

Effect of zinc levels and plant geometry on growth and yield of kharif finger millet (*Eleusine coracana* L.)

Abstract

A field experiment was conducted during *kharif* season (2021) at Crop Research Farm, Department of Agronomy, SHUATS, Allahabad (U.P.). The soil of experimental plot was sandy loam in texture. The treatment consisted of T₁- Zn @ 2kg/ha + 30 cm x 10 cm, T₂- Zn @ 2kg/ha + 20 cm x 10 cm, T₃- Zn @ 2kg/ha + 40 cm x 10 cm, T₄- Zn @ 4kg/ha + 30 cm x 10 cm, T₅- Zn @ 4kg/ha + 20 cm x 10 cm, T₆- Zn @ 4kg/ha + 40 cm x 10 cm, T₇- Zn @ 6kg/ha + 30 cm x 10 cm, T₈- Zn @ 6kg/ha + 20 cm x 10 cm, T₉- Zn @ 6kg/ha + 40 cm x 10 cm. The experiment was laid out in Randomized Block Design, with 9 treatments replicated thrice. Results revealed that maximum plant height (95.49 cm), numbers of tillers per plant (9.86), plant dry weight (21.98 g/plant), effective tillers per m²(466.66), test weight (4.5 g) and number of fingers per plant (7.1), grain yield (3.23 t/ha) and straw yield (4.30 t/ha) was significantly influenced with application zinc 6 kg/ha + spacing 30x10 cm.

Key words: Finger millet, Zinc, plant geometry, yield attributes, kharif.

1. INTRODUCTION

Finger millet (*Eleusine coracana* L.) Gaertn) is a cereal grass grown mostly for its grain. Finger millet is a robust, tufted, tillering annual grass, up to 170 cm high (FAO. 2012; De Wet, 2006; Quattrocchi. 2006). The inflorescence is a panicle with 4-19 ~~finger-like~~ finger-like spikes that resembles a fist when mature, hence the name of finger millet. The spikes bear up to 70 alternate spikelets, carrying 4 to 7 small seeds (Dida et al. 2006). The seed pericarp is independent ~~from of~~ the kernel and can be easily removed from the seed coat (FAO. 2012). Finger millet is a staple food in many African and South Asian countries. It is also considered a helpful famine crop as it is easily stored for lean years (FAO. 2012).

The productivity of finger millet in the country and as well as state is very low as compared to ~~the~~ potential yield of improved genotypes. The secret of boosting its yields mainly lies in suitable planting method and properly fertilizing the crop. ~~Proper~~ ~~The proper~~ sowing method is one of the important nonmonetary inputs in crop production, which affects the crop growth, yield, and quality to ~~a~~ greater extent. Method of establishment ~~play plays~~ an important role to exploit all available resources for growth as it provides optimum growing ~~condition~~ conditions. Transplanting is an economically and environmentally ideal alternative to seeding.

The development of cropping systems such as appropriate inter-row spacing will help ~~crop~~ crops themselves to compete with ~~weed~~ weeds. Several reports indicated that crops planted in narrow row spacing suppress weed growth more than when planted in wider row spacing. Zinc is ~~an~~ essential element for crop production and optimal size of fruit, also ~~it~~ required in the carbonic enzyme which ~~present~~ presents in all photosynthetic tissues, and required for chlorophyll biosynthesis (Ali et al., 2008; Graham et al., 2000). It is also required to maintain the structure of ~~the~~ nucleic acid ~~protein~~ acid-protein, cell membrane and also exerts ~~a~~ vital role in various physiological ~~functions~~ functions viz., ~~Cell~~ Cell growth, division, maturation, and reproduction, Dark adaptation, night vision, Wound healing, host immunity, Taste acuity, Maintenance of pregnancy, fetal growth, etc (Alam et al., 2010, Alloway, 2008).

