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Effect of zinc and boron on seed yield and yield contributing traits of mungbean in acidic soil

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ABSTRACT

The experiment was carried out in Acidic Northern and Eastern hills Soil (AEZ 29) at Regional Agricultural Research Station (RARS), Akbarpur, Moulvibazar during Kharif 1 of 2012 to observe the effect of zinc (Zn) and boron (B) on the seed yield and yield contributing characters of mungbean. There were four levels of zinc (0, 1.0, 2.0, and 4.0 kg/ha) and boron (0, 0.75, 1.5, and 3.0 kg/ha) along with a blanket dose of $N_{24} P_{20} K_{30} S_{15}$ kg/ha. Experiment was laid out in RCBD with three replications. Incase of zinc application, highest seed yield (1.418 ton/ha) was obtained from 1.0 kg Zn/ha which was statistically similar (1.358 t/ha) with dose 1.0 kg Zn/haand but significantly higher (1.034 t/ha) than the control. Again for boron application,the highest seed yield (1.550 t/ha) was found from the treatment 1.50 kg B/ha which was statistically identical with 3.0 kg B/haand the lowest (0.927 t/ha) for control. The combined application of zinc and boron showed significant effect on mungbean yield than the single application of zinc and boron. Results showed that the combination of $Zn_{1.0}B_{1.5}$ produced significantly higher yield (1.677ton/ha) than the control (Zn_0B_0) combination (0.64 ton/ha). Combined application of zinc and boron were observed superior to their single application. Therefore, the combination of 1.0 kg zinc per hectare and 1.5 kg boron per hectaremight be considered as suitable dose for mungbean cultivation in acidic soil of Sylhet region of Bangladesh.

Key Words: *Mungbean, Zinc, Boron, Acidic soil and Seed yield*

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I. Introduction

Mungbean (*Vigna radiata* L. Wilczek) is an important traditional legume crop of Bangladesh characterized by a relative high content of protein (Mensah and Ihenyen, 2009) and excellent nutritional attributes in terms of methionine and cysteine in adequate quantities otherwise lacking in other food crops (Tsou and Hsu, 2000). In Bangladesh, dehulled grain is mainly used to make Daal. Besides, this it is used to prepare various delicious fried food, sweet items and salad (soaked and sprouted grains).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). Mungbean protein is highly and easily digestible than other legume because it has less sulphur containing amino acid with even

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less methionine than lysine. Thus mungbean is excellent component with cereal (Sharma et al., 2011). Pulse cereal ratio should be 1:2 for optimum amino acid balance to human nutrition for cereal based diet in South Asia country but it expand to 1:9 (CGIAR, 2010). Legume incorporation in different rice fallow system seemed highly lucrative compared to wheat and maize in terms of soil fertility, human nutrition and it fetches high market price. Mungbean is assured as catch crops and enhanced soil nitrogen by 33 to 37 kg ha-1 that reduced 25% nutrient demand for succeeding crops (Sekhon et al., 2007), and addition to non-harvestable (manure) biomass of 4461 kg dry weight ha-1 that contained 51.9 kg N ha-1 to soil (Yaqub et al., 2010). Genetic potential of legume is not obtained at field due to poor soil nutrient status, mineral deficiency, etc (Maskey et al., 2004). Zinc is involved in auxin formation, activation of dehydrogenase enzymes; stabilization of ribosomal fractions (Hafeez et al., 2013). and boron is very important in cell division, pod and seed formation (Goldberg and Su, 2007). Ozturk et al., (2006) found that Zn in newly-developed radicles and coleoptiles during seed germination was much higher (up to 200 mg kg^{-1}) thus highlighting the involvement of Zn in physiological processes during early seedling development, possibly in protein synthesis, cell elongation membrane function and resistance to abiotic stresses (Cakmak, 2000). In addition, higher seed Zn contents may better resist invasion of soil-borne pathogens during germination and seedling development thus ensuring good crop stands (Marschner, 1995) and ultimately better yield. B is also functionally associated with one or more of the processes of calcium utilization, cell division, flowering and fruiting, carbohydrate and nitrogen metabolism, disease resistance, water relations, and catalyst for certain reactions (Sprague, 1951). Common B deficiency symptoms in crop plants are interruption in flowering and fruiting (Ho, 1999) and poor yields, with deformed or discolored fruit or grain (Shorrocks, 1997). Morever, these two nutrients are found to have its residual impact on the successive crops, it is imperative that application of Zn and B containing fertilizers are needed to exploit the production potential of crops under cropping systems and also to mitigate the deficiencies of these nutrients. Addition of S + Zn + B in balanced fertilization schedule increased N, P and K utilization efficiency which highlights the role of micronutrients in increasing macronutrient use efficiency (Shukla, 2011). The present study was, therefore, undertaken to evaluate the response of Zn and B on the yield and yield contributing characters of mungbean and to find out a suitable dose of Zn and B for the maximization of mungbean yield in highly acidic soil of Sylhet region.

