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

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The field trial was conducted during the 2022 Rabi season at the Crop Research Farm of the Department of Agronomy, Nain Institute of Agriculture, Sam Higginbottom University of Agriculture, Technology and Science, Prayagraj (U.P.), India. To study the effect of sulphur and zinc on the yield and economics of Rabi maize. The treatment includes sulphur 20, 30, 40 kg/ha and zinc 15, 20, 25 kg/ha. The soil of the experimental area had a sandy clay texture, almost neutral soil reaction (pH 7.8), low organic carbon (0.35%), nitrogen (163.42 kg/ha), phosphorus (21.96 kg/ha) and potassium (21.96). kg/ha). 256.48 kg/ha). Sulphur 40 kg/ha Zinc 25 kg/ha significantly increased yield characteristics and economy. The results showed that higher grain yield (6.42 t/ha) and higher stover yield (14.36 t/ha) were significantly influenced 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 recorded in treatment-9 with application of (Sulphur 40 kg/ha Zinc 25 kg/ha).

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1. INTRODUCTION

One of the most adaptable crops, maize (*Zea mays* L.), is grown worldwide in both tropical and temperate climates. It is a member of the Poaceae or Graminae family. Due to its large production, convenience of use, easy digestion, and low cultivation expenses, maize is one of the most significant cereal crops in the world (Jaliya et al. 2008). Basic human nutrition, animal feed, poultry, fermentation, and numerous industrial uses all involve the utilisation of maize. Every component of the maize plant, including the grains, leaves, stem, ears, and cob, has a market value and is used to produce a variety of cuisines and other goods. Tropical maize has immense potential, and with the right management, it is possible to achieve yields of up to 7,500 kg/ha. Maize is produced on 9.86 million hectares in India, with a yield of 31.51 million tonnes and a productivity of 3195 kg/ha. Maize acreage, production, and productivity in Uttar Pradesh are 0.77 million hectares, 1.80 million tonnes, and 2331 kg/ha, respectively. 2020-2021 (DA and FC - Economics and Statistics Departments). Madhya Pradesh and Karnataka have the greatest amount of maize farming (15%) in India, followed by Maharashtra (10%), Rajasthan (9%), and Uttar Pradesh (8%).Andhra Pradesh has the highest output, with yields of up to 12 tonnes per hectare (IIMR - Indian Institute of Maize Research). In India, around 47 percent is used as chicken feed. 13% of the remaining goods are used for both animal and human use. 12% for industrial use, 14% for personal use, 7% for the starch sector, 7% for processed foods, and 6% for export and other uses. Secondary nutrients in general, and sulphur in particular, help to boost maize yield. Sulphur is essential for higher plant primary metabolism and participates in the creation of secondary metabolites. It influences not just yield but also crop quality by influencing protein metabolism and lipid synthesis. It helps to make important amino acids including cysteine, cystine, and methionine [1].

Zinc is a trace element that is essential for the growth and development of the maize crop. Zinc is essential for protein and carbohydrate metabolism (IAA) in addition to controlling the plant growth hormone indoleacetic acid. It is a necessary component of dehydrogenase and proteinase, and it aids in starch formation, seed maturity, and production Mamta Pandey and Vinay Singh (2018). Zinc insufficiency is a typical occurrence in cereals, particularly under harsh handling conditions and in semi-arid soil locations. In order to improve productivity and nutrient use efficiency, balanced fertilisation is essential (Vinay Singh et al. 2015).

Keeping these considerations in mind, this study “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.).

2. MATERIALS AND METHODS

The field trial was conducted during Rabi season 2021-2022 at Crop Research Farm, Department of Agronomy, Naini Agriculture Institute, SHUATS, Prayagraj (U.P.) India. The soil of the experimental area was sandy in composition, almost neutral in clay reaction (pH 7.8), low in carbon (0.35%). Experimental 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 conducted in a randomized block design with 9 treatments replicated three times. Observations were recorded for number of straws per plant, number of grains/cobs, seed index (g), grain yield (t/ha), straw yield (t/ha) and yield index (%). Statistical analysis of the data was performed using the analysis of variance method (Gomez and Gomez, 1976).

3. RESULTS AND DISCUSSION

3.1 Yield Attributes

3.1.1 Number of cobs per plant

Number of cobs per plant Treatment 40 kg/ha sulphur 25 kg/ha zinc significantly resulted in the highest no. ears per plant (2.33) However, the 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 was statistically equivalent to 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/ear (14.19), number of seeds/ear (405), cob weight (97.88), cob length (14.82 cm). significantly. higher in seed treatment of Zn 4 g/kg with sulphur 20 kg/ha. Ali et al, [2] found that application of sulphur at 25 and 35 kg/ha significantly increased the No. from the days of tasseling and silking.

