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Performance of Brinjal as Influenced by Boron and Molybdenum

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Abstract: The filed study was carried out at Horticultural Research Farm, BARI, Joydebpur during two consecutive seasons of 2004-05 and 2005-06, respectively to evaluate the response of Binjal to each levels of B (0, 0.75, 1.50 and 2.25 kg ha^{-1}) and 4 levels of Mo (0, 0.75, 1.50 and 2.25 kg ha^{-1}) were used in the study for treatment combination. A combined blanket dose of N P K S and CD at the rate of 120:45; 100:20 kg and 5 t ha^{-1} were also mixed up in all the treatment plots. It is evident from both first and second year results that B and Mo either in single or in combination made significant response to the yield and yield attributes of brinjal in B-Mo deficient soil of experimental site. Boron produced significantly higher yield 76.52 t ha^{-1} and 26% yield increase over B control (B_0). Similarly, Molybdenum also made positive response to the yield of brinjal. All the studied parameters were significantly influenced by applied molybdenum up to 1.50 kg ha^{-1}. However, the highest brinjal yield (82.24 t ha^{-1}) was recorded with Mo at the rate of 1.50 kg ha^{-1} and beyond that the yield declined steadily. The 88% yield increase was also noticed in the same treatment. Interaction effect of B and Mo was found to be highly responsive to the yield and yield components of brinjal. However, the highest yield (91.67 t ha^{-1}) was recorded with B-Mo combination at the rate of $B_{1.50}$ $Mo_{1.50}$ kg ha^{-1} and 166% yield increase over B-Mo control (B_0 Mo_0) treatment in 2nd year due to well management practices and favorable agro-climatic condition compared to the first year result.

Key words: Brinjal, boron, molybdenum, fruit yield

INTRODUCTION

Increasing land use intensity, introduction of modern varieties of crop, minimum and unbalanced use of fertilizer and no practice of leaving crop residues, no addition of organic manure to soil have lead to a marked depletion of nutrient reserve in Bangladesh soils. Consequently, along with N, P, K, S and some micronutrient (B and Mo) deficiencies have also been observed.

Brinjal (*Solanum melongena* L.) is one of the most common and popular vegetables in Bangladesh. Brinjal ranks the second position in vegetable next to potato both in acreage and production. It is a year round vegetable but grows well in winter season under Bangladesh condition. The production of brinjal in Bangladesh is 19,200 metric tons (BBS, 2002).

Nutrient is the key factor for crop production. Balanced fertilizer is indispensable for optimum yield of any crop. The micronutrient boron is important for carbohydrate metabolism and translocation. It is also responsible for cell wall development and RNA metabolism. Boron deficiency hampers flowering, fruit setting by retarding pollen germination and pollen tube development (Halfacre and Barden, 1979).

Micronutrients play an important role in increasing yield of crops through their effects on the plant itself until 1980, farmers used only NPK-fertilizers but now they are applying S and Zn along with N P K. Like Zn and S, addition of B, Mg, Mo, Cu or Ca is needed in some soils (Islam, 1992). Deficiencies of B and Mo on some soils and crops were found in some parts of Bangladesh (Jahiruddin *et al*., 1992). Molybdenum is required for the formation of the nitrate reductase enzyme and in the legume it plays an additional role in symbiotic nitrogen fixation. The nitrogen fixing enzyme, nitrogenase is composed of molybdenum and iron and without adequate quantities of these elements, nitrogen fixation can't occur.

Their limited works had been done in this regard at Bangladesh context. From this point of view, the present research was undertaken to find out the optimum rate of boron and molybdenum for brinjal fruit yield in Joydebpur Grey Terrace Soil.

