Interaction Effect of Phosphorus and Zinc on the Concentrations of N, P, K, S and Zn in Mungbean Stover and Seed

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Abstract- A field experiment was conducted at the Sher-e-Bangla Agricultural University Farm, Dhaka 1207, during the kharif season of 2014 to study the effects of Phosphorus and Zinc on the concentrations of N, P, K, S and Zn in Mungbean stover and seed (BARI mug 6). Four levels of phosphorus (P) (0, 15, 20 and 25 kg P ha-1) and three levels of zinc (Zn) (0, 1.5 and 3 kg Zn ha-1) were used in the study. The results revealed that The N, P, K and S concentration of mungbean plant increased significantly from control to P2Zn2 (20 kg P ha-1 + 3 kg Zn ha-1) treatment combination and again decreased with increasing phosphorus more than 20 kg P ha-1. Application of phosphorus and zinc increase organic carbon, N, P, K and S status of postharvest soil significantly.

Index Terms- Mungbean, phosphorus, zinc, concentration of N P K S & Zn, stover and seed.

I. INTRODUCTION

Mungbean (*Vigna radiata* L.) is one of the important pulse crops of Bangladesh, as it is an excellent source of easily digestible protein [1]. It belongs to the family Leguminosae. BARI mug 6 is a yield potential, innovated by Bangladesh Agricultural Research Institute (BARI) that fits well in crop rotation between two cereal crops [2]. In Bangladesh, daily consumption of pulses is only 14.30 g capita^{-1} day^{-1} [3], while World Health Organization (WHO) suggested 45g capita^{-1} day^{-1} for a balanced diet. Mungbean is rich source of vegetable protein. It is considered as poor man's meat containing almost triple amount of protein as compared to rice. It contains 1-3% fat, 50.4% carbohydrates, 3.5-4.5% fibers and 4.5-5.5% ash, while calcium and phosphorus are 132 and 367 mg per 100 grams of seed, respectively [4]. Hence, on the nutritional point of view, mungbean is perhaps the best of all other pulses [5]. Phosphorus and it plays a significant role in the is a key constituent of ATP] energy tranformation in plants6and also essential for energy [storage and release in living cells. The Zn essentially is being employed in functional and structural component of several enzymes, such as carbonic anhydrase, alcohol dehydrase, alkaline phosphatase, phospholipase, carboxypeptidase [7] and RNA polymerase [8]. Further, plants emerging from seeds with lower Zn could be highly sensitive to biotic and abiotic stresses [9]. Zn enriched seeds performs better with respect to seed germination, seedling growth and yield of crops [10]. The farmers of Bangladesh generally grow mungbean with almost no fertilizers. Considering the above facts the present study is aimed at following objectives to study the combine effect of phosphorus and zinc on the concentrations of N, P, K, S and Znin Mungbean.

II. MATERIALS AND METHODS

The experiment was conducted in the experimental farm of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka-1207, Bangladesh during the period from April to July, 2014. The location of the experimental site was at 23.75' N latitude and $90^0$34' E longitude with an elevation of 8.45 meter from sea level. Soil of the study site was silty clay loam in texture belonging to series. The area represents the Agro-Ecological Zone of Madhupur tract (AEZ-28) with P^H 5.8-6.5, ECE-25.28 [11]. BARI mug 6, a high yielding variety of mungbean was released by Bangladesh Agricultural Research Institute, Joydebpur, Gazipur in 2003. It is photo insensitive, semi synchronous maturity, short lifespan (60 to 65 days) and bold seeded crop. Its yield potentiality is about 2 t ha^{-1}. This variety is resistant to yellow mosaic virus diseases, insects and pest attack. The plot selected for the experiment was opened by power tiller driven rotovator on the 10th April 2014, afterwards the land was ploughed and cross-ploughed several times followed by laddering to obtain a good tilth. The experiment consisted of two factors: Factor A: Phosphorus (P), P_0= No P ha^{-1}, P_1=15 kg P ha^{-1}, P_2=20 kg P ha^{-1}and P_3=25 kg P ha^{-1}; Factor B: Zinc (Zn), $_0$Zn= No Zn ha^{-1};$_1$Zn =1.5 kg Zn ha^{-1} and $_2$Zn=3 kg Zn ha^{-1}. Levels of these two nutrient elements made 12 treatment combinations. The experiment was laid out in a Randomized Complete Block Design (RCBD), with three replications. The total number of plots was 36, each measuring 2.5 m x 2 m. Recommended blanket doses of N, K and Sulphur (20 kg N from urea, 30 kg K from MoP and 15 kg S ha^{-1} from Gypsum, respectively) were applied. The whole amounts of MoP, Gypsum and half of Urea fertilizer were applied as basal dose during final land preparation. Rest of the Urea was applied 28 days after sowing. The required amounts of P (from TSP) and Zn (from Zinc oxide) were applied at a time as per treatment combination after field layout of the experiment and were mixed properly through hand spading. Mungbean seeds were sown on 18th April 2014 in lines following the recommended line to line distance of 30 cm and plant to plant distance of 10 cm. Various intercultural

