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Response of Mustard as Influenced by Boron Fertilization in Non-Calcareous Dark Grey Floodplain Soil at Northern Region of Bangladesh

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Abstract: A field study on mustard was conducted in Non-Calcareous Dark Grey Floodplain Soil (AEZ-1) at Rajbari, Dinajpur during the rabi seasons of 2000-2001 and 2001-2002. The objectives were to find out the optimum dose of boron and to evaluate a suitable variety for maximizing the yield of mustard. Four varieties viz., BARI Sarisha-6, BARI Sarisha-7, BARI Sarisha-8 and BARI Sarisha 9 integrated with four levels each of boron (0, 1.0, 1.5 and 2.0 kg ha^{-1}) along with a blanket dose of N_{120} P_{35} K_{65} S_{20} Zn_5 kg ha^{-1} and cowdung at the rate of 5 t ha^{-1} were tested in the study. The interaction effect of variety and boron had a significant response on the yield components of mustard. The highest seed yield (2.23 t ha^{-1}) was recorded in BARI Sarisha-6 with 2 kg B ha^{-1} in the second year (2001-2002), while in the first year (2000-2001), the recorded yield was 1.51 t ha^{-1} which was statistically significant over the boron control (B_0). However, the highest mean seed yield (1.87 t ha^{-1}) was obtained from the same treatment combination by 35.5% yield increase in both the years of study. Though the individual effect of boron and variety were found to be more pronounced than interaction. Here, BARI Sharisha-6 and 2 kg B ha^{-1} separately augmented highest seed yields of mustard (1.91 and 1.98 t ha^{-1}) for both the years of study when a blanket dose of other fertilizers were ensured. In regression analysis, the linear relationship between seed yield and the levels of boron was observed in the mean seed yield of two consecutive years of study. It meant beyond the level, the seed yield might be declined due to the toxic effect of excess dosage of boron.

Key words: Mustard, boron, non-calcareous, dark grey foodplain soil

INTRODUCTION

It has been noticed that intensive cultivation of modern crop varieties through application of higher doses of NPK fertilizers have increased the crop yields mining out the inherent micronutrients from soils. As a result, deficiency of essential micronutrients are very pronounced in some parts of the country particularly in North western region which causes the drastic yield reduction in the recent years. Mustard responds well to chemical fertilizers and the response is influenced by inherent soil fertility. Among micronutrients, boron deficiency may cause sterility i.e., less pods and less seeds per pod, attributing lower seed yield (Islam and Anwar, 1994). Gupta (1980) a reported that boron deficiency causes less siliqua formation and yield reduction of mustard. Deficiency of boron causes restriction of water absorption and carbohydrate metabolism which ultimately affects seed and pod formation and thus reduce the yield. It is reported that yield of mustard in northern parts of the country is very low due to less pod and seed formation. In general Brassica needs higher requirement of boron and they are not responding positively with lower supply and severe deficiency may result in floral abortion and significant drop in seed production. The application of boron in combination with sulphur caused significant increase in seed yield of mustard (Gupta *et al*., 1996; Geng *et al*., 1998; Hue *et al*., 1995). Although several research works have already been done in this regard but evaluation of different varieties developed by BARI in respect of their yielding ability as influenced by boron fertilization is not well documented. Therefore, the present study was undertaken with a view to evaluate a suitable variety of mustard for high yield potential and to find out the optimum dose of boron for maximizing yield of mustard in Non Calcareous Dark Grey Flood-Plain soil at North-western parts of the country.

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MATERIALS AND METHODS

The field studies were carried out in Non-Calcareous Dark Grey Floodplain soils of Agricultural Research Station, Rajbari, Dinajpur during two consecutive years of 2000-2001 and 2001-2002, respectively. The initial soil samples were analyzed and presented in Table 1.