2. Materials and Methods

The experiment was carried out during ~~the~~ Kharif season of 2021, at the CRF (Crop Research Farm) SHIATS, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh. The Crop Research Farm is situated at 25.75° N latitude, 87.19° E longitude, and at an altitude of 98m above mean sea level. Prayagraj has a subtropical and semi-arid climatic condition, with both extremes of temperature, i.e., winter and summer. The soil of the experiment field contains soil Ph of about 6.9, available nitrogen ~~of~~ 278.93

Comment [B1]: 1. **Formatting:** Arial, Bold, 11 fonts, left aligned, caps
2. **Contents:** It should be concise and informative. Your abstract lacks two main components. The first one is the aim of study. The abstract doesn't show the aim or objective of your research. The second important part is the conclusion. What is your final conclusion for the work you did?

Comment [B2]: The introduction should provide a factual background, a clearly defined problem, a proposed solution, a brief literature survey, and the scope and justification of the work to be done (Refer to author guideline).

Include the following in your introduction

- Botanical description of the crop
- Climatic requirements
- Production status (at world and country level)
- Statement of problems
- Objectives

Comment [B3]: The material and method section lacks

- Material used
- Data to be collected and how they are measured
- Data analysis method and type of software used

Kg/ha, available phosphorus of 10.8 Kg/ha, and available Potassium of 206.4 Kg/ha. The experiment was laid out in Randomized Block Design (RBD) with three replications and nine treatments: T₁- Zn@2kg/ha+30 x10cm, T₂- Zn@2kg/ha+20 x10cm, T₃- Zn@2kg/ha+40 x10cm, T₄- Zn@4kg/ha+30 x10cm, T₅- Zn@4kg/ha+20 x10cm, T₆- Zn@4kg/ha+40 x10cm, T₇- Zn@6kg/ha+30 x10cm, T₈- Zn@6kg/ha+20 x10cm, T₉- Zn@6kg/ha+40 x10cm. The recommended RDF for the crop is 60:30:30 Kg/ha. Finger millet GPU- 28 variety was used with a spacing of 30x10 cm with an area of 3 x 3 m for each plot. One quadrat was harvested in every plot for the determination of results and data was subjected to statistical analysis separately by using the analysis of variance technique. The difference among treatment means was compared by using the least significant difference test at 5% probability levels.

Comment [B4]: What is RDF abbreviated for?

3. Results and Discussion

3.1 Growth attributes

Growth parameters of finger millet were measured in terms of Plant-plant height (cm), the number of tillers per plant, and plant dry weight(g/plant) at harvesting time were shown in (Table1). Maximum plant height (95.49 cm) was recorded with application of zinc 6 kg/ha + 30 x 10 cm Spacing which was significantly superior over all other treatments and statistically at par with treatment of zinc 6 kg/ha + 20 x 10 cm Spacing (94.71 cm) and zinc 4 kg/ha + 20 x 10 cm Spacing (93.27 cm). ~~At~~ ~~In~~ all the stages of plant growth, plant height was found to be increased in plant density. The spacing of 30 cm apart rows resulted in taller plant height as compared to other rows spacing this may be due to the competition between plants for the light within a dense plant population. Also, high plant density could reduce light intensity within the plant canopy and encourage IAA synthesis and increase stem elongation. ~~The similar~~ Similar findings were reported by E. A. Ali (2011). ~~Highest~~ The highest number of tillers was recorded with the treatment of the application of zinc 6 kg/ha+ spacing 30 x 10 cm (9.86) which were significantly superior over all other treatments and treatment with the application of zinc 6 kg/ha+ spacing 20 x 10 cm (9.66), zinc 2 kg/ha+ spacing 30 x 10 cm (9.22) which were statistically at par with treatment of the application of zinc 6 kg/ha spacing 30 x 10 cm. Wider crop geometry had given more number of tillers/plant all the growth stages compared to others. The two wider spatial arrangements of 30 x 10 cm and 40 x 10 cm appeared to encourage tiller formation. ~~The similar~~ Similar findings were reported by Andrew Korir et al. (2018). ~~Highest~~ The highest dry weight was recorded with the treatment of application of zinc 6 kg/ha+ spacing 30 x 10 cm (21.98) which were significantly superior over all other treatments and treatment with application of zinc 6 kg/ha+ spacing 20 x 10 cm (21.64), which were statistically at par with treatment of the application of zinc 6 kg/ha spacing 30 x 10 cm. Increased plant population due to closer placing and double seedling/hill increased the number of tillers and eventually plant dry matter accumulation. Improvement of leaves might have increased the photosynthetic efficiency of finger millet and have induced to produce plant dry matter production. This was ~~an~~ ~~in~~ accordance with the earlier findings of Borale et al. (2002) and Rajesh (2011).

