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EFFECT OF ZINC AND BORON ON YIELD AND YIELD CONTRIBUTING CHARACTERS OF MUNGBEAN IN LOW GANGES RIVER FLOODPLAIN SOIL AT MADARIPUR, BANGLADESH

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Abstract

An experiment was carried out in Calcareous Low Ganges River Floodplain Soil (AEZ 12) at Pulses Research Sub-Station (PRSS), Madaripur during Kharif I of 2008 and 2009.The objectives were to evaluate the effect of zinc (Zn) and boron (B) on the yield and yield contributing characters of mungbean (*Vigna radiata* L. Wilczek) and to find out the optimum dose of Zn and B for yield maximization. There were four levels of zinc (0, 0.75, 1.5, and 3.0 kg/ha and boron (0, 0.5, 1.0, and 2 kg/ha) along with a blanket dose of N_{20} P_{25} K_{35} S_{20} kg/ha. The experiment was laid out in RCBD with three replications. Results showed that the combination of $Zn_{1.5}B_{1.0}$ produced significantly higher yield (3058 kg/ha) and (2631 kg/ha, in the year 2008 and 2009, respectively. The lowest yield (2173 kg/ha) and (1573 kg/ha, were found in control (Zn_0B_0) combination. The combined application of zinc and boron were observed superior to their single application in both the years. Therefore, the combination of $Zn_{1.5}B_{1.0}$ might be considered as suitable dose for mungbean cultivation in Bangladesh. But from regression analysis, the optimum treatment combination was $Zn_{1.87}$ $B_{1.24}$ kg/ha for Madaripur.

Keywords: Zinc, boron, mungbean, yield and yield contributing characters.

Introduction

Nutrient deficiency in soil is the key factor for poor productivity of pulses. The extent and magnitude of nutrient deficiency has aggravated in the recent past due to intensive agriculture and indiscriminate use of plant nutrients (Anonymous, 2009). Among pulses, mungbean (*Vigna radiata* L. Wilczek) is an important grain legume in Asia. It occupies an important position in this region. In Bangladesh, mungbean ranks second in acreage and production. It is an important source of protein and several essential micronutrients. It contains 24.5% protein and 59.9% carbohydrate. It also contains 75 mg calcium, 8.5 mg iron, and 49 mg β-carotene per 1 00g of split dal (Afzal *et al*., 2004). The foliage and stem are a good source of fodder for livestock. It synthesizes N in symbiosis with Rhizobia and enriches the soil. Total biomass of the soil is increased. It

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improves the fertility status of soil through atmospheric N fixation and can fix N in soil by 63-342 kg/ha per season1 (Kaisher *et al*., 2010).

The soils of different parts of southern belt of Bangladesh are more or less deficient in boron and molybdenum as well as nitrogen fixing bacteria (*Rhizobium* sp.) which causes poor yield of mungbean. However, there is a great possibility to increase its production by cultivating HYV with balanced fertilization including micronutrient. Micronutrients play an important role in increasing yield of pulses and oilseed legumes through their effects on the plant itself and on the nitrogen fixing symbiotic process. Deficiencies of these nutrients have been very pronounced under multiple cropping systems due to excess removal by HYV of crops and hence their exogenous supplies are urgently required. Zinc and B deficiency is widespread in the country; much observed in wetland rice soils, light textured soils and calcareous soils (Jahiruddin *et al.*, 1992; Rabman *et al.* 1993; Islam *et al.*, 1997). Zinc is involved in auxin formation; activation of dehydrogenase enzymes; stabilization of ribosomal fractions (Obata *et al.*, 1999). Boron is very important in cell division and in pod and seed formation (Vitosh *et al.*, 1997). Rate of water adsorption and carbohydrate translocation restricted due to boron deficiency. Boron ranks third place among micronutrients, its concentration in seed and stem as well as its total amount after zinc (Robinson, 1973). Boron influences the absorption of N, P, K, and its deficiency changed the equilibrium of optimum of those three macronutrients. Inadequate supply of B decreased the economic yield of legume (Raj, 1985). The N and B concentrations of grain for mungbean were markedly influenced by B treatment indicating that the B had a positive role on protein synthesis. lqtidar and Rahman (1984) found that essential amino acid increased with increasing B supply. The critical level of boron with reference to crops in general was reported to a range from 0.3 to 0.8 ppm depending on soil types (Shorrocks, 1984). Therefore, applications of micronutrients in addition to essential major elements have gained practical significance. The present study was, therefore, undertaken (i) to evaluate the response of Zn and B on the yield and yield contributing characters of mungbean, and (ii) to find out a suitable dose of Zn and B for the maximization of mungbean yield.

