Original Research Article

Response of Sulphur and Zinc on Yield and Economics of Pearl Millet. (*Pennisetum glaucum* L.)

ABSTRACT

The present study aimed to highlights the response of Sulphur and Zinc on Yield and Economics of Pearl Millet.(*Pennisetum glaucum* L.). Pearl milet and lentil (Lens culinaris Medikus) are very important crops in the Agra region of Uttar Pradesh for their contribution to human and animal nutrition as components of cropping system and as restorers of soil fertility. A field experiment was conducted during *Zaid* season of 2022 at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.) India. The treatments consist of Sulphur 20,30,40 kg/ha and zinc 5, 10, 15 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 N (163.42 kg/ha), available P (21.96 kg/ha) and available K (256.48 kg/ha). Results revealed, that the higher grain yield (40.95 q/ha) and higher stover yield (40.95 q/ha) were significantlyinfluenced with application of Sulphur 40 kg/ha +Zinc 15 kg/ha. Higher gross returns (INR 92145.00/ha), higher net returns (INR 62365.00/ha) and higher B:C ratio (2.09) were also recorded in treatment-9 (Sulphur 40 kg/ha +Zinc 15 kg/ha). The findings are based on one season therefore; furthertrials may be required for further confirmation.

Keywords: *Pearl millet, Zaid, Sulphur, zinc, yield attributes and economics*

INTRODUCTION

A staple crop of the dry, arid, and semiarid regions is pearl millet. In addition to being a basic diet, it has importance as dry fodder in agricultural method centred on animals. The category of nutrient-dense grains includes sorghum, pear millet, finger millet, and maize. These wholesome cereals are grown in tough conditions with low soil and water quality. Their production in drought-prone areas is effectively ensuring food and fodder security through risk management on a sustainable basis because of their extreme drought tolerance. This category of cereals is comparable to high-quality cereals like rice in terms of nutrients and, in some ways, even outperforms them. The protein composition of pearl millet grain is equivalent to that of wheat, and it includes between 63 and 71 percent starch (**Abdalla *et al.* 1998).**

Pearl millet is also known as *Bajri* or *Bajra* in India. Pearlmillet (*Pennisetum glaucum* L.), often known as 'bullrush millet,' evolved in tropical western Africa, where both wild ancestors and cultivated varieties are found in abundance. It is a member of the Gramineae (Poaceae) family. The cultivated species are *Pennisetum glaucum* L. (2n=14) used for grain

and fodder and *Pennisetum purpureum* (2n=28) used for green and dry fodder **(Anon., 2011)**. India's food grain demand would rise to almost 291 million tons by 2025 and 377 million tons by 2050 (Amarasinghe et al., 2010). Given the restricted capacity for increasing net cultivated land (142 million ha), enhanced per unit area productivity could result in an overall rise in food grain production (Reddy et al., 2022). Pearl millet is a high nutrient feeder that causes a large withdrawal of plant nutrients from the soil. This depletion will reduce agricultural yield.

Among various nutrients, Sulphur is crucial for the synthesis of amino acids that include sulphur, which serve as building blocks. protein synthesis building components. It has a part to play in boosting the production of chlorophyll and promoting photosynthesis (Arya, 2022; Rathore et al., 2022). In light of the aforementioned fact, the current study was carried out to ascertain the impact of sulphur and phosphorus levels on pearl millet production and nutritional characteristics (**Pandey.M *et al.* 2018) (Debbarma and Banti. 2023).**

Zinc, is an essential micronutrient, it is crucial for the growth and development of this 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 major problem in cereals, particularly in coarse treatment, semi-arid soils. Balanced fertilization is essential for increasing productivity and nutrient efficiency (Vinay Singh et al., 2015). Keeping these points in view, the present investigation entitled **‘‘Effect of Sulphur and Zincon Yield and Economics of pearl millet (*Pennisetum glaucum* L.)”** was conducted during *Zaid*-2022, 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 5 kg/ha, Sulphur 20 kg/ha + zinc 10 kg/ha, Sulphur 20 kg/ha + zinc 15 kg/ha, Sulphur 30 kg/ha + zinc

