INFLUENCE OF PRE WATER SOAKING OF CORM AND FOLIAR APPLICATION OF MICRONUTRIENTS ON GLADIOLUS PRODUCTION

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CERTIFICATE

*This is to certify that the thesis entitled " **INFLUENCE OF PRE WATER SOAKING OF CORM AND FOLIAR APPLICATION OF MICRONUTRIENTS ON GLADIOLUS PRODUCTION**" submitted to the Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE (MS)** in **HORTICULTURE,** embodies the results of a piece of bona fide research work carried out by **MD. SHAMSUZZOHA,** Registration. No. **08-03114** under my supervision and guidance. No part of this 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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The Author

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ABSTRACT

The experiment was conducted in the Horticulture Farm, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh, during October, 2013 to March, 2014. The experiment consisted with two factors. Factor A: Pre soaking of corm with water such as, W_0; No pre soaking (control), W_1; Pre soaking with normal water and W_2; Pre soaking with hot water and Factor B: Foliar spray of micronutrient as, F_0; No foliar spray (Control), F_1; Foliar application with 0.25 % Boron and F_2; Foliar application with 0.25 % Zinc. The experiment was laid out in Randomized Complete Block Design with three replications. Highest number of floret spike^{-1} (11.3) and corm yield (8.8 t ha^{-1}) was recorded from W_2 and lowest number of floret spike^{-1} (8.6) and corm yield (5.7 t ha^{-1}) from control. For foliar spray of micronutrient, highest no. of floret spike^{-1} (11.0) and corm yield (8.6 t ha^{-1}) was recorded from F_2 and lowest no. of floret spike^{-1} (8.8) and corm yield (5.6 t ha^{-1}) from control. For interaction effect, highest number of floret spike^{-1} (12.7) and corm yield (10.6 t ha^{-1}) was recorded from W_2F_2 and lowest no. of floret spike^{-1} (7.7) and corm yield (4.3 t ha^{-1}) from W_0F_0. From the above result it may be concluded that combination of pre soaking of corms with hot water and foliar application of 0.25 % Zinc attribute to more floret and corm yield.

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LIST OF ACRONYMS

AEZ	=	Agro-Ecological Zone
BARI	=	Bangladesh Agricultural Research Institute
BADC	=	Bangladesh Agricultural Development Corporation
LAI	=	Leaf area index
ppm	=	Parts per million
et al.	=	And others
N	=	Nitrogen
TSP	=	Triple Super Phosphate
MP	=	Muriate of Potash
G	=	Gypsum
DAS	=	Days after sowing
ha^{-1}	=	Per hectare
G	=	Gram (g)
kg	=	Kilogram
Q	=	Quintal
µg	=	Micro gram
SAU	=	Sher-e-Bangla Agricultural University
SRDI	=	Soil Resources and Development Institute
HI	=	Harvest Index
No.	=	Number
Wt.	=	Weight
LSD	=	Least Significant Difference
^{0}C	=	Degree Celsius
NS	=	Non significant
cm	=	Centimeter
mm	=	Millimeter
Max	=	Maximum
Min	=	Minimum
%	=	Percent
cv.	=	Cultivar
NPK	=	Nitrogen, Phosphorus and Potassium
CV%	=	Percentage of coefficient of variance
Hr	=	Hour
T	=	Ton
viz.	=	Videlicet (namely)

CHAPTER 1

INTRODUCTION

Gladiolus (*Gladiolus grandiflorus*) is 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. 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.

However, dormancy of corms is one of the major hindrances in the year round cultivation of gladiolus and is more pronounced under warmer climatic conditions. Though, the dormancy has physiological importance for gladiolus crop as it allows to overcome the unfavorable environmental conditions but still floriculturists are exploiting the potential of this crop to grow year round by breaking its dormancy. This is helpful in regulating the flowering season according to the need of the market. Pre-planting soaking of corms with hot water is effective in enhancing stock production in gladiolus. During the early stages of the investigations on hot -water treatment, the tetrazolium method of estimating viability of seeds was adapted to give a quantitative estimate of dormancy, resistance to heat, and germinability of gladiolus cormels (Bald and Baker,1953). If gladiolus cormels are fully dormant when treated with hot water, germinability may be improved and the crop of corms increased in size and quality (Magie, 1956). Hot water treatment has successfully eliminated *Fusarium oxysporum*, *Botrytis gladiolorum, Stromatinia gladioli, Rhizoctonia solani* and several species of nematodes and mites from cormel planting stock. (Magie, 1956).

Gladiolus is grown in several areas of Bangladesh and success fully grown in plains as well as in hills. Light sandy soil with 6-7 pH and sunny weather is most congenial for its growth and development. Among micronutrients required in small amount, boron is necessary for carbohydrate transport within the plant (Gauch and Dugger, 1953) and most of absorbed by the plants in undissociated boric acid (H_3BO_3). Micronutrients especially zinc plays a vital role in plant growth and yield. In gladiolus foliar application of zinc is very effective and there was less information about concentration zinc and stage of application which affect more on plant growth and yield (Halder *et al.,* 2007). Zinc is essential for carbon dioxide evolution and utilization of carbohydrate and phosphorus metabolism and synthesis of RNA. In our country not much work has been done on production of gladiolus with foliar spray of zinc and boron. (Hewitt, 1963). Most of the information is available based on the work carried out in the foreign countries but those recommendations cannot be help full as such under our agro-climatic condition. Hence the cultural management and technique for quality flower and corm production need to be developed and standardized. Keeping in view of the above facts, a field trial was carried out with the following objectives-

1. To study the growth and yield of gladiolus under different pre soaking water treatment of corm.
2. To determine the appropriate micronutrient concentration for enhancing the growth and yield of gladiolus.
3. To find out the best combination of pre soaking water treatments and foliar application of micronutrient for ensuring the better growth and yield of gladiolus.

CHAPTER 2

REVIEW OF LITERATURE

Influence of pre soaking water and foliar application of micronutrients on production of Gladiolus. Following review of literature includes reports as studied by several investigators who were engaged in understanding the problems that may help in the explanation and interpretation of results of the present investigation. In this chapter, an attempt has been made to review the available information in home and abroad regarding the influence of pre water soaking and foliar application of micronutrients on production of gladiolus.

2.1 Review related to pre soaking of corm with water on production of gladiolus

Padmalatha *et al.* (2014) conducted an experiment to find out the effect of pre planting treatment of corms with chemicals and plant growth regulators on vegetative growth, flowering and post harvest life in gladiolus. Pre-planting soaking of corms for 24 h improved vegetative and flowering attributes. Salicylic acid (SA) 150 ppm followed by TU 2% was more effective in increasing vegetative growth and reducing number of days to flowering. SA 150 ppm followed by GA_3 150 ppm were effective in improving flowering performance of gladiolus cultivars in terms of increasing number of spikes per plant, spike length and weight and number of florets per spike. Post harvest studies revealed that soaking of corms for 24 h recorded significantly less number of days to first floret opening. Pre-planting treatment of corms with SA 150 ppm recorded minimum days to first floret opening, maximum number of florets opened at a time per spike.

Padmalatha *et al.* (2013) carried out an experiment in 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. 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. 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.

Bald, *et al.* (1956) gave detailed instructions on use of the hot water treatment and cited a case in which a badly diseased lot of spotlight gladiolus cormels was so successfully treated that the disease appeared in less than 0.5% of the resulting plants.

Magie (1956) reported that the hot-water treatment of gladiolus cormels had been tested in Florida since 1953. He stated further that 30 minute soak at 53.5°C killed the following fungi in cormel size pieces of diseased tissue cut from corms *Fusarium oxysporum*, *Stromatinia gladioli*, and *Curvularia lunata*.

Bald and Markley (1955) reported that control of *Fusarium* and other diseases was attained on a field scale when the hot-water treatment was applied to grower's lots of gladiolus cormels. They cautioned, however, for successful treatment, cormels had to be harvested from warm soil after growth during summer.

2.2 Review related to foliar application of micronutrients on production of gladiolus

Chopde *et al.* (2015) conducted an experiment to find out the effect of foliar application of zinc and iron on growth, yield and quality of gladiolus. The treatments comprised of different levels of zinc (control *i.e*. water spray, 0.2%, 0.4% and 0.6%) and iron (control *i.e*. water spray, 0.2%, 0.4% and 0.6%). The results revealed that foliar application of 0.4% zinc and 0.4% iron recorded significantly maximum vegetative growth in respect of plant height and leaf area, yield in respect of spikes plant^{-1} and corms plant^{-1}, quality parameters *viz*.

length of spike, length of rachis, florets spike^{-1}, diameter of spike and diameter of corm and the earliest 50 per cent flowering.

Maurya and Kumar (2014) conducted a field experiment to investigate the effect of different micronutrients on growth, flowering behavior and corm yield of gladiolus (*Gladiolus grandiflorus* L.). The experiment was carried out ten treatments *i.e.* three levels of boron (100, 200 and 300 mg l^{-1}), three levels of zinc (100, 200 and 300 mg l^{-1}) three levels of manganese (100, 200 and 300 mg l^{-1}) and control. Foliar spraying of micronutrients was done after sowing at 3rd and 6th leaf stage. Number of leaves plant^{-1}, number of corm plant^{-1}, number of cormels plant^{-1}, weight of corm plant^{-1} (g), weight of cormels plant^{-1} (g), yield of corm ha^{-1} (q) and yield of cormels ha^{-1} (q) was significantly influenced with spraying of Zn @ 300 mg l^{-1} after sowing at 3rd and 6th leaf stage. Spraying of Mn @ 300 mg l^{-1} after sowing at 3rd and 6th leaf stage was proved to be most effective to increase plant height (cm) of gladiolus.

Kashif *et al.* (2014) carried out an experiment to evaluate the growth and yield response of *Dahlia hybrida* to four foliar fertilizer treatments, viz. T_0, control (no foliar application of nutrients); T_1, NPK (17:17:17); T_2, NPK (15:32:7) + micro power); T_3, NPK (15:32:7) + chelated mix micro-nutrients. The results endorsed the benefits of foliar fertilization by witnessing the improved growth traits of the plant. The results regarding growth and yield showed a significant response to the foliar application of macro and micro-nutrients. It is confirmed from the results that combination of macro and micro-nutrients as foliar application enhanced the growth and yield of *Dahlia hybrida* positively.

An experiment was carried out by Sharma *et al.* (2013) at Chandra Shekhar Azad University of Agriculture and Technology, Kanpur during the year 2010-11. The experiment consists of two levels each of Zn (Zn_0 and Zn_1), Ca (Ca_0 and Ca_1) and B (B_0 and B_1) which were sprayed on gladiolus plant. The dose of foliar spray of Zn, Ca and B were 0.75%, 0.50% and 0.20%, respectively. The height of plant significantly increased by foliar application of Zn, B, and Ca

(79.55 cm, 79.39 cm and 78.75, respectively) interaction effect was also significant between those. The yield of spike increased significantly with foliar application of zinc and calcium, maximum yield of spike (16904.50) was recorded with application of zinc 0.75%. The length of floret was significantly enhanced by the use of B (8.29) and Zn (8.23) while, effect of Ca was non-significant. Results obtained among, from the application of Zn, B and Ca and its interaction Zn exhibited most significant effect on various parameters studied under the investigation.

