms, the weight of the corms, the number and weight of cormels in comparison with those from whole corms.

2.2 Review related to presoaking of corm with GA_3 on production of gladiolus

Mahshid Fakhraie Lahiji (2013) evaluated gladiolus varieties with GA_3 and ethophen treatment. This research work was performed in Varmin Research Center on two varieties namely "white prosperity and rose supreme". The treatments were applied onthe corms and cormel as follow; Gibberellic acid at 4 levels (0, 25, 50,100) mg/l and Ethephon at 4 levels (0,100,200,400) mg/l. The result of combined analysis showed thatthe treatment GA_3 at 100mg/l and Ethe phone at 0 on Rose Supreme variety at the first year have significant effected on the days to sprouting and weight of corm. Also themost number of flowers has been gained through the combination of Gibberellic acidand ethephon at 100mg/l on White prosperity variety at the second year. Combination of Gibberellic acid and ethephon at 50 and 200 mg/l has significant effect on the number of cormels.

Neetu *et al.,* (2013) studied the effect of GA_3 on growth and flowering attributes in gladiolus cultivars. Treatments consisted of GA_3 at 100 ppm, 200 ppm, 300 ppm and 400 ppm alongwith control on 5 cultivars of gladiolus *viz*., Archana,unjan, J.V. Gold, Sabnum and Snow Princes. Experiment was laid-out in a Randomized Block Design and with three replications. The results revealed that maximum length of leaf and width of longest leaf were recorded when GA_3 was sprayed at 400 ppm on cvs. Sabnum and Gunjan. However, maximum number of leaves/plant was registered with cv. Gunjan at 200 ppm GA_3. Among lowering parameters early spike emergence was noticed in cv. Sabnum when, GA_3 was sprayed at higher concentrations (300-400 ppm). In general, higher size of first and fifth floret was recorded with cv. J.V. Gold at 200-300 ppm GA_3. GA_3at 300 ppm also exerted maximum length of spike, whereas maximum number of florets/spike was recorded with cv. Snow Princess when GA_3 was applied at 100-200 ppm.

T. Padmalatha *et al*., (2013) evaluated the effect of thiourea (TU), salicylic acid (SA), potassium nitrate (KNO_3) and gibbrrellic acid (GA_3) with two corm soaking periods on dormancy breaking and corm and cormel production of two gladiolus cultivars Darshan and Dhiraj was investigated during 2008-09 and 2009-10. Cv. Darshan recorded significantly minimum number of days to sprouting and maximum percentage of sprouting over cv. Dhiraj. Pre-planting soaking of corms for 24 h was significantly more influencing over 12 h soaking in decreasing the number of days to sprouting and increasing corm sprouting percentage and number of buds sprouted per corm. TU 2% and SA 150 ppm were highly effective in reducing the number of days taken for sprouting over control. TU 2%, SA 150 ppm, KNO_3 1.5% and GA_3 150 ppm significantly increased sprouting percentage of corms over control and recorded maximum number of sprouts per corm. The cultivar Dhiraj recorded maximum corm size and weight, maximum number of small cormelsand total number of cormels per plant over cv. Darshan. Cv. Darshan recorded higher number of big cormels.Soaking of corms for 24 h significantly improved corm and cormel attributes than 12 h soaking. SA 150 ppm and TU 2% were effective in increasing number of corms per plant. Maximum corm size and weight were recorded with SA 150 ppm and GA_3 150 ppm. Maximum number of big cormels per plant and cormel weight was recorded with TU 2%, GA_3 150 ppm and SA 150 ppm. Control recorded significantly more number of small cormels and total number of cormels per plant.

F.N. Khan *et al*., (2013) carried out an experiment to determine the optimum concentration of benzyladenie (BA) and gibberllic acid (GA_3) to break the dormancy of gladiolus corms in relation to storage period and to find out the effect of BA and GA_3 on growth and development of gladiolus corm and cormels. The effect of GA_3 on dormancy breaking was most pronounced in the 100 ppm treatment being 26.93 days while in the water control took 49.60 days. Among different levels of BA, dormancy breaking was comparatively earlier by 29.60 days when treated with 50 BA. Considering storage periods, corms stored for 30 days followed by different growth regulator treatments sprouted 11.63 and 21.24 days earlier than 75 and 90 days stored corms, respectively. Corms treated with 75 ppm GA_3 and stored for 90 days produced the maximum percentage of spikes (56.9%) whereas90 days stored corms treated with 125 ppm BA produced the highest number of plants (2.41) and corms (2.50) hill-1. The corms treated with 100 ppm GA_3 and stored for 90 days produced the heaviest (21.50 g and 18.82 g, respectively) and largest (4.46 cm and 4.17 cm, respectively) corms.

Rani P. and Singh P. (2013) took an attempt to study the influence of GA_3 pretreated bulbs on growth, flowering and quality of *Polianthes tuberosa* L. cv. Prajwal, laid on randomized block design in an open field condition. For this purpose, bulbs were dipped in three different concentrations of gibberellic acid (GA_3) (0, 50, 100 and 150 ppm), each with 10 replicates. Results indicated that the pretreatment had significantly improved various growth and flowering parameters. Maximum vegetative growth in terms of plant height, number of leaves, leaf length and leaf width was observed in 150 ppm GA_3. In addition, the results also showed that the pretreated bulbs at a higher concentration of GA_3 had significantly increased spike length, rachis length, number of florets per spike and floret length. Early appearance of initial spike, maximum number of bulbs and maximum durability of spike were also recorded with GA_3 150 ppm. GA_3 pretreatment also increased chlorophyll content of leaves. Therefore, it was concluded that GA_3 at 150 ppm proved to be best concentration in enhancing all the vegetative (plant height, number of leaves and sprouting of bulbs), floral (spike length, number of florets/ spikes, floret length) and bulbous characteristics in tuberose.

M. Sudhakar and S. Ramesh Kumar (2012) carried out to study the effect of growth regulators on growth, flowering and corm production of Gladiolus Gladiolus grandiflorus L. cv. white friendship during 2011 in floriculture yard, Department of Horticulture, Faculty of Agriculture, Annamalai Nagar. Four growth regulators viz., GA3, NAA, CCC and MH each at three concentrations in addition to water spray as control comprised thirteen treatments of this experiment. The experiment was laid out in a Randomized Block Design (RBD) with three replication. All the growth and yield parameters were periodicaly observed. The results revealed that the growth regulators application significantly influenced the growtrh and yield of Gladiolus sp cv. white friendship. The maximum No. of florets/spike, spike length (cm) and flower length (cm) were obtained were obtained with GA3 @100ppm as compared to rest of the treatments. Whereas CCC @500 ppm was found the best interms of corms and cormels production.

Sheetal Dogra *et al*., (2012) evaluated to study the effect of gibberellic acid and plantgeometry on growth, flowering and corm production in gladiolus cv. ‘Novalux’ under Jammu conditions. Four concentrations of GA_3(0, 100, 200 and 300 ppm) and three levels of spacing (20x40cm, 30x40cm and 40x40 cm) were tested in Factorial RBD with three replications. The analyzed data indicated that maximum plant height, number of leaves, leaf width, spike length, rachis length, corm diameter, corm weight and early flowering was recorded at 300 ppm GA_3. Corms planted at a spacing of 40x40cmexhibited highest plant height, rachis length, number of florets per spike, floret diameter, number of corms per plant, corm diameter, corm and cormel weight. Among interactions, treatment of corms with 300ppm GA3 and spacing at 40x40 cm was found more effective in the enhancement of vegetative and floral attributes.

V.B. Havale *et al.,* (2008) conducted an experiment to study the effect of growth regulators and chemicals on corms and cormels production of gladiolus during the year 2000–01 at the Department of Horticulture, Dr. D.K.V., Akola. The experiment was laid out in Randomized Block Design with three replications and 12 corm treatments of growth regulators and chemicals on gladiolus crop. The results revealed that BA 50 ppm (T10) recorded maximum number of corms plant^{-1},plot^{-1}, ha^{-1}, weight of corms, and weight of cormels plant^{-1}.

Yousif S. Siraj and Mahmoud S. Al-Safar (2006) evaluated the effect nitrogen and GA_3 pretreatment on growth and development of two cultivars (Topaz and Sancerre) of gladiolus corms during 2003 and 2004 in Al-Hassa, Saudi Arabia. The experimental was loamy sand and received four levels of nitrogen(0, 25, 50and 75 Kg N ha per hectare)applied as urea. Gladioli corms were presoaked for 24 hour in the GA_3 solution at a concentration of 0 and 100 mgL^{-1}.Mean stem height, number of leaves per plant, leaf area, shoot dry weight, number of corms per plant, corms dry weight and flower diameter increased significantly with nitrogen and GA_3 treatment, A significant difference was observed between the performance of two cultivars and the Topaj superior to Sancerre in all growth parameters. This study also confined maximum production of gladiolus at nitrogen 75 kg per hectare and corms are soaked in GA_3 solution of 100 mgL^{-1} before plantation.

CHAPTER III

MATERIALS AND METHODS

The present investigations were carried out at Sher-e-Bangla Agricultural University, Dhaka during August 2013 to March 2014. Materials and methods followed for conducting the experiment are presented under the following headings.

Experimental site:

The experiment was conducted at Horticulture Farm, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh. Location of the site is 23º74´ N latitude and 90º35´ E longitude with an elevation of 8.0 meter from sea level (UNDP - FAO, 1988) in Agro-Ecological Zone of Madhupur Tract (AEZ No. 28).

3.1 Climatic condition

Climate of the experimental site is subtropical. The experiment was carried out during Rabi season. The season is characterized by dry sunny weather, warm at the beginning and end, but cool in December-February. The average length of Rabi growing period ranged from 100-120 days.

3.2 Soil

The land topography was medium high and soil texture was silt clay with pH 6.9.

3.3 Experimental details

3.4.1 Land preparation

The land was brought to a fine tilth by ploughing. Weeds were collected before final land preparation. Cow dung were applied.

3.4.2 Experimental design and layout

The experiment was laid out in a factorial Randomized Complete Block Design (RCBD) with 3 replications. There were 27 (9 x 3) unit plots in the experiment and 30 plants on each plot. The size of unit plot was 1.5m×0.6m. The distance between the blocks was 0.5 m and between the plots was 0.5 m.The plots were raised up to 15 cm.

3.4.3 Planting material

The materials of the experiment were collected from Agritech Nursery, Josssre.

3.4.4 Treatments of the experiment

There were two factors in the experiment.

1) Factor A: Corm division

C_1= Whole corm

C_2= Half corm

C_3= Quarter corm

2) Factor B: Presoaking of corm with 100 ppm GA_3

G_0 =Control

G_1= 12 hours

G_2= 24 hours

There were 9 (3 × 3) treatment combinations were C_1G_0, C_1G_1 ,C_1G_2, C_2G_0, C_2G_1, C_2G_2, C_3G_0, C_3G_1, C_3G_2

3.4.5 Preparation of cut corm

Large corms were cut into two and four sections, retaining a bud with each section. Dithane M-45 was applied to the segments and whole corm to prevent fungus. Then the some segments and some whole corms are treated with 100 ppm GA_3 following 12 hours and 24 hours to break dormancy.