The experiment was laid out in randomized complete block design with replications thrice. It was a factorial experiment taking 4 different levels of boron (0, 1, 1.5 and 2.0 kg ha^{-1}) and 4 varieties of BARI Sarisha-6, BARI Sarisha-7, BARI Sarisha-8 and BARI Sarisha-9) of mustard. There were sixteen different treatment combinations. The unit plot size was 4×5 m. Boric acid was used as a source of boron. Four levels of boron (0, 1.0, 1.5 and 2.0 kg ha^{-1}) with a blanket dose of NPKS Zn and CD at the rate of 120:35:65:40:5 kg ha^{-1} and 5 t ha^{-1} were used in the study. All P, K, S, Zn B and CD and ½ of N were applied at the final and preparation and remaining ½ N was top-dressed prior to flowering. The seeds were sown continually in line 30 cm apart from row to row in the month of November in both the years. The intercultural operations and other management practices were done in time. The crop was harvested on first week of March for both the years of 2000-2002. Data on the yield and yield contributing characters were recorded from ten randomly selected plants of each treatment. The analyzed data was adjusted with Least Significant Difference (LSD) at 5% level of significance.

RESULTS AND DISCUSSION

Interaction effect of variety and B: The combined yield of mustard was significantly influenced by different treatment combinations. Significant variation in pods/plant, filled grains/pod markedly contributed towards the yield of mustard, though the 1000 seed weight failed to bring significant change in yield (Table 2). However, the highest pods (138.47 and 130.16) per plant and maximum filled grains (28.63 and 27.52) per pod were recorded in the treatment BARI Sarisha-6 and 2 kg B ha^{-1} in both the years of (2000-2001) and (2001-2002) which was significantly differed over untreated boron control plants while the immediate second highest pod number per plant and filled grains per pod obtained in the varieties of BARI Sarisha-8 and BARI Sarisha-9 with same

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

Location	pH	OM	Ca	Mg	K	Total N%	P	S	B	Mn	Zn
			---------- Meq/100 g ----------				---------- ($\mu g\ g^{-1}$) ----------				
Rajbari	6.9	1.03	6.70	0.74	0.30	0.09	30	20	0.10	13.0	2.0
Critical level	-	-	2.0	0.8	0.2	0.10	14	14	0.20	5.0	2.0

Source: Soil Science Laboratory, BARI, Joydebpur, Gazipur

Table 2: Interaction effect of variety and levels of boron on the yield and yield contributing characters of mustard at ARS, Rajbari for two successive years (2000-2002)

		Treatment									
		Pod/plant (No.)		Filled grain/pod		1000 seed wt. (g)		Seed yield (t ha^{-1})			% increase over
Variety	Boron (kg ha^{-1})	2000-2001	2001-2002	2000-2001	2001-2002	2000-2001	2001-2002	2000-2001	2001-2002	Mean yield (t ha^{-1})	control (B)
BARI	B_0	83.50	84.29	30.10	25.45	3.67	3.04	1.14	1.62	1.38	-
Sarisha-6	$B_{1.0}$	94.03	86.05	16.87	26.25	3.38	3.10	1.26	1.84	1.55	12.32
	$B_{1.5}$	110.70	100.63	19.53	27.14	3.87	3.22	1.29	1.87	1.58	14.50
	$B_{2.0}$	138.47	130.16	28.65	27.52	3.33	3.43	1.51	2.23	1.87	35.50
BARI	B_0	70.67	71.66	25.40	19.31	3.74	3.52	1.23	1.60	1.42	-
Sarisha-7	$B_{1.0}$	74.97	76.12	14.87	19.61	3.14	3.56	1.25	1.73	1.49	5.00
	$B_{1.5}$	80.07	82.13	20.43	20.04	3.47	3.60	1.29	1.78	1.54	8.52
	$B_{2.0}$	108.00	11.30	26.80	20.72	3.70	3.69	1.36	1.86	1.61	14.18
BARI	B_0	45.67	90.87	23.73	27.64	3.32	3.97	1.29	1.57	1.43	-
Sarisha-8	$B_{1.0}$	47.47	91.27	15.27	28.24	3.44	3.79	1.32	1.87	1.60	11.88
	$B_{1.5}$	70.87	97.05	28.37	27.80	3.69	3.54	1.46	1.94	1.70	18.88
	$B_{2.0}$	114.30	113.19	20.77	28.19	3.34	3.55	1.54	1.92	1.75	22.38
BARI	B_0	35.03	98.50	19.73	16.02	4.07	2.94	1.07	1.39	1.23	-
Sarisha-9	$B_{1.0}$	35.40	104.20	22.07	17.08	3.32	2.95	1.12	1.63	1.38	12.20
	$B_{1.5}$	74.83	109.30	19.77	17.38	3.96	3.08	1.39	1.71	1.55	26.00
	$B_{2.0}$	117.17	116.70	23.40	17.66	3.83	3.21	1.59	1.96	1.76	43.09
LSD (5%)		42.27	2.41	2.62	0.05	NS	NS	0.29	0.03	-	-
CV (%)		31.90	7.23	7.30	6.20	8.80	8.80	13.30	11.50	-	-

