EFFECT OF BORON AND ZINC FERTILIZATION ON CORM AND CORMEL PRODUCTION OF GLADIOLUS IN GREY TERRACE SOILS OF BANGLADESH

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ABSTRACT

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Field trial of corm and cormel production of gladiolus was carried out at Floriculture field of Horticulture Research Centre, BARI, Gazipur during rabi seasons of 2005-2006 and 2006-2007, respectively. The objectives were to evaluate 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 of bulbs for Gladiolus cultivation. Treatments comprising each four levels of B (0, 1, 2 and 3.0 kg/ha) and four levels of Zn (0, 1.5, 3.0 and 4.5 kg/ha) along with blanket dose of $N_{375,}$ $P_{150,}$ $K_{250,}$ S_{20} and CD 5 t/ha were used in the study. It was felt in the study that B-Zn integration contributed more than their single applications. The interaction effects of B and Zn @ $B_{2.0,}$ and $Zn_{4.5}$ kg/ha significantly contributed to the yield of individual corm weight (26.07 g and 27.58 g) and number of cormels (9.78 and 14.43) and weight of cormels/plant (31.94 g and 51.67g) than other B-Zn combination along with control (B_0Zn_0). Single application of B and Zn also contributed to the yield parameters but their response was not pronounced as their integration performed.

Key Words: Yield maximization, Boron, Zinc

INTRODUCTION

Gladiolus (*Gladiolus spp.*) is an important and popular cut flower grown everywhere in the world. It has innumerable cultivars with assortment of attractive colors. This flower bears an economic and aesthetic value for its beauty and elegance. The long flower spikes are excellent as cut flower for ornamentation when arranged in vases. Now, it has been trading in domestic and international markets having great demand. But the paramount problem the farmers are facing judicial use of chemical fertilizers. The requirement of fertilizers like other crops has vital role in growth, quality of flowers, corm and cormel production. Gladiolus is highly responsive to chemical fertilizers. It has been reported that nitrogen, phosphorus, potassium with micro-nutrients especially boron and zinc remarkably increased weight and number of corms and cormels per hill (Afify, 1983, Shah *et al.*,1984 and Mukherjee *et al.,* 1998).

It was also reported by many researchers (Singh *et al.,* 1996 and Das, 1998) that boron and zinc had a significant effect on corm and cormel production. The growers do not have any recommended doses of chemical fertilizers especially micro-nutrients for quality corm and cormel seed production. Even the flower producers multiply their seeds without applying any chemical fertilizers. Resulting, they are deprived of getting optimum sized corms and cormels for flower cultivation. So boron and zinc are treated to be the limiting elements for maximizing corm and cormel production. However, there were scanty information regarding nutritional requirement on the production of corm and cormel for gladiolus cultivation in Bangladesh.

From above context and justification, therefore, a field study was undertaken to find out the optimum dose of Boron and Zinc for maximizing yield of corm and cormel for gladiolus cultivation in Grey Terrace soils at Joydebpur region of Bangladesh.

MATERIALS AND METHODS

The field study on B and Zn was carried out at Floricultural Research field at Horticulture Research Centre, BARI, Gazipur during rabi seasons of 2005-2006 and 2006-2007 respectively. The objective was to evaluate the response of corm and cormel to boron and zinc and their optimum requirement for corm and cormel production of Gladiolus. The fertility status of analyzed soil samples before fertilization was shown in Table 1. The nutrient status of native soil was found to be almost below critical levels. There were sixteen treatment combination comprising each four levels of B (0, 1, 2 and 3 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 designed in a randomized block having replications thrice. The unit plot size and row to row spacing were adjusted by maintaining the distance of 0.9 m x 1 m and 25 cm x 15 cm respectively. BARI Gladiolus-1 was taken as a test crop. The combined blanket dose @ $N_{375}P_{150}K_{250}S_{20}$ and cowdung (CD) 5 t/ha was also included in the treatments. The planting material of uniform sized corms was dibbled on 05 December 05 and 06 respectively. All P, K, S, B, Zn and CD except N were applied and well mixed with the soil during final land preparation. Nitrogen was applied in three equal installments, first $1/3^{rd}$ of N at 30, 2^{nd} top-dress at 45 and last $1/3^{rd}$ at 60 days of sowing. Intercultural practices viz. weeding, irrigation, racking etc were done in time. Five plants were randomly selected from each plot for harvesting corms and cormels at maturity after complete withering of the plants for data recording. The collected data on different parameters were computed and analyzed statistically adjusting with DMRT and LSD test at 5% level of significance.