3.4.6. Preparation of plant growth regulator (GA_3) stock solutions

Stock solution of GA_3 was prepared by dissolving 100 mg of GA_3 in 1000 ml water to get 100 ppm.

3.4.7 Planting of corms

Corms were planted at 7 cm depth in the plot on 15 September, 2013 with sufficient care for minimum injury of corms The corm were planted maintaining 15cm plant to plant distance and 20 cm row to row distance.

3.4.8. Parameters

Data were collected on following parameters

a. Days to 80% germination
b. Plant height (cm)
c. Number of leaf per plant
d. Chlorophyll% of leaf
e. Leaf area (cm^2)
f. Plant height (cm) at flower stalk initiation stage
g. Number of days taken for flower spike initiation(*visual observation*)
h. Number of days taken for full blooming of basal florate (*visual observation*)
i. Number of spike/plot
j. Number of spike/hectare
k. Length of spike (cm)
l. Number of floret/spike
m. Diameter of floret head (cm)
n. Cumulative petal area(mm^2)
o. Vase life (Days) of flower
p. Number of corms per plot
q. Number of cormels per plot
r. Weight of single corm (g)
s. Weight of corm kg / plot
t. Yield of corm t/ha

3.4.9. Intercultural operation

3.4.9.1 Weeding

The experimental site was kept free of weed by periodic hand weeding.

3.4.9.2 Irrigation

Frequency of watering depended upon the moisture status of the soil. However, water logging was avoided, to maintain optimum soil moisture.

3.4.9.3 Disease and pest management

No pesticide was needed for disease and pest management during experimental period.

3.4.9.4 Harvesting

The spikes were harvested when second floret started to bloom at the lower portion of the spike and used for recording different parameters. The corms and cormels were lifted from the ground when the lower foliage turned to yellow colour. These harvested corms and cormels were further used for recording different parameters.

3.5. Data Collection

Data was 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.

3.5.1 Days to 80% germination

It was achieved by counting the days taken for emergence of plant from date of planting of corms.

3.5.2 Plant height

Plant height was measured from sample plants in centimeter from the attachment of the ground level up to the tip of the growing point and mean value was calculated. Plant height was also recorded at 10 days interval from 30 DAS up to 50 DAS.

3.5.3. Number of leaves/plant

The total number of leaves per plant was counted from each selected plant. Data were recorded as average of 5 plant selected at random from inner rows of each plot.

3.5.4. Leaf area

The leaf area (cm^2) was measured using CL-202 Leaf Area Meter by destructive method. Mature single leaves were randomly selected.

3.5.5. Chlorophyll% of leaf

Chlorophyll% of leaf was measured by Spadometer.

3.5.6. Plant height at flower stalk initiation stage

Plant height (cm) were recorded during flower stalk initiation stage by measuring scale.

3.5.7. Number of days taken for the initiation of flower spike (visual)

Number of days taken from emergence of plant to flower spike initiation was recorded by counting the days from planting.

3.5.8. Number of days taken for full blooimg of basal florate (visual)

Number of days taken from emergence of plant to first flowering was recorded by counting the days from planting.

3.5.9. Number of spike/plot

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

3.5.10. Number of spike/ha

Yield of spike per hectare was computed from number of spike per plot and converted to hectare.

3.5.11. Length of the spike

Length of the spike was measured from 25 cm above of the internode to fourth leaf up to the tip of the spike and recorded in centimeters.

3.5.12. Number of florets/spike

Total number of florets per flower spike was counted from each of the spike and mean was calculated.

3.5.13. Diameter of floret head

Diameter (cm)of the first floret head in each spike was measured and expressed in centimeters.

3.5.14. Cumulative petal area

Cumulative petal area $(mm)^2$ was measured from randomly selected flower and expressed in millimeters square.

3.5.15. Vase life

Vase life of gladiolus spikes of different variety from whole and half cut corm was observed in water. The spike with the second floret started to open were cut and were immediately kept in normal water. In the laboratory these flower spikes were kept in vases with normal water to study the vase life of spike in normal water without any chemicals.

3.5.16. Number of corms per plot

There are 30 plants per plot. The total number of corms produced per plot was recorded as corm yield per plot.

3.5.17. Number of cormels per plot

Total number of cormels produced per plot was recorded as cormel yield per plot.

3.5.18. Weight of single corm

Corm weight was determined by electrical balance and weighing the corms from randomly selected 5 plant from inner rows of each plot and mean weight was calculated.

3.5.19. Weight of corm kg per plot

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

3.5.20. Yield of corm t/ha

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

3.5.21. Statistical analysis

Collected data were statistically analyzed using MSTAT-C computer package programme. Mean for every treatments were calculated and analysis of variance for each one of characters was performed by F–test (Variance Ratio). Difference between treatments was assessed by Least Significance Difference (LSD) test at 5% level of significance.

3.5.22. Economic analysis

The cost of production was analyzed to find out the most economic treatment of corm division and time of presoaking with GA3.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