Table 3: Mean effects of variety and levels of boron on the yield and yield contributing characters of mustard at ARS, Rajbari for two successive years of 2000-2001 and 2001-2002

	Pod/plant (No.)		Filled grain/pod		1000 seed wt. (g)		Seed yield (t ha^{-1})			% increase over
Variety	2000-2001	2001-2002	2000-2001	2001-2002	2000-2001	2001-2002	2000-2001	2001-2002	Mean yield (t ha^{-1})	control (B)
BARI Sarisha-6	127.93	126.25	28.70	29.59	3.20	3.20	1.92	1.89	1.91	-
BARI Sarisha-7	88.69	88.50	19.83	19.92	3.58	3.59	1.61	1.63	1.62	-
BARI Sarisha-8	99.68	98.10	28.13	28.14	3.56	3.71	1.81	1.83	1.82	-
BARI Sarisha-9	109.22	109.22	17.02	17.03	3.02	3.04	1.74	1.75	1.75	-
LSD (0.05%)	12.54	1.62	1.61	2.0	NS	NS	0.20	0.21		
Level of Boron										
B_0	99.62	96.10	22.22	22.10	3.27	3.37	1.74	1.55	1.64	-
$B_{1.0}$	100.13	99.93	22.86	22.80	3.29	3.35	1.77	1.77	1.77	7.92
$B_{1.5}$	113.17	107.80	23.28	23.09	3.44	3.36	1.82	1.82	1.82	10.98
$B_{2.0}$	114.22	117.94	24.03	23.70	3.88	3.47	2.01	1.95	1.98	20.73
LSD (0.05%)	12.51	1.62	1.67	2.0	NS	NS	0.20	0.21	-	-

level of boron (2.0 kg ha^{-1}), respectively in both the years (2000-2002) (Table 1). The seed yields for all the varieties increased significantly with the increment of B level from 0 to 2 kg B ha^{-1} in both the years. The highest rate of boron (2 kg ha^{-1}) along with BARI Sarisha-6 sharply contributed to maximum seed yield (2.23 t ha^{-1}) of mustard followed by the varieties of BARI Sarisha-8 (1.92 t ha^{-1}) with same dose of boron (2.0 kg ha^{-1}). The yield difference might be the cause of genetic make up of the varieties tested. Shen *et al.* (1998) and Khurana *et al.* (1998) reported that addition of boron markedly increased the seed yield of mustard and confirmed the present findings. The mean yield of mustard for two consecutive seasons in the same location of Rajbari, contributed highest mean yield (1.87 t ha^{-1}) by BARI Sarisha-6 with 2.0 kg B ha^{-1} which was significantly differed over the untreated boron control (B0). Though the BARI Sarisha-9 increased the yield by 43% which was 8% higher than BARI Sarisha-6.

