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Response of Wheat Varieties to Boron Application in Calcareous Brown Floodplain Soil at Southern Region of Bangladesh

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Abstract: A field trial was conducted at Calcareous Brown Floodplain Soils of Jessore Regional Agriculture Research Station during the rabi seasons of 2000-2001 and 2001-2002. The objectives were to evaluate the response of wheat varieties to different levels of Boron and to find out the optimum dose of B for maximizing yield of wheat viz protiva, Gourab and Sourav and four levels each of B (0, 1.0, 2.0 and 2.5 kg ha^{-1}) along with a blanket dose of $N_{120}P_{45}K_{80}S_{20}Zn_2$ kg ha^{-1} and cowdung 5 t ha^{-1} taken in the study. Results showed that variety protiva along with 2 kg B ha^{-1} produced significantly highest yield in both the years of study. The said treatment gave the highest mean seed yield (5.3 t ha^{-1}) by 66% increase over the boron control (B_0). In case of single effect, all the varieties tested did not contribute significantly to the yield variation. Through the variety protiva was found to be superior as compared to other two varieties. On the other hand, boron either in combination or single greatly contributed to the yield. However, the highest mean yield (4.8 t ha^{-1}) was recorded in 2 kg B ha^{-1} which was significantly 45% higher over boron control. In regression analysis, a linear but quadratic relationship was also observed between grain yield and level of B. It indicated beyond that dose, the seed yield might be declined with every successive dose of B.

Key words: Wheat, Protiva, Sourav, Gourab, boron, calcareous

INTRODUCTION

Wheat (*Triticum acstivum*) is the second important cereal crop after rice in Bangladesh. Its average and total production are consistently increasing to meet up the growing demand of our penurious population. Wheat possesses the high food valued cereal other than rice (Mortern *et al*., 1970; Juliano *et al*., 1964). It can be grown successfully even after the harvest of transplant aman rice either as a mono crop or intercropping with other winter crops. Since, the inception of wheat cultivation in our soil of Bangladesh, it has proved to be the best yielder as a short duration cereal and its acreage of production also remarkably increased by upward trend. But in recent past, the yield and the area of cultivation alarmingly declined though a lot of high yielding wheat varieties had been added to the traditional ones. However, they failed to exert their yield potential. Generally, the north and southern regions of the country are environmentally sound for healthy growing of wheat as a winter cereal. Although, other parts of the country sporadically producing wheat in little quantity. However, the native soil "the reservoir of natural resources" has gradually been losing its fertility and productivity due to continuous reaping of HYV crops and mining of nutrients resources exorbitantly. As the increase in cropping intensity and receding of organic residues from the floor of the soil used as a fuel, the organic matter in most soils has gone down below optimum level encouraging leashing losses of macro and micronutrients significantly. Resulting soil resources are going to be depleted with many essential elements. Therefore, the deficiency of these nutrients is noticed pronouncedly in some parts of the country. Recently, some positive response of micronutrients specially, boron to wheat, maize, soybean, mungbean, papaya, ground nut, Chickpea, Cauliflower etc has been reported by many workers (Islam *et al*., 1992; Jahiruddin *et al*., 1992; Miah *et al*., 1992). So, boron may be considered as a limiting factor can play a significant role in protein synthesis alleviate the sterility problem of cereal crops like wheat and major constituent of seed formation. The experimental evidences also revealed that in boron deficient soils, boron highly responded to grain set, grain per ear and grain yield at maturity by reducing the severity of wheat sterility in South and South East Asia (Karki, 1995; Pante *et al*., 1998; Hossain *et al*., 1997; Das and Gupta, 1998). Under such circumstances, it was designed to conduct the present study for verification and evaluation of the responses of wheat varieties with different levels of boron at calcareous Brown Floodplain Soils of Bangladesh.

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

Location	pH	OM	Ca	Mg	K	Total N%	P	S	B	Mn	Zn
			Meq/100 g								
Jessore	7.5	1.05	12.00	2.30	0.19	0.12	20	16	0.2	4.6	1.8
Critical level	-	-	2.0	0.80	0.20	0.10	14	14	0.20	5.0	2.0

Source: Soil Science Laboratory, BARI

MATERIALS AND METHODS

The field trial was carried out in Calcareous Brown Floodplain Soils of Regional Agricultural Research Station, Jessore during the rabi seasons of 2000-2001 and 2001-2002. The initial soil samples were analyzed and presented in Table 1.

