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Performance of Gladiolus as Influenced by Boron and Zinc

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Abstract: The field study of B and Zn on Gladiolus was conducted at Floriculture Farm of HRC, Gazipur and RARS, Jessore during 2005-2006. The objective was to evaluate the response of B and Zn and to find out the optimum dose of the same for production of gladiolus. It appeared in studied data reveals that B and Zn made promising response to the growth and floral characters of gladiolus. It was also noticed in the tables that B and Zn both either in single or in combination exerted tremendous effect on the yield and quality of gladiolus. However, with subsequent addition of higher rates of B and Zn progressively increased the selective growth and flower characters to some extent and beyond the further increment of the dosage declined the results noticeably. 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 $B_{2.0}$ $Zn_{4.5}$ kg ha^{-1}. along with blanket dose of N_{375} P_{150} K_{250} S_{20} 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) significantly responded to the combined application of boron and zinc at the rate of $B_{2.0}$ $Zn_{4.54}$ as compared to other treatment combinations. Floral characters like floret number (12.85 and 12.45/spike), floret size (9.76×8.93 and 10.28×9.77 cm) and weight of stick (36.73 and 45.12 g) also significantly influenced by said treatment ($B_{2.0}$ $Zn_{4.5}$ kg ha^{-1}) which was markedly differed over rest of treatments combination. Similar trend was noticed as well in single application of B and Zn with increase rates.

Key words: Gladiolus, boron, zinc, floret, floral stick, vase life

INTRODUCTION

Gladiolus (*Gladiolus* sp.) is an important flower found everywhere in the world. It is a popular cut flower owing to its versatile colours and varieties having larger keeping quality of flower. It has great economic value for cut flower trade and much valued by the aesthetic world for beauty and loving people because its prettiness and unparallel elegance (Sadhu and Bose, 1973). They are widely used as artistic garlands, floral ornaments, bouquets etc. The long flower spikes are excellent as cut flower for table decoration when arranged in vases. Flower crops are very much responsive to fertilizers. It is highly capable of exhausting huge nutrients from native soil. So, it requires higher amount of chemical fertilizers in balance proportion for ensuring maximizing flower production.

Fertilizer requirements of gladiolus like other crops, has vital role in growth, quality, corm and cormel production. There are some reports on the requirement of nitrogen (N), Phosphorus (P), Potassium (K) and other fertilization in some countries (Afify, 1989). Major nutrients like nitrogen, phosphorus, potassium along with micronutrients noticeably increase the number of flowers, florets/spike, the longest spike and flowering stem of gladiolus (Afify, 1989). Increasing N fertilization substantially augmented plant growth, number of leaves/plant, spike length and number of florets/spike (Shah *et al*., 1984). It was 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 and Mg. However, information regarding nutritional requirement and appropriate soil management practices are lacking for

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gladiolus cultivation in Bangladesh. Hence, such an investigation was undertaken to evaluate the response of gladiolus to B and Zn and their optimum dose for maximizing flower yield of gladiolus in Grey Terrace, Soils of Joydebpur and High Gangetic Alluvial Soils at Jessore region.

MATERIALS AND METHODS

The field trial of B and Zn on gladiolus was conducted at Floriculture field of Horticultural Research Centre, BARI, Gazipur and Jessore during rabi season of 2005-2006. The objective was to investigate and evaluate the response of gladiolus to boron and zinc and their optimum requirement for growth, flowering, flower quality and corm production of gladiolus. Both the analysed soil samples and their nutrient status of Joydebpur and Jessore experimental sites are shown in Table 1. Nutrient status of experimental soils were found to be low, organic matter was also far below of the optimum level.