Materials and Method

A field experiment was conducted in Calcareous Low Ganges River Floodplain Soil (AEZ 12) at Pulses Research Sub-Station (PRSS), Madaripur during Kharif-I of 2008 and 2009. There were 16 treatment combinations comprising four levels each of zinc (0, 0.75, 1.5, and 3.0 kg/ha and boron (0, 0.5, 1.0, and 2 kg/ha) along with a recommended fertilizer N_{20} P_{25} K_{35} S_{20} kg/ha as per soil test based (BARC, 2005). The treatments were arranged as follows: T_1=Zn_0B_0. T_2= $Zn_0B_{0.5}$. T_3= $Zn_0B_{1.0}$. T_4= $Zn_0B_{2.0}$. T_5= $Zn_{0.75}B_0$. T_6= $Zn_{0.75}B_{0.5}$ T_7= $Zn_{0.75}B_{1.0}$. T_8=

$Zn_{0.75}B_{2.0}$, T_9= $Zn_{1.5}B_0$. T_{10}= $Zn_{1.5}B_0$. T_{11}= $Zn_{1.5}B_{1.0}$. T_{12}= $Zn_{1.5}B_{2.0}$. T_{13}= $Zn_{3.0}B_0$. T_{14}=$Zn_{3.0}B_{0.5}$, T_{15}= $Zn_{3.0}B_{1.0}$. and T_{16}= $Zn_{3.0}B_{2.0}$, Before setting the experiments, initial soil samples were collected from the experimental field from 0-15 cm depth and the collected samples were analyzed for chemical properties using standard procedures in the laboratory. The experiment was laid out in a randomized complete block design with three replications. The unit plot size was 4 m 3 m. The variety was BARI Mung-6. Blanket dose of fertilizers were applied at the time of final land preparation. Zinc and B were applied as zinc sulphate and boric acid, respectively, in the respective treatments plot during final land preparation. Seeds were sown @ 30 kg/ha with a spacing of 40 cm x 10 cm on 21 February 2008 and on 26 February 2009. Two weedings were done at 20 and 35 days after sowing (DAS). The diseases and insects were controlled properly. Harvesting was started from 20 April to 27 May for 2008 and 25 April to 20 May for 2009. Yield contributing characters were recorded from 10 randomly selected plants from each plot. Yield (kg/ha) was recorded from the whole plot technique. Postharvest soil samples were also collected from 0-15 cm depth and were analyzed for chemical properties using the standard procedures in the laboratory. The data were then statistically analyzed by using MSTAT.

Results and Discussion

Effect of zinc

Mungbean yield was significantly increased due to the application of zinc for both the years 2008 and 2009 (Table 1). Highest seed yield (2865 kg/ha) was obtained from T_3 treatment (1.5 kg Zn/ha, which was statistically similar with T_2 and T_4 but significantly higher than T_1 (Control). Similar trend was also observed in 2009. Treatment T_3 though yielded significantly higher than control but statistically no variation was observed with other treatments (Table 1). For both the years, lowest yield was with the control i.e. T_1 treatment. From the Table 1, it was observed that the yield increased gradually with the increase of Zn level up to 1.5 kg/ha and decreased with Zn level 3.00 kg/ha for both the years. Similar trend was also observed by several authors (Ryan and El-Moneim, 2007). No significant variation was observed in case of 100-seed weight Seed weight increased with the increase of Zn level upto 1.5 kg/ha and then decreased with increased level of Zn (3.00 kg/ha) for both the years (Table 1). Except plant height, no other yield contributing characters showed significant variation due to different levels of Zn application. The highest plant height 47.8 cm and 44.0 cm were recorded with Zn level 1.5 kg/ha in the year of 2008 and 2009, respectively, which were statistically identical with T_4 treatment (3.0 kg Zn/ha) for both the years, but statistically significant to others (Table 2).

