Original Research Article

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

ABSTRACT

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. To study the Response of Sulphur and zinc on growth and yield of Pearl millet. 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 significantly influenced 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).

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 commonly known in India as *Bajri* or *Bajra*. Pearlmillet (*Pennisetum glaucum* L.) is also known as 'bullrush millet', originated in tropical western Africa, where the greatest

number of both wild ancestors and cultivated forms occur. It belongs to family Gramineae (Poaceae). 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)**. The food grain demand of India will increase to about 291m ton by 2025 and to 377 m ton by 2050 **(Amarasinghe *et al.*, 2010)**. Since, there is limited scope to increase the net cultivated area (142 million ha), the improved per unit area productivity could trigger overall increase in food grain production **(Reddy *et al*., 2022).** Pearl millet is a heavy nutrient feeder and leads to large withdrawal of plant nutrients from soil. This depletion will result in decline in yield of the crop.

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. 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)**

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 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 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 results in accordance with **vinay singh and mamta pandey (2018).** And also, with the application of Sulphur in that application plays plant metabolic activity, which may lead to the 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. Because Sulphur is a part of amino acid (Cystine) which helps in chlorophyll formation, photosynthetic process, activation of enzymes 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. And also, it performs important functions in pearl millet. It is the best known for its role in the synthesis of proteins, oils and vitamins in pearl millet. Sulphur is associated with the production of crops for superior nutritional and market quality produce **(Chaudhary *et al*., 2014).** Further, with the application of Zinc (15 kg/ha), might be due to the greater photosynthesis efficiency or more nutrients availability due to increasing decomposition rate of organic matter or improved individual plant performance might the 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 plays a vital role in proving vegetative structure for nutrient absorption, increasing sink strength through development of reproductive structures by production of assimilates to fill economically important sink **(Choudhary *et al*., 2016).** Further increase of stover yield may be due to application of zinc 15 kg/ha. Zinc is critical to the growth and development of tryptophane, a necessary amino acid 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

It was 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 along with the zinc 15 kg/ha (Treatment-9). These findings are based on one season therefore; further trials may be required for further confirmation.

REFERENCES

Abdalla, A.A., Eltinay, A.H., Mohamed, B.E. and Abdalla, A.H. (1998) Proximate composition, starch, phytate and mineral content of ten pearl millet genotypes. *Food Chemistry* 63 (2): 243-246.

Amarasinghe UA, Shah T, Singh OP (2010). Changing consumption patterns: Implications on food and water demand in India, International Water Management Institute, Colombo, Sri Lanka. *IWMI Research Report*.;119:43.

Anonymous (2011). Area and production of pearlmillet in India. Agricultural Statistics, Directorate of Economics & Statistics, Govt. of India.

Arshad, Muhammad & Adnan, Muhammad & Ahmed, Sher & Khan, Abdul & Ali, Irshad & Ali, Muhammad & Ali, Azaz & Khan, Azam & Kamal, Muhammad & Gul, Farhana & Khan, Muhammad. (2016). Integrated Effect of Phosphorus and Zinc on Wheat Crop. *American-Eurasian J. Agric. & Environ. Sci.,* **16**. 455-459.

Chaudhary, N.N., Khaif, H.R., Raj, A.D., Yadav, V. and Yadav, P. (2014). Effect of nutrients (K and S) on growth, yield and economics of pearl millet [*Pennisetum glaucum (L.)*]. *International Journal of Forestry and Crop Improvements*, **5**(1): 9-12.

Degra, M. L., Pareek, B. L. and Shivran, R. K. (2008). Effect of sulphur and integrated weed management on productivity and quality of Indian mustard (Brassica juncea) and succeeding fodder pearl millet. Res. on Crops. 9 (3): 573-577.

Lunde, C., Zygadlo, A., Simonsen, H.T., Nielsen, P.L., Blennow, A. and Haldrup, A. (2008). Sulphur starvation in rice: the effect on photosynthesis, carbohydrate metabolism, and oxidative stress protective pathways. Physiologia Plantarum, 134: 508-521.

Pandey, A.B.Abidi and R.P. Singh (2018). Effect of sulphur and phosphorus on yield and quality of pearl millet (*Pennisetum glaucum*). Annals of Plant and Soil Research 20(3): 272–275.

Reddy V.S.N, Rajesh Singh and Chandu Lakshmi Deepika (2022). Effect of phosphorus and zinc on growth and yield of pearl millet (*Pennisetum glaucum* L.). *The Pharma Innovation Journal*; **11**(4): 542-545.

Vinay singh and mamta pandey (2018). Direct effect of sulphur and zinc on productivity, quality and nutrient uptake by pearl millet (Pennisetum glaucum) and their residual effect on succeeding wheat (Triticum aestivum) in pearl millet – wheat crop sequence. Annals of Plant and Soil Research 20(3): 233–238.

Vinay Singh, Harvendra Singh, Seema, Javed Ali and Jagpal Singh (2015). Balanced use of nutrients for sustaining higher production of pearl millet in alluvial soil. *Annals of Plant and Soil Research* **17**(4): 346-349.

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