II. Materials and Methods

Experiment was conducted Acidic Northern and Eastern hills Soil (AEZ 29) at Regional Agricultural Research Station (RARS), Akbarpur, Moulvibazar during Kharif I of 2012. Soil texture was sandy clay (43-85%), silt (<50%) and clay (>20%) and highland soil type with pH 4.5. Annual rainfall was 256 cm at the experimental site. There were 16 treatment combinations comprising four levels each of zinc (0, 1.0, 2.0, and 4.0 kg/ha and boron (0, 0.75, 1.5, and 3 kg/ha) along with a recommended fertilizer N_{24} P_{20} K_{30} S_{15} kg/ha as per soil test based (BARC, 2012). The treatments were arranged as follows: T_1=Zn_0B_0.,T_2= $Zn_0B_{0.75}$,T_3= $Zn_0B_{1.5}$,T_4= $Zn_0B_{3.0}$, T_5= $Zn_{1.0}B_0$, T_6= $Zn_{1.0}B_{0.75}$ T_7= $Zn_{1.0}B_{1.5}$, T_8=$Zn_{1.0}B_{3.0}$, T_9= $Zn_{2.0}B_0$, T_{10}= $Zn_{2.0}B_{0.75}$,T_{11}= $Zn_{2.0}B_{1.5}$, T_{12}= $Zn_{2.0}B_{3.0}$,T_{13}= $Zn_{4.0}B_0$,T_{14}=$Zn_{4.0}B_{0.75}$, T_{15}= $Zn_{4.0}B_{1.5}$, and T_{16}= $Zn_{4.0}B_{3.0}$.The experiment was laid out in a randomized complete block design with three replications. The unit plot size was 4m x 3m. The variety was BARI Mung-6. Blanket dose of fertilizers were applied at the time of final land preparation. Zinc and Boron 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 04 March, 2012. Two weedings were done at 20 and 35 days after sowing (DAS). The diseases and insects were controlled properly. Yield contributing characters were recorded from 10 randomly selected plants from each plot. Yield (kg/ha) was recorded from the whole plot technique. Data were then statistically analyzed by using MSTAT.

III. Results and Discussion

Effect of zinc

Plant height showed significant variation due to different levels of Zinc application (Table 01).The highest plant height 60.89cm was recorded with Zn level 2.0 kg/ha which were statistically identical with the dose 4.0 kg Zn/ha (Table 01). Number of branches per plant showed significant variation with different levels of Zn application. Number of branches per plant was highest (4.235) with Zn level

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2.0 kg/ha and lowest for control (2.2). Days to flowering found insignificant for application of different doses of Zn. Days to maturity was highest (60.17) for 2.0 kg Zn/ha and lowest (57.42) for 1.0 kg Zn/ha. Pod length was highest (9.88 cm) with the dose 1.0 kg Zn/ha which was statistically similar 2 kg and 4 kg Zn/ha and lowest (6.967 cm) in control. Number of pods per plant was highest (22.18) for Zn dose 2.0 kg/ha and lowest (19.72) in control. Number of seeds per pod was highest (10.1) in 1.0 kg Zn/ha which was statistically similar other doses than control. The highest1000-seed weight (51.42g) was obtained from treatment 2.0 kg Zn/ha which was followed by treatment 4 kg Zn/ha and the lowest one (44.20g) found from control. Highest seed yield (1.418 ton/ha) was obtained from 2.0 kg Zn/ha which was statistically similar (1.358 t/ha) with dose 1.0 kg Zn/haand but significantly higher (1.034 t/ha) than control (Table 1). It was observed that the yield increased gradually with the increase of Zn level up to 2.0 kg/ha but decreased with Zn level 4.00 kg/ha. Similar trends were also observed by several authors (Quddus et al., 2011; Ryan and El-Moneim, 2007; Valenciano et al., 2011 in chickpea in acidic soil).