operations such as thinning of plants, weeding and spraying of insecticides were accomplished whenever required to keep the plants healthy and the field weed free. The crop was harvested at maturity on 18th June 2014. The harvested crop of each plot was bundled separately. Ten (10) plants from each plot were selected as random and were tagged for the data collection. Data were collected at harvesting stage. The collected data were analyzed with the help of MSTAT-C program and mean values of all the parameters were adjusted by Duncan's Multiple Range Test (DMRT) at 5% level of probability [12].

III. RESULTS AND DISCUSSION

Nitrogen and phosphorus concentration in stover: The highest concentrations of nitrogen (0.82%) at P_1Zn_2 (15 kg P ha^{-1} + 3 kg Zn ha^{-1} (treatment and phosphorus (0.67%) at P_2Zn_2 (20 kg P ha^{-1} + 3 kg Zn ha^{-1}treatment (w ererecorded in the stover. On the other hand, the lowest concentrations of nitrogen (0.52%) andphosphorus) 0.35 (%were found atP_0Zn_0 (No P + No Zn) treatment in stover (Table 1) .Prasad and Ram [13] found that application of Zn (2.5 and 5.0 µg g^{-1}) increased the concentration of phosphorus in mungbean and grain yield.

Potassium and sulphur concentration in stover: The highest concentration s ofpotassium (1.47%) and sulphur (0.162%) were recorded atP_2Zn_2 (20 kg P ha^{-1} + 3 kg Zn ha^{-1} (treatment in the stover. On the other hand, the lowest concentration s ofpotassium (0.65%) andsulphur) 0.084 (%were found at P_0Zn_0 (No P + No Zn) treatment in stover (Table 1) .

Zinc concentration in stover: Insignificant effect of combined application of different doses of P and Zn on the zinc concentration was observed in stover of mungbean (Table 1). The highest concentration of zinc (0.008 %) in the stover was recorded with the P_3Zn_1 (25 kg P ha^{-1} + 1. 5kg Zn ha^{-1}) treatment combination. On the other hand, the lowest zinc concentration (0.004 %) was found in P_0Zn_0 (No P + No Zn) treatment combination.

Table 1. Interaction effects of phosphorus and zinc on N P K S and Zn concentrations in mungbean stover

Interaction of P and Zn	N %	P %	K %	S %	Zn %
P_0Zn_0	0.52 f	0.35 f	0.65 j	0.084 c	0.004
P_0Zn_1	0.60 e	0.42 e	0.86 i	0.118 a-c	0.006
P_0Zn_2	0.75 bc	0.44 de	0.91 i	0.141 a-c	0.006
P_1Zn_0	0.64 e	0.47 c-e	1.05 h	0.094 bc	0.006
P_1Zn_1	0.76 bc	0.57 b	1.06 gh	0.120 a-c	0.006
P_1Zn_2	0.82 a	0.61 b	1.25 d	0.149 ab	0.006
P_2Zn_0	0.62 e	0.48 cd	1.34 c	0.095 bc	0.006
P_2Zn_1	0.71 cd	0.58 b	1.41 b	0.119 a-c	0.007
P_2Zn_2	0.80 ab	0.67 a	1.47 a	0.162 a	0.007
P_3Zn_0	0.66 de	0.45 de	1.13 ef	0.104 bc	0.007
P_3Zn_1	0.73 c	0.51 c	1.18 e	0.117 a-c	0.008
P_3Zn_2	0.64 e	0.42e	1.10 fg	0.137 a-c	0.007
$LSD_{(0.05)}$	NS	0.053	0.053	0.245	NS

In a column figures having similar letter(s) do not differ significantly whereas figures with dissimilar letter(s) differ significantly.
NS : Non significant.

