Original Research Article

Response of Sulphur and Zinc on Yield and Economics of Maize. (*Zea mays* L.)

ABSTRACT

A field experiment was conducted during *Rabi* season of 2022 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.) India. To study the Response of Sulphur and Zinc on yield and economics of *Rabi* Maize. The treatment consist of Sulphur 20, 30, 40 kg/ha and Zinc 15, 20, 25 kg/ha. The soil of experimental plot was sandy loamy in texture, nearly neutral in soil reaction (pH 7.8), low in organic carbon (0.35%) available Nitrogen (163.42 kg/ha), available Phosphorus (21.96 kg/ha) and available Potassium (256.48 kg/ha). Results revealed, that the higher grain yield (6.42 t/ha) and higher stover yield (14.36 t/ha) were significantlyinfluenced with application of Sulphur 40 kg/ha + Zinc 25 kg/ha. Higher Gross returns (INR 1,30,268.40/ha), Net returns (INR 90,007.00/ha) and maximum Benefit cost ratio (2.23) were also recorded in treatment-9 (Sulphur 40 kg/ha +Zinc 25 kg/ha).

Keywords: *Maize, Rabi, Sulphur, zinc, yield attributes and economics*

INTRODUCTION

Maize (*Zea mays* L.) is one of the versatile crops grown throughout the tropical as well as temperate regions of the world. It belongs to family Poaceae or Graminae. Maize is one of the most important cereal crops in the world due to its high yielding, ease of processing, readily digested and less cost of cultivation.(**Jaliya *et al.* 2008)**. Maize is used as a staple human food, fodder for livestock, poultry feed, for fermentation and many industrial purposes. Maize has immense potential in the tropics and yield of up to 7500 kg/ha can be obtained if the crop is managed properly. Unfortunately, yields are below 5000 kg/ha (**FAO 2007**).

In India, maize is grown in an area of 9.86 million hectares with production of 31.51 million tonnes and productivity of 3195 kg/ha. In Uttar Pradesh the area, production and

productivity of maize are 0.77 million hectares, 1.80 million tonnes and 2331 kg/ha respectively. (**DA&FC- Directorate of economics and statistics 2020-2021**). Among Indian states Madhya Pradesh and karnataka has highest area under maize (15%) each followed by Maharastra (10%), Rajasthan (9%) and Uttar Pradesh (8%). Andhra Pradesh is having the highest productivity and records as high as 12 t/ha. **(IIMR- Indian Institute of Maize Research).** Approximately in India, 47% is used as poultry feed. Of the rest of produce 13% is used as livestock feed and food purpose each. 12% for industrial purpose 14% in starch industry, 7% as processed food and 6 % for export and other purpose.

The role of secondary nutrients in general and particularly sulphur has role in increasing the production of maize. Sulphur plays a vital role in the primary metabolism of higher plants and involve in synthesis of secondary metabolites. It not only influences yield but also improves crop quality owing to its influence on protein metabolism and oil synthesis. It is involved in the synthesis of essential amino acids, like cysteine, cystine and methionine.(**Singh, 2001).**

Zinc, is an essential micronutrient, it is crucial for the growth and development of Maize crop. In addition to controlling the plant growth hormone Indole Acetic Acid, Zinc plays a critical function in the metabolism of proteins and carbohydrates (IAA). It is a crucial part of dehydrogenase and proteinase and encourages the development of starch, seed maturity, and production. **Vinay singh and mamta pandey (2018).** Zinc deficiency is a common phenomenon in cereals, particular in coarse treatment, soil semi-arid regions. Balanced fertilization is the key to achieve higher productivity and nutrient use efficiency **(Vinay Singh *et al.*, 2015).**

Keeping these points in view, the present investigation entitled **‘‘Effect of Sulphur and Zinc on Yield and Economics of *Rabi* Maize (*Zea mays* L.)”** was conducted during *Rabi* 2022-2023, at Crop Research Farm, SHUATS, Prayagraj (U.P).

