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National Academy of Agricultural Science (NAAS) Rating : 3.03

Effect of Sulphur, Zinc and Boron on growth and yield of Rainfed Maize

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ABSTRACT: *A field experiment was conducted during* kharif *season of 2014 on clay loam soil at College of Agriculture Farm, UAS, Raichur, to study the effect of sulphur, zinc and boron on growth and yield of rainfed maize.The experiment comprised of thirteen treatments with three replications. Significantly higher values of growth attributes* viz. *plant height (249.78 cm), leaf area palnt^{-1} (3702.91 cm^2), total dry matter production (233.82 g plant^{-1}), stover and grain yield (8.40 & 12.99 t ha^{-1}, respectively) recorded with the application 125% RDF + 15 kg S + 7.5 kg Zn + 0.5 kg B ha^{-1}*

Key words: *Growth attributes, yield*

INTRODUCTION

Maize (*Zea mays* L.) is a most versatile emerging crop having wider adaptability under varied agro-climatic conditions with highest production and productivity among cereals. In India maize is grown over an area of 9.50 mha with production and productivity of 23.29 mt and 2.45 t ha^{-1}, respectively which is much lower than most of the maize growing countries of the world. In Karnataka, maize is cultivated over an area of 1.1 mha with a production of 4.0 mt and productivity of 3.7 t ha^{-1} which is far below the potential. Similarly, in Raichur district, area, production and productivity is 850 ha, 2637 t and 32.87 qha^{-1}, respectively [1]. In India out of 142 mha of arable land, 60 per cent is under rainfed. Karnataka has second largest area under rainfed agriculture after Rajasthan in the country. In recent years, the survey conducted by [2] in Karnataka indicated that most of the farmers fields are deficient in sulphur (59-80%), zinc (78-87%) and boron (69-78%) in addition to nitrogen and phosphorous. The nutrients *viz*., zinc, boron and sulphur play an important role in increasing the productivity and profitability of many crops including maize. Sulphur and zinc are required for the synthesis of proteins and auxins, which promotes the growth of the plant. Similarly boron plays an important role in germination of pollens, pollen tube development and also involved in sugar translocation. For a sustainable increase in productivity and enhancing the resilience in rainfed systems, the issues related to soil fertility through balanced nutrition needs to be addressed. Hence present investigation taken up to study the effect of sulphur, zinc and boron on growth and yield of rainfed maize.

MATERIALS AND METHODS

A field experiment was carried out during *kharif*2014, at AgriculturalCollege Farm, Raichur to study the optimization of sulphur, zinc and boron on the productivity and profitability of rainfed maize with 900M gold hybrid. The soil of the experimental field was saline (soil pH 7.96) with medium organic carbon (6.5 g kg^{-1}). The available nitrogen was low (276 kg ha^{-1}) with medium P_2O_5 and K_2O (26.5 and 238 kg ha^{-1}, respectively). The soil has below critical limit of available S, Zn and B (9.6 kg ha^{-1}, 0.38 and 0.28 mg kg^{-1}, respectively). The experiment consisted of 13 treatments and replicated thrice with randomised block design. The required quantity of N, P, K, S, Zn and B were applied in the form of urea, DAP, MOP, gypsum, zinc sulphate and borax, respectively. The organic carbon [3], available N [4], available P, K, S [5], DTPA extractable Zn [6] and hot water soluble B [7] were determined as per standard procedures. The five plants were labelled in each treatments for recording growth attributes. The grain and stover yield recorded at harvest.

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RESULTS AND DISCUSSION

Plant growth is dependent on the rate of accumulation of dry matter. The dry matter accumulation may reflect on the economic yield in view of the fact that vegetative parts of the plant serve as a source where as grains are the sink. Dry matter production per plant differed significantly due to different rates of nutrient supply.

The dry matter production per plant differed significantly due to combined application of sulphur, zinc and boron along with nitrogen, phosphorous and potassium (Table 1). Application of 125% RDF + 15 kg S + 7.5 kg Zn + 0.5 kg B ha^{-1} resulted higher accumulation of dry matter (233.82 g $plant^{-1}$). The increased dry matter was usually associated with higher number of green leaves per plant and in turn higher leaf area per plant. The similar results were also obtained by[8] also reported in pot trials with maize by application of 0, 10, 20 and 40 ppm S and 0, 1.25, 2.5, 5.0 and 10.0 ppm Zn. The results revealed that dry matter yield of 45 days old plants increased from 6.4 to 13.6 g pot^{-1} with applied S and from 9.81 to 12.52 g pot^{-1} with applied Zn and was highest (14.95 g) with combined application of 10 ppm S + 2.5 ppm Zn.