Katiyar *et al.* (2012) carried out an experiment to investigate the effect of zinc, calcium and boron on spike production in gladiolus with foliar application in Kanpur in Randomized Block Design with four replications. The experimental plots were 32 with 8 treatments and two levels of each of zinc, calcium and boron treated by zinc sulphate 0.5%, calcium sulphate 0.75% and borax 0.2%, respectively. The results obtained revealed that the foliar spray of zinc at 0.5% to gladiolus plant was most effective to influence the vegetative growth and size of spike.

Reddy and Rao (2012) an experiment was conducted to find out precision foliar application of zinc on gladiolus. The experiment was spraying of zinc at different concentrations (2, 1 and 0%) at different days after planting (4, 6 and 8 weeks). The treatment 2% zinc has significantly increased plant height, number of leaves, leaf length, leaf width and leaf area at 40, 60 and 80 DAP, with highest values when sprayed at 6 weeks after planting compared to 4 and 8 after planting, minimum values were observed with control. Among the floral parameters, the treatment 2% zinc recorded more number of days (97.63) to first floret appearance and 50% flowering (103.32**)** over other treatments whereas, control recorded minimum number of days to first floret appearance and 50% flowering. Similarly, the treatment 2% zinc recorded more number of spikes (1.33), spike length (112.19 cm), number of florets per spike and highest spike growth rate (0.68 cm day^{-1}). While the interaction of 2% zinc and 6 weeks after planting recorded maximum spike length (118.36 cm) and number of florets (13.40).

Singh *et al.* (2012) carried out an experiment in Kanpur to investigate the effect of zinc, iron and copper on yield parameters in gladiolus. The experiment consisted with two levels each of Zn (Zn_0 and Zn_1), Fe (Fe_0 and Fe_1) and Cu (Cu_0 and Cu_1) which were sprayed on gladiolus plant. The dose of foliar spray of zinc, iron and copper were 0.50%, 0.25% and 0.25%, respectively. Weight of corms significantly increased with the application of Zn and Cu (94.38 and 94.82 g, respectively). Diameter of corms influenced significantly with the application of Zn, Fe and Cu (5.71, 5.77 and 5.81 cm diameter, respectively). Foliar spray of Zn, Fe and Cu, significantly increased the number of corms per plant. Interaction between Zn x Fe and Zn x Cu, significantly enhanced the number of corms per plant whereas, the number of corms per plant revealed by Zn (1.74), Fe (1.66) and Cu (1.68) over their respective controls. Maximum increase in cormels production per plant was influenced due to application of zinc (44.97) followed by spray of copper (43.18) and iron (42.11) over their respective controls.

Kumar *et al.* (2012) were 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., GA_3, 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 replications. 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 GA_3 @100ppm as compared to rest of the treatments. Whereas CCC @ 500 ppm was found the best in terms of corms and cormels production of gladiolus.

Lahijie (2012) conducted a field experiment for two consecutive years to study foliar spray of $FeSO_4$ and $ZnSO_4$ on the growth and floral characteristics of gladiolus variety 'Oscar'. The experiment was laid out in a randomized complete block design with three replicates in the field, Varamin Research Center. The evaluated was response and to find out the optimum dose of the same for production of gladiolus variety 'Oscar' an efficient concentration of $FeSO_4$ and $ZnSO_4$ on quality and productivity of gladiolus. Plants were grown and treated with three levels of 0, 0.5%, and 1% of two micronutrients $FeSO_4$ and $ZnSO_4$ and their various combinations at two- leaf and six-leaf stages. The results disclosed that solutions of $Feso_4$ and $Znso_4$ significantly affected plant growth and floral characteristics of gladiolus. Higher contents of both $FeSO_4$ and $ZnSO_4$ speed the plant growth and increased flowering characteristics. Application of 1 % Feso4 accelerated flowering earlier than $ZnSO_4$, as well as elongated days to spike emergence (21.49 days) and first florets opening (38.28). The results showed that 2% of both $FeSO_4$ and $ZnSO_4$ solutions and their mixture delayed the days from basal floret opening and number of floret at a time. The flowering properties like plant height (83.47 cm), length of spike (66.03cm), number of leaves (9.52 $plant^{-1}$) floret number (11.55 $spike^{-1}$), diameter of floret (8.53cm) were significantly different other treatments when a mixed solution of 2% $FeSO_4$ and $ZnSO_4$ was applied. It is concluded that no application of micronutrients on gladiolus ornamental at the commercial scale will produce poor quality of vegetative growth and low number of florets. However, it is suggested that micronutrients play a vital role on the growth and development of gladiolus plants, because of its stimulatory and catalytic effects on flower yield and metabolic processes.

Khosa *et al.* (2011) conducted a field experiment to investigate the foliar fertilization of macro and micro nutrients subjective the vegetative growth and flowering superiority of gerbera. Current study was planned to observe the effect of foliar purpose of macro (NPK) and micro nutrients (Zn, B, Fe and Mn) on gerbera growth and flowering production. Plant height, number of branches per plant, length of branches per plant, number of leave per plant, leaf area, stock length, days to first flower emergence, flower diameter and flower quality increased with foliar fertilization.

Reddy and Chaturvedi (2009) carried out a field experiment to study the effect of zinc ($ZnSO_4$) at 0.5%, calcium ($CaSO_4$) at 0.5% and boron (borax) at 0.25% on growth and flowering in gladiolus cv. Red Majesty with four replications. Foliar application of $ZnSO_4$ at 0.5% found to be significant on different parameters like plant height (73.11 cm), leaf length (52.81 cm), days to flowering (66.11 days), length of spike (54.01 cm), length of rachis (46.26 cm), number of florets per spike (14.00) and floret length (9.08 cm). While borax and $CaSO_4$ have shown non-significant results for most of the characters except days to flowering (66.13 days) and number of florets (13.93) per spike with boron at 0.25%. However, the interaction between boron (0.25%), $ZnSO_4$ (0.5%) and $CaSO_4$ (0.5%), $ZnSO_4$ (0.5%) revealed significant results for plant height 73.27 and 73.33 cm, respectively. While the interaction between boron and $ZnSO_4$ was significantly affected by days to flowering (66.13 days) and rest of the interactions were non-significant.

Halder *et al.* (2007) conducted a field experiment to investigate the response of B and Zn on corm and cormel production and to find out the optimum dose of B and Zn for maximizing yield for gladiolus cultivation. It appeared in studied data reveals that B and Zn made promising response to the growth and floral characters of gladiolus. It is also reported that gladiolus is highly responsive to chemical fertilizers. The sixteen treatment combinations included in the study noted that B and Zn at the rate of B 2.0 and Zn 4.54 kg ha^{-1} along with blanket dose of N375 P150 K250 S20 kg and CD 5 t ha^{-1} exhibited the best performance in flower production and stretched the vase life of flower. The studied parameters like plant height (79.83 and 87.61 cm), length of spike (71.2 and 67.33 cm) length of rachis (48.86 and 45.08 cm) and leaves number (10.77

and 9.87 plant^{-1}) significantly responded to the combined application of boron and zinc at the rate of B 2.0 and Zn 4.54 kg ha^{-1} as compared to other treatment combinations. Floral characters like floret number (12.85 and 12.45 spike^{-1}), floret size (9.76 x 8.93 and 10.28 x 9.77 cm) and weight of spike (36.73 and 45.12 g) also significantly influenced by said treatment (B 2.0 and Zn 4.54 kg ha^{-1}) which was markedly differed over rest of treatments combination. Single application of B and Zn also contribute to the yield parameters of gladiolus.

Singh and Chetan (2000) conducted an experiment in the in Uttar Pradesh, India to study the effects of different spacing and various levels of $ZnSO_4$ on the corms and cormels production of gladiolus cv. Sylvia. The corms were planted at 15 × 20, 20 × 20 and 25 × 20 cm distance and $ZnSO_4$ at a different levels viz. 0, 10 and 20 kg ha^{-1} was applied in the soil during the last ploughing. Planting of corms at 25 × 20 cm resulted to the highest weight of corms plant^{-1}, maximum diameter of corms plant^{-1} and number of cormlels plant^{-1}. Application of the highest level of $ZnSO_4$ caused the highest increase in weight of corms plant^{-1}, diameter of corms and average weight of corm. It is, therefore, suggested that gladiolus cv. Sylvia may be planted at spacing of 25 × 20 cm, and 20 kg $ZnSO_4$ ha^{-1} may be applied during the last ploughing.

CHAPTER 3

MATERIALS AND METHODS

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

3.1 Experimental site

The experiment was conducted at Horticulture Farm, Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh. Location of the site is 23º74´ N latitude and 90º35´ E longitude with an elevation of 8.6 meter from sea level in Agro-Ecological Zone of Madhupur Tract (AEZ No. 28).

3.2 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.

3.3 Soil

The land topography was medium high and soil texture was silt clay with pH 6.5.

3.4 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 was applied @ 5 t ha^{-1} during final land preparation.

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.

