

## Effect of Nutrient management on growth and yield of foxtail millet

### ABSTRACT

The field experiment was conducted during Z Aid season 2023 at experimental field of Crop Research Farm, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India. To study the nutrient management on growth and yield of foxtail millet. The treatments consisting of three levels of Recommended Dose of Fertilizer (RDF) viz., 100% RDF (60-30-30Kg/ha), 75% RDF (45-22.5-22.5 Kg/ha), 50% RDF (30-15-15kg/ha) and three different micro nutrients) viz., (Zinc - 0.5 kg/ha, Boron - 0.5 kg/ha, Iron - 0.5 kg /ha). There were 10 treatments each replicated thrice. The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.3), available nitrogen (278.93 kg/ha), available phosphorus (15.4 kg/ha) and available potassium (173.7 kg/ha). Results revealed that significantly and higher plant height (84.20 cm), plant dry weight (10.61 g), number of tillers/ hill (4.53), length of ears (9.20 cm), number of ears/plant (4.47), test weight (3.47 g), grain yield (1.22 t/ha), straw yield (2.80 t/ha) were recorded in treatment 8 (NPK 100% RDF + Boron 0.5 kg/ha). Maximum gross return (INR 48,408.33), net return (INR 30,913.33) and B:C ratio (1.77) were also recorded in treatment 8 (NPK 100% RDF + Boron 0.5 kg/ha).

**Keywords:** Boron, Foxtail millet, Iron, zinc, Economics .

### INTRODUCTION

Foxtail millet (*Setaria italica*L.) is known as Italian millet, German millet and Korralu, Kangu, Kangani, Koni and Kaon in different parts of India. It is one of the oldest crops cultivated for food, grain, hay and pasture. It ranks second in the total world production of millets and it continues to have an important place in world agriculture providing food for

millions of people in arid and semiarid regions, Sahoo *et al.*, (2020). In India, Andhra Pradesh, Karnataka and Tamil Nadu are the major foxtail millet growing states contributing about 79 per cent of the total cultivated area of about 6 lakh hectares with production of 3 lakh tones and productivity of 602 Kg/ha during 2017-2018. It has the total production of 2.29 m t from the area of 1.057 m ha in the world Grace *et al.*, (2023). According to FAO, the world production of millets is 89.17 million metric tonnes from an area of 74 million ha. India is the largest producer of millets in the world. India is the global leader in production of millets with a share of around 15% of the world total production. In India, millets are cultivated majorly in 21 states in an area of 12.53 million hectares, producing 15.53 million tonnes with a yield of 1237 kg/ha Assocham, (2022). Foxtail millet has a very good nutritional profile and is ahead of rice and wheat in terms of protein, fiber, minerals and vitamins.

NPK fertilization practices increase fertilizer utilization efficiency, leading to optimal economic benefits. Thus, it is crucial to maintain a balanced supply of these essential nutrients to achieve optimal plant growth, development, and yield while minimizing the negative effects of excess or inadequate supply Xing, (G *et al.*, 2023). Zinc plays a vital role in biosynthesis of indole acetic acid (IAA). It helps in formation of nucleic acids and synthesis of proteins, Manjunath and Debbarma, (2023). Boron plays an important role in the physiological process of plants, such as cell elongation, cell division, germination and growth of pollen grains, sugar translocation and movement of growth regulators within the plant, lignin synthesis, cell maturation, meristematic tissue development and protein synthesis. The application of boron also promotes the absorption of nitrogen from soil. (Manjunath and Debbarma, 2023). Iron is important in many physiological and biochemical pathways in plants. It is required for a wide range of biological functions because it is a component of many vital enzymes, such as cytochromes of the electron transport chain. Iron is involved in the synthesis of chlorophyll in plants and is required for the maintenance of chloroplast structure and function (Grace *et al.*, 2023)