Table 01. Effect of Zinc on seed yield and yield contributing characters of mungbean

Levels of Zinc (kg/ha)	Plant height (cm)	No. of branch/plant	Days to flowering	Days to maturity	Pod length (cm)	No. of pods/plant	No. of seeds/pod	1000-seed weight (g)	Yield (t/ha)
0	39.39c	2.208d	35.00	59.42ab	6.967b	19.72c	9.027b	44.20b	1.034c
1.0	55.38b	3.560c	35.50	57.42b	9.880a	21.99ab	10.10a	50.84a	1.358ab
2.0	60.89a	3.762b	34.83	60.17a	9.818a	22.18a	9.997a	51.42a	1.418a
4.0	60.09a	4.235a	35.50	58.08ab	9.237a	21.09b	9.840a	51.21a	1.341b
CV (%)	*2.75*	*2.27*	*4.92*	*2.83*	*8.01*	*3.57*	*2.91*	*3.67*	*4.49*

Table 02. Effect of Boron on seed yield and yield contributing characters of mungbean

Levels of Boron (kg/ha)	Plant height (cm)	No. of branch/plant	Days to flowering	Days to maturity	Pod length (cm)	No. of pods/plant	No. of seeds/pod	1000-seed weight (g)	Yield (t/ha)
0	50.46b	2.894d	35.25	58.75ab	6.908b	18.86b	8.672c	39.47b	0.927c
0.75	54.13a	3.421c	35.33	57.75b	9.111a	21.41a	10.30a	52.01a	1.192b
1.50	55.94a	3.790a	35.58	57.67b	10.01a	22.40a	10.31a	53.38a	1.550a
3.0	55.22a	3.660b	34.67	60.92a	9.874a	22.31a	9.688b	52.82a	1.481a
CV (%)	*2.75*	*2.27*	*4.92*	*2.83*	*8.01*	*3.57*	*2.91*	*3.67*	*4.49*

Effect of boron

Significant variation was observed in mungbean yield due to the application of boron (Table 02). The highest plant height (55.94cm) was recorded with treatment 1.50 kg B/ha and the lowest (50.46 cm) was found with control (Table 02). Number of branches per plant was highest (3.79) with B level 1.50 kg/ha and lowest for control (2.89). Days to flowering found non significant for application of different doses of boron. Days to maturity was highest (60.92) for 4.0 kg B/ha and lowest (57.67) for 1.50kg B/ha. Pod length was highest (10.01 cm) with the dose 1.5 kg B/ha which was statistically similar 0.75 kg and3 kg B/ha and lowest (6.908 cm) in control. Number of pods per plant was highest (22.40) for B dose 1.50 kg/ha and lowest (18.86) in control. Number of pods per plant showed no significant variation due to the application of different levels of boron (Table 02). Verma and Mishra (1999) in mungbean and Ganie et al. (2014) in French bean reported the similar trend. Number of seeds per pod was highest (10.31) in 1.50 kg B/ha which was statistically similar with the dose 0.75 kg B/ha and lowest (8.672) in control. The highest1000-seed weight (53.38 g) was obtained from treatment 1.50 kg B/ha which was followed by treatment 3 kg B/ha and the lowest one (39.47g) found from control. The highest seed yield (1.550 t/ha) was found from the treatment 1.50 kg B/ha which was statistically identical with 3.0 kg B/haand the lowest (0.927 t/ha) for control. Verma and Mishra (1999) reported

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that the boron application has positive effect on mungbean yield. Quddus et al. (2011) and Ashraf (2007) found similar effect of boron in case of mungbean.

Interaction effect of zinc and boron

All the traits except days to flowering showed significant variation due to interaction effect of Zinc and Boron (Table 03). The highest plant height 62.62 cm was recorded with the dose T_{15}= $Zn_{4.0}B_{1.5}$kg/ha and lowest 39.10 in control (T_1= Zn_0B_0kg/ha). Number of branches per plant was highest (4.89) with T_{15}= $Zn_{4.0}B_{1.5}$ and lowest for control (2.16). Days to maturity was highest (62.0) for T_{12}= $Zn_{2.0}B_{3.0}$and lowest (55.33) for T_6= $Zn_{1.0}B_{0.75}$. Pod length was highest (11.53 cm) with the dose T_7= $Zn_{1.0}B_{1.}$ and lowest (6.807 cm) in control. Number of pods per plant was highest (24.13) for T_{11}= $Zn_{2.0}B_{1.5}$and lowest (18.64) in T_5= $Zn_{1.0}B_0$. Number of seeds per pod was highest (10.89) in T_7= $Zn_{1.0}B_{1.0}$ and lowest (8.427) in control. The highest 1000-seed weight (57.00g) was found in treatment T_7 ($Zn_{1.0}B_{1.5}$) lowest (37.57g) in control. The highest yield (1.677 ton/ha) was obtained from T_7 ($Zn_{1.0}B_{1.5}$) treatment and the lowest (0.64 ton/ha) from T_1 (Zn_0B_0). Sakal et al. (1986) and Quddus et al. (2011) found similar results with combined application in mungbean and again, incase of foliar spray of Zn and B, Abdo (2001) observed the identical result.

