Original Research Article

"Effect of Nano zinc and Foliar application of Boron on growth and yield of Fingermillet"

ABSTRACT

A field experiment was conducted during Kharif 2022 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P) to determine the "Effect of nano zinc and foliar application of boron on growth and yield of finger millet (*Eleusine coracana* L.)".The treatments consisted of three levels of [Nano zinc 300 ppm, 600 ppm, 900 ppm] and three levels of foliar application of Boron at [0.1%, 0.3% and 0.5%], whose effect is observed in finger millet. The results revealed that the treatment with application of Nano zinc 900 ppm + Boron at 0.5% recorded higher plant height, number of tillers/plant, plant dry weight, CGR,RGR and yield parameter test weight, seed yield, stover yield and harvest index.

Keywords: Nano zinc; Boron; Growth; Yield.

Introduction

Finger millet (*Eleusine coacana* L. Garten) is known as African millet and Ragi in India. Finger millet belonging to family Poaceae. The third most important millet crop in India. India's third-largest millet crop. One of the main food staples in the some regions of eastern and central Africa and India is finger millet. In Karnataka, Tamil Nadu, Andhra Pradesh, Orissa, Bihar, and Maharashtra there has been tremendous development. Even in the mountains of Himachal Pradesh and Uttar Pradesh, it develops. It is generated yearly in 1.29 million tonnes on 2.5 million hectares (M/ha) of lands **(aut,2019).** An important grain crop, ragi is a C_4 plant with such a high production potential which, under perfect situations, could reach up to 40 to 50 quintals per hectare.

Millets have such a higher nutrient value than other grains like rice and wheat. It performs well as a substitute to rice and wheat. Proteins (5-8%), carbs (65-75%), dietary fibre (15-20%), minerals (2.5-3.5%), and other extractives (1-2%) are all present in finger millet. Among the cereals, it has the greatest calcium content (344 mg/100 g).

Nano fertilizers help to improve the production of dry matter, photosynthesis, or chlorophyll, which benefits plant growth in general **(Qureshi *et al*., 2018).** In view of this, the goal of this research was to develop a cropping system that includes bio seed priming composed of extracts of plant leaves and foliar nanoparticles of zinc oxide nanoparticle which could be simultaneously efficient and environmentally friendly, approach an that could increase seed nutrient content for improved seed emergence, more uniform plant population, and higher yield. As in food industry and agriculture, nanotechnology is essential. Usually nanoparticles (size 1-100 nm) have such a variety of applications in industries including medical and pharmaceuticals. The several patented products using nano- materials, including nano-pesticides, nano-fertilizers, and nano-sensors, have been developed regardless of the ongoing controversy the use of nanoparticles in agriculture **(Prasad *et al*., 2017; Kah, 2015)**.

Zinc deficiency is now recognized as one of the most widespread mineral deficiencies in global human nutrition. Zinc is required for the structural and functional integrity of about 2800 proteins, contributes to protein biosynthesis and is a key defense factor in detoxification of highly toxic oxygen free radicals **(Andreini *et al*., 2009).**

Concluded that foliar or combined soil and foliar application of zinc fertilizer under field conditions is highly effective and very practical way to maximize uptake and accumulation of zinc in whole wheat grain. Finger millet flour fortified with zinc-oxide was specifically examined for the bio accessibility of the fortified mineral, as measured by in-vitro, stimulated gastrointestinal digestion procedure and storage stability **(Bhumika and Kalpana, 2010).**

Nutrients including zinc and boron are recommended. Zinc, among the essential microelements for both plants and animals, is essential to a plant's metabolic process since it promotes the manufacturing of proteins, lipids, carbohydrates, DNA, and enzymes. Zinc is also another important mineral. Serves an essential function in reducing the production and cytotoxicity of free radicals that can damage membrane lipids a lack of zinc affects both vegetative and productive growth, as according research Since the establishment of essentiality of boron for the growth and development of higher plants **(Warington 1923)**, our knowledge about Its importance in agriculture has grown rapidly.