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

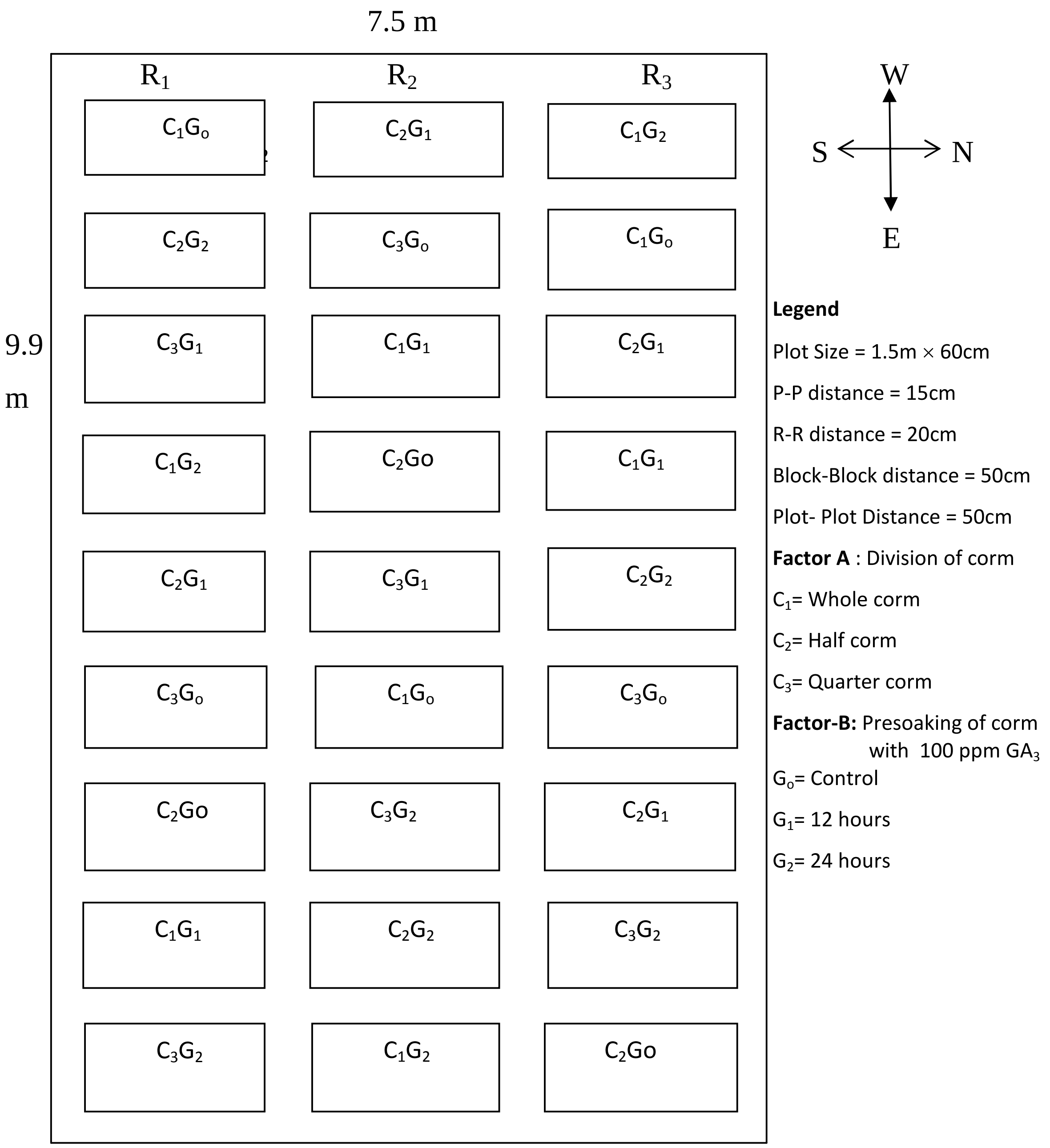


Fig.1. Lay out of experiment

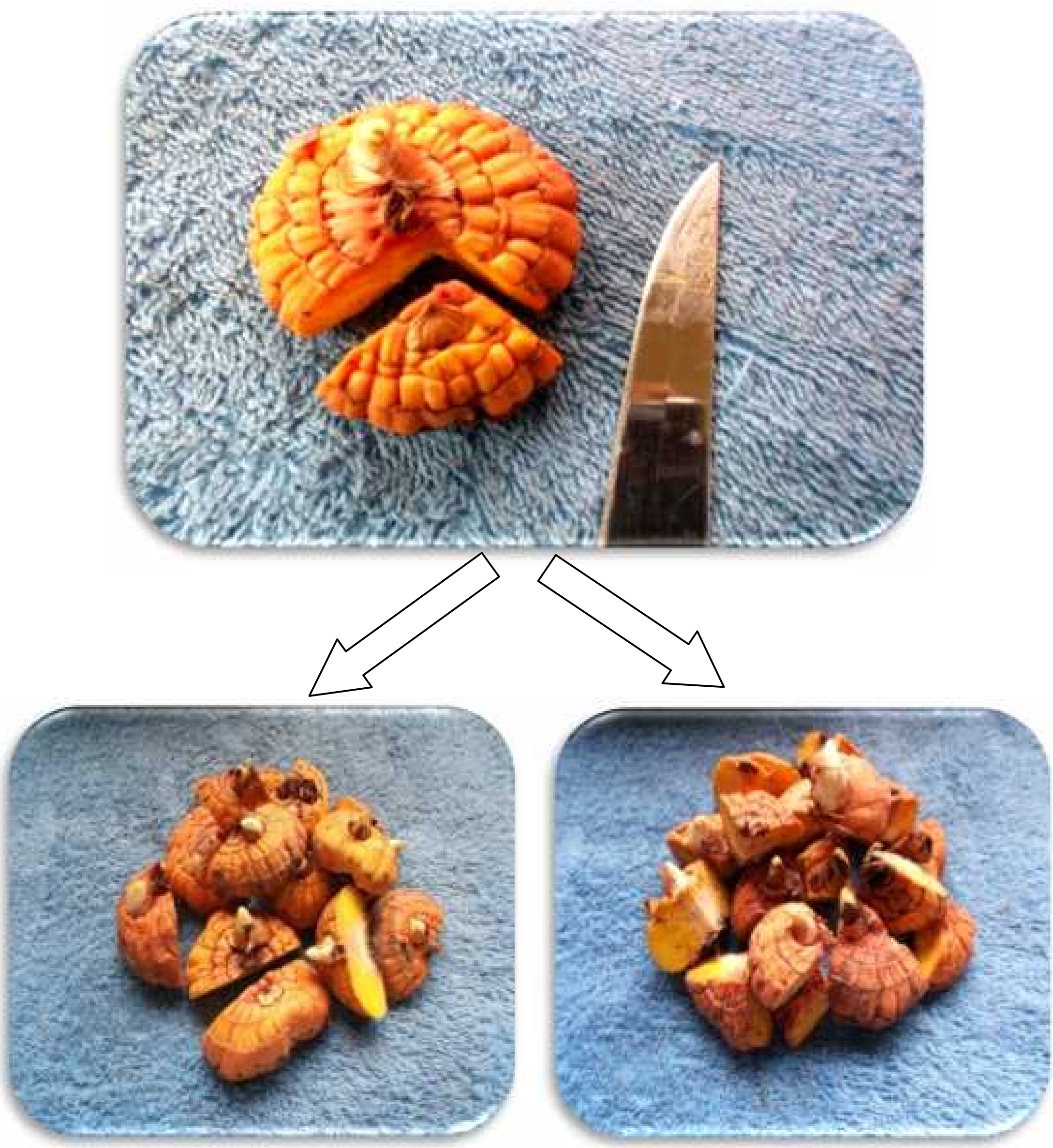


Plate-1: Corm division in to half and quarter size from whole corm

Plate-2.a): Preparation of GA_3 stock solution @ 100 ppm and corm soaked before planting.

Plate. 2(b): An experimental field of gladiolus

a) b)

Plate 3. Measurement of a) leaf area (cm^2) and b) weight of corm (gm)

CHAPTER IV

RESULTS AND DISCUSSION

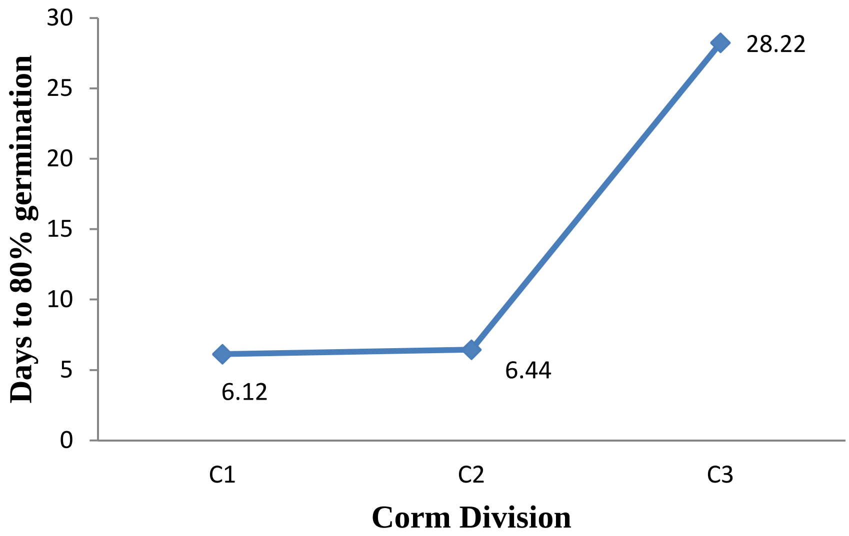
The aim of the present experiment was to use corm division and presoaking with GA_3 for increasing planting material of gladiolus. The results of the experiment were arranged under following heading in this chapter.

4.1 Days to 80% germination:

In considering use of cut corm days to 80% germination was significantly influenced (Appendix I). The longer days required for 80% germination by use of C_3 (28.22 days) whereas shorter from C_1 (6.12 days) and half corm C_2 (6.44 days) (Fig.2). Laskar and Jana (1994) found that large corms took half the time to sprout than the smaller corms due to more amount of reserved food material present in large corm. The result is in conformity with Coyne *et al.* (2010), Laishram *et al.*, (2011), Garg and Singh (1983) and Onfrietti (2007).

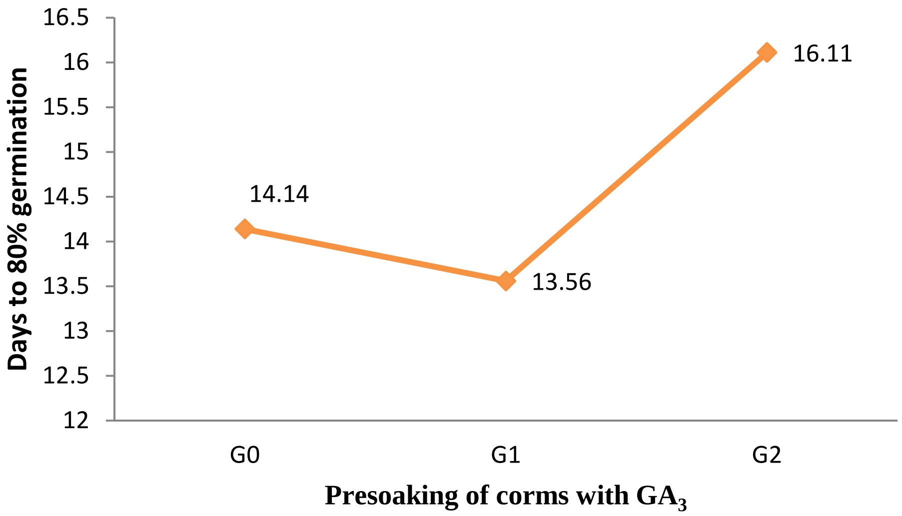
Presoaking of corms with GA_3 had significant effect on germination percentage of gladiolus (Appendix I). Corms were presoaked with GA_3 for 12 hours required minimum days to 80% germination G_0 (13.56 days). G_1 and G_0 was statistically similar. Whereas maximum days were required in case of G_2 (16.11 days) (Fig.3). Application of GA_3 increases the germination% by breaking the dormancy of corms (Laisharam 2009). This result is conformity with Groot and Karssen, (1987) and Khan *et al*., (2013).

Days to 80% germination percentage was influenced significantly by different treatment combinations (Appendix I). The maximum days required for 80% germination was observed in C_3G_2 (30.67 days) whereas the minimum from C_1G_1 (6 days) and C_2G_1 (6.10 days) that is closest to C_1G_1 (Table 1).



C_1 = Whole corm, C_2 = Half corm and C_3 = Quarter corm

Fig.2. Effect of corm division on days to 80% germination



G_0 = Control, G_1= 12 hours and G_2 = 24 hours

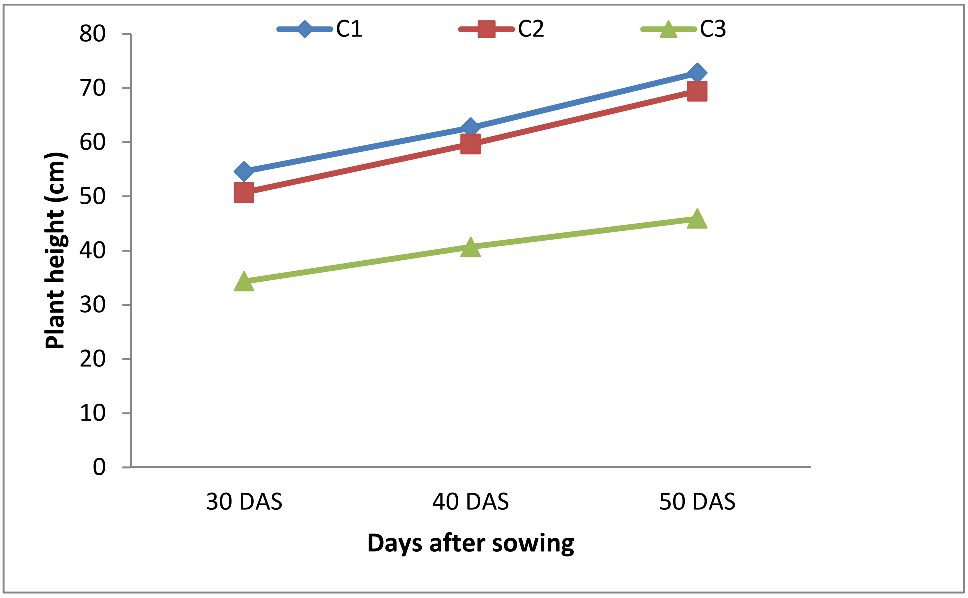
Fig.3. Effect of presoaking corm with GA_3 on days to 80% germination

4.2 Plant height

For plant height at different days after sowing, use of cut corm did not show statistically similar result (Appendix I). Maximum plant height was observed in C_1 (72.78 cm) whereas the minimum from C_3 (45.89 cm) at 50 DAS (Fig. 4). And plant height for C_2 (72.46 cm) similar to whole corm. Barman *et al*.(2006) noted maximum plant height was found in whole corms and half corms than quarter corm due to large size corm contain more food material that accelerated the growth of the plant. This result conformity with Barman *et al*. (2006) and Laishram *et al.*, (2011).

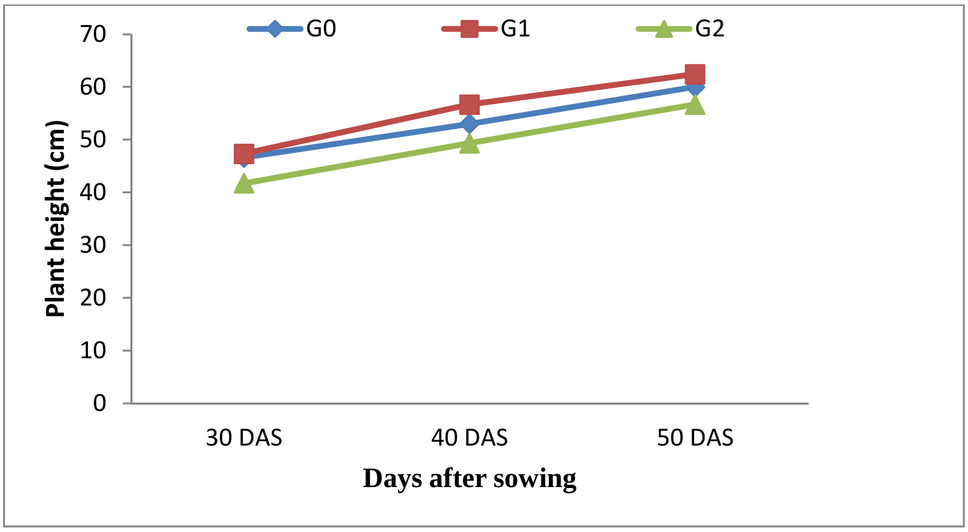
Significant differences were found among the treatment of different concentration of GA_3 (Appendix I). Maximum plant height were recorded in G_1 (62.44 cm) and minimum plant height was recorded in G_2 (56.67 cm) (Fig.5) at 50 DAS. Chopde *et al*. (2011) found that GA_3 hormone plays a role for rapid growth of the plant by its cell division. These observations are in conformity with the earlier reports of Sudhakar and Kumar (2012), Bhalla and Kumar (2008), Awasthi *et al*. (2012) and Chopde *et al*. (2011).

