INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print), 2222-5234 (Online)
http://www.innspub.net
Vol. 15, No. 5, p. 267-274, 2019

RESEARCH PAPER OPEN ACCESS

Influence of Boric acid and Iron Sulphate on vegetative, floral and bulbous growth of White Dutch Iris

Shahid Nadeem[1*], Noor Alam Khan[1], Hussain Shah[2], Asma Hamid[3], Muhammad Kashif Bakhtiar[4]

[1]*Horticulture Research Institute, National Agricultural Research Centre, Islamabad, Pakistan*

[2]*Plants Sciences Division, Pakistan Agricultural Research Council, Islamabad, Pakistan*

[3]*Faculty of Food and Crop Science, Department of Horticulture Sciences, PMAS-Arid Agriculture, Rawalpindi, Pakistan*

[4]*Department of Agriculture, Abdul Wali Khan University Mardan, Pakistan*

Key words: Dutch Iris, Boric acid, Iron sulfate, Geophytes, Growth.

http://dx.doi.org/10.12692/ijb/15.5.267-274 Article published on November 15, 2019

Abstract

Dutch Irises are popular bulbous plants which are used as cut flowers because of their attractive appearance and comparatively long-lasting vase life. Likewise, other bulbous plants they also need additional micronutrients to maintain their healthier life. However, this study aimed to investigate the effect of two micronutrients Boric Acid (H_3BO_3) and Iron Sulphate ($FeSO_4$) on morphological and bulbous growth of White Dutch Iris. The experiment was designed according to Randomized Complete Block Design (RCBD) with six treatments and three replications. The study had shown that foliar application of 1% H_3BO_3 along with 1% $FeSO_4$ had a significant impact on vegetative as well as floral growth in iris plants owing to maximum plant height ($75.11^a \pm 0.19$cm), similarly the increment in leaf length ($81.66^a \pm 0.58$cm), longest spike length ($64.66^a \pm 1.15$cm) and rachis length ($40.66^a \pm 0.67$cm) was observed. The number of leaves ($9.66^a \pm 0.33$) and number of florets/spike ($3.67^a \pm 0.00$) also enhanced but the number of days to bud color ($157.45^d \pm 0.69$) and floret open ($158.89^c \pm 0.77$) reduced expressively by the use of this combination, while the growth of controlled treatment showed poor results. Foliar spray of 2% H_3BO_3 was found highly effective to produce largest size of bulb ($3.52^a \pm 0.34$cm) as well as maximum number of bulbs ($6.60^a \pm 0.20$) while the weight of the bulb ($31.66^a \pm 0.42$g) was found maximum. In conclusion, the impression of iron sulphate was positive as enhanced the floral growth and improves the bulbous characteristics while the combination of boric acid and Iron sulphate had positive affect on the overall growth of White Dutch Iris.

* **Corresponding Author:** Shahid Nadeem ✉ shahidnarc@gmail.com

Introduction

Geophytes have turned to be vital segments of floriculture because of their pleasant aromas, attractive floras and effortless care (Yazici *et al.,* 2016). Furthest, they include tulip, irises, hyacinth, daffodil and day lilies. Irises stand an imperative position among all bulbous ornamental flowers cultivated in temperate regions and fits in Iridaceae family. Helvey (2009) reported that they were even recognized in antique Europe and introduced in gardens throughout the primitive eras. As indication derived their illustrations in art and several written books related to their use.

Royal Horticulture Society, revealed that bared-less irises have more economical value because of its perennial nature, bearing slender grass like leaves with erect stalk taking floras of 3 large scattering fall and 3 smaller erect petals. They stand favorite spring ornamental flowers for their attractive appearance as well as eco-friendly behavior in addition to improve the soil stability (Crişan *et al.,* 2017) but the cultivation of iris is also depending on further factors such as temperature, light, water and agrochemicals similarly macro and micro nutrients. No doubt both have characters in the growth of bulbous flowering plants, regardless of macronutrients; micronutrients as well have a great impact on plant metabolic actions for healthier progress and their shortage cause decline in production as well as quality of flowers (Lahijie, 2012).

