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RESPONSE OF HYBRID TOMATO VARIETIES TO BORON APPLICATION

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Abstract

A field experiment was carried out in Grey Terrace Soil of Joydebpur and Non Calcareous Grey Floodplain Soil of Agricultural Research Station, Burirhat, Rangpur during the *rabi* season of 2010-2011 and 2011-2012. The objectives were to evaluate the effect of boron on the yield and yield attributes of BARI Hybrid Tomato-5 as well as to determine an optimum rate of boron application for maximizing yield. Three varieties of BARI Hybrid Tomato-5 viz., Epoch, NS 815 and BARI Hybrid-5 and five levels of boron (0, 0.5, 1.0, 1.5 and 2.0 kgB ha^{-1}) along with a blanket dose of N_{220} P_{60} K_{120} S_{40} $Zn_{4.0}$ kg ha^{-1} and cow dung 5 t ha^{-1} were used in the study. Results revealed that NS 815 performed the best with 1.5 kg B ha^{-1} that produced 79.7 t ha^{-1} at Joydevpur whereas at Burirhat Epoch performed best (101 t/ha). The said combination increased 31.7% and 57.8% yield over the control at Joydevpur and Burirhat, respectively. However, from regression analysis, a positive but quadratic relationship was observed between yield and boron levels. The optimum dose of boron was appeared to be as 1.37 kg and 1.54 kg B ha^{-1} for Joydevpur and Burirhat, respectively.

Introduction

Tomato (*Lycopersicon esculentum Mill*.) is one of the most important and popular vegetables in Bangladesh. It ranks third in the world's vegetable production, next to potato and sweet potato. It is a cheap source of vitamin-C. Tomato covers about 9.8% of the area under total winter vegetables in Bangladesh and its yield was 6.98 t/ha in the country during the year 2005-06 (BBS, 2007) which is very low as compared to other tomato producing countries of the world. The low yield of tomato in Bangladesh is not an indication of the low yielding potentiality of the crop but for many other factors such as unavailability of quality seeds, imbalanced fertilization, pest and disease infestation and improper irrigation. Adequate supply of nutrient can increase the yield, fruit quality, fruit size, keeping quality, colour, and taste of tomato (Shukla and Naik, 1993). Out of these, balanced fertilization practices and use of quality seeds may improve the yield greatly. Response of tomato to major elements to

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tomato is well documented and recommendations are available. Tomato requires both major and micronutrients for its proper growth (Sainju *et al*., 2003). Among the micronutrients, boron plays an important role in improving the yield and quality of tomato in addition to checking various diseases and physiological disorders (Magalhaes *et al*., 1980). Demoranville and Deubert (1987) reported that fruit shape, yield, and shelf life of tomato were affected by boron deficiency. Boron deficiency reduces yield and quality in tomatoes (Davis *et al*., 2003). Balanced fertilization of macro and micro nutrients can increase production (Swan *et al*., 2001; Ali *et al*., 2008). To improve the quality of tomato, there should have use of balanced fertilization technology to fulfill the growers' need. Studies on management practices, particularly on the management of boron would help increasing quality of tomato. Available information in this regard under Bangladesh conditions is meagre. The present study was, therefore, conducted in order to find out the the response of BARI Hybrid Tomato-5 varieties to boron application and to find out the optimum dose of boron for maximizing yield of tomato.

Materials and Methods

In the *rabi* season of 2010-2011 and 2011-2012 field experiments were conducted in Grey Terrace Soil of Gazipur and Non-Calcareous Grey Floodplain Soil at Agricultural Research Station, Burirhat, Rangpur. The nutrient status of initial soil are presented in Tables 1 and 2. The experiment was laid out in randomized complete block design with three replications. It was a factorial experiment with 5 levels of B (0, 0.5, 1.0, 1.5 and 2.0 kg ha^{-1}) and 3 varieties of tomato viz. Epoch, NS 815 and BARI Hybrid-5. Fifteen different treatment combinations were constituted for verification. The unit plot size was 3x2 m^2 with spacing 60 cm x 40 cm. The blanket dose of chemical fertilizers N_{220} P_{60} K_{120} S_{40} $Zn_{4.0}$ kg ha^{-1} applied as urea, TSP, MoP, gypsum and zinc sulphate, respectively. Cow dung was applied @ 5 t ha^{-1}. All P, K, S, Zn and CD and ½ of N were applied at the time of final land preparation and remaining ½ N was top dressed prior to flowering. Boric acid was used as a source of boron @ 0, 0.5, 1.0, 1.5 and 2.0 kg ha^{-1} as per the treatments in the experimental layout. Irrigation and other intercultural management practices were done as and when necessary. The crop was harvested at time to time and the necessary data on different parameters were recorded from 10 randomly selected plants. Then it was computed and analyzed statistically through MSTAT-C package. The analyzed data was adjusted with least significant difference (LSD) test at 5% level.

