Bangladesh J. Environ. Sci., Vol. 43, 238-241, 2022 @ BAED ISSN 1561-9206

EFFECT OF ZN AND B APPLICATION ON MUSTARD AT MADHUPUR SOIL UNDER AEZ 28

M. F. Islam
Soil Science Division, Bangladesh Institute of Nuclear Agriculture (BINA)
BAU Campus, Mymensingh-2202
Author's email: forhad_bina@yahoo.com

ABSTRACT

Mustard (Binasarisha-9) was evaluated against four Zn levels (0, 3, 6, 9 kg Zn ha^{-1}) and three B levels (0, 2, 4 B ha^{-1}) at Madhupur under AEZ 28. The results revealed that there was a significant improvement in the growth and seed yield with increasing level of B and lower Zn levels, respectively. The highest B level (4 kg ha^{-1}) and lower Zn level (3 kg ha^{-1}) resulted 96 cm plant height, 5.33 branches $plant^{-1}$, 86.33 siliqua $plant^{-1}$, 7.33 cm siliqua length, 28.33 seed $siliqua^{-1}$ and 1633.30 kg seed ha^{-1}. It is suggested that for achieving higher seed yields in mustard, the Zn application may be done at the rate of 3 kg ha^{-1} and with B of 4 kg ha^{-1}.
Key words: Boron, Zinc, yield and mustard

Introduction

The soil of Bangladesh has wide variation and complexity due to diverse nature of physiography, parent materials, land type, drainage conditions and agro ecology. Depending on these aspects, the country has been divided into 30 agro ecological zones (AEZ), which varied greatly in respect of area, land and soil, climate, and cropping intensity (FAO-UNDP, 1988). Some AEZs are very potential for crop agriculture and nutrient supplying capacity but some are being depleted due to intensive cropping. Madhupur Tract (AEZ 28) is one of them. The present study was concentrated to this AEZ which is a region of complex relief and soils are developed over the Madhupur clay. The landscape comprises of level upland, closely or broadly dissected terraces associated with shallow to broad deep valleys. Eleven general soil types exist in the area of which Deep Red Brown Terrace, Deep Red Brown Terrace soils and Acid Basin Clays are the major ones. The soils on the terrace are better drained, friable clay loams to clay overlying friable clay substratum at varying depths. Soils in the valleys are dark grey heavy clays. The top soils are mainly very strongly acidic in reaction but ranges up to slightly acidic with low to medium status of organic matter, low moisture holding capacity and low fertility level. The soils are mainly phosphate fixing low to medium in P, B and K; and medium to optimum in S content. The major land type comprises 56% highland and 18% medium highland (FRG, 2018). Texturally the soils are loam and sandy loam. Over the last 2-3 decades, enormous pressure has been exerted on the soil resource to produce more food for its population. Intensification of agricultural land use has increased remarkably and the cropping intensity has increased from 143% in 1971-72 to about 197% in 2016-2017 (Krishi Diary, 2021). In addition, cultivation of high yielding varieties for all crops has increased remarkably. Consequently, this has resulted in deterioration of soil fertility with emergence of micronutrient deficiency. In this country, chronologically N, P, K, S, Zn and B deficiencies have appeared in soils and crops of Bangladesh (Islam, 2008). Among the micronutrients, next to zinc, boron deficiency is prominent in soils of Dinajpur, Rangpur, Bogra, Sirajganj, Mymensingh, Comilla and Sylhet district (SRDI, 2010). The use of chemical fertilizers as the supplemental source has been increasing steadily but these are not applied in balanced proportion. Of the total fertilizer used in the country, urea alone constituted about 75% (FRG, 2012). Previous study indicated that about 60% cultivable land of Bangladesh is deficient in N, P and K (Miah *et al*., 2008). Moreover, organic matter content in country's soils is low, the majority being below the thresh hold level (1.5%) and it was gradually depleted by 5 to 36% during the period of 1967-1995 (Ali *et al*., 1997). Islam (2008) mentioned that organic matter content in Bangladesh soils is generally around 1% in most and around 2% in few soils.