Nitrogen and phosphorus concentration in seed: The highest concentration of nitrogen (7.46%) and phosphorus (0.69%) were recorded in the seeds of mungbean atP_2Zn_2 (20 kg P ha^{-1} + 3 kg Zn ha^{-1} (treatment combination) Table 2). On the other hand, the lowest concentration of nitrogen (5.74%) and phosphorus) 0.42 (%were found in seeds of mungbean atP_0Zn_0 (No P + No Zn) treatment .Singh *et al.* [14] found significant increase of nitrogen concentration in mungbean due to the application of increasing level of P fertilizer.

Potassium and sulphur concentration in seed: The highest concentration of potassium (2.21%) and sulphur (0.65%) were recorded in seeds atP_2Zn_2 (20 kg P ha^{-1} + 3 kg Zn ha^{-1} (treatment combination) Table 2). On the other hand, the lowest concentration of potassium (1.16%) andsulphur) 0.246 (%were found in seeds atP_0Zn_0 (No P + No Zn) treatmentcombination . Singh *et al.* [14] found significant increase of potassium concentration in mungbean due to the application of P and Zn.

Zinc concentration in seed: There was no significant effect of combined application of P and Zn on the zinc concentration in mungbean seeds (Table 2). The highest concentration of zinc in the seeds (0.008 %) was recorded with the P_2Zn_2 (20 kg P ha^{-1}+ 3 kg Zn ha^{-1}) treatment combinationwhich may be due to the higher supply and subsequent assimilation of this element in the seeds. It was observed that the lowest zinc concentration (0.004 %) in seeds was in P_0Zn_0 (No P + No Zn) treatment combination.

Table 2. Interaction effects of phosphorus and zinc on N P K S and Zn concentrations in mungbean seeds

Interaction of P and Zn	N %	P %	K %	S %	Zn %
P_0Zn_0	5.74 h	0.42 f	1.16 h	0.246 f	0.004
P_0Zn_1	6.79 cd	0.47d-f	1.24 g	0.340e	0.005
P_0Zn_2	6.97 b	0.53 b-d	1.24 g	0.426 cd	0.005
P_1Zn_0	6.22 f	0.49 c-e	1.46 f	0.390 de	0.006
P_1Zn_1	6.28 f	0.52 b-d	1.62 e	0.463 c	0.006
P_1Zn_2	7.05 b	0.53 bc	1.77 d	0.556 b	0.007
P_2Zn_0	6.75 d	0.51 cd	1.57 e	0.356 e	0.007
P_2Zn_1	6.85 c	0.63 b	1.91 c	0.560 b	0.007
P_2Zn_2	7.46 a	0.69a	2.21 a	0.650 a	0.008
P_3Zn_0	6.59 e	0.49c-e	1.91 c	0.393 de	0.007
P_3Zn_1	6.55 e	0.61 b	2.07 b	0.463 c	0.006
P_3Zn_2	6.10 g	0.44 ef	1.62 e	0.440 cd	0.005
$LSD_{(0.05)}$	0.0927	0.053	0.0535	0.0535	NS

In a column figures having similar letter(s) do not differ significantly whereas figures with dissimilar letter(s) differ significantly. NS: Non significant

IV. CONCLUSION

Nutrient concentration (N, P, K, S and Zn) in stover and seed were positively affected due to P and Zn fertilization. The interaction effect of P and Zn was also found remarkable. The N, P, K, S and Zn concentration in stover and seeds also increased with increasing level of P and Zn up to certain level. Based on the results of the present study, the following recommendation may be drawn - Application of Phosphorus and Zinc fertilizers @ 20 kg P ha^{-1} and 3 kg Zn ha^{-1} (P_2Zn_2) may be the best combination for higher nutrient concentration of mungbean stover and seed and also to maintain soil fertility and productivity than their individual application in Tejgaon series under AEZ No.28 in Bangladesh. Recommendation may vary from soil to soil.

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