5 kg/ha, Sulphur 30 kg/ha + zinc 10 kg/ha, Sulphur 30 kg/ha + zinc 15 kg/ha, Sulphur 40 kg/ha + zinc 5 kg/ha, Sulphur 40 kg/ha + zinc 10 kg/ha, Sulphur 40 kg/ha + zinc 15 kg/ha. The experiment was laid out in Randomized Block Design, with 9 treatments replicated thrice. The observations were recorded for Ear head length (cm), Grains/ear head (g), Test weight (g), Grain yield (kg/ha) and Stover yield(kg/ha). The data were subjected to statistical analysis by analysis of variance method **(Gomez and Gomez, 1976).**

RESULT AND DISCUSSION

YIELD ATTRIBUTES

Ear head length (cm) - The significantly maximum ear head length (25.2 cm) [Table-2] was observed in treatment-9 with (Sulphur 40 kg/ha + Zinc 15 kg/ha), which was significantly superior over rest of the treatments. However, treatment-8 (Sulphur 40 kg/ha + Zinc 10 kg/ha), was found to be statistically at par with treatment-9 (Sulphur 40 kg/ha + Zinc 15 kg/ha). The significantly maximum ear head length was observed with the application of zinc 15 kg/ha. Zn are involved in cell division, enzyme activation and with their increased supply, their availability, acquisition, mobilization and influx into the plant tissue increased and thus improved growth attributes and yield components. Similar findings have been reported by Vinay Singh and Mamta Pandey (2018). Furthermore, the use of Sulphur in that application increases plant metabolic activity, which may contribute to an increase in photosynthesis. The similar results were observed by **Lunde et al., (2008).**

No. of Grains/ear head - The significantly higher Grains/ear head (2006.0) [Table-2] was observed in treatment-9 with (Sulphur 40 kg/ha + Zinc 15 kg/ha), which was significantly superior over rest of the treatments. However, treatment-8 (Sulphur 40 kg/ha + Zinc 10 kg/ha), was found to be statistically at par with treatment-9 (Sulphur 40 kg/ha + Zinc 15 kg/ha). The significantly higher Grains/ear head was observed might be due to Sulphur application. Since Sulphur is an amino acid (Cystine), it aids in the production of chlorophyll, photosynthetic processes, enzyme activation, and seed formation. Similar results were observed by **Degra et al. (2008).**

Test Weight (g) - The significantly higher Test weight (8.57 gm) [Table-2] was observed in treatment-9 with (Sulphur 40 kg/ha + Zinc 15 kg/ha), which was significantly superior over rest of the treatments. However, treatment-8 (Sulphur 40 kg/ha + Zinc 10 kg/ha), was found to be statistically at par with treatment-9 (Sulphur 40 kg/ha + Zinc 15

kg/ha). The significantly higher test weight was recorded with the application of Zinc (15kg/ha), might be due to the application of zinc might have increased the photosynthetic efficiency due to improved enzymatic activity and thus might have increased thousand grains weight. similar results are in conformity with the findings of **Arshad *et al.* (2016).**

Grain yield(q/ha) - The significantly higher Grain yield (40.95 q/ha) [Table-2] was observed in treatment-9 with (Sulphur 40 kg/ha + Zinc 15 kg/ha), which was significantly superior over rest of the treatments. However, treatment-8 (Sulphur 40 kg/ha + Zinc 10 kg/ha), was found to be statistically at par with treatment-9 (Sulphur 40 kg/ha + Zinc 15 kg/ha). The significantly higher Grain yield was observed with increasing the Sulphur application level. Furthermore, it serves crucial purposes in pearl millet. It is best known for its part in pearl millet's synthesis of proteins, oils, and vitamins. According to Chaudhary et al. (2014), sulphur is connected to crop production for higher nutritional and market-quality products. Furthermore, the application of Zinc (15 kg/ha) may be due to increased photosynthesis efficiency, increased nutrient availability due to increased organic matter decomposition rate, or improved individual plant performance as possible reasons for higher grain yield in zinc applied plots compared to other plots. These results are in conformity with the findings of **Arshad *et al.* (2016), Norwood (1992) and Jan *et al.* (2013).**

Stover yield(q/ha) - The significantly higher stover yield (65.33 q/ha) [Table-2] was observed in treatment-9 with (Sulphur 40 kg/ha + Zinc 15 kg/ha), which was significantly superior over rest of the treatments. However, treatment-8 (Sulphur 40 kg/ha + Zinc 10 kg/ha), was found to be statistically at par with treatment-9 (Sulphur 40 kg/ha + Zinc 15 kg/ha). The significantly higher stover yield was observed by the application of Sulphur 40 kg/ha. Sulphur is critical in providing vegetative structure for nutrient absorption, boosting sink strength through the establishment of reproductive structures, and filling economically important sinks (Choudhary et al., 2016). Further increase of stover yield may be due to application of zinc 15 kg/ha. Zinc is essential for the growth and development of tryptophane, an amino acid required for plant growth and development. Similar results were conformity with **Reddy *et al.* (2022**).