Zinc is one of the first micronutrients recognized as essential for plants that transported to plant root surface through diffusion (Maqsood *et al.*, 2009). Zn is a micronutrient and in case of its severe deficiency the

symptoms may last throughout the entire crop season (Asad and Rafique, 2000). Until 1980, deficiency of three nutrients viz. N, P and K was identified in Bangladesh soils. In early 1980s, the S and Zn deficiency in rice was observed (Jahiruddin *et al*., 1981; Islam, 1984). The importance of Zn in crop nutrition has received considerable attention during eighties in Bangladesh. Zinc deficiency is particularly evident in calcareous and wetland rice soils (SRDI, 2008; Islam, 2008).

Boron deficiency of some crops was reported (Jahiruddin *et al*., 1995) in early 1990's. Although taken up in small quantities, B deficiency may lead to serious consequences regarding economic yield of various crops. Light textured soils of the country are deficient in plant available boron where significant leaching loss of borate ions occurs. Deficiency of both Zn and B usually occurs in high pH and light textured soils. In Bangladesh, boron deficiency is more common in *rabi* crops (dry season), as observed in wheat (Jahiruddin, 2011) and mustard (Hossain, 2007). Deficiency of B in plants has been considered responsible for causing sterility in wheat and mustard in the country (Ahmed and Hossain, 1997). Boron deficient plants become susceptible to disease, for example black point of wheat, caused by *Bipolaris sorokiniana* fungus (Jahiruddin, 2011).

In view of the significance of zinc and B in crop production process, the experiment was conducted to evaluate the direct effect of micronutrient (zinc and boron) on growth and yield of crops and to determine the requirement of Zn and B for the cropping pattern.

Materials and Methods

The experiment with mustard was set up at Pondura village at Madhupur under AEZ 28. Soil properties descriptions are given in Table 1. The soils are sandy loam in texture, low in fertility status and strongly acidic in reaction. The soils of the experimental field are very low in total nitrogen, low in exchangeable K and medium in S, very high in P and low in Zn and B content.

Table 1. Soil morphological, physical and chemical properties of the experimental site of initial soil

Soil properties	Madhupur soil
AEZ (UNDP and FAO, 1988)	Madhupur Tract
Topography	Medium high land
Drainage	Well drained
Flood level	Above flood level
Sand (%) (2- 0.05 mm)	45.9
Silt (%) (0.05 - 0.002mm)	33.3
Clay (%) (<0.002 mm)	20.8
Soil texture	Sandy loam
pH	5.27
The organic matter (OM) status	1.11
Nitrogen (N)	0.13 %
Phosphorus (P)	7.37 µg g^{-1} soil
Potassium (K)	0.15 meq/100 g soil
Sulfur (S)	13.26 µg g^{-1} soil
Zinc (Zn)	0.60 µg g^{-1} soil
Boron (B)	0.25 µg g^{-1} soil

A research trial was conducted with varying combinations of Zn-B treatments for Mustard crop at AEZ 28 during 2021-2022. The variety used for Mustard was Binasarisha-9. The rates of micronutrients were 0 (control), 3, 6, 9 kg ha^{-1} for zinc (Zn) and 0, 2, 4 kg ha^{-1} for boron (B) as mentioned by subscripts of Zn and B. There were combined seven treatments, viz. T_1: Zn_0B_0, T_2: Zn_3B_2, T_3: Zn_6B_4, T_4: Zn_9B_2, T_5: Zn_3B_4, T_6: Zn_6B_2 and T_7: Zn_9B_4. Subscripts of Zn and B represent kg ha^{-1}. Each treatment replicated three times. The treatments were randomly distributed to the plots within a block. The elements were added as $ZnSO_4.7H_2O$ and H_3BO_3, respectively. Other nutrients viz. N, P, K and S were used at recommended rates

for all plots (rates based on soil test). After ripening the crop, effects of Zn and B on the yield, yield attributes were recorded. The observed values were analyzed in terms of average as well as SD. The analyzed data were analyzed statistically following the analysis of variance (ANOVA) technique and the mean differences were adjudged by Duncan's Multiple Range Test (DMRT) using the statistical computer package program, MSTAT-C (Gomez and Gomez, 1984).