There were sixteen treatment combinations comprising four levels of B (0, 1, 2 and 3 kg ha^{-1}) and four levels of Zn (0, 1.5, 3.0 and 4.5 kg ha^{-1}) were taken in the study. The experiment was laid out in randomized block design having replicated thrice. The unit plot size and plant spacing were 1×0.9 m and 25×15 cm, respectively. BARI Gladiolus-1 was used as a test crop. The combined blanket dose of N_{375} P_{150} K_{250} S_{20} kg ha^{-1} + CD 5 t ha^{-1} were taken in the study. The planting material corms were sown on 5th December/05 at both the locations. All P, K, S, B, Zn and CD except N were applied and mixed up with the soil during final land preparation. Nitrogen was applied in three equal splits, first $^1/_3$rd of N at 30, second top-dress at 45 and remaining $^1/_3$rd at 60 days of sowing. Intercultural operations viz. weeding, irrigation, racking etc were performed in time. Full bloomed flowers were cut time to time to record the field data. The collected data of required parameters from 10 randomly selected plants were analysed statistically and adjusted with DMRT and LSD tests at 5% level of significance.

RESULTS AND DISCUSSION

Effect of Boron: The data presented in Table 2 and 3 revealed that all studied parameters like growth and flower characters were significantly influenced by boron fertilization. It appears in the Table 2 and 3 that with the increase of B levels, growth and other floral characters progressively increased in upward direction (Fig 1a and b). Thereafter with further increment of B rate, growth and yield attributes of flower sharply declined. It is also felt that response of gladiolus was more pronounced to Zn fertilization than that of Boron. Though it is reported fact that Zn and B both are equally responsible for yield and quality of gladiolus along with the major nutrients. However, it is observed in either locations of Joydebpur and Jessore that applied 4 levels of B (0, 1, 2 and 3 kg ha^{-1}) all the studied flower characters like plant height, effective leaves, length of spike and rachis, number of florets, size of floret

Table 1: Chemical properties of the initial soil of the experimental field at Joydebpur and Jessore

Location	pH	OM	Ca	Mg	K	Total N (%)	P	S	B	Cu	Fe	Mn	Zn
			Meq/100 g				μg g^{-1}						
Joydebpur	6.2	1.1	0.5	0.7	0.18	0.16	10	12	0.1	1.0	140	4.0	1.0
Jessore	7.2	1.4	10.0	2.5	0.21	0.17	11	10	0.22	0.5	40	5.0	1.5
Critical level	-	-	2.0	0.8	0.20	-	14	14	0.2	1.0	10	5.0	2.0

Source: Soil Science Lab, BARI

Table 2: Main effect of Boron on the yield and yield components of Gladiolus at Joydebpur

Treatments	Plant height (cm)	Length rachis (cm)	Length spike (cm)	Effective leaves (no)	Florets spike (No.)	Diameter of florets (cm)	Length of florets (cm)	Wt of stick kg ha^{-1} (g)
B_0	67.18d	35.51d	52.9d	8.19d	10.51d	7.12d	8.62d	26.66d
$B_{1.0}$	67.44c	36.76c	56.54c	8.99c	10.48c	7.25c	8.81c	27.47c
$B_{2.0}$	71.89a	44.52a	61.43a	9.65a	11.77a	8.26a	9.33a	28.76a
$B_{3.0}$	68.86b	41.04b	58.6b	9.31b	10.86b	7.77b	9.01b	28.09b
CV (%)	8.90	6.70	8.7	9.60	5.50	10.30	9.40	8.60
Jessore								
B_0	80.07d	36.16d	69.86d	8.85d	8.07d	5.70d	7.60d	36.07d
$B_{1.0}$	84.85c	37.06c	71.08c	9.05c	9.70c	6.70c	8.53c	37.54c
$B_{2.0}$	86.05a	38.65a	72.55a	9.65a	10.88a	7.8a	9.46a	39.77a
$B_{3.0}$	85.39b	37.89b	71.38b	9.56b	9.93b	6.71b	8.45b	37.66b
CV (%)	9.70	8.60	9.30	11.40	8.80	8.40	9.80	7.90

Figures having common letter in a column are not significantly different by DMRT at 5% level, CV = Coefficient of Variation