Combined effect between cut corm and GA_3 concentration showed significant differences on plant height of gladiolus plant (Appendix I). It was observed that the maximum plant height was recorded in C_1G_1 (75cm) which was statistically similar with C_1G_0, C_1G_2, C_2G_1. On the other hand, the minimum plant height was recorded in C_3G_2 (43 cm) which was statistically identical with C_3G_0 and C_3G_1 at 50 DAS (Table 1).



C_1 = Whole corm, C_2 = Half corm and C_3 = Quarter corm

Fig.4. Effect of corm division on plant height at different days after planting



G_0 = Control, G_1= 12 hours and G_2 = 24 hours

Fig.5. Effect of presoaking corm with GA_3 on plant height (cm)

Table 1. Interaction effect of corm division and GA_3 on 80% germination and plant height [Y]				
Treatment [X]	**Days to 80% germination**	**Plant height(cm) at different days after sowing (DAS)**		
		30	40	50
C_1G_0	6.00 f	55.83 a	64.33 a	73.67 a
C_1G_1	6.00 f	55.00 a	64.67 a	75.00 a
C_1G_2	7.33 ef	53.00 a	59.00 a	72.67 a
C_2G_0	6.10 f	47.00 b	51.33 b	69.33 b
C_2G_1	8.33 de	52.00 a	64.67 a	74.87 a
C_2G_2	10.33 c	41.17 c	51.00 b	68.33 b
C_3G_0	27.67 a	37.00 cd	43.33 c	48.00 c
C_3G_1	26.33b	35.00 cd	40.67 c	46.67 c
C_3G_2	30.67 a	31.00 d	30.00 c	43.00 c
$LSD_{0.05}$	**1.751**	**5.13**	**5.366**	**9.065**
CV%	**6.88**	**9.11**	**5.85**	**8.77**

[X] C_1; whole corm,C_2;half corm, C_3;quarter corm. G_0; Control, G_1;12 hours,G_2;24 hours
[Y] 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.

4.3 Number of leaves plant^{-1}

Number of leaves plant^{-1} was significantly influenced by corm size (Appendix I). C_1 produced maximum number of leaves (7.79) while minimum number of leaves (5.89) was found in quarter corms (C_3) (Table 2). Where half corm produced number of leaves per plant was statistically similar with whole corm (Table 2). Whole and half corm produced maximum no. of leaves due to healthy crop Bhat *et al*. (2009). These results are in alliance with the results of Farid Uddin *et al.* (2002) who reported that corm size has significant effect on number of leaves plant^{-1}.

Significant differences were noticed on number of leaves when corms were presoaked by GA_3 for several hours (Appendix I). Maximum number of leaves were recorded from G_1 (7.44) and minimum number of leaves were recorded from G_2 (6.67) (Table 3). GA_3 increases the metabolic reactions in plant by giving some essential elements that's why vegetative growth is increased Dogra *et al*.(2012). The results also agreed with the findings of Memon *et al*., (2009).

Interaction effect between cut corm and GA_3 showed significant differences on number of leaves of gladiolus (Appendix I). Maximum number of leaves were recorded in C_1G_1 (8.0), C_2G_1 (8.0) and minimum no. of leaves were recorded C_3G_2 (5.3) (Table 4).

4.4 Chlorophyll% of leaf

The use of cut corm showed significant differences with respect to chlorophyll% of leaf (Appendix I). The higher chlorophyll% of leaf (65.56) was recorded in whole corm; $C_{1.}$ The lower was recorded in quarter corm C_3 (58.88). Where chlorophyll% of leaf of half corm C_2 (65.46)$^{.}$which was statistically similar to whole corm (Table 2). This result conformity with Barman *et al*., (2006) and Laishram *et al*., (2011).

Significant differences were noticed on chlorophyll% of leaf when corm were presoaked by GA_3 for several hours (Appendix I). Higher chlorophyll% of leaf were recorded (65.07) for 12 hours soaking corm and lower chlorophyll% of leaf were recorded (62.28) when corm were presoaked with GA_3 for 24 hours (Table 3).These results are in close conformity with Janowska and Andrzejak (2010) and Ferrante *et al*. (2009).

Interaction effect between cut corm and GA_3 showed significant differences on chlorophyll% of leaf of gladiolus (Appendix II). Higher chlorophyll% of leaf were recorded in C_1G_1 (68.13), C_2G_1 (67.83) and lower chlorophyll% of leaf were recorded C_3G_2 (58.33) (Table 4).

4.5 Leaf area

The use of cut corm showed significant differences with respect to leaf area (Appendix I). The higher leaf area (43.18 cm²) was recorded in C_1 and C_2 (42.14 cm²). The lower was recorded in quarter corm C_3 (33.80 cm ²) (Table 2). The yield of new corm increased by cutting of large and medium sized corms (MacKay,1981).

Significant differences were noticed on leaf area when corms were presoaked by GA_3 for several hours (Appendix I). Largest leaf area were recorded (41.05cm²) for 12 hours soaking corm and smallest leaf area were recorded (38.15cm²) when corm were presoaked with GA_3 for 24 hours (Table 3). These results are in close conformity with Girisha *et al.* (2012).

Interaction effect between cut corm and GA_3 showed significant differences on leaf area of gladiolus (Appendix I). Largest leaf area were recorded in C_1G_1 (44.97cm²), C_2G_1 (44.44 cm^2) and smallest leaf area were recorded C_3G_2 (32.51cm^2) (Table 4).

Table 2. Effect of cut corm on no. of leaf/plant, chlorophyll% of leaf and leaf area [Y]

Treatment [X]	No. of leaf/plant	chlorophyll% of leaf	Leaf area(cm^2)
C_1	7.79 a	65.49 a	43.18 a
C_2	7.44 a	65.56 a	42.14 a
C_3	5.89 b	58.88 b	33.80 b
$LSD_{0.05}$	**0.45**	**1.858**	**1.045**
CV(%)	**6.41**	**2.94**	**2.63**

[X]$C_{1;}$whole corm,$C_{2;}$half corm, $C_{3;}$quarter corm.
[Y]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.

Table 3. The effect of GA_3 on no. of leaf/plant, chlorophyll% of leaf and leaf area^Y

Treatment^X	No. of leaf/plant	chlorophyll% of leaf	Leaf area(cm^2)
G_0	7.00 ab	62.58 b	39.92 b
G_1	7.44 a	65.07 a	41.05 a
G_2	6.87 b	62.28 b	38.15 c
$LSD_{0.05}$	**0.45**	**1.858**	**1.045**
CV (%)	**6.41**	**2.94**	**2.63**

$^X C_{1;}$whole corm,$C_{2;}$half corm, $C_{3;}$quarter corm.
^{Y}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

Table 4. Interaction effect of corm division and GA_3 on no. of leaf/plant, chlorophyll% of leaf and leaf area(cm^2) ^{Y}

Treatment ^{X}	No. of leaf/plant	chlorophyll% of leaf	leaf area(cm^2)
C_1G_0	7.67 ab	64.67 ab	41.94 c
C_1G_1	8.00 a	68.13 a	44.97 a
C_1G_2	7.67 ab	63.67 b	42.62 bc
C_2G_0	7.33 ab	64.00 b	42.67 bc
C_2G_1	8.00 a	67.83 a	44.44 ab
C_2G_2	7.00 bc	64.83 ab	39.32 d
C_3G_0	6.00 de	59.07 c	35.16 e
C_3G_1	6.33 cd	59.23 c	33.73 ef
C_3G_2	5.33 e	58.33 c	32.51 f
$LSD_{0.05}$	**0.782**	**3.22**	**1.81**
CV%	**6.41**	**2.94**	**2.63**

$^X C_{1;}$ whole corm, $C_{2;}$half corm, $C_{3;}$quarter corm.
^{Y}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

4.6 Plant height at flower stalk initiation stage:

Plant height for flower stalk initiation is significantly differ for various corm size (Appendix II).They were not statistically identical. Flower stalk initiation plant height in case of whole corm and half corm was nearest values like C_1 (73.22 cm) and C_2 (71.56 cm) whereas shortest C_3 (46.78 cm) (Table 5). This result is conformity with N. Menon *et al.* (2009).

There was significant difference showed among the concentration of GA_3 (Appendix II). Flower stalk initiation plant height was higher G_0 (65 cm) when corms were treated by GA_3 for 12 hours. And lower flower stalk initiation plant height was observed in G_2 (69.78 cm) (Table 6). This result is conformity with Devadanam *et al.* (2007) and Panwar *et al.* (2006).

Interaction effect between use of cut corm and GA_3 concentration showed significant differences for flower stalk initiation at plant height among the treatments (Appendix II). They are not statistically identical (Table 7). Among the treatments C_1G_1 (74.33 cm) C_2G_1 (73.33 cm) were best and lower height in C_3G_2 (43.67 cm) (Table 9).

4.7 Days to spike initiation

For spike initiation use of cut corm showed non-significant result. (Appendix II). The shorter days required for spike initiation was by whole corm; C_1 (47 days) and C_2 (48 days) whereas the longer days from quarter corm; C_3 (57.11 days) (Table 5). There is no significant difference between whole corm with half corm. They are statistically identical.

Significant differences were not noticed for days to spike initiation among the different level of GA_3 concentration. (Appendix II). They were statistically identical. 1^{st} spike was emergent within 50 days that was earlier than control (table 6). This finding is in agreement with the observations made by F.n. Khan *et al*. (2013).

Interaction effect between use of cut corm and GA_3 concentration showed non-significant differences for days to spike initiation of gladiolus among the treatments (Appendix II). It was observed that the minimum days required for initiation of gladiolus spike initiation was recorded in C_1G_1 (47 days), C_2G_1 (48 days).On the other hand, the maximum days to initiation of gladiolus spike was recorded with C_3G_2 (58 days) (Table.7).

4.8 Number of days taken for full blooming of basal florate:

There were significant differences among the different size corm with respect to days to fool bloom of basal floret (Appendix II).It was observed that longer days taken for basal floret opening by C_3 (64.89 days) whereas shorter days from C_1 (60.44 days) and C_2 was taken (60.17 days) (Table 5). These results are supported by Kalasareddi *et al.*, (1997) and Abdul Kareem *et al*. (2013). But this result is not in conformity with Laishram *et al.* (2011).

Significant difference were not found among the different concentration of GA_3 (Appendix II). It was observed that minimum number of days were required for full bloom of basal florate was recorded in G_1 (61.67 days) which is statistically identical with G_2 (62.22 days).Whereas maximum days was recorded in G_2 (63.11 days) (Table 6). Likewise, GA_3 treatments at the highest concentration significantly shortened the time taken from planting to flowering in *Iris* sp. Taha (2012).

