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FLOWER AND CORM PRODUCTION OF GLADIOLUS AS AFFECTED BY BORON AND ZINC

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Abstract

The research was conducted at the Floriculture Field of the Horticulture Research Centre of BARI, Gazipur during 2012-13 to find out the optimum dose of B and Zn for maximizing flower and corms yield. The result revealed that B and Zn application exerted positive response to the growth, floral and corm characters of Gladiolus. It was also noted that B and Zn both either in single or in combination exerted tremendous effect on the yield and quality of gladiolus. The sixteen treatment combinations included in the study noted that B and Zn at the rate of $B_{2.0}$ $Zn_{3.0}$ kg ha^{-1} along with blanket dose of N_{200} P_{50} K_{150} S_{20} kg and CD 5 t/ha^{-1} exhibited the best performance in flower and corm production and stretched the vase life of gladiolus flower. The studied parameters like plant height (63.4 cm), number of leaves (9.5), length of spike (103.0 cm) and length of rachis (57.0 cm) significantly responded to the combined application of boron and zinc at the rate of $B_{2.0}$ and $Zn_{3.0}$ kg/ha respectively as compared to other treatment combinations. Floral characters like floret number (14), vase life (14 days) and flowers yield (230000/ha) as well as corm character like number of corm (1.6), number of cormel (12.5), corm weight (28.5 g) and 10 cormel weight (35.0 g) also significantly influenced by treatment ($B_{2.0}$ $Zn_{3.0}$ kg ha^{-1}) which was markedly different over rest of treatment combinations.

Key Words: Gladiolus, Boron, Zinc, flower and corm production.

Introduction

Gladiolus (*Gladiolus grandiflorus* L.), is an herbaceous annual flower belongs to the family Iridaceae. It is one of the most important cut flower in Bangladesh. Gladiolus is a very popular cut flower and occupying fourth place in international cut flower trade. Gladiolus has gained popularity in many parts of the world owing to its unsurpassed beauty and economic value (Bose *et al.*, 2003). It is popular for its attractive spikes having florets of huge forms, dazzling colors, varying size and long durable quality as a cut flower. Gladiolus is very much responsive to fertilizers. It is highly capable of exhausting huge nutrients form native soil. So, it requires higher amount of chemical fertilizers in balance proportion for maximizing flower production (Halder *et al.*, 2007).

Fertilizer requirement of gladiolus like other crops has vital role in growth and quality flower production. Major nutrients like nitrogen, phosphorus, potassium along with micronutrients especially boron and zinc remarkably increase the number of florets/ spike, spike length, rachis length, flower yield,

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weight and number of corms and cormels per hill (Shah *et al.,* 1984 and Mukherjee *et al.,* 1998). Increasing N fertilization substantially augmented plant growth, number of leaves/ plant, spike length and number of florets/ spike (Shah *et al.,* 1984). It is also reported that hardness of the stick, flower colour and post-harvest life can be prolonged to some extent by applying micro-nutrients along with blanket dose of NPK. It is also reported by many researchers (Singh *et al.,* 1996 and Das *et al.,* 1998) that boron and zinc had a significant effect on corm and cormel production. However, information regarding nutritional requirements and appropriate soil management practices are scanty for gladiolus cultivation in Bangladesh. Hence, the present investigation was undertaken to evaluate the response of B and Zn and their optimum dose on gladiolus for maximizing flower and corm yield in Grey Terrace soils of Jeydebpur.

Materials and Methods

The field trial was conducted at Floriculture Field of Horticultural Research Centre, BARI, Gazipur during Rabi season of 2012-2013. Nutrient status of analyzed soil sample of experimental field is shown in Table 1.