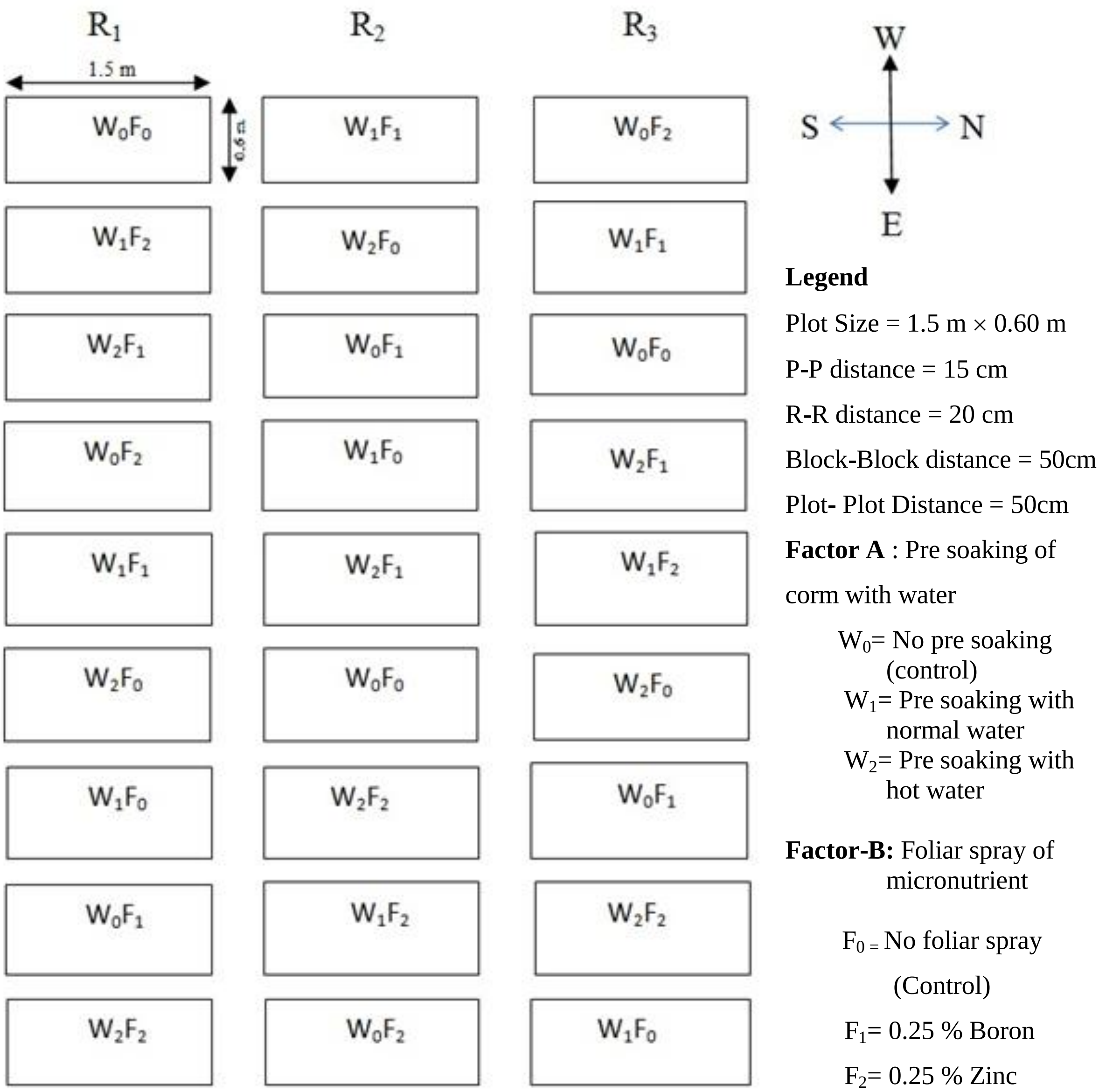

Plate 1. Lay out of the experiment

3.4.3 Planting material

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

3.4.4 Treatments of the experiment

There were two factors in the experiment.

1) Factor A: Pre soaking of corm with water

W_0= No pre soaking (control)

W_1= Pre soaking with normal water (12 hr)

W_2= Pre soaking with 50^0C hot water (15 min)

2) Factor B: Foliar spray of micronutrient

$F_{0\ =}$ No foliar spray (Control)

F_1= Foliar application with 0.25 % Boron

F_2= Foliar application with 0.25 % Zinc

There were 9 (3 × 3) treatment combinations were $W_0F_{0,}$ W_0F_1, $W_0F_{2,}$ $W_1F_{0,}$ $W_1F_{1,}$ $W_1F_{2,}$ $W_2F_{0,}$ $W_2F_{1,}$ W_2F_2.

3.4.5 Preparation of different micronutrients (B, Zn) stock solutions

Stock solution of B and Zn was prepared by dissolving 12.5 mg of H_3BO_3 and $ZnSO_4$ in 1000 ml of water to get 0.25% boron and zinc solution, respectively.

3.4.6 Planting of corms

Corms were planted at 7 cm depth in the plot on 12^{th} October, 2013 with sufficient care for minimum injury of corms. The corm were planted maintaining 15 cm plant to plant distance and 20 cm row to row distance.

3.4.7 Recording of data

The data were recorded on the following parameters

a. Days to 80% germination
b. Plant height (cm)
c. Chlorophyll content on leaf (%)
d. Leaf area (cm^2)
e. Number of days taken for full blooming of basal floret (*visual observation*)
f. Length of the spike (cm)
g. Diameter of spike (cm)
h. Number of floret $spike^{-1}$
i. Diameter of floret head (cm)
j. Number of corms $plot^{-1}$
k. Number of cormels $plot^{-1}$
l. Yield of corm (t ha^{-1})

3.4.8 Intercultural operation

3.4.8.1 Weeding

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

3.4.8.2 Irrigation

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

3.4.8.3 Disease and pest management

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

3.4.8.4 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 color. 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 (cm)

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 30, 50 and 70 DAT.

3.5.3 Leaf area (cm^2)

The leaf area was measured using CL-202 Leaf Area Meter by non destructive method. Mature single leaves were randomly selected.

3.5.4 Chlorophyll content on leaf (%)

Chlorophyll content on leaf (%) was measured by using SPAD-502 plus at 5 different portions of the leaf and mean value was calculated.

3.5.5 Number of days taken for full blooming of basal floret (visual)

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

3.5.6 Length of the spike (cm)

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

3.5.7 Diameter of the spike (cm)

Diameter of the spike was measured by meter scale and recorded in centimeters.

3.5.8 Number of florets spike^{-1}

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

3.5.9 Diameter of floret head (cm)

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

3.5.10 Number of corms plot^{-1}

There are 30 plants plot^{-1}. The total number of corms produced plot^{-1} was recorded as corm yield per plot.

3.5.11 Number of cormels plot^{-1}

There are 30 plants plot^{-1}. The total number of cormels produced plot^{-1} was recorded as cormel yield plot^{-1}.

3.5.12 Yield of corm (t ha^{-1})

Corm yield was recorded on the basis of total harvested corm $plot^{-1}$ and was expressed in terms of yield (t ha^{-1}).

3.6. Statistical analysis

The collected data were compiled and analyzed statistically using the analysis of variance (ANOVA) technique with the help of a computer package program MSTAT-C and the mean differences were adjusted by Least Significance Difference (LSD) test at 5% level of probability (Gomez and Gomez, 1984).

CHAPTER 4

RESULTS AND DISCUSSION

The study was conducted to determine the effect of pre soaking of corms with water and different micronutrients on gladiolus. The results of the experiment were arranged and discussed under the following heading in this chapter.

4.1 Days to 80% germination

Pre soaking of corms with water had significant effect on germination percentage of gladiolus (Figure 1). Corms were presoaked with hot water shows the minimum (12.7) days required to 80% germination which was statistically different from other treatments. Whereas maximum (20.6) days were required in case of W_0 (no water treatment). This might be due to the hot-water treatment of gladiolus corms that helps to control pathogen of corms and germinate earlier than the other two treatments, similar result also found by Magie (1956) who reported that 30 minute soak of corms at 53.5°C hot water killed fungi in cormels size pieces of diseased tissue cut from corms.

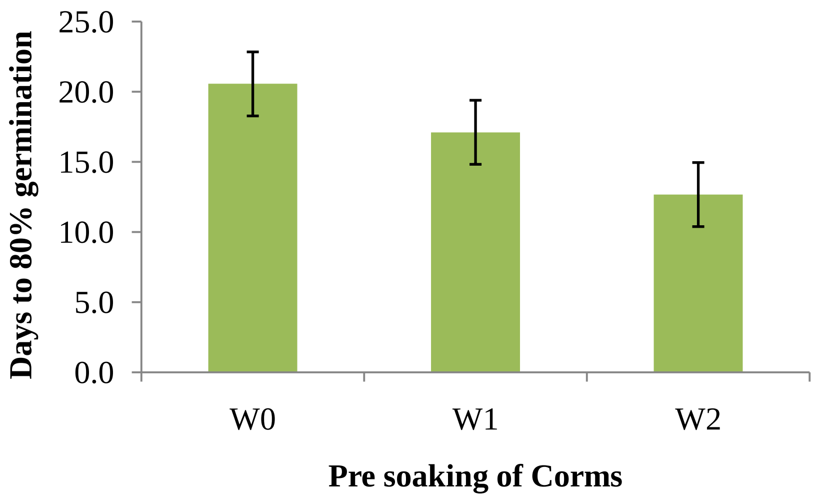

Figure 1. Effect of pre soaking of corms with water on days to 80% germination of gladiolus (W_0 = No water treatment (control), W_1 = Pre soaking with normal water and W_2 = Pre soaking with 50^0C hot water)

4.2 Plant height (cm)

Significant differences were found among the pre soaking of corms with water treatment on plant height of gladiolus at 30 to 70 DAT (Figure 2). Maximum plant height were recorded in W_2 (41.8, 55.9 and 96.1 cm at 30, 50 and 70 DAT, respectively) and minimum plant height was recorded in W_0 (34.7, 49.6 and 84.0 cm at 30, 50 and 70 DAT, respectively). Pre soaking of corms in hot water may control pathogen present in the corms which results better germination of corms and vigorous growth of plant. These observations are in similar with the reports of Kumar *et al.* (2012) and Bhalla and Kumar (2008).

For plant height at different days after transplanting, use of micronutrients showed the significant differences (Figure 3). Maximum plant height was observed in F_2 (40.2, 55.7 and 92.8 cm at 30, 50 and 70 DAT, respectively) and minimum plant height was recorded in F_0 (36.7, 49.0 and 85.9 cm at 30, 50 and 70 DAT, respectively). Similar findings also reported by Chopde *et al.* (2015); Maurya and Kumar (2014).

Combined effect between pre soaking of corms with water and micronutrients showed significant differences on plant height of gladiolus plant (Table 1). It was observed that the maximum plant height was gained from W_2F_2 (44.3, 59.7 and 99.3 cm at 30, 50 and 70 DAT, respectively) which were statistically similar with W_2F_1. On the other hand, the minimum plant height was recorded in W_0F_0 (33.7, 45.7 and 81.8 cm at 30, 50 and 70 DAT, respectively).

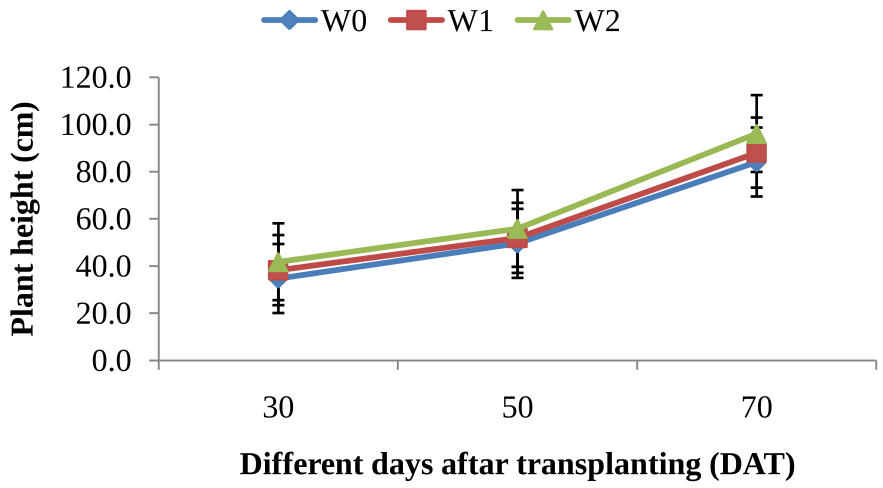

Figure 2. Effect of pre soaking of corms with water on plant height of gladiolus (W_0 = No water treatment (control), W_1 = Pre soaking with normal water and W_2 = Pre soaking with 50^0C hot water)