In the experimental soil, organic matter and other nutrient elements such as N, P, K, Ca, Mg, S, B, Mn and Zn were found almost below critical level. The experiment was laid out in randomized block design with three replications. The unit plot size was 4×5 m and seeds were sown in a continuous line by maintaining row to row distance 30 cm apart. There were three varieties of wheat viz., Protiva, Sourav and Gourav and four levels each of B (0, 1.0, 2.0 and 2.5 kg ha^{-1}) along with a blanket dose of $N_{120}P_{45}K_{80}S_{30}Zn_2$ and CD at the rate of 120:45:80:30:2 kg ha^{-1} and 5 t ha^{-1} of cowdung were used taken in the study. All P, K, S, B, Zn and half at N were applied at the time of final land preparation as basal. The rest half of N was applied at crown initiation (CRI) stage followed by irrigation. The seeds of wheat varieties were sown in the last week of November. Intercultural operation and other management practices were performed in time. The crop was harvested showing in full maturity sign by middle of the March in both the seasons. The necessary data of different parameters were recorded from ten randomly selected plants from each treatment the collected data were analyzed statistically and adjusted with Least Significant Difference (LSD) at 5% level of significance.

RESULTS AND DISCUSSION

Integrated effects of variety and boron: Table 2 showed that all the studied parameters like, spikes m^{-2}, grains per spike, 1000 grain weight and grain yield t ha^{-1} were significantly influenced by variety and levels of boron. The distinct variation among the yield components markedly contributed towards yield of wheat varieties. However, the integrated effects of variety and Boron up to 2.0 kg ha^{-1} significantly increased the spike number m^{-2} and grains per spike but after the increment of the B level (2.5 kg B ha^{-1}) the said parameters declined sharply. However, The highest number of spikes (466.8 and 465.4) and maximum number of grains per spike (46.2 and 46.7) were recorded in Protiva along with 2 kg boron fertilization fallowed by Sourav and Goruab with same dose (2 kg B ha^{-1}) of Boron in both the years of 2000-2001 and 2001-2002, respectively. Where untreated boron control (Bo) plants failed to optimize the yield. Similarly, 1000 grain weight and grain yield responded significantly to different boron levels irrespective of varieties used.

The yield differences among the varieties were found to be almost similar in both the years of study. It may be the reason of proper management care and uniform climatic condition so far. Moreover, B is the key player of augmenting the yield of wheat by reducing the severity of wheat sterility to a great extent. It has been explained many researchers in their reports (Pante *et al.*, 1998; Yong *et al.*, 1995; Rerkasem *et al.*, 1995). The grain yield increased progressively with the increase of B levels up to 2 kg B ha^{-1} and beyond the dose, the yield drastically fallen off. It revealed that application of 2-2.5 kg B ha^{-1} for all the varieties tested successfully contributed to the grain yield over all other treatment combinations. However, the highest grain yield (5.2 and 5.3 t ha^{-1}) were recorded in Protiva variety by applying 2.0 kg B ha^{-1} in two consecutive years. The highest mean yield (5.3 t ha^{-1}) was also derived from same treatment which contributed to 50-60% yield increase over the boron control (B_0).

Effect of variety: Table 3 revealed that three wheat varieties tested in the study did not perfectly respond to the yield difference individually. Though two of the yield contributors such as spikes m^{-2} and grains/spike significantly responded to the grain yield of wheat. However, among the three varieties studied, Protiva exhibited better performance as compared to Sourav and Gourab respectively. Like all other yield attributes, grain yield was also found high in protiva variety. Besides, it was felt from the table that individual effect of boron is found to be more pronounced than varietals response. It might be the cause of boron deficiency in the soils of study area. In both the years, highest grain yield (4.8 and 4.7 t ha^{-1}) was recorded in Protiva while Sourav and Goruab exerted almost similar yields (Table 3). Besides, the mean yield (4.7 t ha^{-1}) was also found higher in Protiva variety. The aforesaid result was in corroboration with the findings of Liu *et al.* (1999).

Table 2: Interaction effects of variety and levels of B on the yield and yield components of wheat at RARS, Jessore for two consecutive years of 2000-2001 and 2001-2002

Variety	Level of B kg ha^{-1}	Spikes m^{-2} 2000-2001	Spikes m^{-2} 2001-2002	Grains/Spike 2000-2001	Grains/Spike 2001-2002	1000 grain wt. (g) 2000-2001	1000 grain wt. (g) 2001-2002	Grain yield t ha^{-1} 2000-2001	Grain yield t ha^{-1} 2001-2002	Mean yield t ha^{-1}	% increase over control (B)
Protiva	B_0	424.00	421.70	36.80	40.40	37.30	42.10	3.10	3.2	3.2	-
	B_1	455.70	453.40	40.20	41.30	39.70	42.20	4.80	3.7	4.6	43
	B_2	466.80	465.40	46.20	46.70	44.50	42.70	5.20	5.3	5.3	66
	$B_{2.5}$	453.40	455.80	42.90	42.60	40.70	43.60	4.90	4.7	4.8	50
Sourav	B_0	414.40	404.10	38.10	39.20	39.00	42.10	3.30	3.4	3.4	-
	B_1	447.80	450.00	40.50	40.70	39.20	43.20	4.10	4.0	4.1	21
	B_2	458.80	462.60	44.80	43.70	43.20	44.90	4.80	4.5	4.7	38
	$B_{2.5}$	454.10	453.10	43.60	42.40	40.40	43.20	4.60	4.2	4.4	29
Gourab	B_0	404.20	410.00	40.60	40.40	38.10	42.60	3.40	3.3	3.4	-
	B_1	453.10	454.10	42.10	39.90	40.50	43.00	4.00	3.6	3.8	12
	B_2	464.00	463.60	43.80	42.40	42.10	44.80	4.80	4.5	4.7	38
	$B_{2.5}$	455.00	455.20	42.80	40.70	41.20	44.00	4.70	4.1	4.4	29
LSD (0.05)		2.19	1.81	1.84	1.02	0.89	1.07	0.16	0.16		
CV %		3.2	3.20	3.50	2.60	2.50	2.30	2.50	2.20	2.3	