## **MATERIALS AND METHODS**

A field experiment was conducted during Zaid season of 2022-2023 at the crop research farm, department of agronomy, Naini Agriculture Institute, Sam Higginbottom University of Agriculture Technology and Sciences (SHUATS), Prayagraj (U.P.) India. The soil of experimental plot was sandy loamy in texture, nearly neutral in soil reaction (pH 7.3), medium in available nitrogen, available phosphorus and available in potassium. The

experiments were laid out in Randomized Block Design with 10 treatments each replicated thrice *viz.*, T1- NPK

50% RDF + Zinc 0.5 kg/ha, T2- NPK 50% RDF + Boron 0.5 kg/ha, T3- NPK 50% RDF + Iron 0.5 kg/ha, T4- NPK 75 % RDF+ Zinc 0.5 kg /ha, T5- NPK 75 % RDF+ Boron 0.5 kg /ha, T6- NPK 75 % RDF+ Iron 0.5 kg /ha, T7- NPK 100% RDF+ Zinc 0.5 kg/ha, T8- NPK 100% RDF+ Boron 0.5 kg/ha, T9- NPK 100% RDF+ Iron 0.5 kg/ha, T10- 30 cm × 10 cm + RDF (control). The observations were recorded for plant height (cm), dry weight (g), number of tillers, crop growth rate (g/m<sup>2</sup>/day), relative growth rate (g/g/day), Number of ears /plant (no.) , length of ears (cm), no of grains/ears, Test weight (g), grain yield (t/ha), stover yield (t/ha), harvest index(%). The data were subjected to statistical analysis by analysis of variance method, RBD at 5% probability (Gomez and Gomez, 1976).

## RESULT AND DISCUSSION

### GROWTH PARAMETERS

**Plant height:** At 80 DAS, significantly highest plant height (84.20 cm) was recorded with the treatment NPK 100% RDF + Boron 0.5 kg/ha. However, the treatment T<sub>9</sub> were found to be statistically at par with highest. This could be due to application of NPK and boron which increased the high photosynthetic activity and chlorophyll synthesis and application of boron forming a synergistic effect with nitrogen uptake which in turn enhances vegetative growth.

Similar results reported by Manjunath and Debbarma, (2023) in finger millet.

**Plant dry weight:** At 80 DAS, significantly highest plant dry weight/plant (10.61 g) was recorded with the treatment NPK 100% RDF + Boron 0.5 kg/ha. However, the treatment T<sub>9</sub> were found to be statistically at par with T<sub>8</sub>. This was due to application of NPK and boron which is significantly increased plant dry weight. The main contribution of photosynthetic activity which improved the cell division and cell enlargement due to increased photosynthetic rate subsequently increasing the plant dry weight. Similar findings reported by Ravi raja *et al.* (2020).

**Number of tillers:** At 80 DAS, significantly highest no. of tillers/plant/plant (4.53) was recorded with the treatment NPK 100% RDF + Boron 0.5 kg/ha. However, the treatment T<sub>1</sub>, T<sub>2</sub>, T<sub>4</sub>, T<sub>6</sub> were found to be statistically at par with T<sub>8</sub>. The number of tillers per plant were higher due to luxuriant availability of NPK and boron for growth and development of auxiliary buds from which tillers are emerged, rapid conversion of synthesized carbohydrates into protein and consequent increase in the number and size of growing cells, resulting

ultimately in increased no. of tillers. Similar findings were reported by Sandhya *et al.* (2017) in millets, Loutharet *al.* (2020) in little millet.

### **Yield attributes**

**No. of ears/plant:** Significantly maximum number of ears/plants (4.47) was recorded with the treatment of application of NPK 100% RDF + Boron 0.5 kg/ha. This might be due to cumulative effect on growth and vigour of plants. By virtue of increased supply metabolites, there might have been significant improvement in growth characters with increasing fertilizer application. Increased growth components owing to increased fertilizer levels might have provided stability in higher supply of photosynthates towards the ear. Similar findings reported in pearl millet by Bahadur and S.K. Chauhan. (2014).