Iron takes part in respiration and struggles as O_2 carrier (Mamatha, 2007) while boron acts as stabilizer of cell wall pectin system (Dordas and Brown, 2005) and helps in firmness of cell wall construction with possible involvement in the integrity of the plasma membrane (Cara *et al.*, 2002). Lilies respond with a great increment in plant height, leaf area, spike weight and chlorophyll content when treated with $FeSO_4$ (Singh *et al.,* 2015), similar trends were also observed in gladiolus with foliar application of Zn (Sharma *et al.,* 2013). A positive effect of zinc sulphate and iron sulphate on flower quality traits of tuberose was detected by (Patel *et al.,* 2017) in term of length of flower spike, rachis length, number of florets per spike and also in-situ longevity of spike on the other hand application of boron along with NPKS is required to achieve higher yield of onion bulbs (Begum *et al.,* 2015). Despite of having all these impressions, essentiality of micronutrients is still not recognized by several flower cultivators' results in nutrient deficiency which badly changes the growth and production of flowers. Therefore, the study was performed to find out the response of different doses of boric acid and iron sulfate on vegetative, floral and bulbous growth in Bared-less/Dutch Irises.

Materials and methods

Experimental site and design

The present research study was conducted at field area of Horticulture Research Institute, National Agricultural Research Centre, and Islamabad, Pakistan during the year of 2018 to 2019. The experiment was replicated thrice according to Randomized Complete Block Design (RCBD) with six treatments. Each replication consisted of 10 plants.

Methodology

Dutch Iris (*Iris × hollandica*) cultivar Wedgewood was selected for field trials and sowed in the 4^{th} week of October on ridges about 2.0-2.5 ft. row to row and 1.0 ft. plant to plant distance respectively. Foliar applications of Boric Acid (H_3BO_3) and Iron Sulphate ($FeSO_4$) were prepared with different concentrations. Six treatments were applied that is; T_o, control; T_1, 1% H_3BO_3; T_2, 2% H_3BO_3; T_3, 1% $FeSO_4$; T_4, 2% $FeSO_4$; T_5, 1% H_3BO_3 + 1% $FeSO_4$. All standard agricultural cultural practices like irrigation, weeding, hoeing, plant protection measures required for iris production were carried out in all the treatments. Data regarding different parameters of plant such as plant height, length of spike , length of rachis, length of leaf, total weight of bulbs/plant, largest weight of bulb, smallest weight of bulb, largest size of bulb, smallest size of bulb was measured by using measuring tape, electric weighing balance and Vernier scale while other characteristics alike number of leaves , days to spike emergence, days to bud color, days to floret open, total number of bulb

/plant, number of florets /plant was recorded respectively by visual observations.

Statistical analysis

The data collected on different parameter was statistically analyzed by using software statistics 8.1. Analysis of variance and the means were compared at 5% level of significance (Steel *et al.* 1997).

Results and discussion

Effect of Boric acid and Iron sulfate on vegetative growth of White Dutch Iris

Foliar spray of micronutrients on Dutch irises considerably affected all the parameters of vegetative characteristics .The outcomes of the present study suggest that the combination of 1% of H_3BO_3 with 1% $FeSO_4$ produced maximum plant height (75.11^a±0.19 cm) tracked by 1% $FeSO_4$(70.44^b±1.02 cm) and (66.44^c±0.51cm) plant height was detected by mean of 1% H_3BO_3. There have been numerous studies in the literature reporting that foliar application is more advantageous than soil application for plants which are incapable to transfer nutrients from the soil because of several physical or chemical properties of the soil (Singh *et al.*,2015). However, the correlation between 2% H_3BO_3 and 2% $FeSO_4$ is interesting because the results on plant heights were statically a little differed (66.22^c±1.07) and (63.82^d ±0.83cm) respectively.

Table 1. Effect of Boric acid and Iron sulfate on vegetative growth of White Dutch Iris.