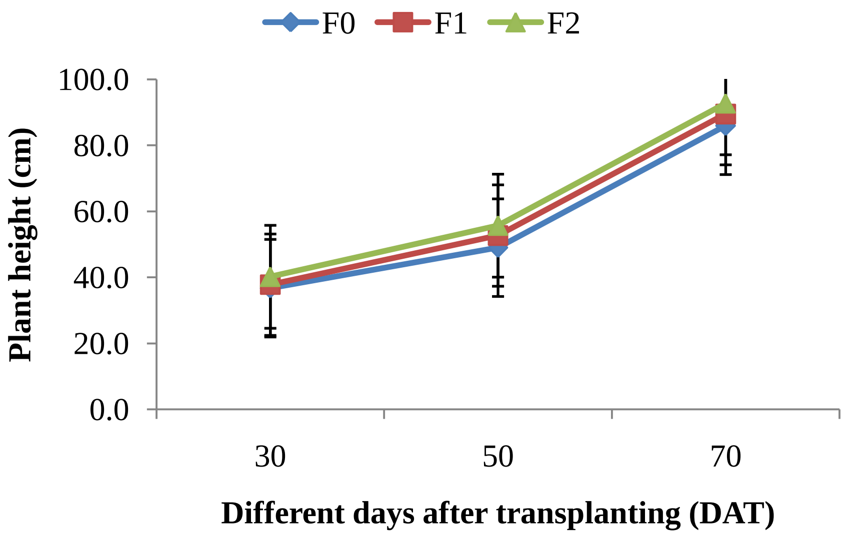

Figure 3. Effect of different micronutrients on plant height of gladiolus (F_0 = No micronutrient application, F_1 = 0.25 % Boron as foliar spraying and F_3 = 0.25 % Zinc as foliar spraying)

Table 1. Interaction effect of pre soaking of corms with water and different micronutrients on plant height of gladiolus

Treatment combination	Different days after transplanting		
	30	50	70
W_0F_0	33.7 d	45.7 d	81.8 e
W_0F_1	34.0 d	49.7 cd	84.2 e
W_0F_2	36.3 cd	53.3 bc	86.1 de
W_1F_0	36.8 cd	49.3 cd	84.2 e
W_1F_1	38.0 b-d	52.3 bc	87.1 c-e
W_1F_2	39.8 bc	54.0 bc	92.8 a-c
W_2F_0	39.7 bc	52.0 bc	91.8 b-d
W_2F_1	41.3 ab	56.0 ab	97.2 ab
W_2F_2	44.3 a	59.7 a	99.3 a
LSD $_{(0.05)}$	**4.4**	**5.7**	**6.7**
CV (%)	**6.7**	**6.2**	**4.3**

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

W_0 = No water treatment (control), F_0 = No micronutrient application,
W_1 = Pre soaking with normal water and F_1 = 0.25 % Boron as foliar spraying and
W_2 = Pre soaking with 50^0C hot water F_3 = 0.25 % Zinc as foliar spraying

4.3 Leaf area plant^{-1} (cm^2)

Significant differences were noticed on leaf area plant^{-1} when corms were presoaked by water (Figure 4). Largest leaf area plant^{-1} were recorded (114.2 cm²) for hot water soaking corm and smallest leaf area plant^{-1} were recorded (100.1 cm²) when corm were not presoaked with any water.

The application of micronutrient showed significant differences with respect to leaf area plant^{-1} (Figure 5). The maximum leaf area plant^{-1} (113.3 cm²) was recorded in F_2 which was statistically different from others. The minimum was recorded in F_0 (100.6 cm^2). These results are in close conformity with Chopde *et al.* (2015).

Interaction effect between pre soaking of corms with water and micronutrients showed significant differences on leaf area plant^{-1} of gladiolus (Table 2). Largest leaf area plant^{-1} were recorded in W_2F_2 (120.2 cm^2) which was statistically similar with W_2F_1 but different from others. Smallest leaf area plant^{-1} was recorded in W_0F_0 (95.0 cm^2).

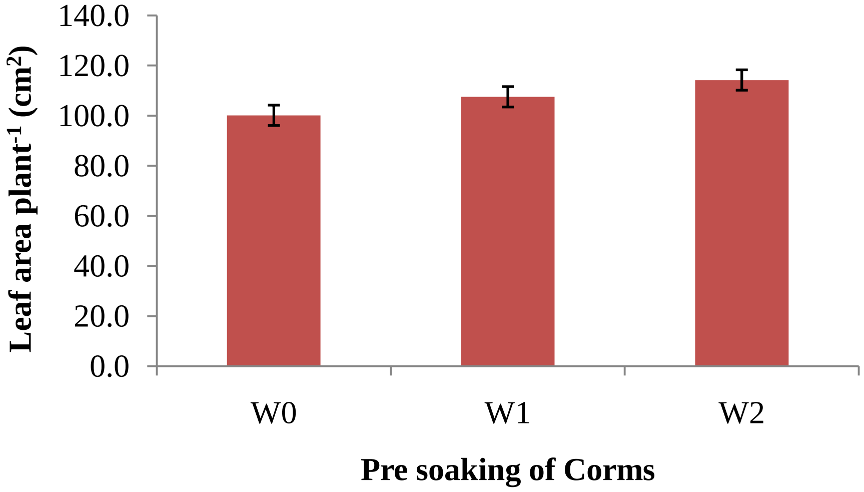

Figure 4. Effect of pre soaking of corms with water on leaf area plant^{-1} of gladiolus (W_0 = No water treatment (control), W_1 = Pre soaking with normal water and W_2 = Pre soaking with 50^{0}C hot water)

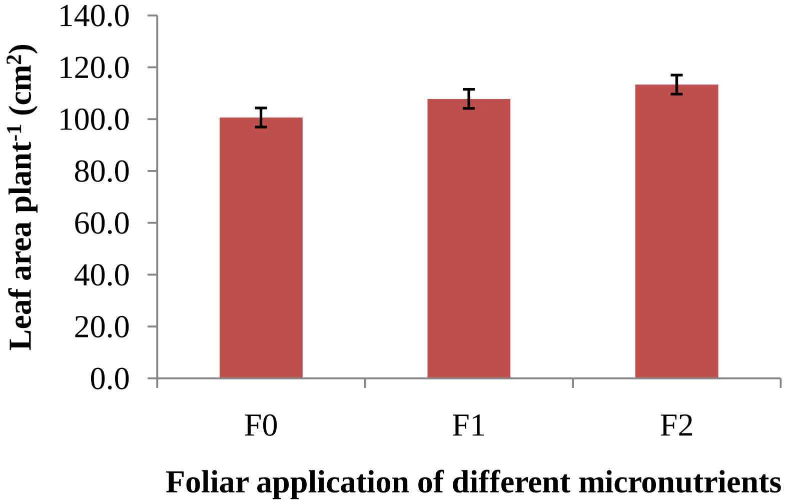

Figure 5. Effect of different micronutrients on leaf area plant^{-1} of gladiolus (F_0 = No micronutrient application, F_1 = 0.25 % Boron as foliar spraying and F_3 = 0.25 % Zinc as foliar spraying)

4.4 Chlorophyll content on leaf (%)

Significant differences were noticed on chlorophyll content on leaf when corms were presoaked by water (Figure 6). Higher chlorophyll content on leaf were recorded (101.9) for hot water soaking corm and lower chlorophyll content on leaf were recorded (82.1) when corm were not presoaked with any water.

The application of micronutrients showed significant differences with respect to chlorophyll content on leaf (Figure 7). The higher chlorophyll content on leaf (103.4) was recorded in F_{2}. The lower was recorded in F_0 (78.7).

Interaction effect between pre soaking of corms with water and micronutrients showed significant differences on chlorophyll content on leaf of gladiolus (Table 2). Higher chlorophyll content on leaf were recorded in W_2F_2 (113.7) and lower chlorophyll content on leaf were recorded in W_0F_0 (64.8).

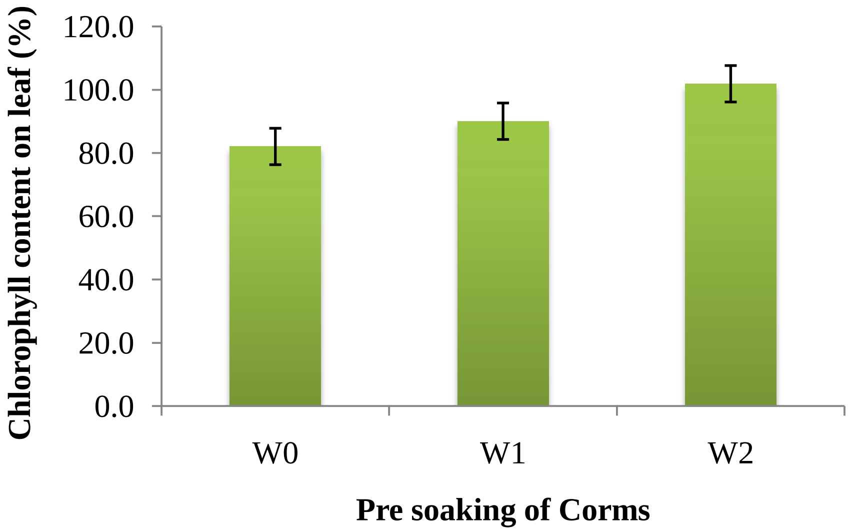

Figure 6. Effect of pre soaking of corms with water on chlorophyll content on leaf of gladiolus (W_0 = No water treatment (control), W_1 = Pre soaking with normal water and W_2 = Pre soaking with 50^0C hot water)

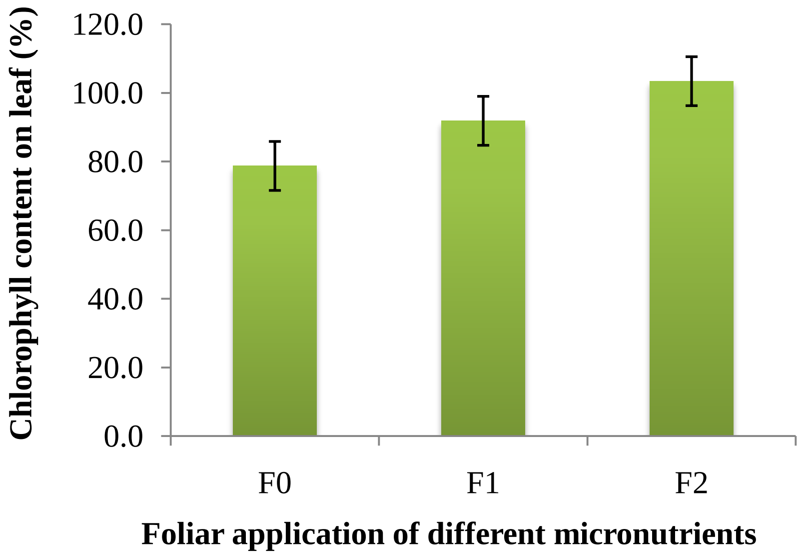

Figure 7. Effect of different micronutrients on chlorophyll content on leaf of gladiolus (F_0 = No micronutrient application, F_1 = 0.25 % Boron as foliar spraying and F_3 = 0.25 % Zinc as foliar spraying)

4.5 Number of days taken for full blooming of basal floret:

Significant differences were found on number of days taken for full blooming of basal floret when corms were presoaked by water (Figure 8). It was observed that minimum number of days were required for full bloom of basal floret was recorded in W_2 (68.1 days) which is statistically identical with W_1. Whereas maximum (72.3) days taken for full blooming was recorded from W_0. Likewise, pre soaking of corms at the hot water significantly shortened the time taken from planting to flowering in *Iris* sp. Taha (2012).