The plant height also contributed for total dry matter and was significantly higher in application of 125% RDF + 15 kg S + 7.5 kg Zn + 0.5 kg B ha^{-1} (249.78 cm). Similar results were obtained by [9] recorded higher plant height of maize (188.33 cm) by the application of sulphur, zinc, boron and molybdenum @ 20, 5, 5 and 0.5 kg ha^{-1}, respectively along with NPK and increased the growth parmeters possibly due to inter relationship with auxin, an important growth parameter regulating the stem elongation and cell enlargement.

The leaf area exposed to sun plays an important role in determining the total biomass production and amount of photosynthates available for grain production. Application of 125% RDF + 15 kg S + 7.5 kg Zn + 0.5 kg B ha^{-1} recorded significantly highest leaf area per plant (3702.91 cm^2). The higher leaf area produced might be due to the balanced nutrient supply that might have enhanced the cell division which resulted in more expansion of leaf surface.The similar results obtained by [10].

Grain and straw yield

Significantly higher grain and straw yield (8.40 t ha^{-1} and 12.99 t ha^{-1}, respectively) was recorded with application of 125% RDF along with 15 kg sulphur, 7.5 kg zinc and 0.5 kg boron ha^{-1}. Increased grain yield owing to S addition could be due to the yield attributes and uptake of nutrients. This might be due to the higher leaf area and dry matter accumulation in leaves which might have supplied required photosynthates to the reproductive parts more precisely to the seed. Increased straw yield may be due to stimulatory effect of applied S in the synthesis of chloroplast and activation of ferrodoxin, photosynthetic process and involvement in protein and harmone synthesis. The results are in collaboration with the findings of[11].

Table 1
Effect of sulphur, zinc and boron on growth and yield of maize at harvest

Treatments	*Plant height (cm)*	*Leaf area $plant^{-1}$ (cm^2)*	*Total dry matter accumulation (g $plant^{-1}$)*	*GrainYield (t ha^{-1})*	*StoverYield (t ha^{-1})*
T_1: Absolute control	173.67	2161.45	104.94	4.02	5.83
T_2-: 100% RDF (100 : 50 : 25 kg N: P_2O_5: K_2O ha^{-1})	189.79	2539.05	143.28	5.34	7.96
T_3: 125% RDF (125: 62.5 : 31.25 kg N :P_2O_5: K_2O ha^{-1})	198.88	2794.06	168.48	6.00	9.36
T_4: 150% RDF (150 : 75 : 37.5 kg N : P_2O_5: K_2O ha^{-1})	199.66	2900.86	167.40	5.96	9.30
T_5: 100% RDF + 10 kg S + 5 kg Zn + 0.25 kg B	208.71	3074.25	152.28	5.53	8.46
T_6: 100% RDF + 15 kg S + 7.5 kg Zn + 0.5 kg B	207.13	3268.66	159.12	5.74	8.84
T_7: 100% RDF + 20 kg S + 10 kg Zn + 1.0 kg B	200.21	3454.21	154.08	5.63	8.56
T_8: 125% RDF + 10kg S + 5 kg Zn + 0.25 kg B	202.52	3588.15	211.59	7.01	11.57
T_9: 125% RDF + 15 kg S + 7.5 kg Zn + 0.5 kg B	249.78	3702.91	233.82	8.40	12.99
T_{10}: 125% RDF + 20 kg S + 10 kg Zn + 1.0 kg B	201.52	3474.41	208.17	6.98	11.38
T_{11}: 150% RDF + 10kg S + 5kg Zn + 0.25 kg B	210.01	3501.16	176.58	5.88	9.81
T_{12}: 150% RDF+ 15 kg S + 7.5 kg Zn + 0.5 kg B	208.39	3495.42	189.18	6.90	10.51
T_{13}:150% RDF + 20 kg S + 10 kg Zn + 1.0 kg B	202.68	3428.45	167.76	6.01	9.32
S.Em$\pm$	10.67	148.18	8.46	0.49	0.49
CD at 5%	31.14	432.51	24.69	1.42	1.42

Note: Treatments T_2 to T_{13} received 7.5 t ha^{-1} FYM.

CONCLUSION

It was concluded that application of 125% RDF along with 15 kg sulphur, 7.5 kg zinc and 0.5 kg boron ha^{-1} recorded significantly higher growth and yield.

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