I J T A
© Serials Publications
National Academy of Agricultural Science (NAAS) Rating : 3.03

Optimization of Sulphur, Zinc and Boron to Enhance the Productivity and Profitability of Rainfed Maize

Navyashree, M. R[1*]., Ravi, M. V[2]., Latha, H. S[3]. and Shridhara B. Nagoli[4]

ABSTRACT: *A field experiment was conducted during kharif season of 2014 on clay loam soil at College of Agriculture Farm, UAS, Raichur, to optimize the quantity of sulphur, zinc and boron on the productivity of maize. The experiment comprised of thirteen treatments with three replications. Significantly higher values yield & yield attributes viz. higher cob length (28 cm), number of grains cob^{-1} (682.29), test weight (32.56 g), stover and grain yield (8.40 & 12.99 t ha^{-1}, respectively Higher net returns (₹79,989 ha^{-1}) and B:C ratio (2.59) were incurred with the application of 125 % RDF along with 15 kg sulphur, 7.5 kg zinc and 0.5 kg boron ha^{-1}.*

Key words: *yield and yield attributes, B:C ratio*

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 mtand 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 the present investigation is planned to study the optimization of sulphur, zinc and boron in the productivity of rainfed maize crop.

MATERIALS AND METHODS

A field experiment was carried out during *kharif* 2014, at Agricultural College 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

* University of Agricultural Sciences, Raichur- 584 102, Karnataka, *E-mail :navinivi33@gmail@gmail.com*

[7] were determined as per standard procedures. The five plants were labelled in each treatments for recording growth and yield attributes. The grain and stover yield and uptake were recorded at harvest. The amount of inputs and out puts per hectare were multiplied with a wage or price of the unit to consolidate all of them in one unit (ha^{-1}) to find the gross return, net return and benefit: cost ratio.

RESULTS AND DISCUSSION

Yield attributes

Among various treatments, application of 125% RDF + 15 kg S + 7.5 kg Zn + 0.5 kg B ha^{-1} (T_9) recorded significantly higher cob length (28.00 cm), number of grain rows per cob (17.27), 100 grain weight (32.56 g) compared to control. Similar results were also obtained by [8] that application of sulphur along with NPK resulted higher cob length, test weight and cob weight which might be due to the increased protein metabolism with S application. [9] and [10] observed that application of S, B, Zn and Mo along with recommended RDF recorded higher cob length, cob weight, number of rows per cob and test weight. 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. Thus, due to higher availability of photosynthates the seed might have developed fully and resulted in bolder seeds and hence recorded higher cob and test weight. [11] recorded higher test weight of maize by applying Zn and B along with NPK which might be due to production of more IAA and chlorophyll which can delay the senescence of leaves and prolongs the period of photosynthesis in which the plants produces carbohydrates and transported to the seeds.

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 [12].

Economics

The highest cost of cultivation, net returns and benefit: cost ratio (50,346, 79,989 and 2.59, respectively) were found in application of 125% RDF along with 15 kg sulphur, 7.5 kg zinc and 0.5 kg boron ha^{-1}. This might

Table 1
Effect of sulphur, zinc and boron yield and yield attributing characters and economics of maize at harvest