Table 03. Interaction effect of zinc and boron on seed yield and yield contributing characters of mungbean

Levels of Zn and B fertilization (kg/ha)	Plant height (cm)	No. of branch/plant	Days to flowering	Days to maturity	Pod length (cm)	No. of pods/plant	No. of seeds/pod	1000-seed weight (g)	Yield (t/ha)
T_1= Zn_0B_0	39.10c	2.16h	35.0	58.33abc	6.807c	19.23de	8.427h	37.57f	0.64g
T_2= $Zn_0B_{0.75}$	40.40c	2.20h	35.0	59.33abc	6.877c	19.20de	9.147efg	44.0def	0.96f
T_3= $Zn_0B_{1.5}$	39.23c	2.19h	35.67	58.67abc	7.03c	20.6bcde	9.167defg	45.57cde	1.26cde
T_4= $Zn_0B_{3.0}$	38.83c	2.27h	34.33	61.33ab	7.157c	19.83cde	9.367cdef	49.67bcd	1.277cde
T_5= $Zn_{1.0}B_0$	42.71c	2.88g	35.67	58.0abc	6.687c	18.64e	8.850fgh	39.23ef	0.76g
T_6= $Zn_{1.0}B_{0.75}$	56.20b	3.28f	37.0	55.33c	10.03ab	21.96abc	10.72a	55.67ab	1.36cd
T_7= $Zn_{1.0}B_{1.5}$	61.23ab	3.95cd	35.0	56.0bc	11.53a	23.42a	10.89a	57.00a	1.677a
T_8=$Zn_{1.0}B_{3.0}$	61.37ab	4.12bc	34.33	60.33abc	11.27ab	23.92a	9.957bc	51.47abc	1.637a
T_9= $Zn_{2.0}B_0$	61.13ab	2.97g	34.67	60.33abc	7.09c	17.95e	8.647gh	39.50ef	1.217cde
T_{10}=$Zn_{2.0}B_{0.75}$	60.67ab	3.84d	35.0	60.33abc	10.81ab	22.96ab	10.80a	55.17ab	1.21de
T_{11}= $Zn_{2.0}B_{1.5}$	61.10ab	4.11bc	34.67	58.0abc	10.86ab	24.13a	10.76a	55.60ab	1.643a
T_{12}= $Zn_{2.0}B_{3.0}$	60.67ab	4.12bc	35.0	62.0a	10.51ab	23.69a	9.783cd	55.40ab	1.60ab
T_{13}= $Zn_{4.0}B_0$	58.90ab	3.56e	35.67	58.33abc	7.05c	19.62cde	8.767fgh	41.57ef	1.093ef
T_{14}=$Zn_{4.0}B_{0.75}$	59.23ab	4.35b	34.33	56.0bc	8.727bc	21.51abcd	10.51ab	53.20ab	1.24cde
T_{15}= $Zn_{4.0}B_{1.5}$	62.20a	4.89a	37.0	58.0abc	10.61ab	21.43abcd	10.43ab	55.33ab	1.62a
T_{16}= $Zn_{4.0}B_{3.0}$	60.02ab	4.12bc	35.0	60.0abc	10.56ab	21.80abcd	9.647cde	54.73ab	1.41bc
CV (%)	*2.75*	*2.27*	*4.92*	*2.83*	*8.01*	*3.57*	*2.91*	*3.67*	*4.49*

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IV. Conclusion

Combined application of Zinc and Boron showed significant effect on mungbean yield than the single application of zinc and boron. Most of the yield and yield contributing characters showed significant variation due to application of different doses of Zn and B. As a result of that, the simultaneous application of zinc and boron were observed superior to their single application. Therefore, the combination of 1.0 kg zinc per hectare and 1.5 kg boron per hectare might be considered as a suitable dose for mungbean cultivation in acidic soil of Sylhet region of Bangladesh.

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