Table 1. Mean effect of zinc on 100-seed weight (g) and yield (kg/ha) of mungbean at on-station, Madaripur during 2008 and 2009.

Levels of Zinc (kg/ha)	100 seed weight (g)			Yield (kg/ha)			(%) Yield increased over control
	2008	2009	Average	2008	2009	Average	
0	5.85	5.20	5.53	2247b	1896b	2072	-
0.75	5.95	5.39	5.67	2737a	2124ab	2431	17.3
1.50	6.01	5.58	5.80	2865a	2303a	2584	24.7
3.00	5.94	5.36	5.65	2686a	2147ab	2417	16.7
CV (%)	1.84	4.77	-	4.27	8.14	-	-

Values within a column having same letter(s) do not differ significantly (p=0.05)

Table 2. Mean effect of zinc on plant height (cm), no. of pods per plant and no. of seeds per pod of mungbean at on-station, Madaripur during 2008 and 2009.

Levels of Zinc (kg/ha)	Plant height (cm)			No. of Pods/plant			No. of seeds/ pod		
	2008	2009	Average	2008	2009	Average	2008	2009	Average
0	46.5b	41.2b	43.9	28.0	28.9	28.5	10.4	8.23	9.29
0.75	46.6b	42.8ab	44.7	28.2	30.5	29.3	10.4	8.33	9.34
1.50	47.8a	44.0a	45.9	28.8	32.6	30.7	10.5	8.64	9.57
3.00	46.9ab	43.Ia	45.0	28.3	29.5	28.9	10.4	8.45	9.43
CV(%)	1.10	2.32	-	7.51	11.43	-	6.40	5.98	-

Values within a column having same letter(s) do not differ significantly (p=0.05)

Effect of boron

No significant variation was observed in mungbean grain yield due to the application of boron in the year 2008, but in 2009 significant variation was observed (Table 3). Seed yield ranged from 2581-2690 kg/ha in the year 2008 where highest (2690 kg/ha with T_3 and lowest (2581 kg/ha with T_1 treatment. In the year 2009, the highest seed yield (2277 kg/ha) at 1.0 kg B/ha (T_3), which was statistically identical with (T_4 and T_2) 0.50 and 2.00 kg B/ha, but statistically significant over control (T_1). Verma and Mishra (1999) reported that the boron application has positive effect on mungbean yield. Similar trend was also reported by Ashraf (2007). Yield contributing character like 100-seed weight showed no significant effect due to boron application (Table 3). Average 100-seed weight, highest (5.79 g) was with T_3 and lowest (5.57 g) with T_1 (control). Plant height showed significant variation due to different levels of B application in 2008, but effect was insignificant in 2009 (Table 4). The highest average plant height (45.49 cm) was recorded with T_3 (1.00 kg B/ha and the lowest (44.44 cm) was found with control (T_1) (Table 4). Other characters, such as number of pods per plant and number of seeds per pod showed no significant variation due to the application of different levels of B in both the years (Table 4). Verma and Mishra (1999) reported the similar trend but different with Anonymous (2000).

Table 3. Mean effect of boron on 100-seed weight (g) and yield (kg/ha) of mungbean at on-station, Madaripur during 2008 and 2009.

Levels of Zinc (kg/ha)	100-seed weight (g)			Yield (kg/ha)			(%) Yield increased
	2008	2009	Average	2008	2009	Average	
0	5.90	5.23	5.57	2581	1902b	2250	-
0.50	5.91	5.35	5.63	2629	2142ab	2386	6.04
1.00	5.98	5.59	5.79	2690	2277a	2484	10.4
2.00	5.97	5.35	5.66	2635	2149ab	2392	6.31
CV (%)	1.84	4.77	-	4.27	8.14	-	-

Values within a column having same letter(s) do not differ significantly (p=0.05).

Table 4. Mean effect of boron on plant height (cm), no. of pods per plant and no. of seeds per pod of mungbean at on-station, Madaripur during 2008 and 2009.