**Length of ears:** Significantly maximum Length of ear (cm) (9.20 cm) was recorded with the treatment of application of NPK 100% RDF + Boron 0.5 kg/ha. However, the treatment T<sub>7</sub>, T<sub>9</sub> were statistically at par with treatment T<sub>8</sub>. This might be due to the better supply of nutrients to the plants which increased the rapid growth and development. Thus, the plant received optimum nutrients produced the maximum length of ear. Similar findings reported in pearl millet by Akhil *et al.* (2023)

**Grains/ear:** Significantly maximum seeds/ears (262.47) were recorded with the treatment of application of NPK 100% RDF + Zinc 0.5 kg/ha. However, the treatment T<sub>4</sub>, T<sub>6</sub>, T<sub>8</sub> were found to be statistically at par with T<sub>7</sub>. This could be due to be application of npk favorably affected the balanced macro nutrients and zinc which acts as an activator of enzymes in plants and is directly involved in the biosynthesis of auxin which increased the seeds/ear. Similar findings reported by Swaroop *et al.* (2023).

**Test weight:** Significantly maximum test weight (3.47 g) was recorded with the treatment of application of NPK 100% RDF + Boron 0.5 kg/ha. However, the treatment T<sub>1</sub>, T<sub>3</sub>, T<sub>4</sub>, T<sub>7</sub>, T<sub>5</sub>, T<sub>7</sub>, T<sub>9</sub> were found to be statistically at par T<sub>8</sub>. The probable reason for increased test weight was mainly due to balanced supply of nutrients throughout the grain filling and development period which might have resulted in bold grains and consequently higher test weight. Similar findings reported in pearl millet by Kalaliyaet *al.* (2022).

**Grain yield:** Significantly maximum seed yield (1.22 t/ha) was recorded with the treatment of NPK 100% RDF + Boron 0.5 kg/ha. Application of RDF and boron increased the concentration of nutrient ions in the soil solution and availability of sufficient nutrients might

have helped in higher nutrient uptake. Which increased the growth and yield contributing characters like number of tillers, dry weight, number of seeds/ear and ear head length. which results in higher yield Mubeena *et al.* (2019)

**Stover yield:** Significantly maximum straw yield (2.80 t/ha) was recorded with the treatment of NPK 100% RDF + Boron 0.5 kg/ha. However, the treatment T<sub>7</sub>, T<sub>9</sub> were found to be statistically at par with T<sub>8</sub>. The straw yield increased due to better root activity and high physiological activities This was due to enhanced translocation of photosynthates from source to sink and induced growth as well as due to optimum doses of borax and npk, improved vegetative growth, better root activity and high physiological activities. Similar findings reported in finger millet by Manjunath and Debbarma. (2023).

**Harvest index:** Significantly maximum Harvest index (30.30%) was recorded with the treatment of NPK 100% RDF + Boron 0.5 kg/ha. However, the treatment T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub>, T<sub>5</sub>, T<sub>6</sub>, were found to be statistically at par with T<sub>8</sub>. Harvest index is directly correlated to the seed yield and haulm yield. Increased harvest index was due to better crop growth from early stages to at harvest. Better performance of crop from vegetative to reproductive stage.

## Economics

**Cost of cultivation:** The cost of cultivation of foxtail millet was discussed in Table 3. The cost of cultivation (18,550.00 INR/ha) was found to be highest in control.

**Gross returns:** Significantly higher gross return (48,408.33 INR/ha) was recorded with treatment NPK 100% RDF + Boron 0.5 kg/ha

**Net returns:** Significantly higher net return (30,913.33 INR/ha) was recorded under treatments NPK 100% RDF + Boron 0.5 kg/ha.

**Benefit-cost ratio:** Significantly higher benefit-cost ratio (1.77) was recorded under treatment treatments NPK 100% RDF + Boron 0.5 kg/ha.

## CONCLUSION

It can be concluded that the application NPK 100% RDF + Boron 0.5 kg/ha (Treatment 8) recorded higher yield and benefit cost ratio in foxtail millet.