Treatments	Plant height (cm)	No of leaves	Spike emergence days	Leaf length (cm)	Spike length (cm)	Rachis length (cm)
T_o	58.11^e±0.51	6.77^d± 0.51	161.78^a ±1.54	65.0^c± 0.88	49.67^e ± 1.73	30.22^d±1.17
T_1	66.44^c±0.51	7.55^c± 0.51	158.55^b ±0.69	71.33^b±0.88	55.44^d ±1.35	38.33^b±0.58
T_2	66.22^c±1.07	8.22^b ±0.51	158.11^b ±0.19	74.22^b±1.35	57.55^{cd}±0.88	35.11^c±0.19
T_3	70.44^b±1.02	9.22^a ±0.38	156.22^c ±0.38	73.33^b±2.03	61.11^b±1.92	39.11^b±1.07
T_4	63.82^d±0.83	8.44^b±0.19	156.56^c ±0.19	73.78^b±0.84	58.88^{bc}±0.51	34.22^c±0.38
T_5	75.11^e±0.51	9.66^a ±0.33	154.11^d±0.38	81.66^a±0.58	64.66^a±1.15	40.66^a±0.67

The results observed in treatment (T_o) were not at par compared to all the other treatments as gave plant height (58.11^e±0.51cm). Similar results were found by (Hussain and Ahmad, 2018) when the bulbous plants were treated with foliar application of micronutrients and plant's progress was desirable and healthier in relation to plant height.

The present findings also support (Sharma *et al.,* 2013) study which concluded that the height of gladiolus's plant improved through foliar application of Zn, B and Ca (79.55cm, 79.39cm and 78.75cm, respectively) but collaboration outcomes stayed noteworthy between B×Ca, Zn×B and Ca×Zn (79.16cm, 80.34 and 79.22cm, respectively) and the supreme tallness of plant (79.55cm) was achieved by the application of zinc. The research study showed that H_3BO_3 along with $FeSO_4$ wields well qualitative and quantitative effects on plant height as compared to the other treatments (Table1). Estimation of means concerning with number and length of leaves/Plant revealed that foliar spray of 1% H_3BO_3 along with 1% $FeSO_4$ also performed well in this character with (9.66^a± 0.33) leaves number and(81.66^a±0.58 cm) leave length in comparison with average number (9.22^a±0.38) and length (73.33^b±2.0cm) of leaves nourished with 1% $FeSO_4$. The more surprising correlation is with the foliar application of 2% $FeSO_4$ and 2% H_3BO_3 with (8.44^b±0.19 and 8.22^b±0.51) numbers of leaves plant^{-1} and (73.78^b±0.84cm and 74.22^b±1.35 cm) length of leaves correspondingly.

It was found that 1% H_3BO_3 gave the satisfactory number of leaves (7.55^c±0.51) with shorter length (71.33^b±0.88cm**)**. Our findings revealed that controlled section expressed lowest number and length of leaves (6.77^d±0.51 and 65.0^c±0.88cm respectively).

Table 2. Effect of Boric acid and Iron sulphate on floral growth of White Dutch Iris.

Treatments	Days to bud color	No of floret/spike	Days to floret open
T_o	$164.33^{a}\pm1.54$	$2.67^{d}\pm0.00$	$165.67^{a}\pm1.53$
T_1	$160.56^{b}\pm 0.51$	$3.11^{c}\pm0.19$	$162.00^{b}\pm0.33$
T_2	$161.22^{b}\pm0.19$	$3.33^{b}\pm0.00$	$162.56^{b}\pm0.19$
T_3	$158.89^{cd}\pm 0.96$	$3.33^{b}\pm0.00$	$160.22^{c}\pm0.69$
T_4	$160.33^{bc}\pm0.00$	$3.33^{b}\pm0.00$	$161.78^{b}\pm0.19$
T_5	$157.45^{d}\pm 0.69$	$3.67^{a}\pm0.00$	$158.89^{c}\pm0.77$