Table 1.Chemical properties of the initial soil of the experimental field at Joydebpur

Location	pH	OM	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

Effect of Boron: Data revealed in Tables (2a and 2b) reflected that all the studied parameters were significantly responded to boron application. It appeared in the tables that yield and attributes of corm like corms per plant, individual corm weight, number of cormels per plant, weight of individual cormel, size of corm and cormel and weight of cormels per plants were altered with the addition of B up to 2 kg/ha. But further increase of boron beyond that level (2 kg B/ha) declined the yield indicators observed in two years study. It was also noticed in tables that boron had a direct effect on producing corm and cormel of Gladiolus in boron deficient soil. However, number of corms and weights of corms per plant received 2 kg B/ha significantly increased the individual corm weight ranged from 10.66 g to 25.97 g in 2nd year while in first year similar trend was observed in Table 2b. Likewise, number of cormels, weight of cormels per plant and size of the bulbs were found to be increased with boron levels up to 2 kg/ha. However, the highest number of cormels (8.99 and 13.35) and weight of cormels/plant (28.13 g and 44.40 g) was recorded with said boron level (2 kg B/ha) which was significantly higher over Boron control (B_0). The size of corms and cormels also noticeably increased with the addition of boron from 0 to 2 kg/ha. This result was conformed by Barma *et al.*, 1998, Sunil and Singh, 1998, Das, 1998 and Potti and Arora, 1986.

Table 2a: Main effect of Boron on the yield of corm and cormel of gladiolus at Joydebpur during 2005-2006

Treatments	No. of corms/ plant	Ind. corm wt (g)	No. of cormels/ plant	Ind. cormel wt. (g)	Weight of cormels/ plant	Length of corm(cm)	Diameter of corm(cm)	Diameter of cormel(cm)
B_0	1.12 c	15.08 c	5.79 c	1.67 d	10.01d	1.41 d	2.42 c	1.28 c
B_1	1.30 b	21.54 b	7.31 b	2.33 c	17.05c	1.79 c	3.08 b	1.56 b
B_2	1.4 a	24.72 a	8.99 a	3.12 a	28.13a	2.11 a	3.43 a	1.76 a
B_3	1.33 b	23.56 a	7.47 b	2.75 b	20.53b	1.89 b	3.29 a	1.62 b
CV (%)	3.27	9.84	8.17	10.15	11.83	4.29	5.30	6.85

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

Table 2b: Main effect of Boron on the yield of corm and cormel of gladiolus at Joydebpur during 2006-2007

Treatments	No. of corms/ plant	Ind. corm wt (g)	No. of cormels/ plant	Ind. cormel wt (g)	Weight of cormels/ plant	Length of corm (cm)	Diameter of corm (cm)	Diameter of cormel (cm)
B_0	1.14 c	10.66 c	4.89 c	0.71 c	12.43c	1.53 d	2.74 d	1.38 c
B_1	1.30 b	23.69 b	11.19 b	2.72 b	30.41b	1.87 c	3.29 c	1.62 b
B_2	1.57 a	25.97 a	13.35 a	3.32 a	44.40a	2.36 a	3.69 a	1.83 a
B_3	1.56 a	23.86 b	12.71 a	3.21 a	40.74a	2.12 b	3.58 b	1.64 b
CV (%)	5.54	9.69	10.34	10.20	15.15	3.71	2.21	5.63