## REFERENCE

- Akhil, K. K. G., Satish, K., J, S., S, K. L. and Mallikarjuna. (2023), Effect of nitrogen and phosphorus levels on growth and yield of pearl millet (*Pennisetum glaucum* L.), *The Pharma Innovation Journal* 2023; **12**(9): 1971-1973.
- Grace, S. P., Dawson, J., Swaroop, T. B., Ratnam, M. K. (2023). Effect of Nitrogen and Iron on Growth and Yield of Foxtail Millet (*Setaria italica* L.). *International Journal of Environment and Climate Change*,**13**(6):180-18
- Kalaliya, A., Sharma, S. K. and Kamboj, B. R. (2022). Effect of nutrient management on growth, yield attributing characters, yield and economics of rainfed pearl millet [*Pennisetum glaucum* (L) R.Br.]. *The Pharma Innovation Journal*; **11**(7): 290-294.
- Louhar, G., Bana, R., S. Kumar, V. and Kumar, H. (2020). Nutrient management technologies of millets for higher productivity and nutritional security. *Indian Journal of Agricultural Sciences*, **90** (12): 2243–50.
- Manjunath, S. and Debbarma, V. (2022). Effect of Zinc and Boron on Growth, Yield and Economics of Finger Millet (*Eleusine coracana* L.). *International Journal of Plant & Soil Science*; **35**(18).
- Mubeena, P., Halepyati, A. S. and B. M. Chittapur, P. M. (2019). Effect of Date of Sowing and Nutrient Management on Nutrient Uptake and Yield of Foxtail Millet (*Setaria italica* L.). *International Journal of Bio-resource and Stress Management*, **10**(1): 092-095.
- Patel, S. P., Malve, S. H., Chavda, M. H. and Vala, Y. B. (2021). Effect of Panchagavya and Jeevamrut on growth, yield attributes and yield of summer pearl millet. *The Pharma Innovation Journal* 2021; **10**(12): 105-109
- Raviraja., Balanagoudar, S. R., Ravi, M.V., Bhat, S. N. and Yadahalli, G. S. (2020). Effect of Integrated Nutrient Management Practice on Growth and Yield of Foxtail Millet (*Setaria italica* L.) in Black Soil. *International Journal of Current Microbiology and Applied Sciences*. **9**(3): 2101-2108.
- Sahoo, I., Satish, P., Hussain, A. S. and Sharma, H. K. S. (2020). Growth, yield attributes and yield of foxtail millet as influenced by varieties and integrated nutrient management. *Journal of Pharmacognosy and Phytochemistry*; **9**(4): 3426-3429.
- Sandhya R. Y., Triveni, U. and Patro, T. S. S. K. (2017). Integrated Nutrient Management for Enhancing the Soil Health, Yield and Quality of Little Millet (*Panicum sumatrense*). *International Journal of Bio-resource and Stress Management*: **8**(1):026-032

Shukla, A., Singh, R., Singh, K. S., Shivanand, Shukla, M. D. and Ram Singh, R. (2020). Study the effect of boron levels on yield attributes of rice crop. *Journal of Pharmacognosy and Phytochemistry*; **9**(6): 730-733.

Swaroop, T. B., and Debbarma, V. (2023). Effect of Organic Manures and Zinc on Growth, Yield and Economics of foxtail millet (*Setaria italica* L.). *International Journal of Environment and Climate Change*: **13**(8): 2231-4784.

Xing, G.; Ma, J.; Liu, X.; Lei, B.; Wang, G.; Hou, S.; Han, Y. (2023). Influence of Different Nitrogen, Phosphorus, and Potassium Fertilizer Ratios on the Agronomic and Quality Traits of Foxtail Millet. *Agronomy*, 13, 2005.