There were sixteen treatment combinations comprising four levels of B (0, 1.0, 2.0 and 3.0 kg/ha) and four levels of Zn (0, 1.5, 3.0 and 4.5 kg/ha) were taken in the study. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. Gladiolus was used as planting material. The combined blanket dose of N_{200} P_{50} K_{150} S_{20} kg ha^{-1} + cowdung (CD) 5 t ha^{-1} was taken in the study. All P, K, S, B, Zn and CD except N were applied and mixed up with the soil during final land preparation. Nitrogen was top-dressed in two equal installments; first at 4 leaf stage and second at spike initiation stage. All corms were thoroughly dusted with Bavistin and planted on Rabi season of2012-2013 at 20 cm´ 20 cm spacing in 2.0 m × 1.5 m sized plot. Intercultural operations like weeding, watering, spraying, etc. were done as and when necessary. Data were collected at different stages of gladiolus. The spikes were cut when lower 2-3 florets showed their blushes of colour. Ten plants from each of the plots were selected randomly for recording data for different characters such as plant height, number of leaves, spike length, rachis length, number of floret**,** vase life, flower yield (no/ ha), corm number, cormel number, corm weight, cormel weight etc. and analyzed statistically and adjusted with DMRT at 5% level of significance (Steel *et al.*, 1997).

Table 1. Chemical properties of the initial soil of the Floriculture experimental field at HRC, BARI, Joydebpur.

Location	pH	M%	Ca	Mg	K	Total N%	P	S	B	Cu	Fe	Mn	Zn
				meq/100g						µg/g			
Joydebpur	6.2	1.1	1.5	0.7	0.18	0.16	10	12	0.1	1.0	140	4.2	1.0
Critical level	-	-	2.0	0.8	0.20	-	14	14	0.2	1.0	10	5.0	2.0

Results and Discussion

Vegetative growth and flowering of gladiolus Effect of boron: Boron played a critical role in augmenting the vegetative growth and other floral characters of gladiolus. The results shown in Table 2. revealed that vegetative growth and flower characters were found increased up to 2.0 kg B/ha but further increase with higher B level (3.0 kg B/ha) exerted slower response to the vegetative growth and flower yield characters of gladiolus. However, application of B @ 2.0 kg/ha significantly increased the plant height, leaf number, length of spike and rachis. The maximum plant height (60.0 cm), number of leaves (9.5), spike length (100.0 cm)and rachis length (55.0 cm) were found in 2.0 kg B/ha. But subsequent addition of higher dose of B @ 3.0 kg/ha lowered these parameters.

There was no marked difference among the treatments in respect of number of florets/spike and vase life but the maximum floret number (13) and vase life (13 days) also found in B @ 2.0 kg/ha. Similar trend was also observed in flower yield by applied B levels from B_0 to $B_{2.0}$ kg/ha. The highest flower yield (230000/ha) recorded in 2.0 kg B/ha which was found superior than other treatments. This result was in partial agreement with the findings of Jhon *et al*., (1997) and Barma*et al*., (1998) in gladiolus.

Effect of zinc

The main effect of Zn on the vegetative growth and floral characters of gladiolus are shown in Table 3. The results revealed that Zn had a positive effect on the studied parameters. All the vegetative and flower characters such as plant height, number of leaves, length of spike and rachis, number of florets, vase life and flower yield were remarkably influenced with the addition of different levels of Zn fertilizers. However, the maximum plant height (58.0 cm), number of leaves (9.0), length of spike (100.0 cm) and rachis (53.0 cm) were found when Zn @ 3.0 kg/ha added to the soil that significantly differed from control and higher doses (4.5 kg/ha) of Zn. But application of higher doses of Zn @ 4.5 kg/ha did not respond positively. There was no significant differences among the treatments in respect of florets/spike and vase life. However, the highest floret numbers (13/spike) and maximum vase life (13 days) also obtained in Zn level (3.0 kg Zn/ha) which was closely followed by Zn @ 1.5 kg/ha. Flower yield was also noticeably responded to the added Zn fertilizer up to 3.0 kg Zn/ha where higher dose of Zn failed to give desired flower yield of gladiolus. The flower yield (228000 no/ha) recorded was also higher in Zn @ 3.0 kg/ha that differed sharply from other treatments. This finding was supported by Mukherjee *et al*., (1998); Potti and Arora (1986) in gladiolus.

Table 2. Effect of boron on vegetative growth and flowering of gladiolus.

Level of boron (Kg/ha)	Plant height (cm)	Number of leaves	Spike length (cm)	Rachis length (cm)	Florets/ spike	Vase life (days)	Flower yield (no/ ha) ('000)
B_1=0.0 (Control)	50.0 c	6.0 b	90.0 c	50.0 b	11.0	11.0	220 c
B_2= 1.0	57.0 ab	7.5 ab	96.0 b	52.0 ab	12.0	12.0	225 b
B_3= 2.0	60.0 a	9.5 a	100.0 a	55.0 a	13.0	13.0	230 a
B_4= 3.0	55.0 b	8.0 ab	92.0 bc	50.0 b	10.0	10.0	223 bc
CV (%)	8.7	8.2	7.4	7.5	6.8	6.4	12.8

Means followed by a common letter are not significantly different at the 5% by DMRT.