Table 3: Mean effects of variety and Boron on the yield and yield contributing characters of wheat at RARS, Jessore during the rabi seasons of 2000-2002

Variety	Spikes m^{-2} 2000-2001	Spikes m^{-2} 2001-2002	Grains/Spike 2000-2001	Grains/Spike 2001-2002	1000 grain wt. (g) 2000-2001	1000 grain wt. (g) 2001-2002	Grain yield t ha^{-1} 2000-2001	Grain yield t ha^{-1} 2001-2002	Mean yield t ha^{-1}	% increase over control
Protiva	253.5a	285.9a	44.5a	33.4a	45.3a	44.7a	4.6a	4.8a	4.7a	-
Sourav	242.0c	284.0b	43.0b	32.7c	44.5b	44.2b	3.8b	4.1b	4.0b	-
Gourab	248.1b	281.2c	43.3b	33.1b	44.4b	44.4b	3.6c	4.2b	3.9c	-
F-test (0.05)	*	*	*	*	*	*	*	*	*	-
B Levels kg ha^{-1}	Effect of boron									
B_0	234.0d	274.2d	39.2d	31.6d	43.3d	43.2c	3.3d	3.2d	3.3d	-
$B_{1.0}$	247.2c	280.3c	44.1c	32.6c	44.4c	44.3b	3.8c	3.7c	3.8c	15
$B_{2.0}$	259.0a	291.9a	46.8a	34.5a	46.2a	45.7a	4.8a	4.7a	4.8a	45
$B_{2.5}$	249.8b	281.8b	44.9b	33.5b	44.7b	44.2b	4.7b	4.5b	4.6b	39
F-test (0.05)	*	*	*	*	*	*	*	*	*	-

*Indicates 5% level of significant

Effect of boron: The means of different yield attributes shown in Table 3 reflected that wheat profusely responded to the different levels of boron. It was also noticed that yield contributing characters increased linearly with the increase of boron up to 2 kg ha^{-1} but after the increment of higher dose (2.5 kg ha^{-1}), the studied parameters got declined downwardly. It might be presumed the soil is moderate deficient in boron. The result placed in the table revealed that spikes m^{-2}, grains/spike, 1000 grain weight and grain yield were greatly influenced by different levels of boron application. The response of wheat to boron levels was found to be little bit difference among the varieties in both the years of study. However, the highest spikes/m^2 (259 and 291.9), grains/spike (46.8 and 34.5) and maximum 1000 grain weight (4.7 and 4.89 g) were recorded with 2 kg B applied. Similarly, highest grain yield (4.8 and 4.7 t ha^{-1}) was obtained from same dose of B (2 kg ha^{-1}) in two consecutive years of 2000-2002. While, highest mean yield (4.8 t ha^{-1}) was also come from said boron level (2 kg ha^{-1}) which was 45% higher over boron control (B_0) treatment. Many scientists (Subedi *et al*., 1995; Young *et al*., 1995; Saifuzzaman, 1995) found similar findings in their study. A positive quadratic relationship was observed between grain yield and levels of B from regressions equation (Fig. 1). It meant beyond the optimum dose of B, there may be the chance of loosing yield with every successive dose of boron.

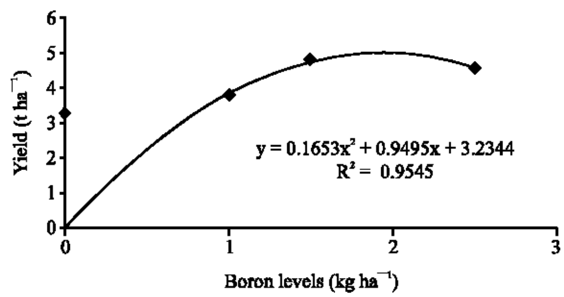

Fig. 1: Level of boron V yield of wheat

CONCLUSIONS

It can be summarized from two years study that 2 kg B ha^{-1} for all the varieties tested viz., Protiva, Sourav and Gourab along with a blanket dose $N_{120}P_{45}K_{80}S_{20}Zn_2$ kg ha^{-1} and cowdung 5 t ha^{-1} was found to be optimum combination in calcareous brown Floodplain Soil at Jessore region. Therefore, the aforesaid fertilizer prescription may be suggested for yield maximization of wheat in sustainable crop agriculture in Bangladesh.

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