These findings are consistent with findings of past studies by (Khalifa *et al.,* 2011) which explained that foliar application of H_3BO_3 (0, 5, 10 or 20 ppm) unaided or in several mixtures are pragmatic to increase the number of leaves per plant in Iris. Furthermore, Hussain and Ahmad (2018) disclosed the increment in the number and length of leaves of gladiolus plant by 0.2% $FeSO_4$. Previous research has shown that $ZnSO_4$ at 0.2% also had noticeable flashes on size of elongated leaf with extreme width verified to be 3.63 cm which stood statistically at par with $ZnSO_4$ 0.4% treatment but substantial to further treatments (Singh *al.,* 2012). Lahijie (2012) published a paper in which he described that foliar application of $FeSO_4$ and $ZnSO_4$ (0.5 or 1%) alone or in blending and at 2- and 6-leaf stages, meaningfully improved number of leaves per plants in gladiolus. Based on the results plants in T_5 (combination of 1% $FeSO_4$ and 1% H_3BO_3) took minimum number of days ($154.11^{d}\pm0.38$) for spike influx/emergence in contrast with 2% $FeSo_4$ ($156.56^{c}\pm0.19$) days. The calculation in this work proposed that 1% $FeSO_4$ had a little variance in spike emergence days ($156.22^{c}\pm0.38$) when equated to the further treatments alike 1% H_3BO_3 and 2% H_3BO_3 with ($158.55^{b}\pm0.69$) days and ($158.11^{b}\pm0.19$ days respectively ,which were found to be expressively parallel to one another as publicized in Table 1. The maximum number of days for spike appearance were calculated in controlled plants ($161.78^{a}\pm1.54$) as compared to all other treatments but the deduction stays at diverse side with findings of previous research by (Patel *et al.,* 2017) in tuberose plants, the days to spike emergence was prior in control (T_o) plants as compared to the plants sprayed by $FeSO_4$ and H_3BO_3.

The fallouts of the arithmetical imitation indicate that the maximum length of spike ($64.66^{a}\pm1.15$cm) was pragmatic through 1% $FeSO_4$ +1% H_3BO_3 The application of 1% $FeSO_4$ also provided supplementary length of spike($61.11^{b}\pm1.92$cm) while plants sprayed by 2% $FeSO_4$ and 2% H_3BO_3 exhibited significantly similar length ($58.88^{bc}\pm0.51$cm and $57.55^{cd}\pm0.88$cm). In table 1 there is a clear trend of decreasing in length of spike ($55.44^{d}\pm1.35$cm), although minimum ($49.67^{e}\pm1.73$cm) length of spikes per plant was experimented in treatment T_o (control). Consistent with findings by (Patel *et al.,* 2017) as found that when the combination of $FeSO_4$ 1.5 % + 0.1 % C.A + $ZnSO_4$ 0.5 % + 0.1 % $CaCO_3$ were applied to tuberose plant that lead to maximum length of flower spike (144.53 cm), rachis length (43.33 cm). Assessment of different concentration of micronutrients exposed that the maximum length of rachis ($40.66^{a}\pm0.67$cm) obtained by the combination of 1% $FeSO_4$ and 1% H_3BO_3 tracked via 1% $FeSO_4$ ($39.11^{b}\pm1.07$cm) and 1% H_3BO_3 ($38.33^{b}\pm0.58$cm) separately. This study also indicates that 2% H_3BO_3 and 2% $FeSO_4$ presented comparable results with ($35.11^{c}\pm0.19$cm and $34.22^{c}\pm0.38$cm) rachis length, respectively. It has been observed that control plants produced minimum length of rachis ($30.22^{d}\pm1.17$cm) exploration verdicts by (Chopde *et al.,* 2015). Also points the treatment of plants with 0.4% Fe and 0.4% Zn resulted in maximum length of rachis.

Effect of Boric acid and Iron sulfate on floral growth of White Dutch Iris

Days to bud color were noted from the period of planting to development of floral buds on the plants. The findings regarding with number of days to bud color showed that the plants treated with 1% $FeSO_4$ +