Table 3. Effect of zinc on vegetative growth and flowering of gladiolus.

Level of zinc (Kg/ha)	Plant height (cm)	Number of leaves	Spike length (cm)	Rachis length (cm)	Florets/ spike	Vase life (days)	Flower yield (no/ha) ('000)
Z_1=0.0	48.0 c	5.8 b	93.0 c	47.0 b	10.0	10.0	216 c
Z_2=1.5	55.0 ab	7.5 ab	97.0 ab	50.0 ab	12.0	12.0	222 b
Z_3=3.0	58.0 a	9.0 a	100.0 a	53.0 a	13.0	13.0	228 a
Z_4=4.5	52.0 b	7.0 ab	94.0 ab	48.0 ab	11.0	11.0	220bc
CV (%)	8.7	8.2	7.4	7.5	6.8	6.4	12.8

Means followed by a common letter are not significantly different at the 5% by DMRT.

Interaction effect of boron and zinc

The interaction between B and Zn was found statistically significant over vegetative and floral characters. It was appeared in Table 4. that all the studied parameters like plant height, number of leaves, length of spike and rachis, number of florets per spike, vase life and flower yield were greatly influenced with the increase of B and Zn integration as compared to their single application. Plant height, number of leaves, spike length and rachis length, progressively increased by adding B and Zn up to $B_{2.0}$ $Zn_{3.0}$ kg/ha, but further increase of B and Zn beyond that level ($B_{2.0}$ $Zn_{3.0}$ kg/ha) depressed the plant height and number of leaves. However, the maximum plant height (63.4 cm), number of leaves (9.5), spike length (103.0cm) and rachis length (57.0 cm) were recorded with $B_{2.0}$ $Zn_{3.0}$ kg/ha while the highest dose of integration ($B_{3.0}$ $Zn_{4.5}$ kg/ha) failed to perform better than other treatment combinations.

Table 4. Interaction effect of boron and zinc on growth and flowering of gladiolus.

Treatments (kg/ha)	Plant height (cm)	Number of leaves	Spike length (cm)	Rachis length (cm)	Florets/ spike	Vase life (days)	Flower yield (no/ha) ('000)
B_0 Zn_0	53.4 c	6.7 b	92.0 c	46.0 c	10.0	10.0	218 d
B_0 $Zn_{1.5}$	54.7 bc	7.8ab	92.7 bc	46.8 bc	10.0	10.0	219 cd
B_0 $Zn_{3.0}$	55.8 bc	8.9ab	93.2 bc	47.9 bc	12.0	11.0	220 cd
B_0 $Zn_{4.5}$	56.4 bc	7.0ab	93.9 bc	48.2 bc	11.0	11.0	218 d
B_1 Zn_0	56.8 bc	7.3ab	94.5 bc	49.7 bc	11.0	11.0	221 cd
B_1 $Zn_{1.5}$	56.7 bc	7.5ab	95.0 bc	50.4 bc	12.0	12.0	222 cd
B_1 $Zn_{3.0}$	58.4 b	7.0 ab	96.0 bc	52.0 b	12.0	12.0	225 c
B_1 $Zn_{4.5}$	61.1 ab	7.8 ab	96.5 bc	54.8 ab	12.0	12.0	219 cd
B_2 Zn_0	62.9 ab	8.5 ab	98.6 ab	55.0 ab	10.0	11.0	218 cd
B_2 $Zn_{1.5}$	62.8 ab	9.2 ab	99.8 ab	55.6 ab	13.0	13.0	228 b
B_2 $Zn_{3.0}$	63.4 a	9.5 a	103.0 a	57.0 a	14.0	14.0	230 a
B_2 $Zn_{4.5}$	62.2 ab	8.0 ab	100.0 ab	55.3 ab	12.0	12.0	220 cd
B_3 Zn_0	61.9 ab	7.8 ab	99.2 ab	55.0 ab	11.0	11.0	218 d
B_3 $Zn_{1.5}$	61.6 ab	7.5 ab	99.8 ab	54.0 ab	11.0	11.0	219 cd
B_3 $Zn_{3.0}$	61.4 ab	7.3 ab	99.3 ab	54.5 ab	11.0	11.0	222 cd
B_3 $Zn_{4.5}$	61.3 ab	7.0 ab	97.0 b	52.0 b	10.0	10.0	219 cd
CV (%)	8.7	8.2	7.4	7.5	6.8	6.4	12.8

Means followed by a common letter are not significantly different at the 5% by DMRT.