Levels of boron (kg/ha)	Plant height (cm)			No. of pods/plant			No. of seeds/pod		
	2008	2009	Average	2008	2009	Average	2008	2009	Average
0	46.4b	42.4	44.4	27.4	27.0	27.2	10.1	8.03	9.08
0.50	46.8ab	42.5	44.6	28.0	29.8	28.9	10.4	8.42	9.42
1.00	47.7a	43.3	45.5	28.4	32.0	30.2	10.6	8.77	9.68
2.00	47.0ab	43.1	45.1	28.3	30.0	29.1	10.5	8.45	9.48
CV (%)	1.10	2.32	-	7.51	11.43	-	6.40	5.98	-

Values within a column having same letter(s) do not differ significantly (p=0.05)

Interaction effect of zinc and boron

The interaction effect between Zn and B on the yield cf mungbean was found statistically significant for both the years (2008 and 2009). The highest yield (3058 and 2631 kg/ha) was obtained from T_{11} ($Zn_{1.5}B_{1.0}$) treatment and the lowest (2173 and 1573 kg/ha) from T_1 (Zn_0B_0) for 2008 and 2009, respectively (Table 5). In the year 2008, Treatment T_1 yielded highest, which was statistically different from the treatments where no Zn was applied. On the other hand, no significant variation was observed with different levels of Zn. In the growing season 2009, similar trend was also observed (Table 5). However, mean yield ranged from 1873 to 2862 kg/ha, where highest was with T_{11} and lowest was with T_1 treatment. Yield increased over control ranged from 9.88 to 52.80% (Table 5).

The combined application of Zn and B showed significant effect on munbean yield than the single application of Zn and B. Sakal *et al*. (1986) observed the similar trend. Other yield contributing components like 100-seed weight, plant height, number of pods per p1ant and number of seeds per pod were significantly influenced due to the combined application of Zn and B except number of seeds per pod in the year 2008 (Table 5). Abdo (2001) reported the same with foliar spray of Zn and B.

Table 5. 100-seed weight (g) and yield (kg/ha) of mungbean as influenced by Zn and B fertilization at on-station, Madaripur during 2008 and 2009.

Levels of Zn and B fertilization (kg/ha)	100-seed weight (g)			Yield (kg/ha)			(%) yield increased over control
	2008	2009	Average	2008	2009	Average	
$T_1=Zn_0B_0$	5.65g	4.92d	5.29	2173d	1573f	1873	-
$T_2=Zn_0B_{0.5}$	5.73fg	5.22bcd	5.48	2245cd	1871e	2058	9.88
$T_3=Zn_0B_{1.0}$	5.97cde	5.42a-d	5.69	2254cd	2143b-e	2198	17.35
$T_4=Zn_0B_{2.0}$	6.03cd	5.23bcd	5.63	2317bcd	1995cde	2156	15.11
$T_5= Zn_{0.75}B_0$	5.93c-f	5.36a-d	5.64	2613a-d	1978cde	2295	22.53
$T_6=Zn_{0.75}B_{0.5}$	6.00cde	5.44abc	5.72	2785ab	2217bcd	2501	33.53
$T_7= Zn_{0.75}B_{1.0}$	5.83d-g	5.59abc	5.71	2763ab	2217bcd	2490	32.94
$T_8=Zn_{0.75}B_{2.0}$	5.87def	5.17cd	5.52	2787ab	2083cde	2435	30.01
$T_9= Zn_{1.5}B_0$	5.83d-g	5.47abc	5.65	2793ab	1922de	2358	26.43
$T_{10}=Zn_{1.5}B_{0.5}$	5.90c-f	5.35a-d	5.63	2814a	2193b-e	2504	33.10
$T_{11}=Zn_{1.5}B_{1.0}$	6.33a	5.77a	6.05	3058a	2631a	2862	52.80
$T_{12}= Zn_{1.5}B_{2.0}$	6.23ab	5.72ab	5.97	2794a	2467ab	2630	40.42
$T_{13}=Zn_{3.0}B_0$	6.l0bc	5.l8cd	5.64	2726ab	2134cde	2430	29.74
$T_{14}=Zn_{3.0}B_{0.5}$	6.00cde	5.38a-d	5.69	2691abc	2285bc	2488	32.84
$T_{15}=Zn_{3.0}B_{1.0}$	5.87def	5.S7abc	5.72	2730ab	2280bc	2505	33.74
$T_{16}=Zn_{3.0}B_{2.0}$	5.80efg	5.30a-d	5.55	2596a-d	1887de	2241	19.65
CV (%)	1.84	4.77	-	4.27	8.14	-	-

Values within a column having same letter(s) do not differ significantly (p=0.05)

Blanket dose : N_{20} P_{25} K_{35} S_{20} kg/ha.