1% H_3BO_3 acquired least number of days (157.45^d±0.69) for bud color and 1% $FeSO_4$ attained (158.89^{cd} ± 0.96) days with a little variance. Table 2 demonstrates that spraying plants with 2% H_3BO_3 took (161.22^b±0.19) days for bud color appearance while treated with 1% H_3BO_3 and 2% $FeSO_4$ (160.56^b±0.51 and 160.33^{bc}±0.00) days respectively, which were analyzed dramatically equal to one another. The finding provides evidence that the extreme sum of days from spike appearance to bud color were deliberated in T_o (164.33^a±1.54). Investigation of discrepancy explained significant ($P< 0.05$) outcomes at 5% possibility level. Outcome of this research study displayed that amalgamation of 1% H_3BO_3 and 1% $FeSO_4$created maximum number of florets (3.67^a±0.00). The study indicates that several treatments alike 2% $FeSO_4$, 1% $FeSO_4$ and 2% H_3BO_3persuaded equal number of flowers (3.33^b±0.00), (3.33^b±0.00) and (3.33^b±0.00) as exhibited in table 2. Plants nourished with 1% H_3BO_3 produced (3.11^c±0.19) number of florets as compared to controlled plants (2.67^d±0.00). A thoughtful deliberation and scrutinizes of micronutrients on plants arisen during the era of (Sajid *et al.,* 2009) demonstrated that flower production was improved by 14% in numbers by application of micronutrients as compared to the control plants. This is also verified by (Chopde *et al.,* 2015) study which reveals that spraying the plants with 0.4 % Fe resulted in maximum number of florets per plant.

Table 3. Effect of Boric acid and Iron sulphate on bulbous growth of White Dutch Iris.

Treatments	No of bulbs / plant	Total weight of bulbs/plant (g)	Largest bulb weight (g)	Smallest bulb weight(g)	Largest bulb size (cm)	Smallest bulb size (cm)
T_o	4.73^e±0.12	50.60^f±0.20	23.53^d±0.21	2.18^c±0.20	2.58^b±0.34	1.40C±0.10
T_1	5.08^d±0.25	57.40^e±0.53	26.70^c ±0.26	3.27^{ab}±0.76	2.97^b±0.07	1.51BC±0.11
T_2	6.60^a±0.20	69.20^a±0.40	31.66^a±0.42	2.76^{bc}±0.38	3.52^a±0.34	1.40C±0.16
T_3	5.70^c±0.10	65.13^c±0.42	26.6^c ±0.42	3.66^a±0.61	2.95^b±0.06	1.59ABC±0.14
T_4	5.23^d±0.15	61.26^d±0.58	26.33^c±0.20	3.33^{ab}±0.23	2.65^b±0.25	1.66AB±0.12
T_5	6.20^b±0.20	68.23^b±0.25	29.56^b±0.21	3.26^{ab}±0.12	2.99^b±0.01	1.8A±0.06

One of the most important present deliberations in this research is the number of days to opening of florets recorded from the time of planting to the day of floret open. Results highlights that each treatment presented diverse reply towards the number of days to floret open. Our finding discovered that T_o (control) grabbed maximum number of days (165.67^a ±1.53) trailed by T_2 (2% H_3BO_3) and T_1 (1% H_3BO_3) which were seized (162.56^b±0.19) and (162.00^b±0.33) days. Among the credible elucidations for these findings is that when $FeSO_4$ is applied 2% it affected as opened the florets in (161.78^b±0.19) days although $FeSO_4$ is applied 1% took (160.22^c±0.69) days. From this data we can see that the minimum number of days (158.89^c±0.77) was recorded with the blending spray of H_3BO_3 and $FeSO_4$. Ahmad *et al.* (2010) testified during their study on micronutrients in 2010 that plants nourished by Boron only or with mixture of other nutrients acquired early flowering when they are linked/compared to unnourished plants. The results are consistent with conclusions of past studies by (Chopde *et al.,* 2015) which were studied the impression of iron concerning with appearance of blossoming time in gladiolus. On the other hand, Comparable outcomes were also presented by (Balakrishnan *et al.,* 2007) in African marigold by 0.5% $FeSO_4$.