Results and Discussion

Effect of variety

Among the three tested varieties the significantly highest yield was recorded for the variety NS 815 at Joydebpur (72.7 t/ha) and Burirhat (87.5 t/ha) (Tables 2

and 3, respectively). The response of yield contributing characters were non-significant. Fruits per plant was the highest by NS 815 at Joydebpur but at Burirhat it was highest by Epoch (Table 2 and3).

Table 1. Chemical properties of the soil at the experimental field (Joydevpur and Rangpur)

Location	pH	OM (%)	Ca	Mg	K	Total N (%)	P	S	B	Zn
			meq/100g				ppm			
Joydebpur	6.4	0.94	6.4	2.7	0.15	0.06	14	15	0.12	1.2
Rangpur	5.1	0.81	5.4	1.5	0.13	0.041	11.1	30.2	0.09	1.85
Critical level	-	-	2.0	0.5	0.12	0.12	10	10	0.2	0.6

Table 2. Mean effects of variety on the yield and yield contributing characters of tomato at BARI, Joydebpur (mean values of two years: 2010-2011 and 2011-2012)

Treatments	Plant height (cm)	Fruit length (cm)	Fruit diameter (cm)	Fruits/plant	Yield/plot (kg)	Yield (t ha^{-1})
Epoch	56.4c	5.14a	5.26a	21.9c	35.3b	58.8b
NS 815	70.9a	5.20a	4.90b	32.8a	43.7a	72.7a
BARI Hybrid-5	58.9b	4.8b	4.66c	24.1b	32.4c	53.9c
LSD, 5%	**	**	**	**	**	**
CV%	4.77	3.03	4.47	7.58	5.81	5.82

Figures in a column having same letter(s) do not differ significantly at 5% level by LSD

Table 3. Mean effects of variety on the yield and yield contributing characters of tomato at RARS, Burirhat, Rangpur, (mean values of two years: 2010-2011 and 2011-2012)

Treatments	Plant height (cm)	Fruit length (cm)	Fruit diameter (cm)	Fruits/ plant	Yield/ plot(kg)	Yield (t ha^{-1})
Epoch	54.8b	4.85b	4.68b	78.0a	51.8a	86.3a
NS815	65.0a	5.38a	5.07a	62.8b	52.5a	87.5a
BARI Hybrid-5	55.2b	4.26c	4.76b	35.1c	48.4b	80.7b
LSD, 5%	**	**	**	**	**	**
CV%	5.28	6.97	6.75	13.3	4.6	4.7

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Effect of boron

The yield of tomato was significantly influenced by the effect of boron application up to 1.5 kg B/ha. Application of B at 1.5 $kgha^{-1}$ gave the highest

yield (72.6 and 99.2 t/ha) over other doses at Joydebpur and Burirhat, respectively (Table 4, 5). The control and the other reduced doses of boron caused significant yield loss as compared to 1.5 kg B/ha. Davis *et al*. (2003) found significantly lower yield on account of boron deficiency. The highest number of fruits per plant (29.8 and 65.8 respectively) was observed at 1.5 kg B/ha which was significantly higher over rest of the boron doses. Other yield contributing characters like plant height and fruit diameter were also significantly influenced by different boron levels. From the quadratic response function the optimum dose of boron were calculated to be 1.33 kg B/ha and 1.55 kg B/ha at Joydebpur and Burirhat, respectively. Taber (2007) recommended about 1.3 kg B ha^{-1} for better yield and quality of tomato.

Table 4. Mean effects of boron on the yield and yield contributing characters of tomato at BARI, Joydebpur (mean values of two years: 2010-2011 and 2011-2012)

Levels of Boron (kg ha^{-1})	Plant height (cm)	Fruit length (cm)	Fruit diameter (cm)	Fruits/ plant	Yield/ plot (kg)	Yield (t ha^{-1})	% yield increased over control
0	59.8b	5.01bc	4.96	22.6c	29.3d	48.9d	-
0.5	60.20b	4.91c	4.87	25.2b	35.2c	58.6c	19.8
1.0	63.12a	5.17a	4.96	27.2b	39.7b	66.1b	34.7
1.5	63.87a	5.02bc	4.92	29.8a	43.5a	72.6a	48.9
2.0	63.46a	5.08ab	4.98	26.4b	37.8b	63.0b	28.6
LSD, 5%	**	**	ns	**	**	**	-
CV%	4.77	3.03	4.47	7.58	5.81	5.82	-

Figures in a column having same letter(s) do not differ significantly at 5% level by LSD

