Indian Journal of Science and Technology

Influence of Zinc and Boron in Residual Blackgram Productivity

M. Naveen Saviour[1*] and P. Stalin[2]

[1]Research Scholar, Department of Soil Science and Agricultural Chemistry, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India-641003; agri_naveen@rediffmail.com

[2]Professor (SS&AC), Department of Soil Science and Agricultural ChemistryTamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India-641003; stalinpreemon@yahoo.com

Abstract

A field experiment was conducted on sandy loam soil to study the effect of applied zinc and boron to the residual blackgram in maize-blackgram cropping system during (2011-12) *kharif* season. There were three and nine levels of NPK as main treatments and Zn and B as sub plot treatments respectively. Results revealed that soil application of $ZnSO_4$ and Borax @ 50 kg and 10 kg ha^{-1} (S8) respectively combined with recommended 100% NPK ha^{-1} to the proceeding crop, significantly recorded the highest dry pod (690.3 kg ha^{-1}) and haulm yield (803.2 kg ha^{-1}) with increase being 52.16 and 50.7% over control for the successive residual blackgram. The same treatment also greatly influenced the yield attributes viz., the highest number of pods $plant^{-1}$ and 100 seed weight and found on par with treatment (S9).

Keywords: Blackgram, Boron, Cropping System, Residual, Yield, Zinc.

1. Introduction

Cropping system has attained great significance in intensified agriculture in India and experiments on cropping systems are the ultimate solution to overcome the drawbacks of mono-cropping system to exploit the soil intensively for enhanced food production. Sustaining the supply of deficient micronutrients along with macronutrients in appreciate amount and right proportion is a key to maximize productivity gains from macronutrients. India is used as an exclusive example to explicate the role of micronutrient play in optimum utilization of macronutrients [4]. By supplying plants with micronutrients, either through soil application, foliar spray, or seed treatment, increased yield and quality grains, as well as macronutrient use efficiency, could be achieved [5]. Among micronutrients, zinc and boron deficiency accounts about 49% and 33% respectively in Indian soils, which reduce not only the yield but also the nutritional quality of the produce [8]. Zinc is involved in auxin formation, activation of dehydrogenase enzymes; stabilization of ribosomal fractions [3] and boron is very important in cell division, pod and seed formation [2]. 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 [9]. Since, maize and blackgram are the two important crops which are preferred much for its nutritional quality, a study was contemplated with soil application of various levels of zinc sulphate and borax along with major nutrients to enhance the productivity of residual blackgram in maize-blackgram cropping system.

*Corresponding author:
M. Naveen Saviour (agri_naveen@rediffmail.com)

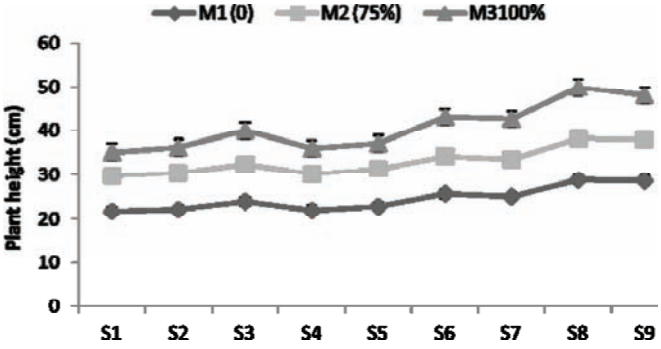

Figure 1. Effect of applied Zn and B on plant height (cm) of residual blackgram.

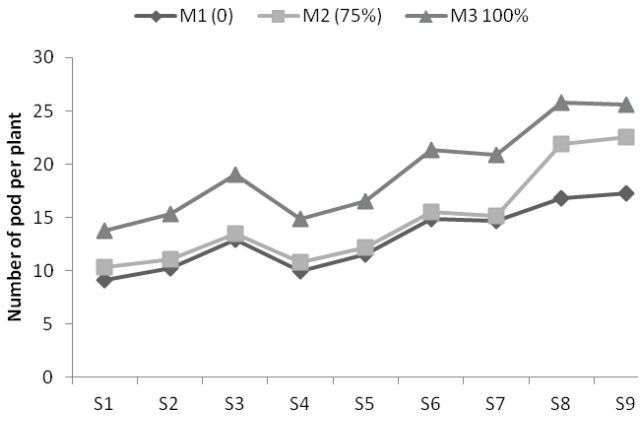

Figure 2. Effect of applied Zn and B on number of pods per plant of residual blackgram.