Table 3: Main effect of Zinc on the yield and yield components of Gladiolus at Joydebpur

Treatments (kg ha^{-1})	Plant height (cm)	Length of rachis (cm)	Length of spike (cm)	Effective leaves (cm)	Florets/spikes (No.)	Diameter of florets (cm)	Length of florets (cm)	Wt of stick (g)
Zn_0	64.76d	30.95d	49.88d	7.8d	9.63d	6.11d	7.88d	22.58d
$Zn_{1.5}$	66.86c	37.74c	56.24c	8.84c	10.64c	7.57c	8.89c	25.27c
$Zn_{3.0}$	74.13a	47.14a	63.84a	10.05a	12.18a	8.67a	9.71a	35.72a
$Zn_{4.5}$	69.63b	41.95b	59.51b	9.45b	11.17b	8.04b	9.29b	27.41b
CV (%)	8.90	6.70	8.70	9.60	5.50	10.30	9.40	8.60
Jessore								
Zn_0	85.86d	37.52d	69.89d	8.07d	10.63d	7.05d	9.36d	37.59d
$Zn_{1.5}$	86.16c	38.05c	72.36c	8.48c	10.89c	7.11c	9.42c	37.91c
$Zn_{3.0}$	87.70a	39.58a	73.89a	9.66a	11.10a	7.92a	9.66a	39.83a
$Zn_{4.5}$	86.64b	38.82b	72.59b	9.60b	10.95b	7.12b	9.49ab	38.28b
CV(%)	9.70	8.60	9.30	11.40	8.80	8.40	9.80	7.90

Figures having common letter in a column are not significantly different by DMRT at 5% level, CV = Coefficient of Variation