Soil fertility status

Initially the soil pH was 7.0. But after completion of two years' trial, the soil pH slightly increased in all treatments might be due to the incorporation of mungbean stover in soil (Table 7). The nutrient status both for macro and micro was influenced by stover incorporation. The amount of organic matter was highest 11.55% with treatment T_{11} and lowest was with T_1 treatment. In most of the cases, the content of macro and micro nutrients were found higher with T_{11} treatment and lowest with T_1 treatment (Table 7). Ahiawat and Srivastava (1997) observed that the incorporation of mungbean stover in soil after picking of pods resulted in an economy of about 23 kg N/ha in succeeding crop. Rao and Bhardwaj (1980) found that the pulses receiving optimum fertilizer, especially P had more pronounced residual effect both for N and P in succeeding cereals.

Table 6. Plant height (cm), no. of pods per plant and no. of seeds per pod of mungbean as influenced by Zn and B fertilization at on-station, Madaripur during 2008 and 2009.

Levels of Zn and B fertilization (kg/ha)	Plant height (cm)			No. of pods/plant			No. of seeds/pod		
	2008	2009	Average	2008	2009	Average	2008	2009	Average
$T_1=Zn_0B_0$	45.2e	39.5f	42.3	25.3c	24.Ic	25.4	9.5	7.62c	8.56
$T_2=Zn_0B_{0.5}$	46.9c	40.6ef	43.8	27.8abc	28.8abc	28.3	10.2	8.35abc	9.27
$T_3=Zn_0B_{1.0}$	46.6cd	42.8bcd	44.7	29.4abc	31.3ab	30.4	10.3	8.40abc	9.35
$T_4=Zn_0B_{2.0}$	47.2bc	42.lcde	44.6	28.4abc	31.4ab	29.9	10.4	8.42abc	9.41
$T_5= Zn_{0.75}B_0$	46.4cd	42.5bcd	44.5	29.7ab	28.8abc	29.2	10.0	7.85bc	8.92
$T_6=Zn_{0.75}B_{0.5}$	45.9de	42.6bcd	44.2	27.3bc	32.0ab	28.6	10.2	8.40abc	9.30
$T_7= Zn_{0.75}B_{1.0}$	46.9c	43.3a-d	45.1	27.4bc	27.6bc	27.5	10.1	8.5labc	9.30
$T_8=Zn_{0.75}B_{2.0}$	47.2bc	43.9abc	45.6	30.2ab	34.2ab	32.2	10.2	8.37abc	9.28
$T_9= Zn_{1.5}B_0$	46.8cd	43.3a-d	45.0	27.Sbc	27.5bc	27.5	10.4	8.47abc	9.43
$T_{10}=Zn_{1.5}B_{0.5}$	47.3bc	43.9abc	45.6	28.Iabc	30.9ab	29.5	10.6	8.05abc	9.32
$T_{11}=Zn_{1.5}B_{1.0}$	49.3a	44.7a	47.0	31 .8a	35.5a	33.6	10.9	8.90a	9.90
$T_{12}= Zn_{1.5}B_{2.0}$	47.9b	44.0ab	46.0	28.7abc	34.7a	31.7	10.7	8.8lab	9.75
$T_{13}=Zn_{3.0}B_0$	47.2bc	43.5a-d	45.3	27.7abc	28.9abc	28.4	10.5	8.20abc	9.35
$T_{14}=Zn_{3.0}B_{0.5}$	46.9bc	43.la-d	45.0	28.5abc	27.7bc	28.1	10.6	8.68ab	9.64
$T_{15}=Zn_{3.0}B_{1.}0$	46.6cd	43.0a-d	44.8	28.2abc	32.4ab	30.3	10.5	8.77ab	9.63
$T_{16}=Zn_{3.0}B_{2.0}$	47.Ibc	41.6de	44.4	27.8abc	30.28abc	29.0	10.3	8.70ab	9.50
CV (%)	1.10	2.32	-	7.51	11.43	-	6.40	5.98	-

Values within a column having same letter(s) do not differ significantly (p=0.05)

Blanket dose: N_{20} P_{25} K_{35} S_{20} kg/ha.