2. Materials and Methods

A field experiment was conducted during *kharif* (2011–12) to study the residual effect of applied Zn and B in succeeding blackgram under maize-blackgram cropping system in B and Zn-deficient sandy loam soils (Fine loamy hyperthermic Ultic Haplustalfs) in Pudukkottai district, Tamil Nadu. The treatments included for the main crop maize hybrid (NK-6240) and residual blackgram (var.VBN-3) were three levels of NPK as main plot treatments viz., M_1: Control (No N, P and K), M_2: 75% NPK kg ha^{-1}, M_3: 100% NPK ha^{-1} (250:75:75) and nine levels of sub plot treatments as $ZnSO_4$ @ 37.5 kg ha^{-1} (S2), 50 kg $ZnSO_4$ ha^{-1}(S3), 10 kg Borax ha^{-1} (S4), 15 kg Borax ha^{-1} (S5), 37.5 kg $ZnSO_4$ ha^{-1} + 10 kg Borax ha^{-1} (S6), 37.5 kg $ZnSO_4$ ha^{-1} + 15 kg Borax ha^{-1} (S7), 50 kg $ZnSO_4$ ha^{-1} + 10 kg Borax ha^{-1} (S8) and 50 kg $ZnSO_4$ ha^{-1} + 15 kg Borax ha^{-1} (S9) and also without application of fertilizers was maintained as absolute control (S1) in split plot design. Totally, 27 treatments replicated thrice imposed with fertilizer sources viz; urea (46% N), super (16% P), potash (60% K), zinc sulphate (Zn–21%), borax (B–11%) and gypsum (18% S). The experimental initial soil analysed for sandy clay loam in texture with pH: 6.42, EC: 0.06 dSm^{-1}. The organic carbon content of soil was 0.33 per cent with low in available $KMNO_4$ N (264 kg ha^{-1}), medium in Olsen P (15.4 kg ha^{-1}) and high NH_4OAC K (222 kg ha^{-1}). The DTPA extractable micronutrients viz., Fe (14.2 mg kg^{-1}), Mn (8.3 mg kg^{-1}) and Cu (1.37 mg kg^{-1}) were sufficient while DTPA Zn (0.84 mg kg^{-1}) and HWSB (0.20 mg kg^{-1}) were deficient. The fertilizer requirement for maize and blackgram followed were 250:75:75 and 25:50:25 kg NPK ha^{-1} respectively. Uniform dose of S @ 40 kg ha^{-1} for maize and 20 kg ha^{-1} for successive black gram were applied to all treatment plots without disturbing the mail plot. Need based plant production and protection measures were taken up and the crops were grown to maturity and harvested. The yield and yield parameters were recorded during harvest stage of crop.

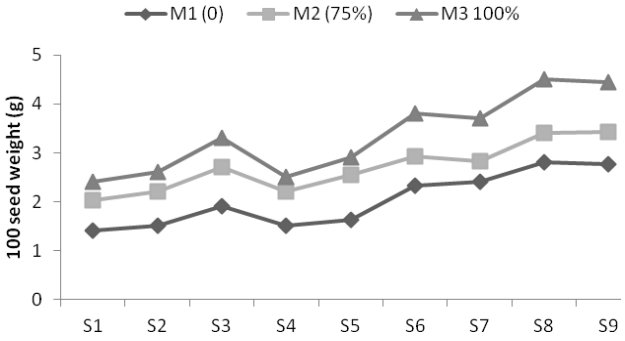

Figure 3. Effect of applied Zn and B on 100 seed weight (g) of residual blackgram.