Results and Discussion

The highest B level (4 kg ha^{-1}) and lower Zn level (3 kg ha^{-1}) resulted 96 cm plant height, 5.33 branches $plant^{-1}$, 86.33 siliqua $plant^{-1}$, 7.33 cm siliqua length, 28.33 seed $siliqua^{-1}$. The seed yield ranged from 0.80-1.63 t ha^{-1} over the treatments. Treatment T_5 (Zn at 3 kg ha^{-1} and B at 4 kg ha^{-1}) recorded the highest yield (1.63 t ha^{-1}). Zn-B control treatment recorded minimum seed yield (0.80 t ha^{-1}). In terms of seed yield, the treatments can be ranked in the order: T_1>T_2> T_6> T_7> T_4> T_3> T_5.

Table 2. Effect of Zn and B on yield and yield attributes of Mustard

Treatment	Plant height (cm)	Branches/ plant (no.)	Siliqua/ plant (no.)	Pod length (cm)	Seeds/ pod (no.)	Grain Yield (t/ha)	Stover yield (t/ha)
T_1=Zn_0B_0	89.66 b	3.33 b	61.00 c	6.11 c	24.44 b	0.80 c	4.26
T_2=Zn_3B_2	94.33 a	4.55 ab	72.00 bc	6.83 bc	27.66 a	1.26 b	4.47
T_3=Zn_6B_4	94.66 a	5.00 a	81.33 ab	7.53 ab	29.00 a	1.40 b	4.69
T_4=Zn_9B_2	92.00 ab	4.66 ab	80.00 ab	7.53 ab	29.00 a	1.36 b	4.95
T_5=Zn_3B_4	96.00 a	5.33 a	86.33 a	7.73 a	28.33 a	1.63 a	5.13
T_6=Zn_6B_2	93.00 ab	4.66 ab	81.33 ab	7.43 ab	27.00 ab	1.30 b	4.55
T_7=Zn_9B_4	96.00 a	5.33 a	80.66 ab	7.53 ab	27.33 ab	1.33 b	4.58
CV%	2.53	9.36	8.69	6.13	6.01	9.95	3.89
SE	1.37	0.52	3.88	0.25	0.95	0.07	0.08

In a column, mean followed by common letter(s) do not differ significantly at 5% level by DMRT
CV= Coefficient of variation, SE (±) = Standard error of means

The grain yield can be improved by addition of Zn fertilization (Maqsood *et al.*, 2009). Kutuk *et al.* (2000) also suggested that the application of Zn has become necessary for improved crop yields. Mandal and Sinha, (2004) recommended application of ZnSO4 at the rate of 20 kg ha^{-1} for oilseeds including mustard. Moniruzzaman *et al.* (2008) applied zinc at the concentrations of 0, 2.5, 5.0 and 7.5 kg ha^{-1} and suggested 8 kg Zn ha^{-1} for brassica species. Yang *et al.* (2009) reported that the combined application of B with Zn resulted in higher seed yield than the application of B or Zn alone, and the seed yield of the B+Zn treatment was the highest in all treatments, 68.1% above the control.

Stover yield of mustard ranged from 4.26 - 5.13 t ha^{-1}. Treatment T_5 (Zn at 4 kg ha^{-1} and B at 3 kg ha^{-1}) with NPKS gave the maximum stover yield (5.13 t ha^{-1}) which corresponded to the maximum seed yield over the control yield (1.63 t ha^{-1}). In terms of stover yield, the treatments were found non-significant. Yield attributes of the crop were also significant.

Conclusion

It is suggested that for achieving higher seed yields in mustard, the Zn application may be done at the rate of 3 kg ha^{-1} and with B of 4 kg ha^{-1}.