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

Effect of Zinc: The effect of zinc on corm and cormel production is shown in Tables 3a and 3b. It inferred from studied data revealed that zinc also made a promising response to bulbs production of Gladiolus. It appeared in tables that with the addition of zinc from 0 to 3.0 kg/ha in treated plants multiplied the bulb 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 weights of cormels progressively increased with 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 highest individual weight of corm (22.22 g and 24.21 g) was obtained in 3 kg Zn/ha which was marginally differed among zinc levels but significantly higher over zinc control (8.87 g and 11.65g). Similar trend was also observed in other parameters like number and weight of cormels per plant and sizes of corm and cormel. The highest number of cormels (9.78and 12.09) and highest weights per plant of the same (20.92g and 36.24 g) were 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). Length and diameter of corm and cormel also responded to the Zn fertilizer but narrowly differed to each other. The effect of zinc on the studied parameter was found to be almost same in both the years might be the reason of well soil management and similar weather condition. This result was in agreement with findings Roy and Sarker, 1995, Jhon *et al.,* 1997 and Mukherjee *et al.,* 1998.

Table 3a: Main effect of Zinc on the yield of corm and cormel of gladiolus at Joydebpur during 2005-2006

Treatments	No. of corms/ plant	Ind. corm wt (g)	No. of cormels/ plant	Ind. cormel wt (g)	Weight of cormels/ plant	Length of corm (cm)	Diameter of corm (cm)	Diameter of cormel (cm)
Zn_0	1.26 b	8.87c	3.94 c	0.81c	12.43c	1.12c	1.44c	1.48 b
$Zn_{1.5}$	1.28 b	21.08 ab	7.34 ab	2.41 b	18.20b	1.77 bc	3.07 ab	1.56 ab
$Zn_{3.0}$	1.33 a	22.22 a	9.78a	2.63a	20.92a	1.89 a	3.18 a	1.60 a
$Zn_{4.5}$	1.28b	21.73a	7.49b	2.52 ab	19.17ab	1.83ab	3.03ab	1.57a
CV (%)	3.27	9.84	8.17	10.15	11.83	4.29	5.30	6.85

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

Table 3b: Main effect of Zinc on the yield of corm and cormel of gladiolus at Joydebpur during 2006-2007

Treatments	No. of corms/pl ant	Ind. corm wt (g)	No. of cormels/ plant	Ind. cormel wt (g)	Weight of cormels/ plant	Length of corm (cm)	Diameter of corm (cm)	Diameter of cormel (cm)
Zn_0	1.33 c	11.65 c	3.09 d	1.84c	25.73c	1.88 c	3.11 c	1.27 c
$Zn_{1.5}$	1.39 bc	22.98 ab	9.36 c	2.72 ab	32.07b	1.94 bc	3.32 b	1.50 b
$Zn_{3.0}$	1.45 a	24.21 a	12.09 a	2.94 a	36.24a	2.08 a	3.46 a	1.64 a
$Zn_{4.5}$	1.41ab	23.34ab	11.60ab	2.75ab	32.94ab	1.98b	3.42 a	1.53 b
CV (%)	5.54	9.69	10.34	10.20	15.15	3.71	2.21	5.63