In addition to helping with cell division, cell elongation, cell membrane strength, flowering, pollination, seed set, and sugar translocation, boron is essential for the growth and nutrition of crop plants. Although calcium and boron are necessary to improve grain yields, their mixed application can have an effect on the accessibility and use of boron by plants **(Kanwal *et al*., 2008)**.

The biological responses of plants, such as cell elongation, cell maturation, meristematic tissue development, and protein synthesis, all benefit from the presence of the element borax **(Mengel and Kirkby, 1982).** The use of boron to finger millet is essential for improving the crop's growth, development, and yield. The application of boron also promotes the soil's uptake of nitrogen, that improves plant height and dry weight **(Jing *et al*., 1994).** The information on finger millet's boron content in Karnataka is important. Thereby, the aim of this research was to Research the effects of graduated boron doses on the growth and yield of finger millet, an important staple food crop in Karnataka's Eastern Dry Zone. Although many research have been performed simultaneously, a thoroughly repeated experiment in various Karnataka regions is needed to determine the considered valid.

MATERIALS AND METHODS:

The experiment was conducted during kharif season of 2022 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The soil of the field constituting a part of central gangetic alluvium is neutral and deep. The soil of the experimental field was sandy loam in texture, nearly neutral in soil reaction (pH 7.4),low level of organic carbon (0.51%), available N (108.69 Kg/ha), P (80.5 kg/ha), K (83.3 kg/ha) The treatment consists of Nano zinc @ 300ppm + Boron@ 0.1%, Nano zinc @ 300ppm + Boron@ 0.3%, Nano zinc @ 300ppm + Boron@ 0.5%, Nano zinc @ 600ppm + Boron@ 0.1%, Nano zinc @ 600ppm + Boron@ 0.3%, Nano zinc @ 600ppm + Boron@ 0.5%, Nano zinc @ 900ppm + Boron@ 0.1%, Nano zinc @ 900ppm + Boron@ 0.3%, Nano zinc @ 900ppm + Boron@ 0.5% and control.

The experiment was laid out in Randomized Block Design, with 10 treatments replicated thrice. The observations were recorded for plant height, plant dry weight, Crop growth rate (g/m^2/day), Relative growth rate (g/g/day), test weight (g), seed yield (t/ha), strover yield (t/ha) and harvest index (%). The collected data was subjected to statistical analysis by analysis of variance method.

3. RESULTS AND DISSCUSSION

Growth parameters

Plant height:

The data revealed that significant and higher plant height (36.3 cm) was observed in treatment T_9 [ZnO (900 ppm) + Boron (0.5%)] However, treatment T_8[ZnO (900 ppm) + Boron (0.3%)] where stastiscally at par with the treatment T_9 [ZnO (900 ppm) + Boron (0.5%)].

Improved nutritional uptake and absorption, notably of zinc and boron, which were lacking in the soil at the experimental site, may have contributed to the increase in plant height. The rise in plant height brought on by the administration of micronutrients may be linked to the crop receiving the right nutrition, which promotes growth. In addition to enhancing the nutrient supply, the addition of FYM may have enhanced the physical qualities of the soil, fostering favourable conditions for crop growth. The taller plants seen with micronutrient treatment may be a result of enhanced meristamatic cell activity and cell elongation, which raises plant height. In conjunction with Zn spraying, **Dadhich and Gupta (2005)** and **Jakhar *et al*., (2006)** also noted increased plant height. According to **Mubshar *et al*., (2012),** boron spraying increased plant height.

Number of Tillers/plant:

The data revealed that treatment T_9 [ZnO (900 ppm) + boron (0.5%)] recorded significant and maximum number of tillers/plant (6.4) which was superior to all the treatment and the treatment T_8 [ZnO (900 ppm) + Boron (0.3%)] and T_7 [ZnO (600 ppm) + Boron (0.5%)] were statiscally at par with the treatment T_9 [ZnO(900 ppm)+ Boron (0.5%)].