Combined effect of corm division and use of GA_3 concentration on days to fool bloom of basal floret showed significant variation (Appendix II). It was observed that the minimum days required for basal floret blooming was recorded in C_1G_1 (60.00 days) which was statistically identical with C_2G_1 (60.77 days) whereas the maximum from C_3G_2 (65.67 days) (Table 7).

Table 5. Effect of corm division on plant height(cm) at flower stalk initiation stage, days to spike emergence and spike length(cm) [Y]

Treatment [X]	**Plant height(cm) flower stalk initiation stage**	**Days to spike emergence**	**Days to full bloom of basal florate**
C_1	73.22 a	47.00 b	60.44 b
C_2	72.00 a	48.00 b	60.17 b
C_3	46.78 b	57.11 a	64.89 a
$LSD_{0.05}$	**1.921**	**1.497**	**0.8162**
CV (%)	**3.03**	**2.96**	**1.31**

[X]$C_{1;}$ whole corm,$C_{2;}$half corm, $C_{3;}$quarter corm.
[Y] 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.

Table 6. The effect of GA_3 on plant height(cm) flower stalk initiation stage days to spike emergence and spike length(cm) [Y]

Treatment [X]	**Plant height(cm) at flower stalk initiation stage**	**Days to spike emergence**	**Days to full bloom of basal florate**
G_0	63.78 b	50.56 a	62.22 b
G_1	65.00 a	50.11 a	61.67 b
G_2	60.78 c	51.44 a	63.11 a
$LSD_{0.05}$	**1.912**	**1.497**	**0.8162**
CV (%)	**3.03**	**2.96**	**1.31**

[X]$C_{1;}$whole corm,$C_{2;}$half corm, $C_{3;}$quarter corm.
[Y] 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.

Table 7. Interaction effect of corm division and GA_3 on plant height(cm) flower stalk initiation stage days to spike emergence and spike length(cm) [Y]

Treatment [X]	Plant height (cm) at flower stalk initiation stage	Days to spike emergence	Days to full bloom of basal florate
C_1G_0	73.67 a	47.00 b	60.33 cd
C_1G_1	74.33 a	47.00 b	60.00 d
C_1G_2	71.67 ab	47.00 b	61.00 cd
C_2G_0	69.33 b	48.00 b	61.67 bc
C_2G_1	72.33 a	47.33 b	60.67 cd
C_2G_2	67.00 b	48.67 b	62.67 b
C_3G_0	48.33 c	56.67 b	64.67 a
C_3G_1	48.33 c	56.00 a	64.33 a
C_3G_2	43.67 d	58.67 a	65.67 a
$LSD_{0.05}$	**3.312**	**2.593**	**1.414**
CV%	**3.03**	**2.96**	**1.31**

[X]C_1 ;whole corm,C_2;half corm, C_3;quarter corm.
[Y] 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.

4.9. Length of spike

The use of cut corm on length of flower spike was not significantly influenced (Appendix II). Longest spike was recorded in C_1 (84.33 cm), C_2 (84.00 cm) whereas shortest spike length in C_3 (63.44 cm) (Table 8). The results also agreed with the findings of Memon *et al.,* (2009) and Dod *et al.,* (1989).

Significant differences were noticed for length of spike (cm) of gladiolus by different level of GA_3 concentration (Appendix II). Length of spike (cm) was observed more in case of G_1 (77.89 cm).G_0 and G_1 were statistically identical (Table 9). This findings are agreement with Al-Khassawreh *et al*. (2006), Sharma *et al*. (2006), Bhalla and Kumar (2008), Mayoli *et al*. (2009) and Dogra *et al*. (2012).

Interaction effect between use of cut corm and GA_3 concentration showed significant differences for spike length of gladiolus among the treatments (Appendix II). Length of spike maximum from C_1G_1 (85 cm), C_2G_1 (84.83 cm) and minimum from C_3G_2 (61.33 cm) (Plate 4).

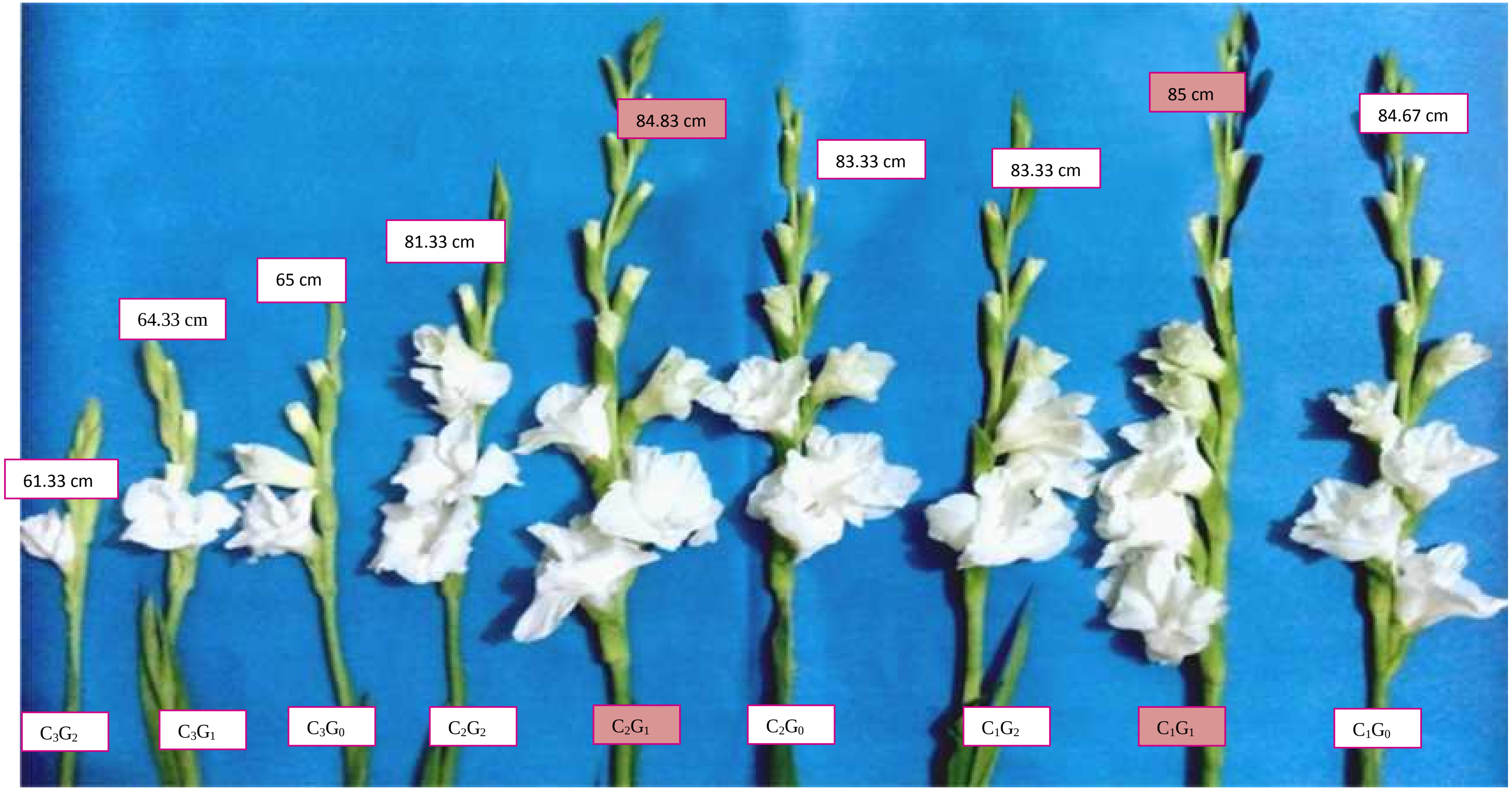


Plate 4.Different length (cm) of spike of gladiolus from interaction effect of corm division and presoaking with GA_3

C_1 = Whole corm, C_2 = Half corm and C_3= Quarter corm, G_0 = Control, G_1= 12 hours and G_2 = 24 hours

4.10. Number of spike/plot and spike/ha:

A significant effect was observed on yield of spike by use of cut corm (Appendix II).The highest yield of spike 21.22/plot and 2,33,333/ha was produced from whole corm and lowest yield from quarter corm 6.33/plot and 70,300/ha. But the production from half corm was 20.67/plot and 2,32,000/ha that is near about to whole corm (Table 8).This present findings is agreed with This findings are agreement with Al-Khassawreh *et al*. (2006).

Significant differences were noticed for yield of number of spike/plot and spike/hectare of gladiolus by different level of GA_3 concentration (Appendix II). The highest yield of spike 17/plot and 1,88,600/ha was produced by 12 hours presoaked with 100 ppm GA_3 treatment which was statistically significant from other treatments. Whereas minimum spike yield was recorded 14.89/plot and 1,65,400 /ha from G_2 (Table 9). This result is in agreement with the findings of Barman and Rajni 2004.

Interaction effect between use of cut corm and GA_3 concentration showed significant differences for spike length of gladiolus among the treatments (Appendix II). Maximum yield of spike 25.67/plot and 2,85,220 /ha from C_1G_1 and minimum yield of spike 5.33/plot and 59,300 / ha from C_3G_2.In that case C_2G_1 produced spike 25/plot and spike 2,77,777 /ha near about to C_1G_1 (Table 10) .

Table 8. Effect of corm division on no. of spike/plot,spike length (cm) and no. of spike thousand/ha (cm) [Y]

Treatment [X]	Length(cm) of spike	No. of spike/plot	No. of spike thousand/ha
C_1	88.33 a	21.22 a	233.3 a
C_2	83.00 b	20.67 ab	232.0 a
C_3	63.44 c	6.33 b	70.3 b
$LSD_{0.05}$	**1.077**	**1.01**	**11.07**
CV (%)	**1.4**	**6.43**	**6.65**

[X]C_1 ;whole corm,C_2;half corm, C_3;quarter corm.
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.

Table 9. The effect of GA_3 on no. of spike/plot and no. of spike thousand/ha [Y]

Treatment [X]	Length (cm) of spike	No. of spike/plot	No. of spike(thousand)/ha
G_0	77.67 a	15.00 b	166.7 b
G_1	77.89 a	17.33 a	188.6 a
G_2	75.22 b	14.89 b	165.4 b
$LSD_{0.05}$	**1.077**	**1.01**	**11.23**
CV (%)	**1.4**	**6.43**	**6.65**

[X]C_1 ; whole corm,C_2;half corm, C_3;quarter corm.
[Y] 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.