There were significant differences among the different micronutrients with respect to days to fool bloom of basal floret (Figure 9). It was observed that longer days taken for basal floret opening by F_0 (72.0 days) whereas shorter days from F_2 (68.6 days).

Combined effect of pre soaking of corms with water and micronutrients on days to fool bloom of basal floret showed significant variation (Table 2). It was observed that the minimum days required for basal floret blooming was recorded in W_2F_2 (65.7 days) which was statistically identical with W_1F_2 and W_2F_1; whereas the maximum was observed from W_0F_0 (74.0 days).

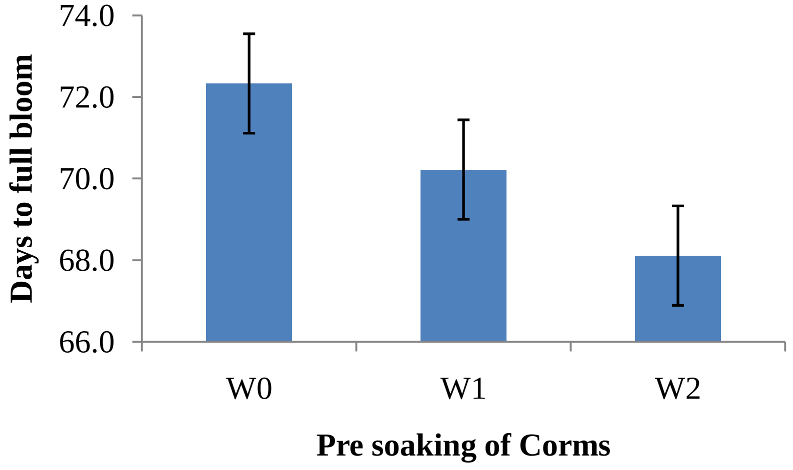

Figure 8. Effect of pre soaking of corms with water on days to full bloom of gladiolus (W_0 = No water treatment (control), W_1 = Pre soaking with normal water and W_2 = Pre soaking with 50^0C hot water)

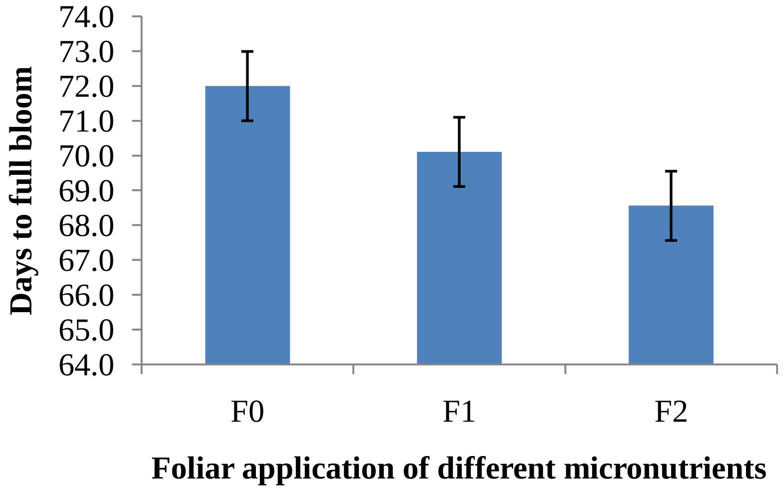

Figure 9. Effect of different micronutrients on days to full bloom of gladiolus (F_0 = No micronutrient application, F_1 = 0.25 % Boron as foliar spraying and F_3 = 0.25 % Zinc as foliar spraying)

Table 2. Interaction effect of pre soaking of corms with water and different micronutrients on leaf area plant^{-1} (cm^2), chlorophyll% of leaf and days to full bloom of gladiolus

Treatment combination	Leaf area Plant^{-1} (cm^2)	Chlorophyll content on leaf (%)	Days to full bloom
W_0F_0	95.0 e	64.8 f	74.0 a
W_0F_1	99.2 e	86.3 de	72.0 ab
W_0F_2	106.3 d	95.1 b-d	71.0 ab
W_1F_0	100.4 e	76.9 e	71.7 ab
W_1F_1	108.5 cd	91.7 cd	70.0 b
W_1F_2	113.5 bc	101.6 b	69.0 bc
W_2F_0	106.6 d	94.4 b-d	70.3 ab
W_2F_1	115.8 ab	97.6 bc	68.3 bc
W_2F_2	120.2 a	113.7 a	65.7 c
LSD $_{(0.05)}$	**5.8**	**9.5**	**3.8**
CV (%)	**3.1**	**6.0**	**3.1**

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

W_0 = No water treatment (control),
W_1 = Pre soaking with normal water and
W_2 = Pre soaking with 50^{0}C hot water

F_0 = No micronutrient application,
F_1 = 0.25 % Boron as foliar spraying and
F_3 = 0.25 % Zinc as foliar spraying

4.6 Diameter of basal floret (cm)

Diameter of florets indicating that with the incensement of plant height this associated character could be improved (Kumar *et al*., 2012). Maximum diameter of basal floret was found in W_2 (11.2 cm) whereas minimum from W_0 (9.4 cm) (Figure 10). These results are in consonance with findings of Kumar *et al.* (2012).

There were significant differences among the different micronutrients with respect to the diameter of basal floret (Figure 11). It was observed that maximum diameter of basal floret was found in F_2 (10.9 cm) whereas minimum from F_0 (9.6 cm).

Combined effect of pre soaking of corms with water and micronutrients on the diameter of basal floret showed significant variation (Table 3). Maximum basal floret diameter was recorded in W_2F_2 (12.0 cm) which was statistically similar with W_1F_2 and W_2F_1 while minimum basal floret diameter was recorded with W_0F_0 (8.9 cm).

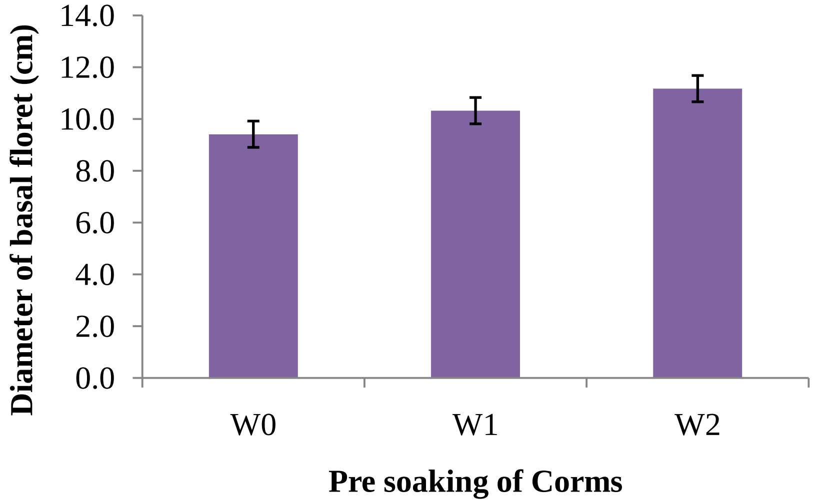

Figure 10. Effect of pre soaking of corms with water on diameter of basal floret of gladiolus (W_0 = No water treatment (control), W_1 = Pre soaking with normal water and W_2 = Pre soaking with 50^0C hot water)

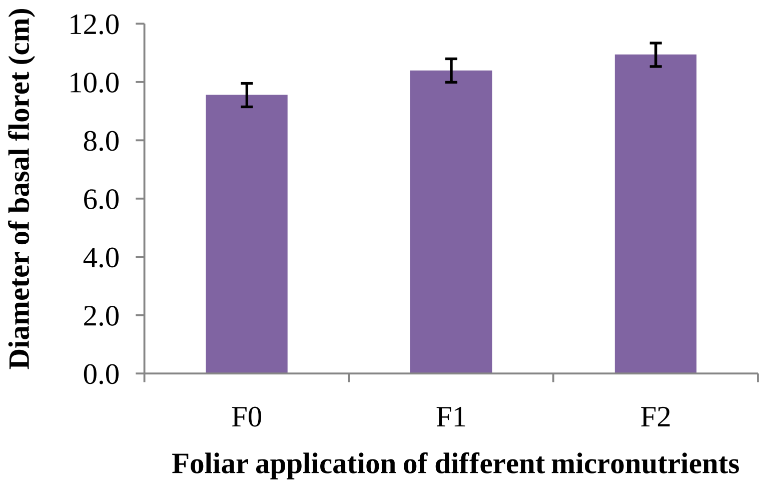

Figure 11. Effect of different micronutrients on diameter of basal floret of gladiolus (F_0 = No micronutrient application, F_1 = 0.25 % Boron as foliar spraying and F_3 = 0.25 % Zinc as foliar spraying)

4.7 Diameter of spike (cm)

Significant differences were noticed for diameter of spike of gladiolus by pre soaking of corms with water (Figure 12). Maximum diameter of spike was found in W_2 (12.0 cm) whereas minimum from W_0 (10.1 cm).

There were significant differences among the different micronutrients with respect to the diameter of spike (Figure 13). It was observed that maximum diameter of spike was found in F_2 (12.1 cm) whereas the minimum from F_0 (10.3 cm).

Combined effect of pre soaking of corms with water and micronutrients on the diameter of spike showed significant variation (Table 3). Maximum diameter of spike was recorded in W_2F_2 (13.1 cm) which was statistically similar with W_1F_2 and W_2F_1 while minimum was recorded with W_0F_0 (9.1 cm).

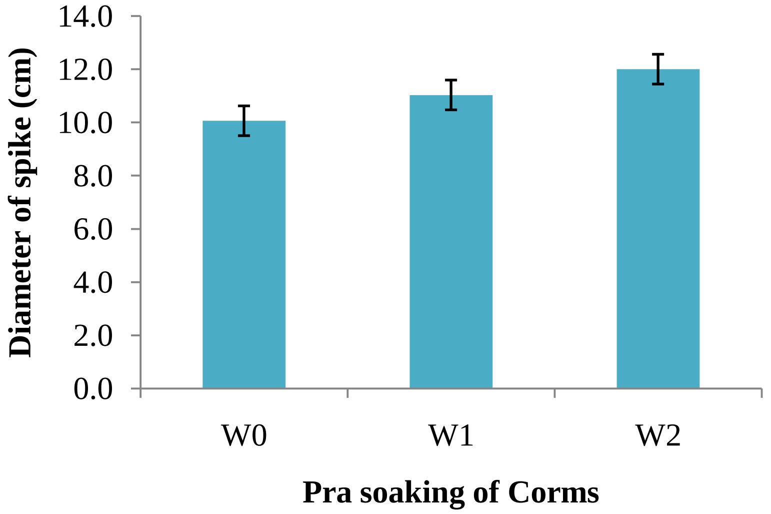

Figure 12. Effect of pre soaking of corms with water on diameter of spike of gladiolus (W_0 = No water treatment (control), W_1 = Pre soaking with normal water and W_2 = Pre soaking with 50^0C hot water)

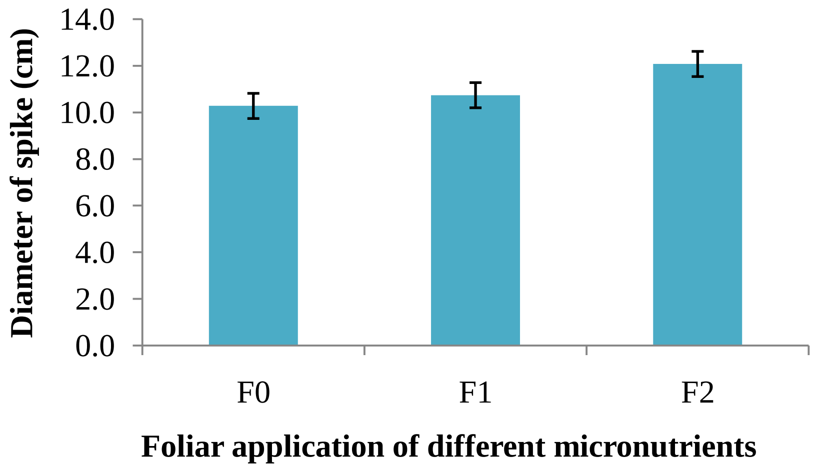

Figure 13. Effect of different micronutrients on diameter of spike of gladiolus (F_0 = No micronutrient application, F_1 = 0.25 % Boron as foliar spraying and F_3 = 0.25 % Zinc as foliar spraying)

4.8 Length of spike (cm)

Significant differences were noticed for length of spike (cm) of gladiolus by different level of water concentration (Figure 14). Length of spike (cm) was observed highest in case of W_2 (68.4 cm) which was significantly different from other treatments. Shortest length of spike was observed in W_0 (58.4 cm). These findings are agreement with Padmalatha *et al.* (2014); Bhalla and Kumar (2008).