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

Interaction effect of B and Zn

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 per plant and sizes of the bulbs Tables (4a and 4b). Number of corms and weights of individual corm increased with the increase of Boron and Zinc levels simultaneously up to $B_{2.0}Zn_{4.5}$ kg/ha but further augmenting of boron levels incorporating with zinc up to the highest level (4.5 kg/ha) showed reducing trend. It is also noticed in tables for both the years of study that number of corms per plant were 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 (26.07 g and 27.58 g) was recorded with the treatment T_{12} ($B_2Zn_{4.5}$ kg/ha) which was at par with treatments T_{13} and T_{14} where control T_1 (B_0Zn_0) gave poor yield of corm (9.17 g and 10.26 g). Other parameter like number of cormels, weight of cormels per plant and size of corm and cormel were significantly influenced by addition of B and Zn with increase levels. However, the highest number of cormels (9.78 and 14.43/plant) and maximum weight of cormels (31.94 and 51.67 g/plant) were obtained with same boron-zinc interaction ($B_{2.0}Zn_{4.5}$ kg/ha). This result was supported by Jhon *et al.,* 1997, Mukherjee *et al.,* 1998, Devecchi and Barni, 1997 and Singh, 1996. It was also inferred that combination of B and Zn contributed more than their single applications where boron played marginally higher role than zinc. Besides, length and diameter of both corm and cormel also received the same dosage of $B_{2.0}Zn_{4.5}$ kg/ha in combination while untreated Zn-B controls plants performed poor.

Table 4a: Interaction effect of Boron and Zinc on the corm and cormel production of Gladiolus at Joydebpur during 2005-2006

Treatments	No. of corms/ plant	Ind. corm wt (g)	No. of cormels/ plant	Ind. cormel wt (g)	Weight of cormels/ plant	Size of corm		Diameter of cormel (cm)
						Length of corm (cm)	Diameter of corm (cm)	
T_1=B_0Zn_0	1.03h	9.17h	2.87i	0.73l	4.81j	1.18j	1.03h	1.06i
T_2= $B_0Zn_{1.5}$	1.11g	14.30gh	5.68h	1.67k	9.31i	1.37i	2.36g	1.29h
T_3= $B_0Zn_{3.0}$	1.11g	15.83fg	6.73g	1.73jk	11.71hi	1.45i	2.48g	1.35gh
T_4= $B_0Zn_{4.5}$	1.22f	18.02ef	6.86fg	2.07i-k	14.19gh	1.63h	2.82f	1.41f-h
T_5= B_1Zn_0	1.26ef	19.93de	6.94fg	2.11h-j	14.70f-h	1.71gh	2.92ef	1.47e-g
T_6= $B_1Zn_{1.5}$	1.30c-f	21.43c-e	7.17fg	2.24g-i	16.08e-g	1.73f-h	3.03d-f	1.56c-f
T_7= $B_1Zn_{3.0}$	1.32b-e	22.27b-d	7.41e-g	2.47f-i	18.13d-f	1.84d-f	3.16c-e	1.59c-e
T_8= $B_1Zn_{4.5}$	1.34b-d	22.53b-d	7.71d-g	2.5e-h	19.31de	1.87c-e	3.20cd	1.61c-e
T_9= B_2Zn_0	1.37bc	23.14a-d	8.61b-d	3.02a-d	25.99b	1.98bc	3.25cd	1.67b-d
T_{10}= $_2Zn_{1.5}$	1.36bc	24.41a-c	8.73bc	3.07a-c	26.81b	2.03b	3.34bc	1.70a-c
T_{11}= $_2Zn_{3.0}$	1.38b	25.27ab	8.85ab	3.13ab	27.78b	2.17a	3.39bc	1.73ab
T_{12}= $_2Zn_{4.5}$	1.48a	26.07a	9.78a	3.26a	31.94a	2.26a	3.72a	1.86a
T_{13}= B_3Zn_0	1.38b	24.25a-c	8.33b-e	2.90a-e	24.24bc	1.98bc	3.59ab	1.73a-c
T_{14}= $_3Zn_{1.5}$	1.33b-d	24.17a-c	7.80c-f	2.65d-g	20.60cd	1.93b-d	3.54ab	1.69bc
T_{15}= $_3Zn_{3.0}$	1.31b-e	23.55a-c	6.95fg	2.73b-f	19.05de	1.87c-e	3.07d-f	1.57c-f
T_{16}= $_3Zn_{4.5}$	1.28d-f	22.27b-d	6.78g	2.70c-f	18.25d-f	1.79e-g	2.98d-f	1.50d-g
CV (%)	3.27	9.84	8.17	10.15	11.83	4.29	5.30	6.85