Table 10. Interaction effect of corm division and GA_3 on no. of spike/plot, no. of spike/hectare and spike length (cm) [Y]

Treatment [X]	Length (cm) of spike	No. of spike/plot	No. of spike(thousands)/ha
C_1G_0	84.67 a	18.67 c	207.5 b
C_1G_1	85.00 a	25.67 a	285.2 a
C_1G_2	83.33 a	19.67 b	218.5 b
C_2G_0	83.33 a	17.00 cd	188.8 c
C_2G_1	84.83 a	25.00 ab	277.77 a
C_2G_2	81.33 b	18.00 cd	207.4 b
C_3G_0	65.00 c	5.67 f	62.30 e
C_3G_1	64.33 c	8.00 e	88.90 d
C_3G_2	61.33 d	5.33 f	59.30 e
$LSD_{0.05}$	**1.866**	**1.75**	**19.46**
CV%	**1.4**	**6.43**	**6.65**

[X]C_1 ;whole corm,C_2;half corm, C_3;quarter corm.
[Y] 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.

4.11. Number of florate per spike

The effect of corm division on number of floret/spike was significantly influenced (Appendix II). Maximum no. of floret/spike were recorded in whole corm C_1 (11.22) and C_2 (11.00) whereas minimum in C_3 (7.22) (Table 11).This result is similar to Laishram *et al.,* 2011.

Significant differences were found among the corm presoaking with GA_3 according to different level time (Appendix II). The maximum number of floret/spike 10 was recorded when corm were presoaked with GA_3 for 12 hours and minimum number of floret/spike 9.33 was recorded when corm were presoaked with GA_3 for 12 hours (Table 12). This result is in agreement with the findings of Barman and Rajni 2004, Patel *et al*. 2010, Chopde *et al*. 2012, Sudhakar and Kumar 2012 and Neetu *et al*. 2013.

Interaction effect of cut corm presoaking with GA_3 concentration showed significant differences for number of floret/spike of gladiolus among the treatments (Appendix II). The maximum number of floret/spike was recorded in C_1G_1 (11.33), and from C_2G_1 (11.00) that is near about to C_1G_1.On the other hand, the minimum number of floret/spike C_3G_2 (6.33) (Table 13).

4.12. Diameter of floret

Diameter of florets indicating that with the incensement of plant height this associated character could be improved (Kumar *et al.*, 2011). Bigger floret head was found C_1 (10 cm) whereas minimum from C_3 (5.944 cm) (Table 11). Th is result agrred with the findings of Laishram *et al*., 2011.

When corm were presoaked with 100 ppm GA_3 for 12 hours was found effective for maximum floret diameter G_2 (8.667 cm) and minimum floret diameter Go (8.667 cm) (Table 12). These results are in consonance with findings of Kumar *et al.* (2012) ,Rana *et al.* (2005), Singh *et al.* (2003).

Maximum floret head diameter was recorded in C_1G_1 (10.33 cm) which was statistically similar with C_1G_2 and C_2G_2 while minimum floret head diameter was recorded with C_3G_2 (5.83 cm) (Table 13).

4.13. Cumulative petal area

The use of cut corm on cumulative petal area was significantly influenced (Appendix III).Large cumulative area were found in C_1 (111.0 mm^2) and small were found in C_3 (70.51 mm^2) (Table 11). This result similar with Abdul kareem *et al.*, 2013.

Significant differences were noticed on cumulative petal area when corms were pretreated by GA_3 for several hours. Large size cumulative petal area (99.09 mm^2) was found when corm were presoaked with GA_3 for 12 hours. Whereas small size petal area (93.80 mm^2) were noticed in 24 hours presoaked corms (Table12). This result is agree with Sakine Faraji *et al*. (2011).

Interaction effect between cut corm and presoaked with GA_3 for several hours showed significant differences on cumulative petal area of gladiolus flower among the treatments (Appendix III). It was observed that the largest petal area was recorded in C_1G_1 (114.5 mm^2) whereas the smallest petal area in C_3G_2 (69.38 mm^2), cumulative petal area of C_2G_1 (112.2 mm^2) closest to C_1G_1 (Table 13).

4.14. Vase life

Use of cut corm did not show a statistically similar result for vase life (Appendix III).Longer days were recorded by whole corm; C_1 (7.33 days) and C_2 (7.00 days) whereas shorter from quarter corm; C_3 (5.556 days) (Table 11).Whole and half corm produced higher leaf area, higher spike length than quarter corm that is correlated with longer vase life (Mohante 1994). This is conformity with Laishram *et al.*, (2011) and Suresh *et al.*, (2008)

Significant differences were noticed on vase life when corm were pretreated by GA_3 for several hours (Appendix III). Maximum days were recorded (7.22days) for 12 hours soaking corm and minimum days were recorded(5.778 days) when corm were presoaked with GA_3 for 24 hours (Table12). This result agreed with Dalal *et al*. 2009.

Interaction effect between cut corm and GA_3 showed significant differences 0n vase life of gladiolus flower (Appendix III). Maximum number of days were recorded in C_1G_1 (8.667 days), in C_2G_1 (8.00 days) and minimum number of days in C_3G_2 (5.0 days) (Table 13).

Table.11. Effect of corm division on no. of florate/spike, diameter of florate (cm), cumulative petal area (mm^2) and vase life (days)[Y]

Treatment[x]	No.of florate per spike	Diameter of florate (cm)	Cumulative petal area(mm^2)	Vase life (days)
C_1	11.22 a	10.00 a	111.0 a	7.33 a
C_2	11.00 a	9.556 ab	110.2 ab	7.00 a
C_3	7.222 b	5.944 b	70.51 b	5.55 b
$LSD_{0.05}$	**0.5483**	**0.4333**	**2.091**	**0.7227**
CV%	**5.7**	**5.09**	**2.17**	**11.35**

[X]C_1;whole corm,C_2;half corm, C_3;quarter corm.
[Y]In a column means having similar letter (s) are statistically identical and those having dissimilar letter (s) differsignificantly as per 0.05 level of probability

Table 12. The effect of GA_3 on no. of florate/spike, diameter of florate (cm), cumulative petal area (mm^2) and vase life (days)[Y]

Treatment [X]	No.of florate per spike	Diameter of florate(cm)	Cumulative petal area(mm^2)	Vase life (days)
G_0	9.556 ab	8.389 a	95.85 b	6.111 b
G_1	10.00 a	8.667 a	99.09 a	7.222 a
G_2	9.333 b	8.444 a	93.80 b	5.778 b
$LSD_{0.05}$	**0.5483**	**0.4333**	**2.091**	**0.7227**
CV%	**5.7**	**5.09**	**2.17**	**11.35**

X G_0;Control,G_1;12 hours,G_2;24 hours
[Y]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

Table 13. Interaction effect of corm division and GA_3 on no. of florate/spike, diameter of florate (cm), cumulative petal area (mm^2) and vase life (days)[Y]

Treatment[x]	No.of florate per spike	Diameter of florate (cm)	Cumulative petal area(mm^2)	Vase life (days)
C_1G_0	11.00 a	9.66 ab	110.5 b	6.667 b
C_1G_1	11.33 a	10.00 a	114.5 a	8.667 a
C_1G_2	11.33 a	10.33 a	108.0 b	6.333 b
C_2G_0	10.00 b	9.667 ab	105.4 c	6.000 c
C_2G_1	11.00 a	10.00 a	112.2 a	8.000 a
C_2G_2	10.00 ab	9.00 b	104.0 c	6.000 c
C_3G_0	7.333 c	6.00 c	71.58 d	5.667 d
C_3G_1	8.00 c	6.00 c	70.56 d	6.000 c
C_3G_2	6.333 d	5.833 c	69.38 d	5.000 d
$LSD_{0.05}$	**0.9496**	**0.7505**	**3.622**	**1.252**
CV%	**5.7**	**5.09**	**2.17**	**11.35**

[X] C_1 ;whole corm,C_2;half corm, C_3;quarter corm. G_0 ;Control,G_1;12 hours,G_2;24 hours
[Y] 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

4.15. Number of corm per plot

Use of cut corm showed significant differences with respect to number of corm/plot (Appendix III). The higher number of corm was observed in C_1 (27.89) and the lower in C_3 (7.444).Number of corm from C_2 is near to C_1 (Table 14). The yield of new corm increased by cutting of large and medium sized corms (Barman 2006).This result agreed with N. Memon (2009).

Significant differences were noticed when corm were presoaked by GA_3 for several hours with respect to number of corms per plot (Appendix III). The maximum number of corms per plot was recorded in G_1 (22.22). The minimum number of corms per plot was recorded in G_2 (18.89) (Table 15).This result is agreed Bhalla and Kumar (2008) and Laishram and Hatibarua (2009).

The interaction effect of cut corm and presoaked corm by GA_3 for several hours on number of corm per plot of gladiolus plant was significantly influenced (Appendix III). It was observed that the maximum number of corm per plot was recorded in C_1G_1 (29.67) and minimum C_3G_2 (6.33) and corm from C_2G_1 is closest to C_1G_1 (Table 16). This finding similar with Memon, 2009.

4.16. Number of cormel per plot

Use of cut corm did not show statistically similar result (Appendix III). The cormel yields observed by whole corm (51.89/plot) while the lower from quarter corm (6.444/plot) C_2 is statistically similar with C_1 (Table 14). The present results are in accordance with the findings of Gowda (1988).

Significant differences were noticed when corm were presoaked by GA_3 for several hours with respect to number of cormel per plot (Appendix III).Maximum number of cormel (37.56) were produced when corm were treated with GA_3 for 12 hours and lower number from G_2 (28.22) (Table 15). The result agrees with the findings of Mohanty *et al.,* (1994).

The interaction effect of cut corm and presoaked corm by GA_3 for several hours on number of corm per plot of gladiolus plant was significantly influenced (Appendix III). The maximum number of cormels/plot (55) was recorded from C_1G_1 while the minimum from C_3G_2 (4.33) (Table 16).

4.17. Weight of single corm

Significant differences were noticed among the use of cut corm recorded for weight of single corm (Appendix III). The higher corm weight was recorded in whole corm; C_1 (52.7g) whereas the lower in quarter corm; C_3 (47.3 gm) (Table 14). This result is conformity with Ramachandradu and Thangam (2007) and Laishram *et al.,* 2011.

Significant differences were noticed when corm were presoaked by GA_3 for several hours with respect to weight of single corm (Appendix III).Maximum weight of single corm were found (50.8gm) when corm were treated with GA_3 for 12 hours and minimum weight from G_2 (50.1) in case of corm treated for 24 hours (Table 15). The present findings are in agreement with the reports of Shoor *et al*. (2005).

Interaction effect between use of cut corm and presoaked with GA_3 showed significant differences for weight of single corm of gladiolus (Appendix III). It was observed that the maximum weight of single corm was recorded in C_1G_1 (53 gm) the minimum weight of single corm was recorded in C_3G_2 (47 gm) (Table 16).

4.18. Yield of corm kg/plot:

A significant effect was observed on yield of corm by use of cut corm (Appendix III). The highest of corm (1.3 kg/plot) was produced from whole corm and lower from quarter corm (0.4 kg/plot) (Table 14). This present findings is agreed with Priyakumari & Sheela 2005.

The yield attributes related to corm weight kg/plot significantly increased by the application at all the concentration of GA_3 when compared to control (Appendix III). The highest weight of corm 1.0 kg/plot was produced by 12 hours presoaked with 100 ppm GA_3 treatment which was statistically significant from other treatments. Whereas minimum corm yield was recorded 0.9 kg/plot from $G_{3.}$ (Table 15). The present findings are in agreement with the reports of Uddin *et al.* (2002) and Bhat *et al*. (2009).