MATERIALS AND METHODS

A field trial on brinjal was conducted at HRC Farm, Joydebpur, Gazipur during the rabi seasons of 2004-2005 and 2005-2006. The soil of the experimental site was silty

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

			Ca	Mg	K		P	S	B	Cu	Fe	Mn	Zn
Location	pH	OM	meq/100 g			Total N %	($\mu g\ g^{-1}$)						
Joydebpur	6.2	1.1	0.5	0.7	0.18	0.16	10	12	0.1	1	140	4	1.0
Critical level	-	-	2.0	0.8	0.20	-	14	14	0.2	1	10	5	2.0

clay loam in texture. The physical and chemical properties of the analysed soil sample are shown in Table 1. The treatments were laid out in a randomized block design (factorial) having replications thrice. There were sixteen treatments combinations comprising each of four levels of boron (0, 0.075, 1.50 and 2.25 kg ha^{-1}) and four levels of molybdenum (0, 0.075, 1.50 and 2.25 kg ha^{-1}). The unit plot size and plant spacing were 25×75 cm. The variety Kazla (BARI Begun-4) was taken as a test crop. Thirty days seedlings were transplanted on 27 November for both the years of 2004-2005 and 2005-2006, respectively. A combined blanket dose of N_{150} P_{45} K_{100} S_{20} kg ha^{-1} and 5t CD/ha were applied before final land preparation. Nitrogen was splited into three equal installments. The 1/3rd N was applied around the plants after 15 days of planting, 2nd installment at first flower appearing stage and remaining one at fruiting stage. All necessary intercultural operations like weeding irrigation, spraying pesticides etc. were performed as and when required by the experiment. Young fruits were harvested time to time at edible stage. Five plants were randomly selected from each and every treatment for recording necessary yield data. The collected data were compiled and analysed statistically adjusted with Duncans Multiplie Range Test (DMRT) and Least Significant Difference at 5% level of significant.

RESULTS AND DISCUSSION

Effect of boron: Table 2 reflected that boron significantly influences the yield and yield attributes of brinjal. Yield and yield components of brinjal progressed in upward direction up to 1.50 kg B/ha and thereafter declined. However, the highest plant height (95.30 and 94.30 cm), fruit size (15.49×5.80 cm and 15.54×5.36 cm) and individual fruit weight (63.52 and 91.0 g) were obtained from applied boron at the rate of 1.50 kg ha^{-1}. The height brinjal yield (48.26 and 76.52 t ha^{-1}) was also recorded with said boron level (1.50 kg ha^{-1}) in two consecutive years of study. It might be the reason of well management practices and soil deficient in boron. Smit and Combrink (2004), Paithankar *et al.* (2004) and Ben-Gal and Shani (2004) found similar findings in their investigation and confirmed the present finding.

Effect of molybdenum: The yield of brinjal was significantly augmented due to Mo application. The significant increase of growth and other yield attributes were observed with the successive addition of Mo up to 1.50 kg ha^{-1} and beyond that the yield declined steadily (Table 3). However, applied 4 levels of Mo (0, 0.75, 1.5 and 2.25 kg ha^{-1}) the highest plant height (95.12 and 93.24 cm), fruits/plant (50.63 and 12.69 cm) and fruit weight (63.75 and 91.53 g) significantly progressed in upward trend but beyond that level the trend sharply fallen off. All the yield and yield contributing characters responded positively by adding molybdenum levels due to native soils are in Mo deficient. In the similar way yield of brinal was highly influenced by applying Molybdenum to some extent. However the highest brinjal yield (48.1 and 82.24 t ha^{-1}) was recorded with applied Mo at the rate of 1.50 kg ha^{-1} as compared to other Mo rates and significantly differed over Mo control (Mo) and 88% yield increase recorded in same Molybdenum level (1.50 kg ha^{-1}).

Correlation-regression analysis: It reveals in the regression equations (Fig. 1 and 2) reflected that at the