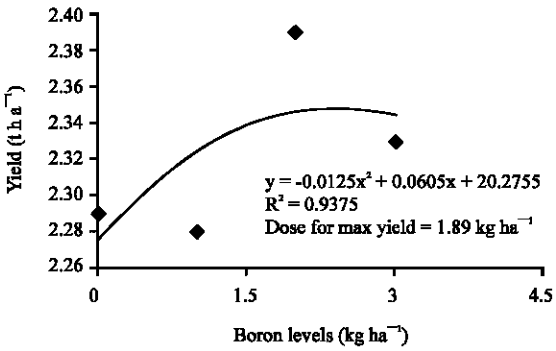

Fig.1a: Response of boron on the yield of Gladiolus at Joydebpur

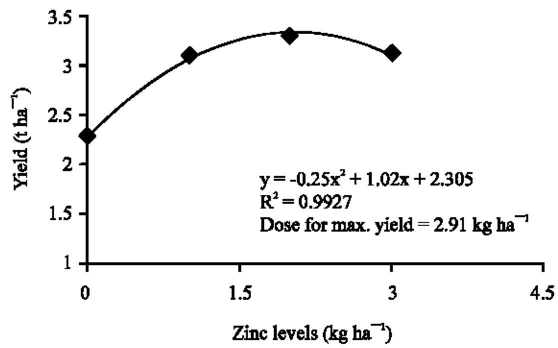

Fig. 2a: Response of zinc on the yield of Gladiolus at Joydebpur

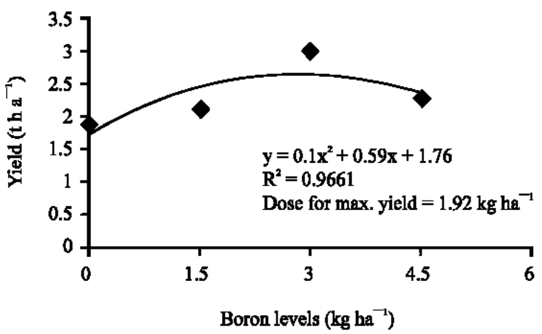

Fig.1b: Response of boron on the yield of Gladiolus at Jessore

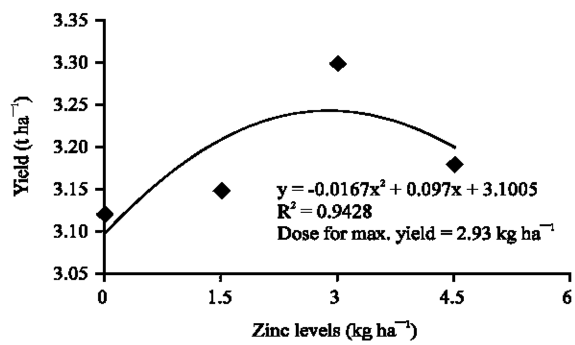

Fig. 2b: Response of zinc on the yield of Gladiolus at Jessore

(length and diameter) and weight of stick significantly responded to the B up to 2.0 kg ha^{-1} and beyond that level, negative response was noticed. The analysed soils of both the locations indicate that soil nutrient status was found to be highly deficient made a profound response to the flower characters of gladiolus. However, significantly the highest plant height (71.89 and 86.05 cm), length of spike (61.43 and 72.55 cm), length of rachis (44.52 and 38.65 cm) and effective leaves (9.66 and 9.65/plant) were recorded in B 2.0 kg ha^{-1} and significantly differed over other B levels and B control (B_0) at both the locations. Similarly, flower characters like number of florets (11.77 and 10.88/spike), floret size (9.33×9.46 cm and 10.46×7.80 cm) and weight of stick (28.76 and 39.77 g) was found to be significantly responded to B and recorded with same B level (2.0 kg ha^{-1}) which was statistically different over other B levels. Similar findings were reported by Bhattacharjee *et al.* (1998), Graonassy *et al.* (1994) and Jhon *et al.* (1997a, b). They further stated that with the increment of B up to the certain level made a significant contribution to the flower character of gladiolus.

Effect of Zn: The effect of Zn on growth and flower characters of gladiolus are shown in Table 2 and 3 reveals

Table 4: Interaction effect of Boron and Zinc on the yield and yield components of Gladiolus at Joydebpur