Interaction effect between use of cut corm and presoaked with GA_3 showed significant differences to yield of corm kg/plot (Appendix III). Maximum yield of corm come from C_1G_1 (1.3 kg/plot) and and lower from C_3G_2 (0.3 kg/plot).Whereas C_2G_1 produced (1.2 kg corm/plot) that is near about to C_1G_1 (Table 16).

4.19 Yield of corm t/ha:

Significant variation was recorded in terms of corm yield per hectare for corm division (Appendix III).The highest corm yield was recorded C_1 (14 t/ha) while the lowest C_3 (3.7 t/ha) and from C_2 (13.7 t/ha) (Table 14).Similar findings were also reported by Bhat *et al.* (2009).

Corm yield per hectare varied significantly due to pre-soaking of corms with GA_3 for several hours (Appendix V). The highest corm yield (11 t/ha) was recorded from corm treated with GA_3 for 12 hours. while the lowest (9.6 t/ha) was recorded from corm treated with GA_3 for 12 hours (Table 15). These results are agreement with the findings of Lahiji 2013.

Interaction effect showed significant variation on corm yield per hectare of gladiolus (Appendix V). The highest corm yield was recorded from C_1G_1 (14.7 t/ha) while the lowest from C_3G_2 (3.4 t/ha).On the other hand C_2G_1 produced 14.1 t/ha that was near about to C_1G_1 (Table 16).

Table. 14. Effect of corm division on yield of gladiolus ^{Y}

Treatment ^{X}	No. of corm per plot	No.of cormel per plot	Weight of single corm (gm)	Weight of corm kg/plot	Yield of corm t/ha
C_1	27.89 a	51.89 a	52.4 a	1.3 a	14.0 a
C_2	26.35 ab	50.22 a	52.0 a	1.55 ab	13.7 ab
C_3	7.444 b	6.444 b	47.3 b	0.4 b	3.7 b
$LSD_{0.05}$	**1.283**	**4.824**	**0.9**	**0.1**	**0.3**
CV%	**6.54**	**14.69**	**1.8**	**3.1**	**3.36**

$^{X}C_{1;}$whole corm,$C_{2;}$half corm, $C_{3;}$quarter corm.
^{Y}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.

Table 15. The effect of GA_3 on yield of gladiolus [Y]

Treatment[X]	No. of corm per plot	No.of cormel per plot	Weight of single corm (gm)	Weight of corm kg/plot	Yield of corm t/ha
G_0	18.56 b	32.78 ab	50.4 a	0.9 b	9.8 b
G_1	22.22 a	37.56 a	50.8 a	1.0 a	11 a
G_2	18.89 b	28.22 b	50.1 a	0.9 b	9.6 b
$LSD_{0.05}$	**1.283**	**4.824**	**0.9**	**0.1**	**0.3**
CV%	**6.54**	**14.69**	**1.8**	**3.1**	**3.4**

XG_0 ;Control,G_1;12 hours,G_2;24 hours
[Y]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

Table 16. Interaction effect of corm division and GA_3 on yield of gladiolus [Y]

Treatment[X]	No. of corm per plot	No.of cormel per plot	Weight of single corm (gm)	Weight of corm kg/plot	Yield of corm t/ha
C_1G_0	26.33 b	53.00 a	52.7 a	1.2 b	13.8 b
C_1G_1	29.67 a	55.00 a	53.0 a	1.3 a	14.7 a
C_1G_2	26.00 b	47.00 a	52.3 a	1.2 b	13.6 b
C_2G_0	23.00 c	35.67 b	51.0 ab	1.1 c	12.3 c
C_2G_1	28.87 a	51.67 a	52.3 a	1.2 b	14.1 ab
C_2G_2	24.00 bc	33.33 b	50.7 b	1.0 d	11.7 d
C_3G_0	6.667 de	7.667 c	47.0 c	0.3 f	3.5 f
C_3G_1	9.333 d	7.333 c	47.7 c	0.4 e	4.4 e
C_3G_2	6.333 de	4.333 c	47.0 c	0.3 f	3.4 f
$LSD_{0.05}$	**2.253**	**8.355**	**1.6**	**0.1**	**0.6**
CV%	**6.54**	**14.69**	**1.8**	**3.1**	**3.4**

[X]C_1; whole corm,C_2;half corm, C_3;quarter corm. G_0; Control,G_1;12 hours,G_2;24 hours
[Y]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.

4.20 Economic analysis:

Economic analysis in detail was done according to the procedure of Alam *et al*. (1989).Material, non material and overhead cost including of the marketable spike and corm were recorded for all the treatments and concluded on per hectare basis. The cost and return were worked out and the data were presented in (Table 17).

4.20.21. Cost of production

Total cost of production ranged from taka 269,654 to 163,624. Among the treatment cost variation was due to corm division and GA_3 level. Highest cost of production required for whole corm with 12 hours and 24 hours. On the other hand cost was lower in Quarter with control. (Table 17)

4.20.22 Gross return

Gross return from different treatments ranged from taka 1,36,940 to 643,900 per hectare. The highest gross return was obtained from the $C_1G_{1,}$ C_1G_1 and the lowest gross return from C_3G_2 (Table 17).

4.20.23 Net return

Net return or net profit was calculated through excluding the production cost from the gross return. The highest net return comes from the $C_1G_{1,}$ C_2G_1 and the lowest gross return from C_3G_2 (Table 17).

4.20.24 Benefit Cost Ratio (BCR)

The benefit cost ratio was the highest (2.79) from the C_2G_1 and 2.38 from the C_1G_1.While BCR lowest (0.68) from the C_3G_2.From the economic point of view the above result indicate that C_2G_1 cultivation more profitable than C_1G_1.

Table17. Cost and Return of Gladiolus cultivation as influenced by corm division and pre-soaking with GA_3

Treatment combination	Cost of production (Tk/ha)	Yield of corm (t/ha)	Price of corm (t/ha)	Yield of spike (thousand/ ha^{-1})	Price of cut flower	Gross return (Tk/ha)	Net return (Tk/ha)	Benefit cost ratio
C_1G_0	2,32,754	13.8	69,000	207.5	4,15,000	4,84,000	251,246	2.07
C_1G_1	2,69,654	14.7	73,500	285.2	570,400	6,43,900	374,246	2.38
C_1G_2	2,69,654	13.6	68,000	218.5	437,000	5,05,000	235,346	1.87
C_2G_0	1,87,039	12.3	61,500	188.80	377,777	4,39,277	252,238	2.34
C_2G_1	2,23,939	14.1	70,500	277.77	555,555	6,26,055	402,116	2.79
C_2G_2	2,23,939	11.7	58,500	207. 4	414,800	4,73,300	249,361	2.11
C_3G_0	1,63,624	3.5	17,500	62.30	124,600	1,42,100	-021,524	0.80
C_3G_1	2,00,524	4.4	22,500	88.90	177800	2,00,300	-000,224	0.99
C_3G_2	2,00,524	3.4	17,000	59.97	119,940	1,36,940	-063,584	0.68

Gross return = Price of corm (t/ha) + Price of cut flower (thousand/ ha^{-1})
Net return = Gross return - Total cost of production
Benefit cost ratio = Gross return / Total cost of production

Price of spike @ 2 tk/piece
Price of corm @ 5000 tk/t

C_1 = Whole corm,
C_2 = Half corm and
C_3= Quarter corm,

G_0 = Control,
G_1= 12 hours and
G_2 = 24 hours

CHAPTER V

SUMMARY AND CONCLUSION

5.1. Summary

The present investigations entitled “Influence of division of corm and pre-soaking with GA_3 on growth and yield of gladiolus“(*Gladiolus grandiflorus*)” was conducted at Sher-e-Bangla Agricultural University, Dhaka during the period from August 2013 - March 2014. The study was undertaken with the objective of exploring the possibilities of producing marketable grades of cut flower and flowering grade corms.

The experiment was comprised with two factors viz. (1) Factor A: Corm division) C_1: whole corm and ii) C_2: half corm iii) C_3: quarter corm and (2) Factor B: Presoaking with 100 ppm Gibberelic acid (GA_3) i.e.1) Go:control 2) G_1:12 hours and 3) G_2:24 hours. There were on the whole 3 (3×3) : 27 treatments combinations. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. The results thus obtained are summarized below:

There was significant difference on days to germination percentage and plant height (cm) DAS with corm division and presoaking with $GA_3$and also with their interaction.Whole corm showed the better result for germination percentage (6.44 days) and plant height (72.78 cm at 50 DAS) where half corm showed lower result compare to whole corm (9.44 days) and (60.44 cm) and quarter corm performed very poor. On the other hand, it was also observed that the lowest days to germination percentage (6.00 days) was recorded with the treatment combination of whole corm and presoaking with GA_3 for 12 hours (C_2G_1). Combination effect of half corm and presoaking with GA_3 for 12 hours (C_2G_1) require minimum days to germination (7.33 days). The highest plant height were recorded with combination of whole corm and presoaking with GA_3 for 12 hours (75 cm at 50 DAS) and quarter corm presoaking with GA_3 for

24 hours (43.00 cm) and combination of half corm and presoaking with GA_3 for 12 hours (65.67 cm at 50 DAS) that was near about (C_1G_1).

The results under the present study revealed that there was significant effect on plant height at flower stalk initiation stage, number of days taken for spike initiation, spike length, days to full bloom of basal florate, no of floret/spike, floret head diameter, cumulative petal area (cm^2), no. of leaves, chlorophyll% of leaf, leaf area (cm^2), vase life, no. of corm/plot, no. of cormel/plot use of cut corm. In case of whole corm plant height at flower stalk initiation stage (73.22 cm), number of days taken for spike initiation (47 days), spike length(84.33 cm), days to full bloom of basal florate (60.44 days),no of floret/spike(11.22), floret head diameter (10.00 cm), cumulative petal area (111.0 mm^2),chlorophyll% of leaf (65.590, leaf area (43.18 cm^2),vase life (7.222 days), no. of corm/plot (27.33), no. of cormel/plot (51.89). But the minimum plant height at flower stalk initiation stage (46.78 cm) the maximum days taken for spike initiation (57.11 days), minimum spike length (63.44 cm),maximum days to full bloom of basal florate (64.89 days),no of floret/spike(7.22), floret head diameter (5.944 cm), lowest cumulative petal area (70.51 mm^2),chlorophyll% of leaf (58.88), leaf area (38.15cm^2), minimum vase life (5.56 days), no.of corm/plot (7.44), no. of cormel/plot (6.44) in quarter corm. On the other hand in all cases of parameter half corm performed near to whole corm.

The performance of presoaked corm with GA_3 had no significant effect on plant height at flower stalk initiation stage, number of days taken for spike initiation, spike length, days to full bloom of basal florate,no of floret/spike, floret head diameter, cumulative petal area (cm^2). But the result showed 12 hours presoaked corm performed over 24 hours and control.In case of Days to 80% germination require minimum days (13.56 days), carried maximum chlorophyll% (65.07) and leaf area (41.05 cm3).Maximum vase life observed

(7.222 days), Maximum corm no. (22.22) and cormel (37.56) were produced per plot.