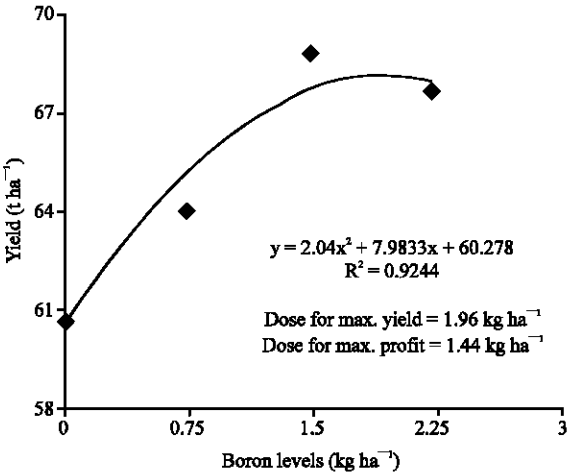

Fig. 1a: Response of boron on the yield of Brinjal, 06

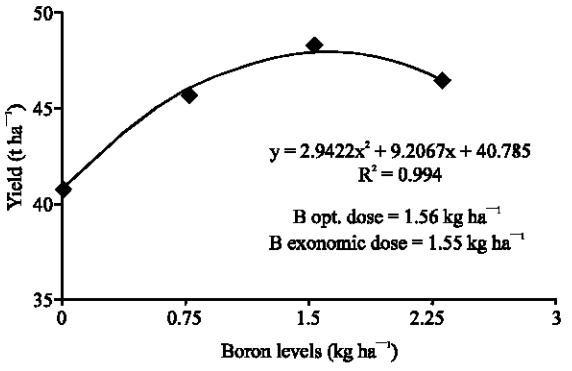

Fig. 1b: Response of boron on the yield of Brinjal, 05

Table 2: Main effects of boron on the yield and yield attributes of brinjal during 2005-2006

Treatments (kg ha^{-1})	Plant ht. (cm)	Fruit yield/ plant (kg)	Fruit/plant (No.)	Single fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Fruit yield (t ha^{-1})	% increase over control
B_0	76.00c	2.87b	62.98c	71.22b	14.10b	4.67c	60.67d	-
$B_{0.75}$	83.00b	3.18ab	66.97b	73.44b	14.33b	5.03b	63.94c	5
$B_{1.50}$	94.30a	3.36a	73.88a	81.50a	15.54a	5.36a	68.84a	26
$B_{2.25}$	86.12b	3.26ab	68.78b	81.06a	14.39b	5.31ab	67.52b	14
CV (%)	8.50	8.30	6.60	7.20	7.80	11.20	8.70	-
2004-2005								
B_0	84.52b	1.87b	41.87b	54.99b	13.55ab	4.54c	40.88b	-
$B_{0.75}$	93.47ab	2.18ab	46.91ab	61.45ab	14.44a	5.54b	45.75ab	11
$B_{1.50}$	95.30a	2.36a	50.80a	63.52a	15.43a	5.80a	48.26a	18
$B_{2.25}$	94.67ab	2.26a	49.31ab	63.48ab	14.73ab	5.72ab	46.91ab	14
CV (%)	10.50	8.70	8.20	8.90	5.30	5.80	6.20	-

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

Table 3: Main effects of Molybdenum on the yield and yield attributes of brinjal during 2005-06

Treatments (kg ha^{-1})	Plant height (cm)	Fruit yield/ plant (kg)	Fruit/plant (No.)	Single fruit weight. (g)	Fruit length (cm)	Fruit diameter (cm)	Yield (t ha^{-1})	Yield increase (%)
Mo_0	74.12c	3.10ab	62.27c	67.25b	12.71c	4.10c	67.37d	-
$Mo_{0.75}$	81.00b	3.15a	66.80b	73.94b	14.14b	4.92b	76.72c	54.00
$Mo_{1.5}$	93.24a	3.34a	72.69a	83.35a	16.70a	6.03a	83.65a	88.00
$Mo_{2.25}$	88.33b	3.21a	70.34a	82.68a	15.02b	5.31b	82.24b	76.00
CV (%)	8.50	8.30	6.60	7.20	7.80	11.20	8.70	-
2004-05								
Mo_0	87.51b	2.10ab	43.99b	57.74ab	13.87ab	4.92ab	42.36b	-
$Mo_{0.75}$	91.99ab	2.15a	45.80ab	60.55a	14.45a	5.38a	44.40ab	4.82
$Mo_{1.50}$	95.12a	2.34a	50.63a	63.25a	15.22a	5.74a	48.14a	13.64
$Mo_{2.25}$	93.33a	2.21a	48.47ab	62.10a	14.61a	5.57a	46.90ab	10.72
CV (%)	10.50	8.70	8.20	8.90	5.30	5.80	6.20	-