The use of micronutrients was significantly influenced the length of spike of gladiolus (Figure 15). Longest spike was recorded in F_2 (65.8 cm) whereas shortest spike length in F_0 (61.2 cm). These findings are agreement with Chopde *et al.* (2015) and Katiyar *et al.* (2012).

Combined effect of pre soaking of corms with water and micronutrients on the length of spike showed significant variation (Table 3). Highest length of spike was recorded in W_2F_2 (70.7 cm) which was statistically similar with W_2F_1 while minimum was recorded with W_0F_0 (55.7 cm).

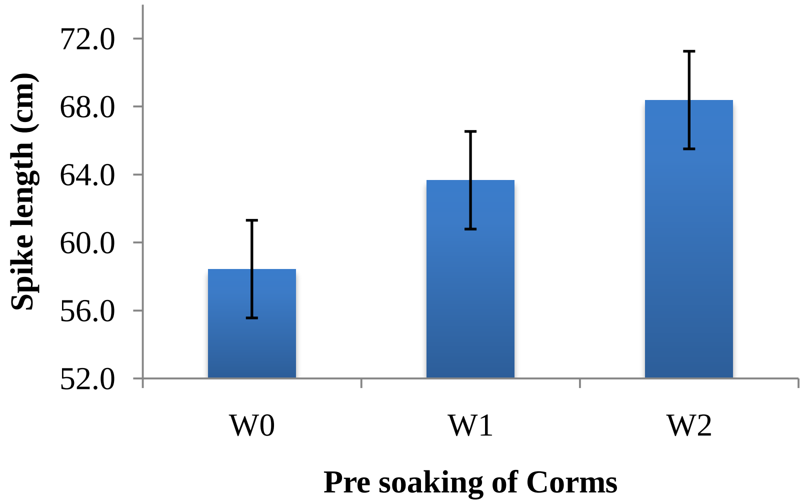

Figure 14. Effect of pre soaking of corms with water on spike length of gladiolus (W_0 = No water treatment (control), W_1 = Pre soaking with normal water and W_2 = Pre soaking with 50^0C hot water)

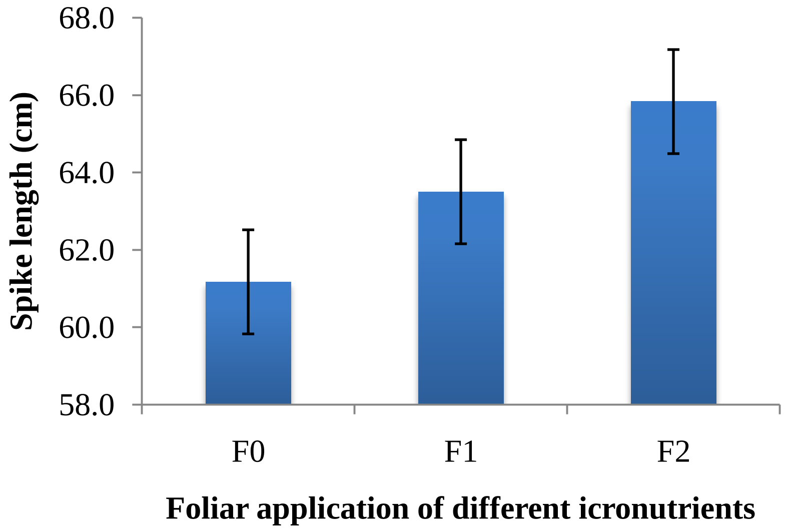

Figure 15. Effect of different micronutrients on spike length of gladiolus (F_0 = No micronutrient application, F_1 = 0.25 % Boron as foliar spraying and F_3 = 0.25 % Zinc as foliar spraying)

Table 3. Interaction effect of pre soaking of corms with water and different micronutrients on diameter of basal floret, diameter of spike and length of spike of gladiolus

Treatment combination	Diameter of basal floret (cm)	Diameter of spike (cm)	Spike length (cm)
W_0F_0	8.9 e	9.1 d	55.7 e
W_0F_1	9.5 de	9.9 cd	58.2 de
W_0F_2	9.8 de	11.2 bc	61.5 cd
W_1F_0	9.6 de	10.5 b-d	62.0 cd
W_1F_1	10.3 b-d	10.7 b-d	63.7 c
W_1F_2	11.0 a-c	12.0 ab	65.3 bc
W_2F_0	10.2 cd	11.3 bc	65.8 bc
W_2F_1	11.3 ab	11.6 a-c	68.7 ab
W_2F_2	12.0 a	13.1 a	70.7 a
$LSD_{(0.05)}$	**1.1**	**1.8**	**4.6**
CV (%)	**6.3**	**9.2**	**4.2**

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

W_0 = No water treatment (control), F_0 = No micronutrient application,
W_1 = Pre soaking with normal water and F_1 = 0.25 % Boron as foliar spraying and
W_2 = Pre soaking with 50^{0}C hot water F_3 = 0.25 % Zinc as foliar spraying

4.9 Number of floret spike^{-1}

Significant differences were found among the corm pre soaking with water according to different level on number of floret spike^{-1} (Figure 16). The maximum number of floret spike^{-1} (11.3) was recorded when corm were presoaked with hot water and minimum number of floret spike^{-1} (8.6) was recorded when corm were not presoaked with any water. Similar observation was also reported by Padmalatha *et al.* (2014).

Number of floret spike^{-1} was significantly influenced by the different micronutrients (Figure 17). Maximum number of floret spike^{-1} were recorded in F_2 (11.0) whereas minimum in F_0 (8.8). This result is in agreement with the findings of Chopde *et al.* (2015), Maurya and Kumar (2014), Kumar *et al.* (2012) and Reddy and Rao (2009).

Interaction effect of corm pre soaking with water and micronutrients showed significant differences for number of floret spike^{-1} of gladiolus among the treatments (Table 4). The maximum number of floret spike^{-1} was recorded in W_2F_2 (12.7) which were statistically at par with W_2F_1. On the other hand, the minimum numbers of floret spike^{-1} W_0F_0 (7.7).

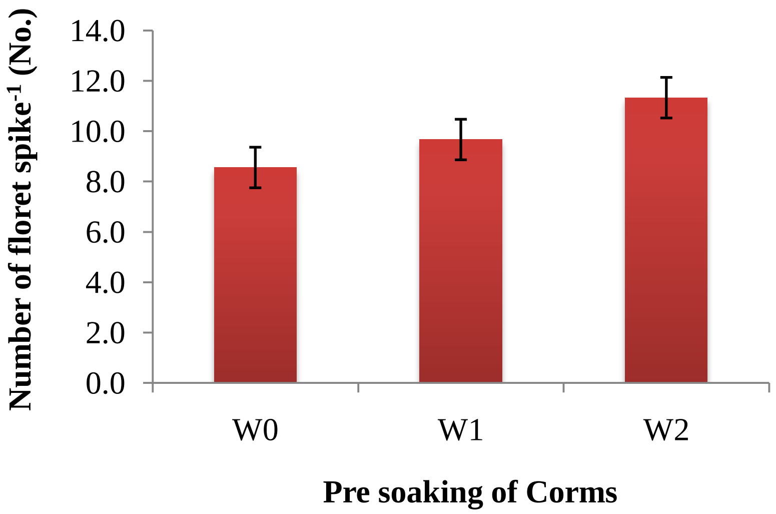

Figure 16. Effect of pre soaking of corms with water on number of floret spike^{-1} of gladiolus (W_0 = No water treatment (control), W_1 = Pre soaking with normal water and W_2 = Pre soaking with 50^0C hot water)

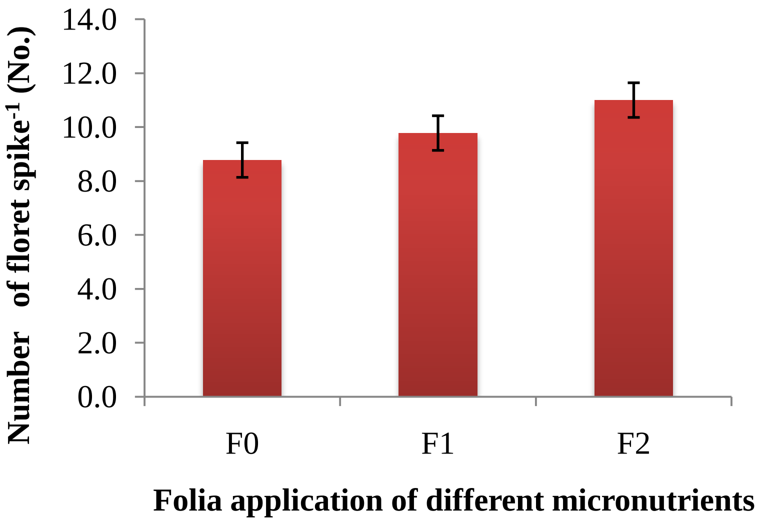

Figure 17. Effect of different micronutrients on number of floret spike^{-1} of gladiolus (F_0 = No micronutrient application, F_1 = 0.25 % Boron as foliar spraying and F_3 = 0.25 % Zinc as foliar spraying)

4.10 Number of corm plot^{-1}

Significant differences were noticed when corm were presoaked with water for with respect to number of corms plot^{-1} (Figure 18). The maximum number of corms plot^{-1} was recorded in W_2 (18.9). The minimum number of corms plot^{-1} was recorded in W_0 (14.0). This result is also coincided with the result of Bhalla and Kumar (2008).

Use of micronutrients showed significant differences with respect to number of corms plot^{-1} (Figure 19). The higher number of corm was observed in F_2 (18.2) and the lower in F_0 (14.4). This result is agreed Maurya and Kumar (2014), Sudhakar and Kumar (2012) and Reddy *et al.* (2009).