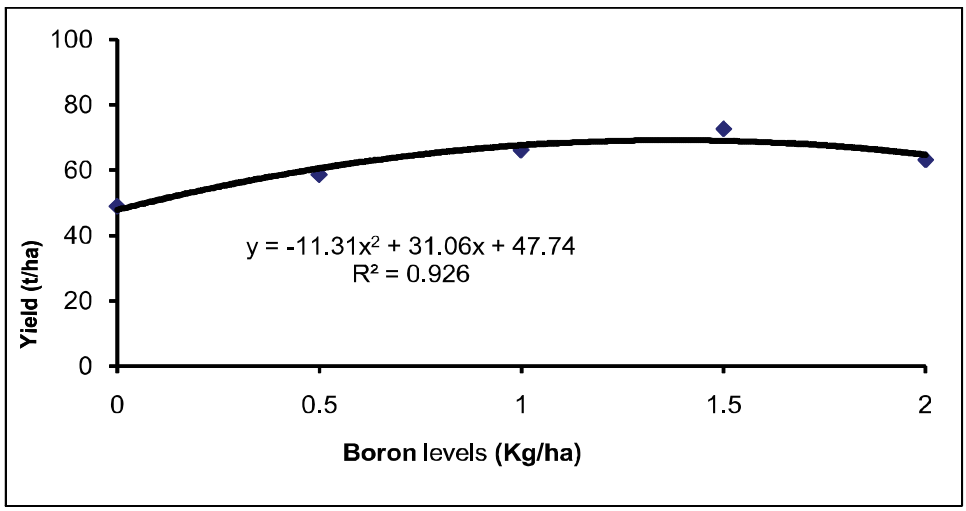

Fig. 1. Response of BARI Hybrid Tomato-5 varieties to boron application at Joydebpur.

Interaction effects of variety and boron

The interaction effect of the varieties and boron levels was non-significant on all the characters with the exception for yield and yield per plot (Tables 6 and 7). The highest yield was obtained (101.4 t/ha) for Epoch in Burirhat at 1.5 kg B/ha whereas the highest yield (79.7 t/ha) was in NS 815 in Joydebpur. A positive but quadratic relationship was observed between boron and yield of tomato regardless of varieties (Fig. 1). From the quadratic equation the optimum dose of boron was calculated to be 1.37 kg B ha^{-1} and 1.54 kg B ha^{-1} for Joydebpur and Burirhat, respectively.

Table 5. Mean effects of boron on the yield and yield contributing characters of tomato at RARS, Burirhat, Rangpur (mean values of two years: 2010-2011 and 2011-2012)

Levels of Boron (kg ha^{-1})	Plant height (cm)	Fruit length (cm)	Fruit diameter (cm)	Fruits/ plant	Yield/plot (kg)	Yield (t ha^{-1})	% yield increased over control
0	56.4c	4.79a	4.87	43.2b	35.1d	58.6d	-
0.5	58.1abc	4.9a	4.91	58.5a	48.1c	80.2c	34.5
1.0	60.3a	4.81a	4.75	63.3a	55.3b	92.2b	58.6
1.5	60.0ab	4.88a	4.88	65.8a	59.5a	99.2a	70.6
2.0	57.0bc	4.76a	4.79	62.4a	56.4b	94.0b	62.1
LSD, 5%	**	**	ns	**	**	**	
CV%	5.28	6.9	6.75	13.3	4.6	4.7	

Figures in a column having same letter(s) do not differ significantly at 5% level by LSD.

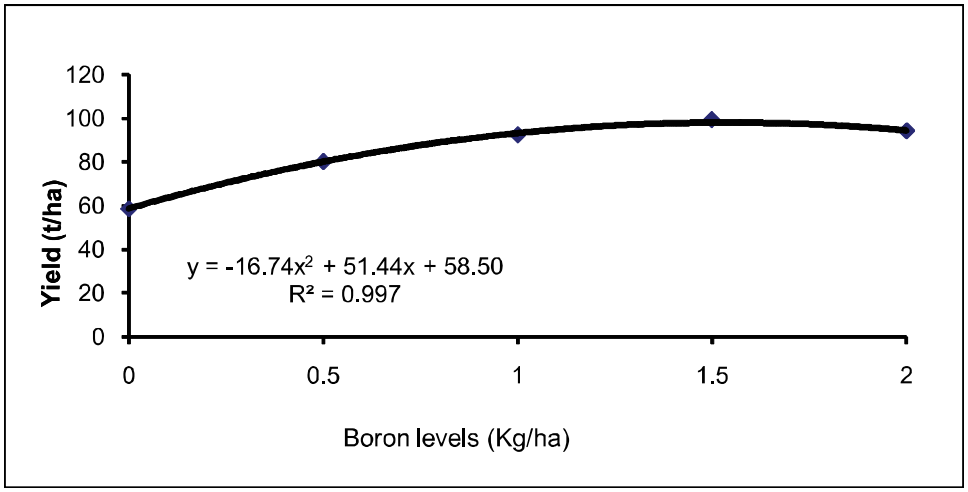

Fig. 2. Response of BARI Hybrid Tomato-5 varieties to boron application at Burirhat.