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

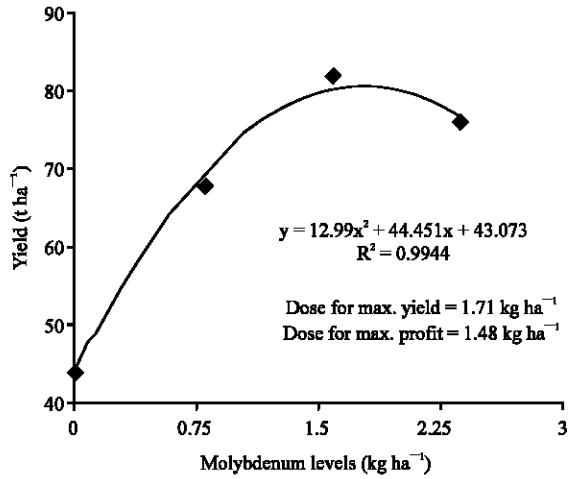

Fig. 2a: Response of molybdenum on the yield of Brinjal, 06

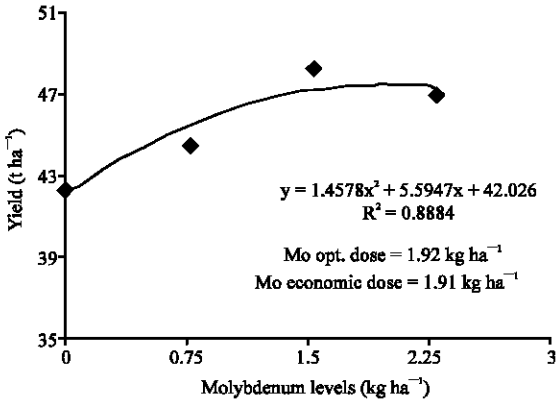

Fig. 2b: Response of molybdenum on the yield of Brinjal, 05

increase B and Mo levels the yield increased positively to some extent and further increment of the doses the yield declined sharply. The values of R^2 (0.9244, 0.994 and 0.9924, 0.8884) indicates the variables yield and levels of B and Mo are positively correlated.

Interaction effect of B and Mo: It is evident from studied tables reveal that both B and Mo had an significant effect on the yield and yield attributes of brinjal. But incase of single effect, Molybdenum was found to be more responsive to brinjal than that of Boron (Table 4a and b). However, with the integration of B-Mo at increase rates significantly increased the studied parameters at certain levels but beyond the farther increment the upward trend sharply declined. It was happened in the study in both the years of 2004-2005 and 2005-2006. The yield and yield attributes of brinjal like plant height, number of leaves, fruit size, fruit weight and number of fruits per plant progressively increased by the increase of boron-molybdenum integration up to certain limit and thereafter this declined sharply. The highest plant height (98.40 and 93.20 cm), fruit length and diameter

Table 4a: Interaction effects of boron and molybdenum on the yield and yield attributes of brinjal during 2005-2006

Treatments (kg ha^{-1})	Plant height (cm)	Fruit/plant (No.)	Individual fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Yield (t ha^{-1})
B_0Mo_0	75.20f	55.00f	56.08i	12.74g	3.67e	34.52i
$Mo_{0.75}$	77.03e	59.42e	65.92h	13.51d	4.31cd	61.11f
$Mo_{1.50}$	80.12d	70.33c	75.25f	16.18bc	5.73ab	76.83d
$Mo_{2.25}$	79.10de	67.18d	71.75g	13.97d	4.98c	70.23e
$B_{0.75}Mo_0$	81.20d	61.08e	69.25g	11.88f	4.27cd	42.26h
$Mo_{0.75}$	82.12d	65.37de	68.08g	13.56d	5.04c	60.27f
$Mo_{1.50}$	84.20c	71.58c	79.75e	16.40ab	5.48b	79.31cd
$Mo_{2.25}$	83.11c	69.83cd	78.67e	14.99cd	5.32b	73.92e
$B_{1.50}Mo_0$	84.32c	64.25de	77.70e	12.41e	4.04d	47.16g
$Mo_{0.75}$	86.12bc	69.43b	77.67e	13.51d	5.14b	70.19e
$Mo_{1.50}$	93.20a	77.75a	91.00a	17.06a	6.59a	91.67a
$Mo_{2.25}$	87.20b	70.33c	84.33c	14.47cd	5.62c	76.86e
$B_{2.25}Mo_0$	87.00b	68.75c	81.83d	13.29d	4.39cd	50.64g
$Mo_{0.75}$	83.62c	73.00b	89.08b	15.97bcx	5.13b	77.91d
$Mo_{1.50}$	82.30d	74.00b	85.60c	16.67ab	6.33a	85.56b
$Mo_{2.25}$	80.12d	71.08c	84.58c	16.64ab	5.31b	81.16c
CV (%)	5.1	4.6	9.8	7.8	13.0	6.7