MATERIALS AND METHODS

A field experiment was conducted during *Rabi* season of 2021-22 at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (U.P.) India. The soil of experimental plot was sandy loamy in texture, nearly neutral in soil reaction (pH 7.8), low in organic carbon (0.35%), The treatments consist of Sulphur 20 kg/ha + zinc 15 kg/ha, Sulphur 20 kg/ha + zinc 20 kg/ha, Sulphur 20 kg/ha + zinc 25 kg/ha, Sulphur 30 kg/ha + zinc 15 kg/ha, Sulphur 30 kg/ha + zinc 20 kg/ha, Sulphur 30 kg/ha + zinc 25 kg/ha, Sulphur 40

kg/ha + zinc 15 kg/ha, Sulphur 40 kg/ha + zinc 20 kg/ha, Sulphur 40 kg/ha + zinc 25 kg/ha. The experiment was laid out in Randomized Block Design, with 9 treatments replicated thrice. The observations were recorded for Number of cobs per plant, Number of Grains/cob, seed Index (g), Grain yield (t/ha) Stover yield (t/ha) and harvest Index (%). The data were subjected to statistical analysis by analysis of variance method **(Gomez and Gomez, 1976).**

RESULT AND DISCUSSION

YIELD ATTRIBUTES

Number of cobs per plant

Treatment 40 kg/ha sulphur + 25 kg/ha zinc resulted in significantly highest no. of cobs per plant (2.33) However treatment 30 kg/ha sulphur + 20 kg/ha zinc, 30 kg/ha sulphur + 25 kg/ha zinc, 40 kg/ha sulphur + 20 kg/ha zinc were found to be statistically at par with 40 kg/ha sulphur + 25 kg/ha zinc.

The experimental data indicated that, the yield contributing characters namely cob/plant (1.34), number of rows/cob (14.19), number of seeds/cob (405), cob weight(97.88), cob length(14.82 cm) were significantly higher by seed treatment of Zn at 4g/kg with sulphur 20 kg/ha. **Ali *et al,* 2013** found that application of sulphur at 25 and 35 kg/ha gave significant increase in no. of days of tasseling and silking.

Number of grains per cob

Significant effect was observed by the statistical analysis of number of grains/cob. Treatment (9) 40 kg/ha sulphur + 25 kg/ha zinc recorded significant and highest number of grains/cob (533.8). however, treatment (6) 30 kg/ha sulphur + 25 kg/ha zinc and treatment (8) 40 kg/ha sulphur + 20 kg/ha zinc were found to be statistically at par with 40 kg/ha sulphur + 25 kg/ha zinc.

Singh *et al* 2021 revealed that application of Zinc 30 kg/ha resulted in higher No. of grains per cob (415.0). **Sinha *et al* 1995** started that application of sulphur gave significant increase in number of rows/cob, cobs and grains weight of maize.

Grain yield (t/ha)

The grain yield showed increasing trend with the application of sulphur and zinc in maize. The highest grain yield was obtained with the treatment 40 kg/ha sulphur + 25 kg/ha zinc (6.42 t/ha).Treatment with 40 kg/ha sulphur + 20 kg/ha (6.20) zinc were found to be statistically at par with 40 kg/ha sulphur + 25 kg/ha zinc.

Yield and yield attributes were significantly affected by sulphur at different levels. Maize crop fertilized fertilized with 150 kg N/ha along with 45 kg S/ha significantly resulted in seeds/cob (30.65), test weight (20.90), grain yield (4.87). **Alam *et al.*, (2003).**

Stover yield (t/ha)

The stover yield of maize was also influenced by the application of sulphur and zinc. Highest stover yield (14.36 t/ha) was recorded highest in treatment (9) with 40 kg/ha sulphur + 25 kg/ha zinc. However no par values are observed. The lowest stover yield (12.96) was observed with treatment (1) with 20 kg/ha sulphur + zinc 15 kg/ha

Mehta 2005 reported that application of sulphur at 60 kg/ha gave highest uptake by maize grains and stover from his study. **Subhradip *et al.* 2022** stated that better photosynthetic mobilization was observed due to application of Zinc Sulphate at 60 kg/ha and 30 kg/ha respectively.

Harvest index (%)

The data showed significant difference in with 40 kg/ha sulphur + 25 kg/ha zinc (30.9) harvest index. however, treatment (6) with 30 kg/ha sulphur + 25 kg/ha zinc and treatment (8) 40 kg/ha sulphur + 20 kg/ha zinc were found to be statistically at par with 40 kg/ha sulphur + 25 kg/ha zinc.