3. Results and Discussion

The data revealed that the effect of the applied micronutrients (Zn and B) greatly influenced the plant height and yield attributes viz., the highest number of pods plant^{-1} and 100 seed weight were graphically represented in Figures 1, 2 and 3. Application of 50 kg $ZnSO_4$ ha^{-1} + 10 kg Borax ha^{-1} along with 100% recommended NPK (M_3S_8) evidenced with plant height (49.8 cm) with 56.27% increased over control. The same treatment also, registered significantly with the highest number of pods plant^{-1} (25.8) and 100 seed weight (4.50 g) which was statistically on par with the treatment combination M_3S_9. The lowest number of pods plant^{-1} (9.1) and 100 seed weight (1.41 g) was registered in the absolute control.

Table 1. Effect of applied zinc and boron on pod and haulm yield (kg ha^{-1}) on residual black gram

NPK levels (kg ha^{-1})	Micronutrients levels (Zn and B) (kg ha^{-1})									
	Pod yield (kg ha^{-1})									
	S_1 (Zn0B0)	S_2 (Zn37.5)	S_3 (Zn50)	S_4 (B10)	S_5 (B15)	S_6 (Zn37.5B10)	S_7 (Zn37.5B15)	S_8 (Zn50B10)	S_9 (Zn50B15)	Mean
M_1 (0)	330.2	338.3	363.0	337.6	348.0	388.5	383.4	417.0	409.5	368.4
M_2 (75%)	365.1	375.1	417.5	371.2	399.1	451.4	443.2	558.5	541.7	435.9
M_3 (100%)	425.3	436.3	498.5	436.1	458.5	561.3	555.2	750.3	725.1	538.5
Mean	373.5	383.2	426.3	381.6	401.9	467.1	460.6	575.3	558.8	447.6
Haulm yield (kg ha^{-1})										
M_1 (0)	395.2	404.3	429.0	403.9	416.7	453.6	447.5	494.1	491.6	437.3
M_2 (75%)	435.1	441.1	473.5	440.6	552.2	514.4	509.3	635.6	598.3	511.1
M_3 (100%)	502.2	513.1	555.4	512.6	525.4	644.2	636.1	803.2	798.1	610.0
Mean	444.2	452.8	486.0	452.4	498.1	537.4	531.0	644.3	629.3	519.5

	Pod yield				Haulm yield			
	M	S	M at S	S at M	M	S	M at S	S at M
SEd	3.58	7.14	12.02	12.37	3.91	8.23	13.99	14.25
CD (0.05)	9.94	14.36	25.34	24.88	10.86	16.54	28.97	28.65

Regarding yield, the pod and haulm yield ranged from 330.2 to 690.3 kg ha^{-1} and 395.2 to 803.2 kg ha^{-1} respectively. The significant increase in dry pod (690.3 kg ha^{-1}) and haulm yield (803.2 kg ha^{-1}) were recorded with the application of 50 kg $ZnSO_4$ ha^{-1} + 15 kg Borax ha^{-1} along with 100% recommended NPK (M_3S_8) which is statistically on par with the treatment combination M_3S_9. The pod and haulm yield increase being 52.16 and 50.7% over control (Table 1). The lowest pod and haulm yield was registered in the absolute control (330.2 kg ha^{-1} and 395.2 kg ha^{-1}) than the treatments enhanced with NPK or Zn and B or combined with NPK or Zn and B. The increased effect on yield attributes and yield maybe due to the combined effect of both Zn and B along with NPK which might have triggered the overall growth of the crop since the soil was deficient in Zn and B. Similar increase in growth and yield due to zinc application were also observed in rice-maize cropping system by Chandrapala et al. [1]. The data clearly suggested that addition of Zn and boron along with NPK had a significant response in terms of grain production. Similar results were reported by Poongothai and Chitdeshwari [7] and Subramanian et al. [10]. Patel et al. [6] highlighted the benefits of inclusion of leguminous crop in potato based cropping system. Sudarsan and Ramasamy [11] also found that residual effect of $ZnSo_4$ gave good seed and haulm yield in blackgram crop in a groundnut-blackgram cropping system and similar findings were reported in residual blackgram in rice-rice-pulse cropping sequence.

Considering the whole cropping system, soil application of Z and B along with NPK increased not only the productivity of maize but also enhanced the yield successive residual blackgram. From this study it is concluded that in maize-blackgram cropping system, application of $ZnSO_4$ and Borax @ 50 kg and 10 kg ha^{-1} along with 100% recommended NPK increased the successive blackgram yield considerably in zinc and boron deficient soils.

4. References

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