Regression analysis showed positive and quadratic response for mean yield and applied Zn. (Fig. 1). The optimum dose of Zn was calculated from the quadratic response function and was 1.87 kg/ha (Table 8). For optimum dose, the maximum seed yield (2613 kg/ha could be expected for Madaripur area (Table 8). However, the optimum economic dose of Zn was 1.84 kg/ha. The use efficiency showed that each 1 kg Zn could produce 287 kg/ha of seed yield. Beyond the optimum dose, 1 kg/ha excess Zn was applied, then a risk of loosing 154 kg/ha of seed yield was noted (Table 8).

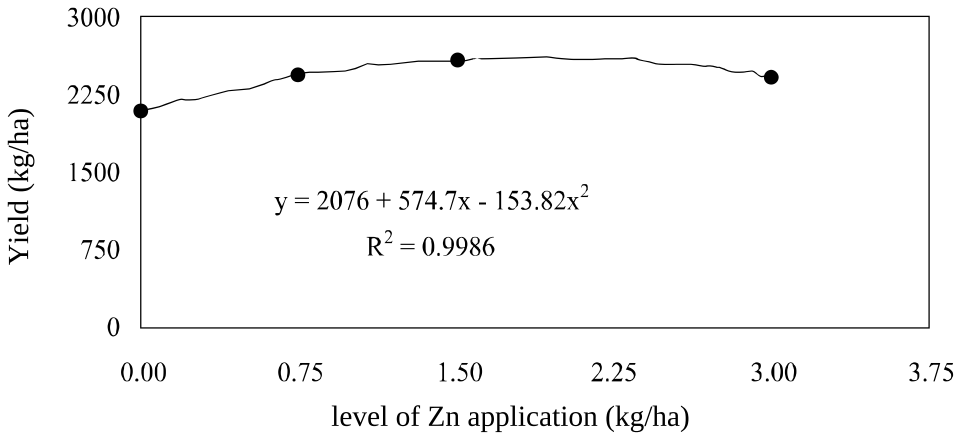

Fig. 1. Response of mungbean to Zn fertilization.

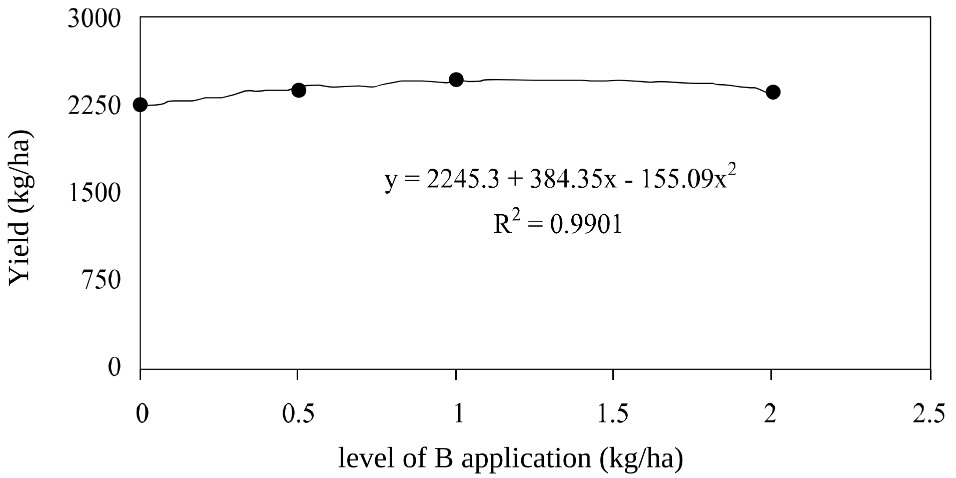

Fig. 2. Response of mungbean to B fertilization

Table 7. Fertility status of initial and post harvest soil.