Besides, number of florets and vase life were highly influenced with higher doses of B and Zn integration. The highest number of florets (14/spike) and longest vase life (14 days) were obtained with $B_{2.0}Zn_{3.0}$ kg/ha which was higher than other combinations. Similar trend of increase was also noticed for flower yield. However, the highest flower yield (230000 no/ha) was received by treatment combination ($B_{2.0}$ $Zn_{3.0}$ kg/ha) which greatly differed and was higher over B_0 Zn_0. The positive yield response was due to added integrated chemical fertilizers applied to the study area as the native fertility failed to provide with balance nutrition. This result was corroborated with findings of Halder *et al.*, (2007) and Shah *et al.*, (1984) in gladiolus.

Corm and cormel character of gladiolus

Effect of boron: Data revealed in Table 5. reflected that all the studied parameters were significantly responded to boron application. It appeared in the Table 4. that yield attributes like corms per plant, corm weight, number of cormels per plant and weight of 10 cormel were altered with the addition of B up to 2.0 kg/ha. But further increase of boron beyond that level (2.0 kg B/ha) declined the yield indicators observed in study. It was also noticed in Table 4. that boron had a direct effect on producing corm and cormel of gladiolus in boron deficient soil. However, number of corms and weight of corms per plant received 2.0 kg B/ha significantly increased the individual corm weight ranged from 15.1 g to 28.7 g. Likewise, number of cormels and 10 cormel weight were found to be increased with boron levels up to 2 kg/ha. However, the highest number of cormels (10.5) and weight of 10 cormels/plant (37.0 g) were recorded with said boron level (2.0 kg B/ha) which was significantly higher over control (B_0). Similar observation was recorded by Pathasarathy and Nagaraju (1999) and Singh (2000) in gladiolus.

Effect of zinc

The effect of zinc on corm and cormel production is shown in Table 6. It inferred from studied data that zinc also made a promising response to corm production of gladiolus. It appeared in Table 5. that with the addition of zinc from 0 to 3.0 kg/ha in treated plants multiplied the corm yield and their numbers significantly over the zinc control (Zn_0). It was noticed that number of corms per plants found to be narrowly increased while individual weight of corm and number and weight of 10 cormels progressively increased

Table 5. Main effect of boron on the yield of corm and cormel of gladiolus.

Treatment	No. of corms/ plant	Corm weight (g)	No. of cormels/ plant	10 cormel weight (g)
B_0	1.0 b	15.1 c	6.0b	18.0 d
B_1	1.3 ab	21.5 b	8.4ab	23.0 c
B_2	1.5 a	28.7 a	10.5 a	37.0 a
B_3	1.2ab	25.5 a	8.5 ab	29.0 b
CV (%)	8.7	9.8	8.9	10.5

Means followed by common letter(s) in a column are not significantly different at 5% level by DMRT.

Table 6. Effect of zinc on the yield of corm and cormel of gladiolus.

Treatments	No. of corms/ plant	Corm weight (g)	No. of cormels/ plant	10 Cormel weight (g)
Zn_0	1.0 b	15.0 c	5.4 b	21.0 c
$Zn_{1.5}$	1.2 ab	20.0 b	7.2 ab	27.0 b
$Zn_{3.0}$	1.4 a	25.0 a	9.8 a	32.0 a
$Zn_{4.5}$	1.0 b	22.0 ab	7.0 ab	26.0 b
CV (%)	8.7	9.8	8.9	10.5

Means followed by common letter(s) in a column are not significantly different at 5% level by DMRT.

with the increase of zinc levels up to 3.0 kg/ha. But further increment of zinc dosage depressed the yield of corm and cormel. However, the maximum weight of corm (25.0 g) was obtained in 3.0 kg Zn/ha.