Effect of variety: It was revealed from the Table 3 that the yield and yield attributes of the tested varieties viz. BARI Sarisha-6, BARI Sarisha-7, BARI Sarisha-8 and BARI Sarisha-9 were greatly influenced by irrespective levels of boron. Yield contributing characters like pods per plant, filled grains per pod and seed yield significantly progressed among treatments except 1000 seed weight. In four tested varieties, BARI Sarisha-6 performed the best and highest pods/plant (127.93 and 126.25) and maximum filled grains/pod (28.70 and 29.59) recorded in the same variety in both the years of 2000-2001 and 2001-2002. The highest seed yields (1.92 and 1.89 t ha^{-1}) were also obtained from BARI Sarisha-6 in two successive years. While other three varieties viz. BARI sarisha-7, BARI Sarisha-8 and BARI Sarisha-9 failed to give optimum seed yield. The mean seed yield of two consecutive seasons also found to be higher (1.91 t ha^{-1}) by the same variety of BARI Sarisha-6. Tomar and Raghu (1998) and

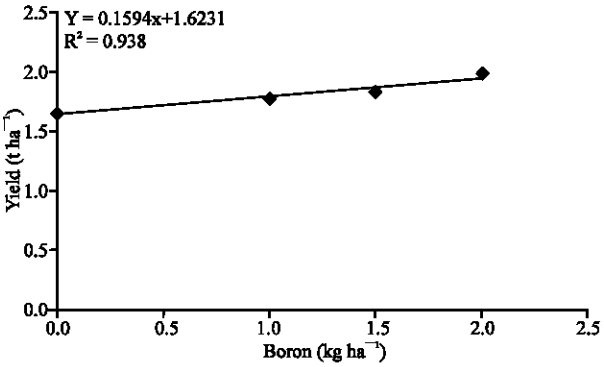

Fig. 1: Level of Boron vs yield of Mustard

Patil *et al.* (1996) supported the result and stated that *Brassica juncea* exhibited significantly higher yield than *Brassica campus* varieties. The mean seed yield of two studied years were found also higher (1.9 t ha^{-1}) in BARI Sarisha-6 as compared to other varieties.

Effect of boron: The mean effect of boron showed that yield and yield attributes of mustard varieties significantly boosted the seed yield of mustard up to 2.0 kg B ha^{-1} in both the studied years. It was also revealed in the Table 3 that with the increment of boron levels other yield contributing characters increased linearly to some extent. Number of pods per plant, filled grains per pod (siliqua) and seed yield were responded significantly by boron fertilization. The highest number of pods (114.22 and 117.74) and filled grains (24.08 and 23.70) per plant were obtained in applied highest level of B (2.0 kg ha^{-1}) which was statistically differed over boron control (B_0) in both the years of 2000-2001 and 2001-2002, respectively. Subbaiah (1996) and Shen *et al.* (1993) in their study suggested that boron deficiency could often increase the pollen abortion and lead to significant drop in seed production. The seed yield progressively increased with

the increase of boron level up to 2 kg B ha^{-1}. The highest mean seed yield (1.98 t ha^{-1}) was recorded in applied boron at the level of 2 kg B ha^{-1} which was differed noticeably to other boron levels and 20.73% yield increase over boron control (B_0). From the mean data, a positive and linear relationship was observed between seed yield and level of B at the study area (Fig. 1).

CONCLUSIONS

It can be summarized from the two years study that BARI Sarisha-6 in combination with 2.0 kg B ha^{-1} along with a blanket dose of $N_{120}P_{35}K_{65}S_{20}Zn_5$ and cowdung 5 t ha^{-1} were found to be suitable for maximizing yield of mustard in Non-Calcareous Dark Grey Floodplain Soil at Rajbari, Dinajpur. Therefore, the variety BARI Sarisha-6 with 2 kg B ha^{-1} along with the aforesaid blanket dose of other fertilizers and manure may be recommended for sustainable yield and to nourish the soil fertility in Non-Calcareous Dark Grey Floodplain Soil of northern region of Bangladesh.

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