Treatments ($kg\ ha^{-1}$)	Plant height (cm)	Leaves/plant (cm)	Length of spikes (cm)	Length of rachis (cm)	Florets/spikes (No.)	Length of florets (cm)	Diameter of florets (cm)	Wt of stick (g)
$B_o\ Zn_o$	63.30de	6.57g	41.67I	21.07k	9.34f	5.63k	5.33k	20.50j
Bo $Z_{1.5}$	65.20cd	8.00ef	54.00fg	34.30h	10.42gh	7.23j	5.42k	25.17efg
$B_0\ Zn_{3.0}$	68.20c	8.83e	55.25ef	41.78d	10.72ef	8.7efh	7.29fgh	26.05ef
$B_0\ Zn_{4.5}$	72.20bc	9.33cd	60.67c	44.88c	11.56b	9.09cde	7.75def	34.92b
$B_1\ Z_0$	63.67de	7.62f	49.00h	30.17j	9.40dij	9.44abc	8.01cde	22.77I
$B_1\ Z_{1.5}$	66.07cd	9.03de	54.50fgt	32.89I	9.71I	7.78I	6.00j	24.88fgh
$B_1\ Zn_{3.0}$	67.66c	9.48cd	59.50c	36.87g	10.70efg	8.57fg	7.14gh	26.83de
$B_1\ Zn_{4.5}$	62.37bc	9.83c	63.17b	47.09b	12.04bc	9.17cd	7.43fg	35.40ab
$B_2\ Zn_0$	64.73de	8.37e	53.17g	34.29h	9.56ij	9.71ab	8.42bc	23.17hi
$B_2\ Zn_{1.5}$	67.94c	9.03de	57.25dc	39.68e	10.63fg	8.05hi	6.24ig	25.37efg
$B_2\ Zn_{3.0}$	70.67bc	9.57cd	59.78c	42.32d	10.98e	8.96def	7.50efg	28.02cd
$B_2\ Zn_{4.5}$	79.83a	10.77a	67.33a	48.86a	12.85a	9.76a	8.93a	46.73a
$B_3\ Zn_0$	67.33c	8.64e	55.67ef	38.28f	10.16h	9.26ab	8.73b	23.87ghi
$B_3\ Zn_{1.5}$	68.42c	9.30cd	59.20cd	44.08c	11.79cd	8.44gh	6.78hi	25.67ef
$B_3\ Zn_{3.0}$	71.98bc	9.91bc	63.50b	46.84b	12.29b	9.37abc	8.33bc	25.60ab
$B_3\ Zn_{4.5}$	76.20b	10.00b	64.66b	47.00ab	12.30b	9.61ab	8.83ab	34.60b
CV (%)	6.90	9.70	8.60	7.40	8.10	7.60	7.250	9.20
Jessore								
$B_o\ Zn_o$	82.40c	7.00c	63.80g	28.87ab	8.80ab	6.55g	7.52ab	33.59b
Bo $Z_{1.5}$	85.13abc	8.60abc	69.53ef	34.33b	9.73b	7.42f	7.59ab	35.12ab
$B_0\ Zn_{3.0}$	86.10abc	8.73ab	69.59ef	34.57b	10.47b	7.73f	7.99a	39.84ab
$B_0\ Zn_{4.5}$	88.97abc	7.87c	73.05bc	37.87ab	11.27ab	8.69e	7.61ab	40.97ab
$B_1\ Z_0$	85.43abc	9.13bc	69.20ef	36.17ab	10.40b	8.65e	6.43b	35.26ab
$B_1\ Z_{1.5}$	86.07abc	9.20bc	70.43e	38.20ab	10.61ab	9.47bc	7.54ab	37.20ab
$B_1\ Zn_{3.0}$	88.11abc	9.67ab	71.48d	38.20ab	10.60b	9.73b	8.01a	39.43ab
$B_1\ Zn_{4.5}$	89.48ab	9.60abc	73.23bc	38.21ab	11.13ab	9.47bc	8.22a	40.39ab
$B_2\ Zn_0$	82.90abc	9.53abc	72.81cd	36.59ab	10.40b	9.41bc	7.60ab	34.41b
$B_2\ Zn_{1.5}$	86.57abc	9.60abc	73.91bc	36.78ab	10.80ab	9.33cd	7.77ab	36.39ab
$B_2\ Zn_{3.0}$	90.61b	9.73ab	75.51b	39.68ab	11.45ab	9.28d	7.91ab	43.46ab
$B_2\ Zn_{4.5}$	94.13a	9.87a	87.97a	46.08a	10.93a	10.28a	8.23a	45.36a
$B_3\ Zn_0$	86.17abc	9.40abc	68.50f	37.00ab	10.53b	9.43bc	7.36ab	35.72ab
$B_3\ Zn_{1.5}$	87.31abc	9.60abc	71.17de	37.67ab	10.87ab	9.44bc	7.56ab	40.66ab
$B_3\ Zn_{3.0}$	87.33abc	9.60abc	72.80cd	38.25ab	11.07ab	9.37cd	7.75ab	40.66ab
$B_3\ Zn_{4.5}$	88.73abc	9.63ab	74.53b	39.48ab	11.20ab	9.55bc	7.87ab	40.92ab
CV (%)	10.60	9.80	10.20	9.40	8.90	10.30	10.20	8.70