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

Table 4b: Interaction effect of Boron and Zinc on the corm and cormel production of Gladiolus at Joydebpur during 2006-2007

Treatments	No. of corms/ plant	Ind. corm wt (g)	No. of cormels/ plant	Ind. cormel wt (g)	Weight of cormels/ plant	Size of corm		Diameter of cormel (cm)
						Length of corm (cm)	Diameter of corm (cm)	
T_1=B_0Zn_0	1.02h	10.26f	3.83h	0.83h	9.56i	1.28j	1.05k	1.19j
T_2= $B_0Zn_{1.5}$	1.15g	18.68e	8.77gh	1.55gh	13.63i	1.50i	2.84j	1.39i
T_3= $B_0Zn_{3.0}$	1.19fg	19.95de	9.13f-h	1.74gh	15.89i	1.63h	2.98i	1.45hi
T_4= $B_0Zn_{4.5}$	1.20fg	21.73c-e	9.83e-g	2.30f	22.62gh	1.71h	3.08hi	1.51g-i
T_5= B_1Zn_0	1.27e-g	22.32b-e	10.57d-g	2.62ef	27.53fg	1.73gh	3.19gh	1.54f-h
T_6= $B_1Zn_{1.5}$	1.29d-f	23.43b-d	10.87d-f	2.66ef	29.00e-g	1.85fg	3.28fg	1.61e-g
T_7= $B_1Zn_{3.0}$	1.30d-f	24.33a-c	11.37c-e	2.76d-f	31.44d-f	1.92d-f	3.39ef	1.66d-f
T_8= $B_1Zn_{4.5}$	1.35de	24.69a-c	11.97b-d	2.83c-e	33.66d-f	1.99de	3.31fg	1.69c-f
T_9= B_2Zn_0	1.40cd	25.21a-c	12.47a-d	3.04b-e	37.83b-d	2.02d	3.43de	1.75b-e
T_{10}=$B_2Zn_{1.5}$	1.52bc	25.58ab	12.92a-c	3.33ab	42.64bc	2.15c	3.52cd	1.79a-d
T_{11}= $_2Zn_{3.0}$	1.61b	25.53ab	13.57ab	3.34ab	45.44ab	2.52b	3.87ab	1.86ab
T_{12}= $_2Zn_{4.5}$	1.75a	27.58a	14.43a	3.56a	51.67a	2.74a	3.94a	1.91a
T_{13}= B_3Zn_0	1.63ab	24.80a-c	13.50ab	3.27a-c	43.96a-c	2.47b	3.75b	1.81a-c
T_{14}= $_3Zn_{1.5}$	1.58b	24.24a-c	12.88a-c	3.35ab	43.00bc	2.25c	3.63c	1.73b-e
T_{15}= $_3Zn_{3.0}$	1.55b	23.56b-d	12.35b-d	3.15a-d	38.97b-d	1.88ef	3.59c	1.55f-h
T_{16}= $_3Zn_{4.5}$	1.51bc	22.86b-d	12.12b-d	3.06b-e	37.02c-e	1.90ef	3.36ef	1.45hi
CV (%)	5.54	9.69	10.34	10.20	15.15	3.71	2.21	5.63

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

It was conferred from two years study that Boron and Zinc @ $B_{2.0}$ and $Zn_{4.5}$ kg/ha along with a blanket dose of $N_{375}P_{150}K_{250}S_{20}$ and CD 5 t/ha was found to be optimum for corm and cormel production. So, it may be recommended that Boron and Zinc in combination @ $B_{2.0}$ kg and $Zn_{4.5}$ kg/ha along with said blanket dose would be suitable for maximizing corm and cormel production in Grey Terrace soils at Joydebpur region of Bangladesh.

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