Treatment	pH	OM (%)	Total N (%)	Ca	Mg	K	P	S	Mn	Zn	B
				Meq./100g			µg/g				
T_1=Zn_0B_0	7.0	1.22	0.070	11.1	3.2	0.09	17	15	6.0	0.80	0.11
T_2=$Zn_0B_{0.5}$	7.1	1.25	0.075	11.4	3.3	0.09	18	17	7.0	1.2	0.14
T_3=$Zn_0B_{1.0}$	7.2	1.27	0.075	11.8	3.4	0.09	20	17	7.5	1.3	0.15
T_4=$Zn_0B_{2.0}$	7.3	1.30	0.077	11.9	3.3	0.07	19	16	8.0	0.82	0.18
T_5= $Zn_{0.75}B_0$	7.2	1.29	0.080	11.7	3.5	0.08	20	18	8.0	1.5	0.12
T_6=$Zn_{0.75}B_{0.5}$	7.4	1.31	0.085	12.0	3.2	0.09	21	19	8.2	1.4	0.14
T_7= $Zn_{0.75}B_{1.0}$	7.3	1.33	0.084	11.9	3.6	0.09	20	18	8.0	1.5	0.25
T_8=$Zn_{0.75}B_{2.0}$	7.4	1.38	0.088	12.1	3.4	0.08	21	17	7.3	1.4	0.26
T_9= $Zn_{1.5}B_0$	7.2	1.32	0.080	12.0	3.5	0.09	19	18	8.4	1.6	0.12
T_{10}=$Zn_{1.5}B_{0.5}$	7.3	1.40	0.089	12.2	3.3	0.11	21	18	7.7	1.5	0.19
T_{11}=$Zn_{1.5}B_{1.0}$	7.3	1.55	0.096	12.3	3.6	0.12	23	20	8.5	1.6	0.25
T_{12}= $Zn_{1.5}B_{2.0}$	7.3	1.54	0.095	12.5	3.4	0.11	22	19	8.0	1.7	0.29
T_{13}=$Zn_{3.0}B_0$	7.3	1.50	0.093	11.9	3.4	0.11	21	20	8.0	1.8	0.14
T_{14}=$Zn_{3.0}B_{0.5}$	7.4	1.52	0.094	12.4	3.3	0.09	22	18	7.9	1.9	0.18
T_{15}=$Zn_{3.0}B_{1.}0$	7.2	1.45	0.095	12.1	3.5	0.10	20	19	8.0	1.8	0.23
T_{16}=$Zn_{3.0}B_{2.0}$	7.4	1.46	0.089	12.3	3.2	0.08	21	21	7.0	1.8	0.28
Initial level	7.0	1.11	0.073	11.3	3.3	0.08	17	17	8	0.95	0.13
Critical level	-	-	0.12	2.0	0.8	0.2	14	14	5	2	0.20

Table 8. Response function of mungbean to Zn and B for seed yield at Madaripur.

Regression equation	Co-efficient of determina tion (R^2)	Optim -um dose (kg/ ha)	Econo-mic dose (kg/ha)	Maxi-mum seed yield (kg/ha) for optimum dose	Production of seed (kg/ha) for 1 kg Zn or B (use efficiency)	Beyond optimum dose the reduction of seed yield (kg/ha) for 1kg Zn or B
Zn						
$y= 2076 + 574.7x -153.82x^2$	0.9986	1.87	1.84	2613	287	154
B						
$y= 2245.3 + 384.35x-155.09x^2$	0.9901	1.24	1.18	2483	192	155

Mungbean = 45 Tk./kg; Zn = 377 Tk./kg; B = 800 Tk./kg.

A positive and quadratic relationship was also found between seed yield and levels of B (Fig. 2). The optimum dose of B from the quadratic production function was 1.24 kg/ha (Table 8). Using the optimum dose, the maximum seed yield 2483 kg/ha could be expected for Madaripur area (Table 8). However, the optimum economic dose of B was 1.18 kg/ha. The use efficiency showed that each 1 kg B could produce 192 kg/ha of seed yield upto the optimum level. Above this optimum dose, 1 kg/ha excess B if applied then there was a risk of loosing 155 kg/ha of seed yield.

Conclusion

From two years' trial, it may be concluded that the combination of $Zn_{1.5}B_{1.0}$ with a blanket dose of N_{20} P_{25} K_{35} S_{20} kg/ha was found suitable for maximizing the yield of mungbean in Calcareous Low Ganges River Floodplain Soil (AEZ-12) at Madaripur region of Bangladesh.

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