Effect of Boric acid and Iron sulfate on bulbous growth of White Dutch Iris

It appears from the aforementioned investigations that most attention has been paid to know the importance of these micro-essential nutrients to improve the health of a plant. The results of our research indicated that the largest number of bulbs (6.60^a±0.20) produced from the plants which were treated with 2% H_3BO_3. The results also show that combination of $FeSO_4$ and H_3BO_3 ranked second position with ($6.20^{b}\pm0.20$) bulbs per plant. The association among 1% $FeSO_4$, 2% $FeSO_4$ and 1% H_3BO_3 is stimulating for the reason that they had a little difference in production of bulblets/plants ($5.70^{c}\pm0.10$, $5.23^{d}\pm0.15$, $5.08^{d}\pm0.25$) respectively. The current discoveries also suggest that the least number of bulbs ($4.73^{e}\pm0.12$) were estimated in T_o (control). Manna and Maity (2016) provided in-depth analysis of the same work on bulbous growth of onion. The result is in the lines of earlier literature (Hussain and Ahmad, 2018) that found the number of corms formed/plant speckled as of 1.0 to 1.2; hence neither a solo foliar application of micronutrients nor in mixture have any effect on corm figure/plant. This work presents that a dose of 2% H_3BO_3 performed well as compared to all other treatments because of holding the heavier weight ($69.20^{a}\pm0.40$g) of bulbs per plant but when we applied H_3BO_3 with 1% $FeSO_4$ produced ($68.23^{b}\pm0.25$g) weight of bulbs. Indicate that 1% $FeSO_4$ tempted ($65.13^{c}\pm0.42$g) bulbs total weight. It was found that 2% $FeSO_4$ had a weight of bulbs ($61.26^{d}\pm0.58$g) and 1% H_3BO_3 was ($57.40^{e}\pm0.53$g). The lowest weight of bulbs ($50.60^{f}\pm0.20$g) was recorded in controlled plant. (Manna, 2013) found that boron triggered substantial development in bulb diameter, individual bulb weight, marketable and total yield, which is in good agreement with the results of the present study. Neck thickness (1.39 cm) and bulb weight (57.1 g) were formed by 0.5% boron application imperative to thorough going marketable (25. 9t h-1) and total yield (30.7t h-1) of onion. Furthermore, analogous consequences were attained by (Manna and Maity, 2016).

The results showed that foremost bulb weight was obtained ($31.66^{a}\pm0.42$) by 2% H_3BO_3 and (29.56^{b} ±0.21) by the collaboration of 1% H_3BO_3 and 1% $FeSO_4$. It was also noted that the other three treatments alike 1% H_3BO_3, 2% $FeSO_4$ and 1% $FeSO_4$ carried the weight of bulb of ($26.70^{c}\pm0.26$g, $26.33^{c}\pm0.20$ and $26.6^{c}\pm0.42$g) respectively. The lowermost weight of bulb ($23.53^{d}\pm0.21$g) signified in controlled plants. Hussain and Ahmad (2018) presented a comprehensive view for corm weight designated substantial variances between treatments. The corms of gladiolus added maximum weight under mutual application of micronutrients significantly higher than the corm weight formed in further treatments. Similar consequences also settled the findings of (Ahmed *et al.,* 2002; Halder *et al.,* 2007) who observed foliar application of different micronutrients increased corm weight in gladiolus. The evidence from this study suggests that the smallest weight of bulblet per plant was observed in T_3 (1% $FeSO_4$) ranked the first position with weight of ($3.66^{a}\pm0.61$g). The present work also displayed that all further treatments T_4 (2% $FeSO_4$), T_1 (1% H_3BO_3) and T_5 (1% $FeSO_4$+1% H_3BO_3) with weight of ($3.33^{ab}\pm0.23$g, $3.27^{\mathbf{ab}}\pm0.76$g and $3.26^{\mathbf{ab}}\pm0.12$g) correspondingly. The finding highlighted that T_2 (2% H_3BO_3) produced ($2.76^{\mathbf{bc}}\pm0.38$g) and the minimum weight ($2.18^{c}\pm0.20$g) was detected in T_o (control). (Singh *et al.,* 2012) stated that foliar application of Zn (0.50%) improved weight of corms in gladiolus. Treatment of either $ZnSO_4$ (0, 0.15, 0.30 or 0.45%) or H_3BO_3 (0, 5, 10 or 20 ppm) either single or in various blends as foliar spray also significantly increased both fresh and dry weight of bulbs in Iris (Khalifa *et al.,* 2011). Table 2 directs that the largest bulb size was depicted as ($3.52^{a}\pm0.34$) by the application of H_3BO_3 @ 2% and ($2.99^{b}\pm0.01$) by the combination of H_3BO_3 and $FeSO_4$ @ 1%. The discussion of the results transmits with the nourishing of plants by 1% H_3BO_3, 1% $FeSO_4$ and 2% $FeSO_4$ carried size of bulb of ($2.97^{b}\pm0.07$, $2.95^{b}\pm0.06$ and $2.65^{b}\pm0.25$) respectively. It was stated that in controlled plants, the shortest size of bulb was (2.58^{b} ±0.34) among all the treatments as represented in Table.3. In instant, several fascinating grades signifying the potential of micronutrients have been reported, but most of the revisions in the open literature did not instantaneously observe the impact of the amalgamation that formed expressively largest size bulblets of tuberose was that of 150 mg·L-1 N united with 0.5% iron sulfate and 0.05% citric acid (Eidyan *et al.,* 2014). The mean comparison of treatments regarding the smallest size of bulb per plant described the dominance of 1% H_3BO_3+1% $FeSO_4$ ($1.80^{a}\pm0.06$) over all other treatments. Our findings exposed that T_4 (2% $FeSO_4$) formed