The increased number of tillers due to the application of these micronutrients might be related to their physiological role in plants. The stimulatory effect of Zn on enzymes and on increased availability of major nutrients might have caused for increased number of tillers in the present study. These results corroborate the findings of **Dadhich and Gupta (2005)** and **Mubshar *et al*., (2012)**. The results very clearly indicated that, application of both the nutrients increased the number of tillers per hill and also the need for application of boron at an early stage of crop to increase tiller numbers. These results are in accordance with findings of **Muhammad *et al*., (2012).**

Plant dry weight (g):

Results revealed that treatment T_9 [ZnO (900 ppm) + Boron (0.5%)] recorded siginificantly higher plant dry weight (8.24). which was superior to all the treatment and treatment T_6 [ZnO (600 ppm)+ Boron (0.5%)] ,were statiscally at par with treatment T_9 [ZnO (900 ppm)+ Boron (0.5%)].

Kobraee *et al*., (2011) claimed that zinc, iron and boron application at the same time could lead to higher dry matter and seed yield as compared to using them separately. Foliar application with micronutrients (Fe, B and Zn) might be due to their critical role in crop growth, involving in photosynthesis processes, respiration and other biochemical and physiological activates and thus their importance in achieving higher yields **(Salih, 2013).**

Crop Growth Rate (g/m^2/day):

The data recorded that during 60-80DAS that treatment T_9 [ZnO (900 ppm) + Boron (0.5%)] was highest crop growth rate (28.50 g/m^2/day).

Releative Growth Rate (g/g/day):

The data revealed that during 60-80 DAS,treatment T_{10} control:100:50:50 (NPK kg/ha)recorded siginificantly higher relative growth rate (0.046 g/g/day).

Yield parameter:

Test weight:

Significant and maximum test weight (3.82) was recorded in treatment T_9 [ZnO (900) + boron (0.5%)]. However, treatment T_8 [ZnO (900ppm) + boron (0.3%)] was stastically at par with the treatment T_9 [ZnO (900) + boron (0.5%)].

Seed yield(t/ha):

Significant and higher seed yield (2.69 t/ha) was obtained in treatment T_9 [ZnO (900) + boron (0.5%)], and there were no stastically at par value.

Consequently, providing zinc and boron to a soil low in those elements improved plant development and growth in general, which in turn will increase crop yields of grain and straw. Again several research in various crops, such as those by **Shrivastava et al. (2003), Sammauria (2007), Singh *et al*., (2009), Tripathi *et al*., (2011),** and **Jat *et al*., (2015),** also support these conclusions. The combined use of Zn and B in this experiment improved crop yield much more than both element's application alone. These results are similar with **Muhammad *et al*., (2012) and Quddus *et al*., (2011)**

Stover yield (t/ha):

Significant and higher seed yield (4.29 t/ha) was obtained in treatment T_9 [ZnO (900) + boron (0.5%)], and there were no stastically at par value.

Sandhya Rani *et al*., (2017) reported higher grain and straw yield (78.1q $ha^{-1}$and 33.7q ha^{-1} respectively) of finger millet with application of 150% RDF+$ZnSO_4$@0.5% Foliar spray+$FeSO_4$ @ 0.2%. Thus, application of zinc and boron in a soil deficient in zinc and boron improved overall growth and development of plants and ultimately the grain and straw yields. These findings are also supported by **Shrivastava *et al*., Sammauria, Singh *et al*.**

Harvest index (%):

Significant and higher harvest index (38.59 %) was obtained in treatment T_9 [ZnO (900) + boron (0.5%)], and there were no stastically at par value.