Figures having common letter in a column are not significantly different by DMRT at 5% level, CV = Coefficient of Variationand

that zinc made a promising response to the studied parameters. It appears in the tables that floral characters showed better response to the added zinc fertilizer with increase dosage up to the level of B at the rate of 3.0 $kg\ ha^{-1}$ and beyond that rate declined it sharply Fig. 2a and 2b. It is also noticed in the tables that zinc either in single or combination exerted significant effect on growth and other floral characteristics. However, applied 4 levels of Zn at the rate of 0,1.5, 3.0 and 4.5 $kg\ ha^{-1}$, significantly the highest plant height (74.13 and 87.70 cm), the longest length of spike (63.84 and 76.89 cm) and rachis (47.14 and 39.58 cm), maximum effective leaves (10.05 and 9.66/plant) obtained in 3.0 kg Zn ha^{-1} followed by rest of Zinc levels and Zn control (Zn_0). The floral characters like floret number, length and diameter of floret and weight of floral stick profusely accelerated by augmenting Zn levels up to 3.0 kg/ha. The highest number of florets (12.18 and 11.01/spike), the larger sized floret (9.71×8.67 and 9.66×7.92 cm) and maximum weight of floral stick (36.71 and 40.83 g) was recorded in said Zn level (3.0 kg Zn ha^{-1}) which was noticeably differed over rest of Zn levels and native nutrient treatment (Zn_0) at both the locations of Joydebpur and Jessore. The effect of Zn at earlier mentioned locations are appeared to be almost similar might be the fact that well management practice, appropriate agro-climatic situation and above all Zn deficiency in studied soil. This result partially corroborated by Roy Chowdhury and Sarker (1995) and reflected it in their reports.

Interaction effect of B and Zn: The effect of boron and zinc on gladiolus are presented in Table 4 significantly differed due to zinc-boron interaction. The integrated effect of Zn and B was found to be more distinctive as compared to the main effect of the same. It is also noticed in Table 4 that Zn and B with increase rate in combination made a promising response to the different growth and floral characters of gladiolus. With the advancement of higher doses of Zn and B, all the selected parameters like growth and flower components significantly increased up to the certain level and beyond the further increment, it sharply declined. The analyzed soil data reveal that B and Zn in native soil at both the locations were found to be critical level meant highly responsive to the cut flower. The literature of cut flowers cited that Zn and B either have combined and single effect on flower production. However, the growth parameters like plant height, length of spike and rachis, effective leaves and floral character like florets number/spike, size of floret and weight of stick were tremendously influenced with the increase of Zn and B in combination. The highest plant height (79.83 and 94.13 cm), length of spike (67.33 and 87.97 cm) and rachis (48.86 and 46.08 cm) and maximum number of effective leaves (10.77 and 9.87/plant) was recorded with higher boron-zinc combination at the rate of $B_{2.0}$ $Zn_{4.5}$ kg ha^{-1} which was statistically significant over rest of the treatment combinations. Similar trend was also found in floret number (12.85 and 12.87/spike), floral length and diameter (9.76×8.93 and 10.28×8.56 cm) and the weight of stick (46.73 and 50.36 g) by same combination ($B_{2.0}$ $Zn_{4.5}$ kg ha^{-1}) which was similar to the treatments of $B_{3.0}$ $Zn_{1.5}$ kg/ha and $B_{2.0}$ $Zn_{3.0}$ kg/ha and significantly differed over all other treatments and Boron-Zinc control (B_0Zn_0). This result confirmed and supported by Jhon *et al.* (1997a,b), Mukherjee *et al.* (1998) and Devecchi and Barni (1997).

CONCLUSIONS

It was felt in the study at both the locations of Joydebpur and Jessore reveale that Boron at the rate of $B_{1.90}$ and Zinc at the rate of $Zn_{2.92}$ kg ha^{-1} along with the blanket dose of N_{375} P_{150} K_{250} S_{20} kg and CD 5 t ha^{-1} was found to be optimum for gladiolus production. So it may be summarized that Boron and Zinc at the rate of $B_{2.0}$ kg and $Zn_{3.0}$ kg ha^{-1} along with the said blanket dose could be suitable for maximizing yield and flower quality of Gladiolus at Grey Terrace Soils of Joydebpur and high Gangatic Floodplain Alluvial Soils of Jessore regions in Bangladesh.

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