(1.66[ab]±0.12) size of iris bulb while T_3 (1% $FeSO_4$) grew (1.59[abc]±0.14). Table 3 depicted the overcomes of 1% H_3BO_3 as(1.51[bc]±0.11) and the shortest size of bulb were produced with foliar application of 2% H_3BO_3 and controlled treatment (1.40[c]±0.16 and 1.40[c]±0.10) with relatively no difference. Research finding by (Chopde *et al.,* 2015) also leads towards impression of gladiolus bulb size by micronutrients especially $FeSO_4$.

Conclusion

The results presented here facilitate the improvements in growth parameters of iris plant. However, from findings of the present study, it can be concluded that the foliar application of micronutrients boric acid and iron sulphate at the time of planting and later on, had a positive effect on the vegetative and floral growth of the plant and also influenced greatly on bulbous characteristics. Although, the plants grown in control zone remain unaffected and showed no variation regarding all parameters excluding the bulb size and weight.

References

Ahmad I, Khan MA, Qasim M, Ahmad R, Randhawa MA. 2010. Growth, yield and quality of (*Rosa hybrida L*) as influenced by various micronutrients. Pakistan journal of Agriculture Science **47,** 5-12.
https://pakjas.com.pk/papers/4.pdf

Ahmed MJ, Akbar A, Kosar N, Khan ZA. 2002. Introduction and evaluation of Exotic gladiolus (*Gladiolus grandiflorus*) cultivars. Asian Journal Plant Science **1,** 560-562.
http://www.docsdrive.com/pdfs/ansinet/ajps/2002/560-562.pdf

Balakrishnan V, Jawaharlal M, Kumar TS, Ganga M. 2007. Response of micro-nutrients on flowering, yield and xanthophyll content in African marigold (*Tagetes erecta Linn.*). Journal of Ornamental Horticulture **10,** 153-156.
http://www.indianjournals.com/ijor.aspx?target=ijor:joh&volume=10&issue=3&article=004

Begum R, Jahiruddin M, Kader M, Haque M, Hoque A. 2015. Effects of zinc and boron application on onion and their residual effects on Mungbean. Progressive Agriculture **26,** 90-96.
https://www.banglajol.info/index.php/PA/article/view/25961

Cara FA, Sánchez E, Ruiz JM, Romero L. 2002. Is phenol oxidation responsible for the short-term effects of boron deficiency on plasma-membrane permeability and function in squash roots? Plant Physiology and Biochemistry **40,** 853-858.
https://doi.org/10.1016/S0981-9428(02)01447-X

Chopde N, Nehare N, Maske S, Lokhande S, Bhute P. 2015. Effect of foliar application of zinc and iron on growth, yield and quality of gladiolus. Plant Archives **15,** 417-419.
http://plantarchives.org/PDF%2015%20-%201/417-419%20(2853).pdf

Crişan I, Vidican R, Borsai O, Stoie A, Stoian V. 2017. Herbaceous companion plants for Iris in Cluj county. ProEnvironment/ProMediu **10.**
https://journals.usamvcluj.ro/index.php/promediu/article/view/12894

Dordas C, Brown PH. 2005. Boron deficiency affects cell viability, phenolic leakage and oxidative burst in rose cell cultures. Plant and soil **268,** 293-301.
https://link.springer.com/article/10.1007/s11104-004-0309-1