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

S. No.	Treatment combinations	Number of cobs/plants	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

3.1.2 Number of grains per cob

A significant effect was observed in the statistical analysis of the number of grains/cobs. Treatment (9) 40 kg/ha sulphur 25 kg/ha zinc recorded significant and highest number of grains per 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 statistically equivalent to 40 kg/ha sulphur 25 kg/ha zinc.

Singh et al. [1] showed that application of zinc at 30 kg/ha resulted in higher number of grains per cob (415.0). Sinha et al., 1995, reported that sulphur application significantly increased the number of corn cobs, number of cobs, and grain weight.

3.1.3 Grain yield (t/ha)

Grain yield showed an increasing trend with the use of sulphur and zinc in corn. The highest grain yield was obtained in the treatment of sulphur 40 kg/ha and zinc 25 kg/ha (6.42 t/ha). At a treatment sulphur content of 40 kg/ha, 20 kg/ha (6.20) zinc was found to be statistically at par with 40 kg/ha sulphur and 25 kg/ha zinc.

Yield and yield attributes were significantly affected by sulphur at different levels. Maize crop fertilized with 150 kg N/ha and 45 kg S/ha significantly yielded seeds/cob (30.65), test weight (20.90), grain yield (4.87) Alam et al. [3].

3.1.4 Stover yield (t/ha)

The highest stover yield (14.36 t/ha) was recorded in treatment (9) with sulphur 40 kg/ha + 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 [4] reported that application of sulphur at 60 kg/ha resulted in the highest assimilation into corn grain and forage in his study. Subhradip et al. [5] stated that better photosynthetic mobilization was observed due to the application of zinc sulphate at 60 kg/ha and 30 kg/ha.

3.1.5 Harvest index (%)

The results showed a significant difference in with 40 kg/ha sulphur and 25 kg/ha zinc (30.9) harvest index. however, treatment (6) 30 kg/ha sulphur 25 kg/ha zinc and treatment (8) 40 kg/ha sulphur 20 kg/ha zinc were statistically at par with 40 kg/ha sulphur + 25 kg/ha zinc. The highest stover yield, biological yield and maximum harvest index was recorded with zinc at 30 kg/ha [6]. Significant increase in grain yield (4606 kg/ha) and stover yield (7115 kg/ha) with application 40 kg S/ha compared to control [7].

3.2 Economics

3.2.1 Gross returns

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

The highest gross returns (INR 1,30,268.40/ha) were obtained in treatment-9 (sulphur 40 kg/ha + zinc 25 kg/ha) compared to other treatments.

3.2.2 Net returns

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

3.3 Benefit Cost Ratio

The maximum benefit-cost ratio (2.23) was found to be highest in treatment-9 (sulphur 40 kg/ha + zinc 25 kg/ha) compared to other treatments [8,9].

4. 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/cobs, grain yield, stover yield and harvest Index were recorded and proven economically viable with application of Sulphur 40 kg/ha along with the zinc 25 kg/ha (Treatment-9). These findings are based on one season therefore, further trials may be required for further confirmation.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Singh MV. Importance of sulphur in balanced fertilizer use in India. Fertilizer News. 2001;46:31-35.
2. Ali A, Iqbal Z, Hassan S, Yasin M, Khaliq T, Ahmad S. Nitrogen and sulphur effects

on maize crop phenology, growth, and yield characteristics. Science International. 2013;363-366

3. Alam MM, Islam MN. Effect of sulphur and nitrogen on the yield and seed quality of maize. Journal of Biosciences. 2003;3:643-654.
4. Mehta YK, Shaktawat MS, Singhi SM. Influence of sulphur, phosphorous and farmyard manure on yield attributes and yield of maize (*Zea mays* L.) in southern Rajasthan conditions. Indian Journal of Agronomy. 2005;50(3):203-205
5. Subhradip Bhattacharjee, Bhale VM, Pramod Kumar, Rakesh Kumar. Effect of potassium and zinc nutrition on growth and yield of short duration maize (*Zea mays* L.). Indian Journal of Agricultural Research. 2022;56(1):22-27.
6. Chauhan TM, Ali J, Singh SP, Singh SB. The effect of nitrogen and zinc nutrition on wheat productivity, quality, and nutrient uptake. Annals Plant Soil Research. 2014;16(2):98-101.
7. Choudhary R, Singh D, Singh P, Dadarwal RS, Chaudhari R. Impact of nitrogen and sulphur fertilization on yield, quality and uptake of nutrient by maize in southern Rajasthan. Annals of Plant and Soil Research. 2013;15(2): 118-121.
8. Anonymous. Area and production of pearl millet in India. Agricultural Statistics, Directorate of Economics & Statistics, Govt. of India; 2011.
9. Jagdeep Singh, Ram Partap, Amritpal Singh, Naresh Kumar, Krity. Effect of nitrogen and zinc on growth and yield of maize (*Zea mays* L.). International Journal of Bio-resource and Stress Management. 2021;12(3):179-185.

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