Baktear Hossain *et al*., (2001) also reported similar improvement in growth and yield of finger millet crop with the application of NPK and Zn. The greater growth, higher photosynthetic activity, and movement of photosynthates from source to harvest are the results of which the yield qualities have improved. The increased supply of nutrients provided by the application of FYM to get fertilizers there with chemical fertilisers may be the cause of the improvement in growth as a result of better physiological processes in plants. Moreover, the application of FYM might have enhanced the physical, chemical, and biological characteristics of the soil, which collectively might have favoured the processes in the soil that change nutrients, leading to an increase in the availability of nutrients. Nutrient uptake by the crop was improved by the rise in nutrient availability, the increase in nutrient availability improved the crop's nutrient uptake, which ultimately led to an improvement in growth and production parameters. According to **Jena *et al*., (2006)** and **Mohamed *et al*., (2010),** the application of zinc and boron may have enhanced the transfer of photosynthates from source to sink, which may account for the higher values of yield attributes (2015). Increased plant vigour, improved photosynthesis, and better transfer of photosynthates from source to sink may all contribute to the better yield parameters brought on by the combined application of N, P, K, Zn, and B. **(Ramachandrappa *et al*., 2014)**

Table 1. Effect of Nano zinc and foliar application of boron on growth of Finger millet crop

		60 DAS			60-80DAS	
Sl No.	**Treatment**	**Plant height (cm)**	**Number of tillers/plant**	**Dry weight (g/plant)**	**Crop growth rate (g/m^2/day)**	**Relative growth rate (g/g/day)**
1	ZnO (300 ppm) + Boron at (0.1%)	34.0	5.0	7.48	26.37	0.044
2	ZnO (300 ppm) + Boron at (0.3%)	34.3	5.1	7.61	26.84	0.044
3	ZnO (300 ppm) + Boron at (0.5%)	35.1	5.7	8.00	27.68	0.043
4	ZnO (600 ppm) + Boron at (0.1%)	34.8	5.5	7.84	27.04	0.043
5	ZnO (600 ppm) + Boron at (0.3%)	35.5	5.9	8.06	27.55	0.043
6	ZnO (600 ppm) + Boron at (0.5%)	36.2	6.1	8.17	27.77	0.043
7	ZnO (900 ppm) + Boron at (0.1%)	35.0	5.6	7.91	27.33	0.043
8	ZnO (900 ppm) + Boron at (0.3%)	35.9	6.0	8.09	27.87	0.043
9	ZnO (900 ppm) + Boron at (0.5%)	36.3	6.4	8.24	28.50	0.043
10	Control (100:50:50 NPK kg/ha)	32.8	4.9	7.08	26.90	0.046
	F test	S	S	S	S	S
	SEm(±)	0.10	0.16	0.04	0.21	0.0003
	CD (P=0.05)	0.29	0.49	0.11	0.63	0.0001

Table 2. Effect of Nano zinc and foliar application of boron on yield parameter of Finger millet crop

Sl No.	Treatment	Test weight (g)	Seed yield (t/ha)	Stover yield (t/ha)	Harvest index (%)
1	ZnO (300 ppm) + Boron at (0.1%)	3.50	1.83	3.39	35.09
2	ZnO (300 ppm) + Boron at (0.3%)	3.57	1.91	3.56	34.96
3	ZnO (300 ppm) + Boron at (0.5%)	3.74	2.08	3.98	34.35
4	ZnO (600 ppm) + Boron at (0.1%)	3.61	1.98	3.71	34.80
5	ZnO (600 ppm) + Boron at (0.3%)	3.75	2.14	4.05	34.58
6	ZnO (600 ppm) + Boron at (0.5%)	3.78	2.34	4.14	36.15
7	ZnO (900 ppm) + Boron at (0.1%)	3.63	2.02	3.86	34.37
8	ZnO (900 ppm) + Boron at (0.3%)	3.77	2.20	4.09	34.92
9	ZnO (900 ppm) + Boron at (0.5%)	3.82	2.69	4.29	38.59
10	Control (100:50:50 NPK kg/ha)	3.45	1.78	3.22	35.62
	F test	S	S	S	S
	SEm(±)	0.05	0.05	0.05	0.56
	CD (P=0.05)	0.16	0.14	0.11	1.30

CONCLUSION

It can be concluded that application of nano zinc(900ppm) and Boron (0.5%) s foliar spray as performed better in growth parameters and yield attributes of finger millet (GPU-67). Since the findings based on one season, futher trails are needed to confirm the results.

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