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

Table 4b: Interaction effects of B and Mo on the yield and yield components of brinjal during 2004-2005

Treatments (kg ha^{-1})	Plant height at harvest (cm)	Fruit yield/ plant (kg)	No. of fruits/plant	Single fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Fruit yield (t ha^{-1})
B_0Mo_0	76.87k	1.76b	41.10i	48.84i	13.21d	4.18e	40.10f
$Mo_{0.75}$	85.24j	1.82b	41.67i	55.44h	13.67d	4.66de	41.24e
$Mo_{1.50}$	88.58h	1.99b	42.89h	58.56f	13.89c	4.82cd	41.83e
$Mo_{2.25}$	87.38i	1.89ab	41.83i	57.13g	13.44c	4.51de	41.35e
$B_{0.75}Mo_0$	90.18g	2.00ab	43.13h	57.34g	13.82c	5.07c	42.72dc
$Mo_{0.75}$	93.68e	2.08ab	44.52h	60.52e	14.37bc	5.56bc	43.13d
$Mo_{1.50}$	95.83cd	2.34a	51.31d	63.83cd	15.10b	5.82ab	49.10bc
$Mo_{2.25}$	94.17de	2.28a	48.67e	63.10d	14.45bc	5.71bc	48.00c
$B_{1.50}Mo_0$	91.54f	2.18ab	46.28g	62.36d	14.28bc	5.21bc	43.38d
$Mo_{0.75}$	94.72de	2.31a	49.39de	63.35d	15.12b	5.68ab	48.32c
$Mo_{1.50}$	98.54a	2.57a	54.64a	64.89a	16.66a	6.20a	51.42a
$Mo_{2.25}$	96.39c	2.36a	52.55c	64.28c	15.64b	6.12a	49.91b
$B_{2.25}Mo_0$	91.44f	2.10ab	45.46gh	61.43de	14.18bc	5.21bc	43.24d
$Mo_{0.75}$	94.33de	2.17ab	47.29f	62.88d	14.62bc	5.63ab	44.87d
$Mo_{1.50}$	97.54b	2.45a	53.68b	65.72b	15.24b	6.10a	50.67ab
$Mo_{2.25}$	95.38d	2.32a	50.81de	63.88d	14.89bc	5.69ab	48.87c
CV (%)	11.30	8.60	9.20	8.40	5.10	5.70	6.90

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

(16.66×6.20 and 17.06×6.59 cm), number of fruits (54.64 and 77./75/plant), single fruit weight (91.0 g) were obtained from B-Mo combination at the rate of B 1.50, M1.50 kg ha^{-1} and significantly differed over other treatment combinations and B-Mo control treatment (Bo Mo). This was partially agreement with the findings of Agwah and Mahmoud (1994), Gunes *et al.* (1999) and Yadav *et al.* (2001a, b).

CONCLUSIONS

It is summarized from the two years study felt that Boron at the rate of 1.96 kg ha^{-1} (optimum dose), 1.44 kg ha^{-1} (econimic dose) and that of Molybdenum at the rate of 1.71 kg ha^{-1} (optimum) 1.48 kg ha^{-1} (economic) along with combined blanket dose of N_{150} P_{45} K_{100} S_{20} kg and CD 5 t ha^{-1} were found to be optimum for maximizing yield of brinjal. So, it may be suggested that B at the rate of 1.5 kg ha^{-1} and Mo at the rate of 1.50 kg ha^{-1} along with a blanket dose of N_{150} P_{45} K_{100} S_{20} kg and CD 5 t ha^{-1} can be suitable fertilizer package for brinjal production in Gray Terrace Soil of Joydebpur.

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