Table 6. Interaction effect of variety and levels of boron on the yield and yield contributing characters of tomato at BARI, Joydebpur (mean values of two years: 2010-2011 and 2011-2012)

Treatments		Plant height (cm)	Fruit length (cm)	Fruit diameter (cm)	Fruits/ plant	Yield/plot (kg)	Yield (tha^{-1})	% yield increased over control
Variety	Boron (kg ha-)							
Epoch	0	54.0	5.07a	5.23	19.7	26.1f	43.4g	-
	0.5	54.3	5.06a	5.25	20.3	34.6de	57.7e	32.5
	1.0	55.4	5.18a	5.24	22.3	37.4cd	62.4de	44.2
	1.5	59.0	5.14a	5.22	23.7	40.8bc	68.0cd	58.1
	2.0	59.4	5.24a	5.35	23.3	37.4cd	62.3de	32.8
NS 815	0	66.3	5.18a	4.91	29.3	36.4cde	60.7e	-
	0.5	68.7	5.24a	4.82	31.7	43.9ab	73.1bc	20.4
	1.0	73.7	5.19a	4.84	34.7	45.2ab	75.3ab	25.0
	1.5	74.0	5.15a	4.86	35.3	47.8a	79.7a	31.7
	2.0	72.1	5.23a	5.05	33.0	45.0ab	75.0ab	25.0
BARI hybrid 5	0	59.2	4.79b	4.74	18.7	25.5f	42.5g	-
	0.5	57.7	4.44c	4.54	23.7	27.0f	45.0g	5.8
	1.0	60.3	5.14a	4.82	24.7	36.4cde	60.6e	42.8
	1.5	58.6	4.77b	4.66	30.3	42.0bc	70.0bc	66.7
	2.0	58.9	4.76b	4.54	23.0	31.0ef	51.7f	21.4
LSD, 5%	-	ns	**	ns	Ns	**	**	-
CV (%)	-	4.77	3.03	4.47	7.58	5.81	5.82	-

Figures in a column having same letter(s) do not differ significantly at 5% level by LSD

Conclusions

It can be concluded from studies that boron at the rate of 1.4 $kgha^{-1}$ and 1.50 kg ha^{-1} along with a blanket dose of N_{220} P_{60} K_{120} S_{40} $Zn_{4.0}$ kg ha^{-1} and cow dung 5 t ha^{-1} is considered to be as the best combination for all the varieties tested in Grey Terrace Soil of Joydevpur and Non-Calcareous Grey Floodplain Soil of Rangpur, respectively. From the regression analysis the optimum dose of boron was found to be 1.37 kg Bha^{-1} and 1.54 kg B ha^{-1} at Joydebpur and Burirhat, respectively.

Table 7. Interaction effect of variety and boron on the yield and yield contributing characters of tomato at RARS, Burirhat (mean values of two years: 2010-2011 and 2011-2012)

Treatments		Plant height (cm)	Fruit length (cm)	Fruit diameter (cm)	Fruits /plant	Yield/ plot (kg)	Yield (t ha^{-1})	% yield increased over control
Variety	Boron (kg ha^{-1})							
Epoch	0	48.4	4.61	4.50	56.8	38.8f	64.7f	-
	0.5	53.7	4.87	4.75	79.5	47.8e	79.7e	23.4
	1.0	57.7	4.86	4.76	80.8	55.8bcd	93.0bcd	45.3
	1.5	58.3	5.10	4.82	87.4	60.8a	101.4a	57.8
	2.0	56.3	4.81	4.57	85.5	55.8bcd	93.0bcd	45.3
NS 815	0	69.3	5.33	5.19	47.7	34.4g	57.3g	-
	0.5	64.0	5.42	5.01	63.5	52.6d	87.7d	52.6
	1.0	64.7	5.33	4.90	68.5	56.5abcd	94.2abcd	47.4
	1.5	66.3	5.48	5.08	70.1	59.7ab	99.6ab	73.6
	2.0	60.7	5.31	5.18	64.1	59.2ab	98.7ab	71.9
BARI hybrid 5	0	51.3	4.45	4.91	25.1	32.2g	53.7g	-
	0.5	56.7	4.41	4.96	32.4	44.0e	73.3e	37.7
	1.0	58.7	4.23	4.58	40.5	53.6cd	89.3cd	67.9
	1.5	55.3	4.07	4.72	39.8	58.0abc	96.7abc	75.4
	2.0	54.0	4.15	4.63	37.6	54.2cd	90.3cd	69.8
LSD, 5%	-	ns	ns	Ns	ns	**	**	-
CV (%)	-	5.28	6.97	6.75	13.3	4.7	4.7	-

Figures in a column having same letter(s) do not differ significantly at 5% level by LSD

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