ECONOMIC ANLYSIS

Gross Returns

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

Highest gross return (92145.00 INR/ha) was obtained in treatment-9 (Sulphur 40 kg/ha + zinc 15 kg/ha) as compared to other treatments.

Net Returns

Net return (62365.00 INR /ha) was found to be highest in treatment-9 (Sulphur 40 kg/ha + zinc 15 kg/ha) as compared to other treatments.

Benefit Cost Ration

Benefit Cost ratio (2.09) was found to be highest in treatment-9 with (Sulphur 40 kg/ha + zinc 15 kg/ha) as compared to other treatments.

CONCLUSION

The study concluded that with the application of Sulphur 40 kg/ha along with the zinc 15 kg/ha (Treatment-9), has performs positively and improves growth and yield parameters. Maximum ear head length, higher number of grains/ear head, test weight, grain yield and stover yield were also recorded and proven economically viable with application of Sulphur 40 kg/ha alongwith the zinc 15 kg/ha (Treatment-9). Given that these results are based on a single season, further investigations may be necessary for further validation. REFERENCES

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Table-1. Effect of Sulphur and zinc on yield attributes of pearl millet.

S. No.	Treatment combinations	Ear head length (cm)	No. of Grains/ ear head	Test weight (g)	Grain yield(q/ha)	Stover yield(q/ha)	Harvest index (%)
1.	Sulphur 20 kg/ha +Zinc 5 kg/ha	19.8	1837.1	6.75	32.29	47.55	40.44
2.	Sulphur 20 kg/ha +Zinc 10 kg/ha	20.8	1876.0	6.81	33.94	48.20	41.32
3.	Sulphur 20 kg/ha +Zinc 15 kg/ha	21.5	1902.4	7.19	34.61	49.11	41.34
4.	Sulphur 30 kg/ha +Zinc 5 kg/ha	21.3	1911.1	7.45	35.24	50.99	40.87
5.	Sulphur 30 kg/ha +Zinc 10 kg/ha	22.4	1929.6	7.81	36.16	54.03	40.10
6.	Sulphur 30 kg/ha +Zinc 15 kg/ha	22.7	1938.4	7.99	37.03	58.36	38.83
7.	Sulphur 40 kg/ha +Zinc 5 kg/ha	23.5	1965.3	8.10	37.82	59.33	38.93
8.	Sulphur 40 kg/ha +Zinc 10 kg/ha	24.5	1981.1	8.31	39.03	63.32	38.14
9.	Sulphur 40 kg/ha +Zinc 15 kg/ha	25.2	2006.0	8.57	40.95	65.33	38.53
	F test	S	S	S	S	S	S
	SEm (±)	0.27	6.07	0.13	0.40	0.65	0.41
	CD (p=0.05)	0.81	18.19	0.40	1.21	1.94	1.23

Table-2. Economic analysis of different treatment combinations of pearl millet.

S. No.	Treatment combinations	Cost of cultivation	Gross returns	Net returns	B:C ratio
1.	Sulphur 20 kg/ha +Zinc 5 kg/ha	27780	72645	44865	1.62
2.	Sulphur 20 kg/ha +Zinc 10 kg/ha	28280	76365	48085	1.70
3.	Sulphur 20 kg/ha +Zinc 15 kg/ha	28780	77873	49093	1.71
4.	Sulphur 30 kg/ha +Zinc 5 kg/ha	28280	79298	51018	1.80
5.	Sulphur 30 kg/ha +Zinc 10 kg/ha	28780	81353	52573	1.83
6.	Sulphur 30 kg/ha +Zinc 15 kg/ha	29280	83325	54045	1.85
7.	Sulphur 40 kg/ha +Zinc 5 kg/ha	28780	85103	56323	1.96
8.	Sulphur 40 kg/ha +Zinc 10 kg/ha	29280	87825	58545	2.00
9.	Sulphur 40 kg/ha +Zinc 15 kg/ha	29780	92145	62365	2.09