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**Table :1. Effect of Nutrient management on growth attributes of foxtail millet**

S. No	Treatment combinations	Plant height	Dry weight	No. of tillers
1.	NPK 50% RDF + Zinc 0.5 kg/ha	78.36	9.50	3.80
2.	NPK 50% RDF + Boron 0.5 kg/ha	78.60	9.75	3.67
3.	NPK 50% RDF + Iron 0.5 kg/ha	79.17	9.69	3.00
4.	NPK 75% RDF + Zinc 0.5 kg/ha	78.00	9.87	3.80
5.	NPK 75%RDF + Boron 0.5 kg/ha	76.53	9.63	3.00
6.	NPK 75% RDF + Iron 0.5 kg/ha	77.25	9.66	3.53
7.	NPK 100% RDF + Zinc 0.5 kg/ha	80.89	10.32	2.67
8.	NPK 100% RDF + Boron 0.5 kg/ha	84.20	10.61	4.53
9.	NPK 100% RDF + Iron 0.5 kg/ha	83.12	10.50	3.00
10.	Control (N, P, K- 60, 30,30 Kg/ha)	76.47	9.56	2.67
	S. Em ( $\pm$ )	1.06	0.14	0.52
	CD (p = 0.05)	3.16	0.44	1.57

**Table:2. Effect of Nutrient management on yield attributes and yield of foxtail millet**

S.No	Treatment combination	At harvest						
		No. of ears/plant	Length of ears (cm)	No. of seeds/ear	Test weight (g)	Grain yield (t/ha)	Stover yield (t/ha)	Harvest index (%)
1.	NPK 50% RDF + Zinc 0.5 kg/ha	4.07	8.33	242.27	3.37	1.03	2.45	29.52
2.	NPK 50% RDF + Boron 0.5 kg/ha	3.93	8.13	241.13	2.80	0.85	2.18	28.18
3.	NPK 50% RDF + Iron 0.5 kg/ha	4.13	8.27	243.87	3.10	0.94	2.29	29.23
4.	NPK 75% RDF + Zinc 0.5 kg/ha	4.07	8.27	251.87	3.17	0.86	2.43	26.17
5.	NPK 75% RDF + Boron 0.5 kg/ha	4.07	8.40	243.07	3.10	0.95	2.39	28.61
6.	NPK 75% RDF + Iron 0.5 kg/ha	4.00	8.17	254.67	2.90	0.96	2.26	29.83
7.	NPK 100% RDF + Zinc 0.5 kg/ha	4.07	8.87	262.47	3.23	1.10	2.71	28.85
8.	NPK 100% RDF + Boron 0.5 kg/ha	4.47	9.20	258.87	3.47	1.22	2.80	30.30
9.	NPK 100% RDF + Iron 0.5 kg/ha	4.00	9.00	245.27	3.10	0.95	2.64	26.51
10.	Control (N, P, K- 60, 30,30 Kg/ha)	4.13	8.27	246.20	2.60	0.88	2.16	28.99
	S. Em ( $\pm$ )	0.08	0.21	4.39	0.16	0.03	0.12	1.19
	CD (p = 0.05)	0.25	0.63	13.06	0.49	0.10	0.38	-

**Table 3: Effect of Nutrient management on economics of foxtail millet**

S.no	Treatment combination	Cost of cultivation (INR/ha)	Gross returns (INR/ha)	Net returns (INR/ha)	B:C ratio
1.	NPK 50% RDF + Zinc 0.5 kg/ha	17,350.00	42,066.67	24,716.67	1.42
2.	NPK 50% RDF + Boron 0.5 kg/ha	174,95.00	35,308.33	17,813.33	1.02
3.	NPK 50% RDF + Iron 0.5 kg/ha	168,30.00	38,625.00	21,795.00	1.30
4.	NPK 75% RDF + Zinc 0.5 kg/ha	168,00.00	36,050.00	19,250.00	1.15
5.	NPK 75% RDF + Boron 0.5 kg/ha	174,95.00	39,100.00	21,605.00	1.23
6.	NPK 75% RDF + Iron 0.5 kg/ha	169,00.00	39,133.33	22,233.33	1.32
7.	NPK 100% RDF + Zinc 0.5 kg/ha	173,50.00	45,283.33	27,933.33	1.61
8.	NPK 100% RDF + Boron 0.5 kg/ha	174,95.00	48,408.33	30,913.33	1.77
9.	NPK 100% RDF + Iron 0.5 kg/ha	182,00.00	39,850.00	21,650.00	1.19
10.	Control (N, P, K- 60, 30,30 Kg/ha)	185,50.00	37,033.33	18,483.33	1.00

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