Treatments	*Length of Cob (cm)*	*Number of grain cob^{-1}*	*Test weight (g)*	*Grain Yield (t ha^{-1})*	*Stover Yield (t ha^{-1})*	*Cost of cultivation (₹ ha^{-1})*	*Net returns (₹ ha^{-1})*	*B:C ratio*
T_1: Absolute control	21.00	345.80	23.65	4.02	5.83	33,201	32,729	1.99
T_2-: 100% RDF (100 : 50 : 25 kg N: P_2O_5: K_2O ha^{-1})	22.00	462.00	26.82	5.34	7.96	42,703	45,307	2.06
T_3: 125% RDF (125: 62.5 : 31.25 kg N :P_2O_5: K_2O ha^{-1})	25.67	529.20	26.78	6.00	9.36	45,098	54,622	2.21
T_4: 150% RDF (150 : 75 : 37.5 kg N : P_2O_5: K_2O ha^{-1})	26.33	536.25	27.91	5.96	9.30	46,185	52,875	2.14
T_5: 100% RDF + 10 kg S + 5 kg Zn + 0.25 kg B	25.33	550.20	27.09	5.53	8.46	44,281	47,294	2.07
T_6: 100% RDF + 15 kg S + 7.5 kg Zn + 0.5 kg B	25.00	576.81	28.12	5.74	8.84	45,425	49,745	2.10
T_7: 100% RDF + 20 kg S + 10 kg Zn + 1.0 kg B	27.00	570.00	28.32	5.63	8.56	45,956	47,169	2.03
T_8: 125% RDF + 10kg S + 5 kg Zn + 0.25 kg B	25.33	627.12	30.21	7.01	11.57	48,17	68,814	2.43
T_9: 125% RDF + 15 kg S + 7.5 kg Zn + 0.5 kg B	28.00	682.29	32.56	8.40	12.99	50,346	79,989	2.59
T_{10}: 125% RDF + 20 kg S + 10 kg Zn + 1.0 kg B	25.00	543.15	29.78	6.98	11.38	50,151	67,624	2.35
T_{11}: 150% RDF + 10kg S + 5kg Zn + 0.25 kg B	26.67	562.10	29.54	5.88	9.81	47,876	55,579	2.16
T_{12}: 150% RDF+ 15 kg S + 7.5 kg Zn + 0.5 kg B	21.33	470.40	28.99	6.90	10.51	49,305	60,410	2.23
T_{13}:150% RDF + 20 kg S + 10 kg Zn + 1.0 kg B	25.67	485.80	29.88	6.01	9.32	48,982	50,793	2.04
S.Em±	1.46	27.55	1.44	0.49	0.49	-	-	-
CD at 5%	4.27	80.42	4.19	1.42	1.42	-	-	-

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

be attributed to the higher grain and straw yield of maize crop in the respective treatment. The results are in conformity with the findings of [13].

REFERENCES

Anonymous, (2014), Agicultural statistics at a glance, Directorate of Economics and Statistics.

Girish Chander, Wani, S. P., Sahrawat, K.L., Pardhasaradhi, G., Rajesh, C., Narasimha Rao, Pal, C.K. and Prasad Kamadi, (2008), Macro benefits from zinc, boron and sulphur fertilization of rainfed systems in the semi-arid zone of India resilient dryland systems. *Curr. Sci. J.,* 93(10): 1428 1432.

Walkley, A. J. and Black, C. A., (1934), An examination of the method for determining soil organic matter and a proposed modification of the chromic acid titration. *Soil Sci.,* 37: 28-29.

Subbiah, K. K. and Asija. C. L., (1956), A rapid procedure for the estimation of availablenitrogen in soil. *Curr. Sci*., 25:259 – 260.

Jackson, M. L., (1973), *Soil Chemical Analysis*, Prentice Hall of India,Pvt. Ltd., New Delhi, Pp. 498.

Lindsey, W. L. and Norvell, W. A., (1978), Development of a DTPA soil test for zinc, iron, manganese and copper. *Soil Sci. Soc. American J.,* 42: 421-428.

Berger, K. C. and Truog, E., (1939), Boron determination in soils and plants using the quinalizarin reaction. *Industrial and Engineering Chemistry,* Analytical Edition,11: 540-545.

Bharathi, C. and Poongothai, S., (2008), Direct and residual effect of sulphur on growth, nutrient uptake, yield and its use efficiency in maize and subsequent greengram. *Res. J. Agric. and biological Sci.,* 4(5): 368-372.

Dibaba, D. H., Hunshal, C. S., Hiremath, S. M., Awaknavar, J. S., Wali, M. C., Nadagouda B. T. andChandrashekar, C. P., (2013), Performance of maize (*Zea mays* L.) hybrids as influenced by different levels of nitrogen, phosphorus, potassium and sulphur application. *Karnataka J. Agric. Sci.,* 26(2): 194-199.

Adhikary, B. H., JibanShreshtha and Bandhu Raj Baral, (2010), Effects of micronutrients on growth and productivity of maize in acidic soil. *Int. Res. J. Applied and Basic Sci.,* 1(1): 8-15.

Ziaeyan, A.H. and Rajaie, M., (2009), Combined effect of zinc and boron on yield and nutrients accumulation in corn, *Int. J. Plant Prod.*, 3: 35-44.

Rajashekara, R., Wani, S. P., Sahrawat, K.L. and Pardhasaradhi, 2010, Integrated nutrient management to enhance on-farm productivity of rainfed maize India. *Int. J. Soil Sci.,* 5(4): 216-224.

Devi, K.N., LaikangbamNongdrenKhomba Singh, MaibamSumarjit Singh, SoibamBasanta Singh and KeishamKhamba Singh, (2012), Influence of sulphur and boron fertilization on yield, quality, nutrient uptake and economics of soybean (*Glycine max*) under upland conditions, *J. Agril. Sci.*, 4: 15-20.