The highest stover yield, biological yield and maximum harvest index was recorded under application zinc at 30 kg/ha**. (Chauhan *et al.*, 2014).** Significant increase in the grain yield (4606 kh/ha) and stover yield (7115 kg/ha) with application of 40 kg S/ha compared to control**. (Choudhary *et al.*, 2013).**

ECONOMIC ANALYSIS

Gross Returns

Observations regarding the economics of treatments are given in table 2.

Highest gross return (1,30,268.40 INR/ha) were obtained in treatment-9 (Sulphur 40kg/ha + zinc 25 kg/ha) as compared to other treatments.

Net Returns

Net return (90,007.00 INR/ha) were higher in treatment-9 (Sulphur 40kg/ha + zinc 25 kg/ha) as compared to other treatments.

Benefit Cost Ration

Maximum Benefit Cost ratio (2.23) was found to be highest in treatment-9 with (Sulphur 40kg/ha + zinc 25 kg/ha) as compared to other treatments.

CONCLUSION

It is concluded that with the application of Sulphur 40 kg/ha in combination with the zinc 25 kg/ha (Treatment-9), has achieved maximum yield and economics. Significantly higher number of cobs per plant, number of grains/cob, grain yield, stover yield and harvest Index were recorded and proven economically viable with application of Sulphur 40 kg/ha alongwith the zinc 25 kg/ha (Treatment-9). These findings are based on one season therefore, further trials may be required for further confirmation.

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Table-1. Effect of Sulphur and zinc on yield attributes of *Rabi* Maize.

S. No.	Treatment combinations	Number of cobs/plant	Number of Grains/ cob	Grain yield(t/ha)	Stover yield(t/ha)	Harvest Index (%)
1.	Sulphur 20 kg/ha +Zinc 15 kg/ha	1.83	417.3	4.93	12.96	27.5
2.	Sulphur 20 kg/ha +Zinc 20 kg/ha	1.87	428.5	4.97	13.13	27.5
3.	Sulphur 20 kg/ha +Zinc 25 kg/ha	2.00	483.8	5.58	13.79	28.8
4.	Sulphur 30 kg/ha +Zinc 15 kg/ha	1.93	460.8	5.23	13.30	28.2
5.	Sulphur 30 kg/ha +Zinc 20 kg/ha	2.10	489.2	5.83	13.95	29.5
6.	Sulphur 30 kg/ha +Zinc 25 kg/ha	2.17	509.6	6.10	14.12	30.2
7.	Sulphur 40 kg/ha +Zinc 15 kg/ha	1.97	471.0	5.33	13.59	28.2
8.	Sulphur 40 kg/ha +Zinc 20 kg/ha	2.23	517.8	6.20	14.22	30.4
9.	Sulphur 40 kg/ha +Zinc 25 kg/ha	2.33	533.8	6.42	14.36	30.9
	F test	S	S	S	S	S
	SEm (±)	0.10	8.20	0.10	0.04	0.37
	CD (p=0.05)	0.30	24.58	0.31	0.13	1.12

Table-2. Economic analysis of different treatment combinations of *Rabi* Maize.

S. No.	Treatment combinations	Cost of cultivation	Gross returns	Net returns	B:C ratio
1.	Sulphur 20 kg/ha +Zinc 15 kg/ha	38,774.25	1,00614.60	61,840.35	1.59
2.	Sulphur 20 kg/ha +Zinc 20 kg/ha	39,304.50	1,01447.40	62,142.90	1.58
3.	Sulphur 20 kg/ha +Zinc 25 kg/ha	39,834.75	1,13,616.60	73,781.85	1.85
4.	Sulphur 30 kg/ha +Zinc 15 kg/ha	38,988.25	1,06,602.60	67,614.35	1.73
5.	Sulphur 30 kg/ha +Zinc 20 kg/ha	39,518.50	1,18,569.60	79,051.10	2.00
6.	Sulphur 30 kg/ha +Zinc 25 kg/ha	40,048.75	1,23,918.00	83,869.25	2.09
7.	Sulphur 40 kg/ha +Zinc 15 kg/ha	39,200.25	1,08,651.60	69,451.35	1.77
8.	Sulphur 40 kg/ha +Zinc 20 kg/ha	39,730.50	1,25,910.00	86,179.5	2.16
9.	Sulphur 40 kg/ha +Zinc 25 kg/ha	40,260.75	1,30,268.40	90,007.00	2.23