The highest number of cormels per plant and 10 cormel weights (9.8 and 32.0 g respectively) were also recorded with 3.0 kg Zn/ha where zinc control in untreated plants performed poor yield than that of other Zn levels ($Zn_{1.5}$ kg and $Zn_{4.5}$ kg/ha). These results are in agreement with findings of Mahesh and Misra (1993) and Mukherjee *et al.,* (1998) in gladiolus.

Interaction effect of boron and zinc

The interaction between B and Zn was found statistically significant for yield of corm and cormel and their major yield components like number of corms, weights of corm, number and weight of cormels (Table 7). Number of corms and weights of corm increased with the increase of Boron and Zinc levels simultaneously up to $B_{2.0}$and $Zn_{3.0}$ kg/ha but further augmentation of boron levels incorporating with zinc up to the highest level (4.5 kg/ha) showed reducing trend. It is also noticed in Table 6. that number of corms per plant was found to be narrowly increased while weight of corm significantly differed among the treatments and more higher over Boron-Zinc control (B_0Zn_0). The highest individual weight of corm (28.5 g) was recorded with B_2 $Zn_{3.0}$ kg/ha which was at par with treatments B_3 Zn_0 and B_3 $Zn_{4.5}$ where control B_0 Zn_0 gave poor yield of corm (15.0 g). Other parameters like number of cormels and weight of 10 cormels were significantly influenced by addition of B and Zn with increased levels. However, the highest number of cormels (12.5) and maximum weight of 10 cormels (35.0) were obtained with same boron-zinc interaction ($B_{2.0}Zn_{3.0}$ kg/ha). This result was supported by Jhon*et al.,* (1997), Devecchi and Barni (1997) and Singh (2000). It was also inferred that combination of B and Zn contributed more than their single applications where boron played marginally higher role than zinc while untreated Zn-B controls plants performed poor.

Table 7. Interaction effect of boron and zinc on the corm and cormel production of gladiolus.

Treatments	No. of corms/ plant	Corm weight (g)	No. of cormels/ plant	10 cormel weight (g)
B_0Zn_0	1.0 b	15.0 d	5.8 c	21.0 d
B_0 $Zn_{1.5}$	1.1 ab	20.0 c	7.1bc	27.0bc
B_0 $Zn_{3.0}$	1.1 ab	23.8 bc	9.7ab	32.0ab
B_0 $Zn_{4.5}$	1.2 ab	22.0 bc	7.0bc	26.0 c
B_1 Zn_0	1.2 ab	23.4 bc	7.5bc	28.0bc
B_1 $Zn_{1.5}$	1.3 ab	24.0 b	7.9bc	29.0bc

Table 7. Continued.

Treatments	No. of corms/ plant	Corm weight (g)	No. of cormels/ plant	10 cormel weight (g)
$B_1 Zn_{3.0}$	1.4 ab	24.5 ab	8.0 b	30.0 b
$B_1 Zn_{4.5}$	1.3 ab	23.8 bc	8.2ab	28.0bc
$B_2 Zn_0$	1.3 ab	24.0 b	8.3 ab	29.0bc
$B_2Zn_{1.5}$	1.3 ab	25.0 ab	9.0ab	31.0ab
$B_2 Zn_{3.0}$	1.6 a	28.5 a	12.5 a	35.0 a
$B_2Zn_{4.5}$	1.3 ab	25.5 ab	9.4ab	32.0ab
$B_3 Zn_0$	1.3 ab	24.3 ab	8.3ab	29.0bc
$B_3Zn_{1.5}$	1.2 ab	24.2 ab	8.1 ab	27.0bc
$B_3Zn_{3.0}$	1.2 ab	24.8 ab	6.9bc	28.0bc
$B_3Zn_{4.5}$	1.1 ab	23.0 bc	6.8bc	26.0cb
CV (%)	8.7	9.8	8.9	10.5

Means followed by common letter(s) in a column are not significantly different at 5% level by DMRT.

Conclusion

It is inferred from field study that Boron and Zinc @ B 2.0 and Zn 3.0 kg/ha, respectively along with a blanket dose of N_{200} P_{50} K_{150} S_{20}kg/ha^{-1}and CD 5.0 t/ha was found to be optimum for flower, corm and cormel production in gladiolus under Grey Terrace soils at Joydebpur region of Bangladesh.

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