Different parameters were also significantly influenced by interaction effect of use of cut corm and presoaking with GA_3.Minimum days taken for 80% germination (6 days),maximum length of spike (85cm),minimum days required to full of basal florate (60 days), maximum no. of spike 2,85,200 per/ha maximum cumulative petal area (114.5 mm^2) , maximum leaf area (44.97 cm^2), maximum vase life (8.667 days) and no, of corm per plot (25.67) and yield of corm 14 t/ha were observed in C_1G_1. Interaction effect of C_2G_1 showed in case of maximum parameter about closest result like C_1G_1 .Like Minimum days taken for 80% germination (8.33 days),maximum length of spike (84.33 cm), no. of spike 2,77,770 per ha, minimum days required to full bloom of basal florate (60.67 days), maximum cumulative petal area (112.2 mm^2) , maximum leaf area (44.44 cm^2) , maximum vase life (7.00 days) no. of corm per plot (27.67) and yield of corm 13.7 t/ha. In all cases of parameter C_3G_2 showed poor result compare to C_1G_1 and C_2G_1.

5.2. Conclusion

Considering the above discussion it may be concluded that

1. In the experiment, whole corm was more effective than quarter corm.
2. Better performance was observed for the pre-soaking of full corm and half corm with 100 ppm GA_3 for 12 hours.
3. The treatment under the study, C_1G_1 is the best and C_2G_1 also performed like C_1G_1 for growth, flowering and yield of gladiolus.
4. Several experiments can be carried with different size corm and different concentration of GA_3 to get other results.
5. Considering the present situation of the experiment further studies might be conductecd at diiferent Agro-Ecological Zone (AEZ) of Bangladesh for regional adaptability and other performances.

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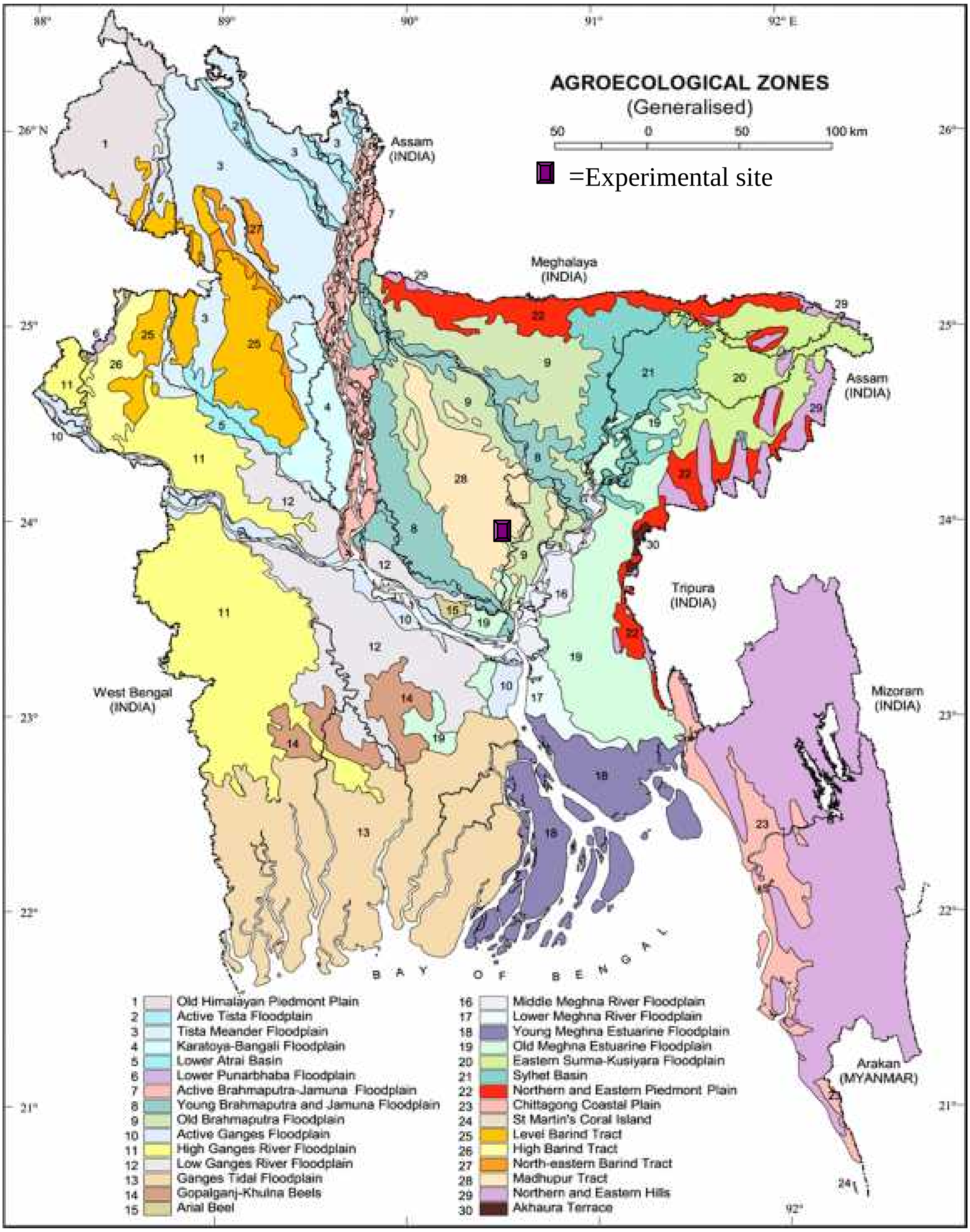
APPENDICES

Appendix A. Experimental location on the map of Agro-ecological Zones of Bangladesh



Appendix I Analysis of variance (ANOVA) for Days to 80% germination, Plant height, No. of leaves/plant, Chlorophyll% of leaf and leaf area (cm^2).

Source of variance	Degrees of freedom	Mean square						
		Days to 80% germination	Plant height (cm) DAS			No.of leaves/ plant	Chlorophyll % of leaf	Leaf area (cm^2)
			30	40	50			
Corm division (A)	2	2307.63	930.36 *	1137.00 *	1530.48 *	9.14	132.45 *	237.98 *
GA_3 (B)	2	30.297	83.86 *	121.00 *	75.70 *	1.37	21.09 *	19.20 *
AB	4	9.021	19.34 *	56.50 *	14.44 *	0.15	4.13 *	6.99 *
Error	16	16.370	16.979	9.61	27.42	0.21	3.456	1.09

* Significant at 5% level of significance

Appendix II Analysis of variance (ANOVA) for plant height at flower stalk initiation stage, no.of days for flower initiation, full blooming of basal florate,no.of spike/plot,spike/hectare, length of the spike no. of florate per spike and diameter of florate (cm)

Source of variance	Degrees of freedom	Mean square							
		Plant height (cm)at flower stalk initiation stage	No. of days for spike initiation	No. of days taken for full blooming of basal florate	No. of spike/plot	No. of spike thousand /ha	Length of the spike (cm)	No. of florate /spike	Diameter of florate head(cm)
Corm division (A)	2	1847.370 *	297.370 *	47.444	602.81 *	74365.453 *	1230.432 *	40.48	44.52
GA_3 (B)	2	42.48	4.148 *	4.773	17.14 *	2117.30	19.702 *	1.037	0.194
AB	4	3.259 *	1.478 *	0.222	0.148	17.988 *	1.703*	0.981	0.472
Error	16	3.662	2.245	0.667	1.023	126.351	1.162	0.30	0.188

* Significant at 5% level of significance

Appendix III Analysis of variance (ANOVA) for Cumulative petal area (mm^2), Vase life (days), number of corms, cormels/plot, weight of single corm (gm), Weight of corm kg/plot and yield of corm kg/plot and t/ha

Source of variance	Degrees of freedom	Mean square						
		Cumulative petal area (mm^2)	Vase life (days)	No. of corms/plot	No. of cormels/plot	Weight of single corm(gm)	Weight of corm kg/plot	Yield of corm t/ha
Corm division (A)	2	4305.75 *	5.259 *	1058.77	5013.37 *	69.333	2.204 *	280.27 *
GA_3 (B)	2	64.157 *	5.148 *	37.00	196.034	1.000	0.055 *	6.457 *
AB	4	16.77 *	0.704 *	0.785	83.98 *	1.000	0.003 *	0.478 *
Error	16	4.379	0.525	1.694	23.30	0.833	0.001	0.156

* Significant at 5% level of significance

Appendix IV. Per hectare production cost of gladiolus

A. Input cost

Treatment combination	Labour cost	Ploughing cost	Corm cost	Irrigation cost	Insecticides	GA_3	Manure and fertilizer				Sub total (A)
							Cowdung	Urea	TSP	MP	
C_1G_0	30,000	15,000	82,000	12,000	9,000	0	20,000	1,600	6,500	3,500	1,49,600
C_1G_1	30,000	15,000	82,000	12,000	9,000	30,000	20,000	1,600	6,500	3,500	2,09,600
C_1G_2	30,000	15,000	82,000	12,000	9,000	30,000	20,000	1,600	6,500	3,500	2,09,600
C_2G_0	30,000	15,000	41,000	12,000	9,000	0	20,000	1,600	6,500	3,500	1,38,600
C_2G_1	30,000	15,000	41,000	12,000	9,000	30,000	20,000	1,600	6,500	3,500	1,68,600
C_2G_2	30,000	15,000	41,000	12,000	9,000	30,000	20,000	1,600	6,500	3,500	1,68,600
C_3G_0	30,000	15,000	12,000	12,000	9,000	0	20,000	1,600	6,500	3,500	1,17,600
C_3G_1	30,000	15,000	12,000	12,000	9,000	30,000	20,000	1,600	6,500	3,500	1,47,600
C_3G_2	30,000	15,000	12,000	12,000	9,000	30,000	20,000	1,600	6,500	3,500	1,47,600

Appendix V. Contd.

B. Overhead cost (Tk./ha)

Treatment combination	Cost of lease of land for 6 month (13% of value of land Tk. 5,00,000/year)	Miscellaneous cost (Tk. 5% of the input cost)	Interest on running capital for 12 months	Subtotal (Tk) (B)	Total cost of production (Tk./ha)[input cost(A)+Overhead cost(B)]
C_1G_0	32,500	8,980	11,674	53,125	2,32,754
C_1G_1	32,500	11,980	15,574	60,054	2,69,654
C_1G_2	32,500	11,980	15,574	60,054	2,69,654
C_2G_0	32,500	6,930	9009	48,439	1,87,039
C_2G_1	32,500	9,930	12,909	55,339	2,23,939
C_2G_2	32,500	9,930	12,909	55,339	2,23,939
C_3G_0	32,500	5,880	7,644	46,024	1,63,624
C_3G_1	32,500	8,880	11,544	52,923	2,00,524
C_3G_2	32,500	8,880	11,544	52,924	2,00,524