The interaction effect of corm presoaked with water and micronutrients on number of corm plot^{-1} of gladiolus plant was significantly influenced (Table 05). It was observed that the maximum number of corm plot^{-1} was recorded in W_2F_2 (20.3) and minimum in W_0F_0 (12.0).

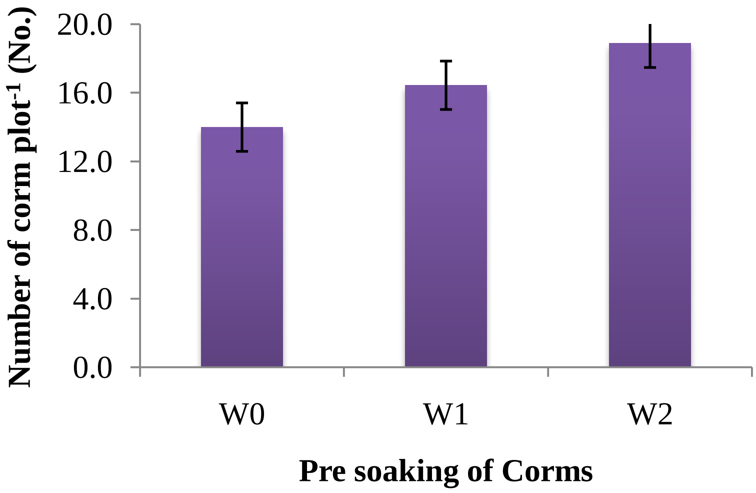

Figure 18. Effect of pre soaking of corm with water on number of corm plot^{-1} of gladiolus (W_0 = No water treatment (control), W_1 = Pre soaking with normal water and W_2 = Pre soaking with 50^0C hot water)

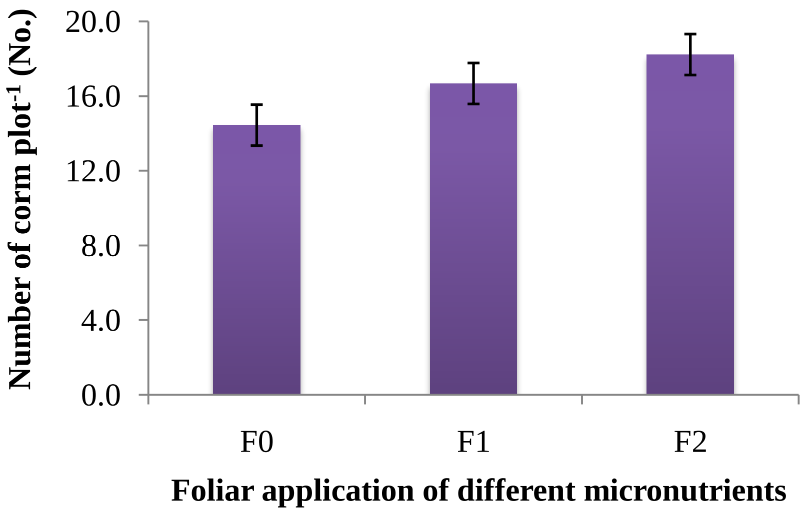

Figure 19. Effect of different micronutrients on number of corm plot^{-1} of gladiolus (F_0 = No micronutrient application, F_1 = 0.25 % Boron as foliar spraying and F_3 = 0.25 % Zinc as foliar spraying)

4.11 Number of cormels plot^{-1}

Significant differences were noticed when corm were presoaked by water with respect to number of cormels plot^{-1} (Figure 20). Maximum number of cormel (17.0) were produced when corm were treated with hot water and lower number from W_0 (11.0). The result agrees with the findings of Padmalatha *et al.* (2014); Bald and Markley (1955).

Significant differences were found due to micronutrients with respect to number of cormels plot^{-1} (Figure 21). Maximum number of cormels (16.1) was produced in F_2 and lower number in F_0 (11.4). The result agrees with the findings of Chopde *et al.* (2015), Maurya and Kumar (2014), Kumar *et al.* (2012) and Reddy and Rao (2009).

The interaction effect of corm presoaked with water and micronutrients on number of cormels plot^{-1} of gladiolus plant was significantly influenced (Table 4). The maximum number of cormels plot^{-1} (19.3) was recorded from W_2F_2 whiles the minimum from W_0F_0 (9.7).

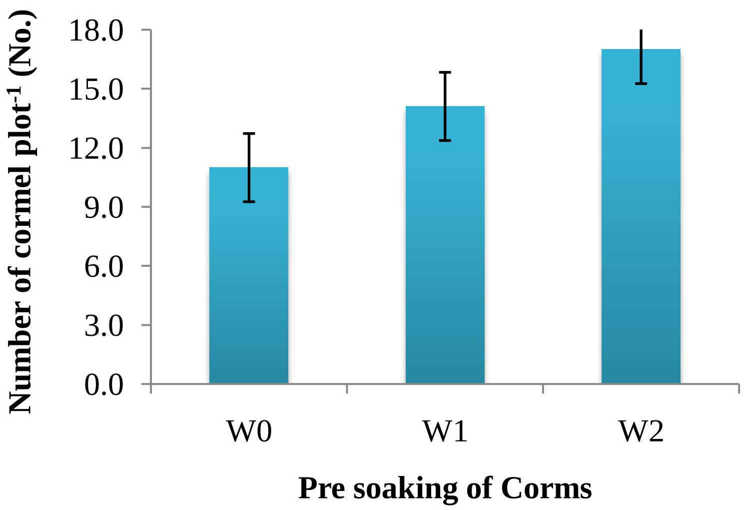

Figure 20. Effect of pre soaking of corm with water on number of cormels plot^{-1} of gladiolus (W_0 = No water treatment (control), W_1 = Pre soaking with normal water and W_2 = Pre soaking with 50^0C hot water)

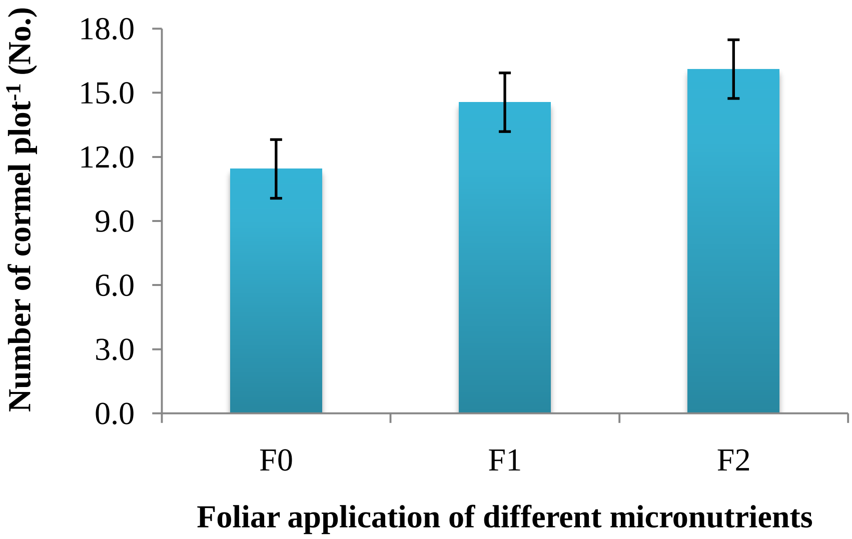

Figure 21. Effect of different micronutrients on number of cormels plot^{-1} of gladiolus (F_0 = No micronutrient application, F_1 = 0.25 % Boron as foliar spraying and F_3 = 0.25 % Zinc as foliar spraying)

4.12 Yield of corm (t ha^{-1})

Corm yield per hectare varied significantly due to pre-soaking of corms with water (Figure 22). The highest corm yield (8.8 t ha^{-1}) was recorded from corm treated with hot water while the lowest (5.7 t ha^{-1}) was recorded from corm treated without any water. These results are in agreement with the findings of Padmalatha *et al.* (2014).

Significant variation was recorded in terms of corm yield per hectare for micronutrients (Figure 23). The highest corm yield was recorded F_2 (8.6 t ha^{-1}) while the lowest F_0 (5.6 t ha^{-1}). The result is in agreement with the findings of Chopde *et al.* (2015), Maurya and Kumar (2014) and Kumar *et al.* (2012).

Interaction effect showed significant variation on corm yield per hectare of gladiolus (Table 4). The highest corm yield was recorded from W_2F_2 (10.6 t ha^{-1}) while the lowest from W_0F_0 (4.3 t ha^{-1}).

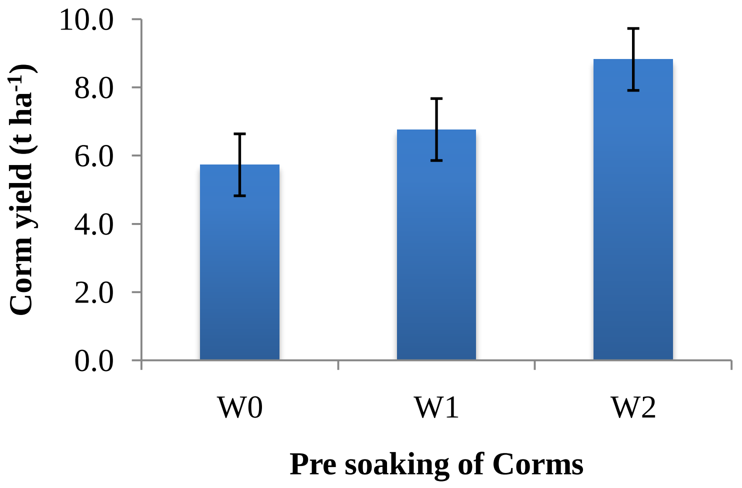

Figure 22. Effect of pre soaking of corm with water on corm yield of gladiolus (W_0 = No water treatment (control), W_1 = Pre soaking with normal water and W_2 = Pre soaking with 50^0C hot water)

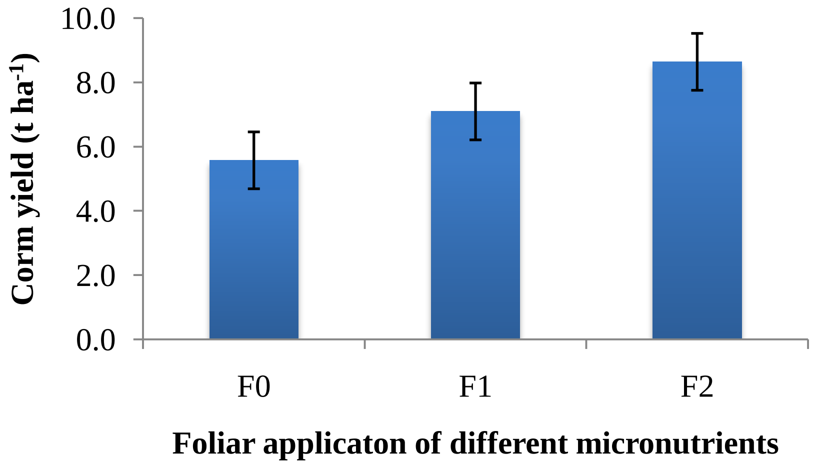

Figure 23. Effect of different micronutrients on corm yield of gladiolus (F_0 = No micronutrient application, F_1 = 0.25 % Boron as foliar spraying and F_3 = 0.25 % Zinc as foliar spraying)