References

Ahmed, S. and Hossain, M. B. 1997. The problem of boron deficiency in crop production in Bangladesh. *In: Boron in soils and plants,* Springer Netherlands pp. 1-5.

Ali, M. M., Shaheed, S. M. and Kubota, D. 1997. Soil degradation during the period 1967-1995 in Bangladesh. II. Selected chemical characters. *Soil Sci. Plant Nutr.*, 43: 879-890.

FAO-UNDP, 1988. Land Resources Appraisal of Bangladesh for Agricultural Development: Agro-cological Regions of Bangladesh. Technical Report No. 2, FAO, Rome.

FRG (Fertilizer Recommendation Guide), 2012. BARC (Bangladesh Agricultural Research Council), Farmgate, Dhaka.

FRG (Fertilizer Recommendation Guide), 2018. BARC (Bangladesh Agricultural Research Council), Farmgate, Dhaka.

Gomez, K. A. and Gomez, A. A. 1984. Statistical procedure for agricultural research. Second Edn. International Rice Research Institute, John Wiley and Sons. New York. pp. 1-340.

Hossain, M. A. 2007. Requirement of boron for mustard-mungbean-rice pattern and zinc for maize-mungbean-rice pattern in calcareous soil. PhD Dissertation, Department of Soil Science, Bangladesh Agriculture University, Mymensingh.

Islam, M. S. 1984. Zinc and sulphur deficiency problem in Bangladesh soils. *Annual report,* FAO-BARC Coordinated Programme.

Islam, M. S. 2008. Soil fertility history, present status and future scenario in Bangladesh. *Bangladesh J. Agric. Environ*., 4 (Special Issue): 129-151.

Jahiruddin, M. 2011. Screening, selection and molecular characterization of boron efficient wheat genotypes. Project Report, Department of Soil Science, BAU, Mymensingh.

Jahiruddin, M., Ali, M. S., Hossain, M. A., Ahmed, M. U. and Hoque, M. M. 1995. Effect of boron on grain set, yield and some other parameters of wheat cultivars. *Bangladesh J. Agric. Sci.*, 22(1) 179-184.

Jahiruddin, M., Bhuiya, Z. H., Hoque, M. S. and Rahman, L. 1981. Effect of rates and methods of zinc application on rice. *Madras Agric. J.*, 68 211-216.

Krishi Diary, 2021. AIS (Agricultural Information Service). Farmgate, Dhaka.

Kutuk, C., Gökhan, C., Abdullah, B. and Başkan, O. 2000. Effect of Humic Acid on some soil properties. Bildiri Özetleri, Soil Science Department, Agricultural Faculty, Ankara University, 06110-Ankara Turkey.

Mandal and Sinha, A. C. 2004. Nutrient Management Effects on Light Interception, Photosynthesis, Growth, Dry-matter Production and Yield of Indian Mustard (*Brassica juncea*). *J. Agronomy Crop Sci*., 55 (4): 287-291.

Miah, M. A., Saha P. K. Islam, A, Hasan, M. N. and Nosov, V. 2008. Potassium fertilization in rice-rice and rice-wheat cropping system in Bangladesh. *Bangladesh J. Agric. and Environ*., 4 (Special Issue): 51-67.

Moniruzzaman, M., Mozumder, S. N. and Islam, M. R. 2008. Effects of Sulfur, Boron, Zinc and Molybdenum on Yield and Profitability of Broccoli (*Brassica oleracea* L. Var. italica). *J Agric Rural Dev*., 6.

SRDI, 2008. GIS map, Zinc status of Bangladesh soils. SRDI, Farmgate, Dhaka.

SRDI, 2010. GIS map, Boron status of Bangladesh soils, SRDI, Farmgate, Dhaka.

Yang, M., Shi, L., Xu, F. S., Lu, J. W. and Wang, Y. H. 2009. Effects of B, Mo, Zn, and their interactions on seed yield of rapeseed (*Brassica napus* L.). *Pedosphere*, 19 (1): 53-59.