Eidyan B, Hadavi E, Moalemi N. 2014. Pre-harvest foliar application of iron sulfate and citric acid combined with urea fertigation affects growth and vase life of tuberose (*Polianthes tuberosa L.*)'Por-Par'. Horticulture, Environment, and Biotechnology **55,** 9-13.
http://dx.doi.org/10.1007/s13580-014-0061-2

Halder N, Ahmed R, Sharifuzzaman S, Bagam K, Siddiky M. 2007. Effect of boron and zinc fertilization on corm and cormel production of gladiolus in grey terrace soils of Bangladesh. International Journal of Sustainable Crop Production **2,** 85-89. http://ggfjournals.com/assets/uploads/17.8589_.pdf

Helvey J. 2009. Irises: Vincent Van Gogh in the Garden: Getty Publications.

Hussain S, Ahmad M. 2018. The Effect of Micronutrients (B, Zn and Fe) Foliar Application on the Growth, Flowering and Corm Production of Gla diolus (*Gladiolus grandiflorus L.*) in Calcareous Soils. http://hdl.handle.net/123456789/4095

Khalifa R, Shaaban S, Rawia A. 2011. Effect of foliar application of zinc sulfate and boric acid on growth, yield and chemical constituents of iris plants. Ozean Journal of Applied Science **4,** 129-144. https://www.academia.edu/download/46396213/3.pdf

Lahijie M. 2012. Application of micronutrients Feso4 and Znso4 on the growth and development of Gladiolus variety" Oscar". International Journal of Agriculture and Crop Sciences **4,** 718-720. http://ijagcs.com/718-720.pdf

Mamatha N. 2007. Effect of sulphur and micronutrients (iron and zinc) on yield and quality of cotton in a vertisol. Master of Science (Agriculture), college of agriculture, Dharwad University of agricultural sciences. India.

Manna D, Maity T. 2016. Growth, yield and bulb quality of onion *(Allium cepa L.*) in response to foliar application of boron and zinc. Journal of plant nutrition **39,** 438-441. https://www.tandfonline.com/doi/abs/10.1080/01904167.2015.1109099

Manna D. 2013. Growth, yield and bulb quality of onion *(Allium cepa L.)* in response to foliar application of boron and zinc. SAARC Journal of Agriculture **11,** 149-153.

Patel TD, Viradia R, Tejashwini C, Patel HV, Patel UR. 2017. Studies on effect of foliar application of micronutrient (Fe & Zn) on growth, flowering quality and yield of tuberose (*Polianthes tuberosa L.*) CV. Prajwal. International Journal of Communication Systems **5,** 93-97.

Sajid GM, Kaukab M, Ahmad Z. 2009. Foliar application of plant growth regulators (PGRs) and nutrients for improvement of lily flowers. Pakistan Journal of Botany **41,** 233-237. http://www.pakbs.org/pjbot/PDFs/41(1)/PJB41(1)233.pdf

Sharma J, Gupta A, Kumar C, Gautam R. 2013. Influence of zinc, calcium and boron on vegetative and flowering parameters of gladiolus cv. *Aldebran.* The Bioscan **8,** 1153-1158. http://www.thebioscan.in/Journals_PDF/8407%20JYOTI%20SHARMA.pdf

Singh AK, Hembrom R, Singh J, Sisodia A, Pal A. 2015. Effect of iron and zinc on growth and postharvest life in *Lilium cv. Tresor*. Environment and Ecology **33,** 625-628.

Singh J, Krishan K, Katiyar P, Vijai K. 2012. Influence of Zinc, Iron and Copper on growth and flowering attributes in *Gladiolus cv. Sapna.* Progressive Agriculture **12,** 138-143. http://www.indianjournals.com/ijor.aspx?target=ijor:pa&volume=12&issue=1&article=020

Steel R, Torrie J, Dickey D. 1997. Principle and procedure of statistics. A Biometrical approach . New York: McGraw-Hills Book Co: Inc.

Yazici K, Köse H, Gülgün B. 2016. Using Beautiful Flowering Bulbous (Geophytes) Plants in the Cemetery Gardens in the City of Tokat. Journal of International Environmental Application and Science **11,** 216-222. https://dergipark.org.tr/en/pub/jieas/issue/40300/481418