Table 04. Interaction effect of pre soaking of corms with water and different micronutrients on number of floret spike^{-1}, corms plot^{-1}, cormels plot^{-1} and corm yield of gladiolus

Treatment combination	Florets spike^{-1} (No.)	Corms plot^{-1} (No.)	Cormels plot^{-1} (No.)	Corm yield (t ha^{-1})
W_0F_0	7.7 d	12.0 e	9.7 f	4.3 e
W_0F_1	8.3 cd	14.0 de	11.0 d-f	6.0 cd
W_0F_2	9.7 bc	16.0 cd	12.3 c-f	6.8 c
W_1F_0	8.3 cd	14.0 de	10.3 ef	5.2 de
W_1F_1	10.0 bc	17.0 bc	15.3 a-d	6.6 c
W_1F_2	10.7 b	18.3 ab	16.7 a-c	8.5 b
W_2F_0	10.3 b	17.3 bc	14.1 b-e	7.2 c
W_2F_1	11.0 ab	19.0 ab	17.3 ab	8.7 b
W_2F_2	12.7 a	20.3 a	19.3 a	10.6 a
LSD $_{(0.05)}$	**2.0**	**2.3**	**4.5**	**1.2**
CV (%)	**11.5**	**7.9**	**18.4**	**9.9**

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

W_0 = No water treatment (control),
W_1 = Pre soaking with normal water and
W_2 = Pre soaking with 50^{0}C hot water

F_0 = No micronutrient application,
F_1 = 0.25 % Boron as foliar spraying and
F_3 = 0.25 % Zinc as foliar spraying

CHAPTER V

SUMMARY AND CONCLUSION

5.1 Summary

The present investigations entitled "Effect of pre soaking of corms with water and different micronutrients on growth and yield of gladiolus" was conducted at Sher-e-Bangla Agricultural University, Dhaka during the period from October, 2013 to March 2014. The study was undertaken with the objective of investigate the effect of pre soaking of corms with water and different micronutrients on growth and yield of gladiolus.

The experiment was comprised with two factors viz. (1) Factor A: Pre soaking of corms with water i.e. i) W_0 = No water treatment (control), ii) W_1 = Pre soaking with normal water, iii) W_2 = Pre soaking with 50^0C hot water and (2) Factor B: Different micronutrients i.e. i) F_0 = No micronutrient application (control), ii) F_1 = 0.25 % Boron as foliar spraying, iii) F_2 = 0.25 % Zinc as foliar spraying. There were on the whole 3 × (3×3) = 27 treatments combinations. The experiment was laid out in split plot design with three replications. The results thus obtained are summarized below:

There was significant difference on days to germination percentage and plant height (cm) with corm pre soaking by water and different doses of micronutrients and also with their interaction. Pre soaking of corms with hot water showed the lowest days to germination percentage (12.7 days) and highest plant height (96.1 cm at 70 DAT) where control treatment showed maximum days to germination percentage (20.6 days) and lowest plant height (84.0 cm at 70 DAT). On the other hand, it was also observed that the minimum days to germination percentage (11.0 days) was recorded with the treatment combination of W_2F_2. Combination of W_0F_0 requires maximum days to germination (22.0 days). The highest plant height were recorded with combination of W_2F_2 (99.3 cm at 70 DAT) and the lowest was W_0F_0 (81.8 cm at 70 DAT).

The results under the present study revealed that there was significant effect of pre soaking of corms with water on leaf area (cm^2), chlorophyll% of leaf, days to full bloom of basal floret, diameter of basal floret (cm), diameter of spike (cm), length of spike (cm), number of floret $spike^{-1}$, number of corm $plot^{-1}$, number of cormels $plot^{-1}$ and corm yield (t ha^{-1}) of gladiolus. Highest and lowest results were observed on leaf area (114.2 and 100.1 cm^2), chlorophyll% of leaf (101.9 and 82.1), diameter of basal floret (11.2 and 9.4 cm), diameter of spike (12.0 and 10.1 cm), length of spike (68.39 and 58.44 cm), number of floret $spike^{-1}$ (11.3 and 8.6), number of corms $plot^{-1}$ (18.9 and 14.0), number of cormels $plot^{-1}$ (17.0 and 11.0) and corm yield (8.8 and 5.7 t ha^{-1}) in W_2 and W_0, respectively. Maximum and minimum days to full bloom of basal floret were observed (72.3 and 68.1 days) in W_0 and W_2, respectively.

Different levels of micronutrients was significant on leaf area (cm^2), chlorophyll% of leaf, days to full bloom of basal floret, diameter of basal floret (cm), diameter of spike (cm), length of spike (cm), number of floret $plot^{-1}$, number of corms $plot^{-1}$, number of cormels $plot^{-1}$ and corm yield (t ha^{-1}) of gladiolus. Highest and lowest results were observed on leaf area (113.3 and 100.6 cm^2), chlorophyll% of leaf (103.4 and 78.7), diameter of basal floret (10.9 and 9.6 cm), diameter of spike (12.1 and 10.3 cm), length of spike (65.8 and 61.2 cm), number of floret $spike^{-1}$ (11.0 and 8.8), number of corm $plot^{-1}$ (18.2 and 14.4), number of cormels $plot^{-1}$ (16.1 and 11.4) and corm yield (8.6 and 5.6 t ha^{-1}) in F_2 and F_0, respectively. Maximum and minimum days to full bloom of basal floret were observed (72.0 and 68.6 days) in F_0 and F_2, respectively.

Different parameters were also significantly influenced by interaction effect of pre soaking of corms with water and different micronutrients. Highest and lowest results were observed on leaf area (120.2 and 95.0 cm^2), chlorophyll%

of leaf (113.7 and 64.8), diameter of basal floret (12.0 and 8.9 cm), diameter of spike (13.1 and 9.1 cm), length of spike (70.7 and 55.7 cm), number of floret spike^{-1} (12.7 and 7.7), number of corm plot^{-1} (20.3 and 12.0), number of cormels plot^{-1} (19.3 and 9.7) and corm yield (10.6 and 4.3 t ha^{-1}) in W_2F_2 and W_0F_0, respectively. Maximum and minimum days to full bloom of basal floret were observed (74.0 and 65.7 days) in W_0F_0 and W_2F_2, respectively.

5.2 Conclusion

Considering the above discussion it may be concluded that

- In the experiment, better performance was observed for the pre-soaking of corms with hot water.

- 0.25 % Zinc as foliar spraying showed the better performance than 0.25 % Boron as foliar spraying.

- The treatment under the study, W_2F_2 is the best and W_2F_1 performed near about W_2F_2 for growth, flowering and yield of gladiolus.

- Several experiments can be carried with pre-soaking of corms by water and different micronutrients to get other results.

- Considering the present situation of the experiment further studies might be conducted at different Agro-Ecological Zone (AEZ) of Bangladesh for regional adaptability and other performances.

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APPENDICES

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

A. Morphological characteristics of the experimental field

Morphological features	Characteristics
Location	Horticulture garden, Sher-e-Bangla Agricultural University, Dhaka
AEZ	AEZ-28, Modhupur Tract
General Soil Type	Shallow Red Brown Terrace Soil
Land type	Medium high land
Flood level	Above flood level
Drainage	Well drained

B. The initial physical and chemical characteristics of soil of the experimental site (0 - 15 cm depth)

Physical characteristics	
Constituents	**Percent**
Sand	27
Silt	43
Clay	30
Textural class	Silty clay
Chemical characteristics	
Soil characters	**Value**
pH	5.6
Organic carbon (%)	0.5
Organic matter (%)	0.8
Total nitrogen (%)	0.03
Available P (ppm)	20.0
Exchangeable K (me/100 g soil)	0.1
Available S (ppm)	45

Appendix II. Monthly meteorological information during the period from October, 2013 to March, 2014

Year	Month	Air temperature (^{0}C)		Relative humidity (%)	Total rainfall (mm)
		Maximum	Minimum		
2013	October	30.2	14.9	67.8	137
	November	28.1	11.8	58.2	47
	December	25.0	9.5	69.5	0
2014	January	25.2	12.8	69	00
	February	27.3	16.9	66	39
	March	31.7	19.2	57	23

Source: Metrological Centre, Agargaon, Dhaka (Climate Division)

Appendix III. Analysis of variance of the data on plant height (cm) as influenced by combined effect of pre soaking of corms with water and different micronutrients of gladiolus

Source of variation	df	Mean square of plant height (cm) at different days after transplanting		
		30 DAT	50 DAT	70 DAT
Replication	2	2.6	24. 8	47.9
Pre soaking of corms (A)	2	113.8	92.3*	340.8*
Different micronutrients (B)	2	28.0*	100.3*	104.4*
Pre soaking of corms (A) X Micronutrients (B)	4	1.0*	2.3*	6.2*
Error	16	6.5	10.7	15.0

*Significant at 5% level of significance

^{NS} Non significant

Appendix IV. Analysis of variance of the data on days to 80% germination, leaf area plant^{-1} (cm^2), chlorophyll content on leaf (%), days to full bloom, diameter of basal floret (cm) and diameter of spike (cm) as influenced by combined effect of pre soaking of corms with water and different micronutrients of gladiolus

Source of variation	df	Mean square values					
		Days to 80% germination	Leaf area plant^{-1} (cm^2)	Chlorophyll content on leaf (%)	Days to full bloom	Diameter of basal floret (cm)	Diameter of spike (cm)
Replication	2	1.3	23.4	103.8	7.4	0.3	1.1
Pre soaking of corms (A)	2	140.8*	446.9*	893.2*	40.1*	6.9*	8.5*
Different micronutrients (B)	2	13.0*	364.4*	1378.2*	26. 8*	4.4*	7.9*
Pre soaking of corms (A) X Micronutrients (B)	4	1.1*	5.2*	65.9*	1.1*	0.2*	0.1*
Error	16	1.0	11.1	30.3	4.9	0.4	1.0

*Significant at 5% level of significance

^{NS} Non significant

Appendix V. Analysis of variance of the data on spike length (cm), florets spike^{-1} (No.), corms plot^{-1} (No.), cormels plot^{-1} (No.) and corm yield (t ha^{-1}) as influenced by combined effect of pre soaking of corms with water and different micronutrients of gladiolus

Source of variation	df	Mean square values				
		Spike length (cm)	Florets spike^{-1} (No.)	Corms plot^{-1} (No.)	Cormels plot^{-1} (No.)	Corm yield (t ha^{-1})
Replication	2	30.4	1.0	12.4	0.3	0.1
Pre soaking of corms (A)	2	222.7*	17.6*	53.8*	81.0*	22.3*
Different micronutrients (B)	2	49.0*	11.2*	32.4*	50.8*	21.2*
Pre soaking of corms (A) X Micronutrients (B)	4	1.4*	0.3*	0.6*	3.5*	0.4*
Error	16	7.2	1.3	1.7	6.7	0.5

*Significant at 5% level of significance

^{NS} Non significant

PLATES

Plate 2. General view of the experimental field

Plate 3. Florets of gladiolus