Comment [B5]: • Have a separate section to make clearer as follows

3.1. Growth parameters

- 3.1.1. Plant height
- 3.1.2. Number of tillers per plant
- 3.1.3. Dry weight

• The discussion is not compared with works of other scholars, sufficiently. Please, modify your discussions again by comparing with works of more authors .

Treatment details	Plant height (cm)	No of tillers	Plant dry weight (g/plant)
zinc@2kg/ha+30x10 cm	90.58	9.22	19.70
zinc@2kg/ha+20x10 cm	85.98	8.88	18.98
zinc@2kg/ha+40x10 cm	86.92	8.55	18.27
zinc@4kg/ha+30x10 cm	92.74	8.87	20.53
zinc@4kg/ha+20x10 cm	93.27	9.21	20.76
zinc@4kg/ha+40x10 cm	89.92	8.96	19.35
zinc@6kg/ha+30x10 cm	95.49	9.86	21.98
zinc@6kg/ha+20x10 cm	94.71	9.66	21.64
zinc@6kg/ha+40x10 cm	92.23	8.99	20.31

F- test	S	S	S
SEm (±)	0.89	0.21	0.21
CD (5%)	2.68	0.64	0.65

Table 1 Effect of zinc and plant geometry on growth attributes of kharif Finger millet

3.2 Yield attributes

Yield attributes of Finger millet ~~was were~~ measured in terms of ~~the~~ number of effective tillers per m², number of ear-head per plant, ~~and~~ test weight(g) at harvesting ~~time was shown in the~~ (table 2). Treatment with application of zinc 6 kg/ha + 30 x 10 cm was recorded maximum number of effective tillers per m² (466.66) which was significantly superior over all other treatments and treatment with of application of zinc 6 kg/ha + 20 x 10 cm (450) which was statistically at par with the treatment with zinc 4 kg/ha + 20 x 10 cm. Due to wider spacing, there is good aeration and ~~produce~~ ~~produces~~ more number of tillers and productive tillers. Under 30 x 10 cm spacing, there is better conversion of productive tillers that produced more ~~number of~~ tillers per unit area. This was earlier reported by **Kumar et al. (2019)**. Treatment with application of zinc 6 kg/ha + 30 x 10 cm was recorded maximum number of ear-head per plant (7.10) which was significantly superior over all other treatments and treatment with of application of zinc 6 kg/ha + 20 x 10 cm (6.70) which was statistically at par with the treatment with zinc 6 kg/ha + 30 x 10 cm. Plant spacing 30 x 10 cm provides a favourable microclimate to crop for effective utilization of available moisture, nutrient, and its early adoption leads to better partitioning of photosynthates to reproductive parts ~~there by~~ ~~thereby~~ recording better growth and yield attributes. Closer row spacing, 30 cm produced ~~the~~ highest number of ear head. ~~The similar~~ ~~Similar~~ findings were reported by **Gondal et al. (2017)**. Treatment with application of zinc 6 kg/ha + 30 x 10 cm was recorded maximum test weight (4.50 g) which was significantly superior over all other treatments. The ~~increase~~ ~~increased~~ grain weight may be due to ~~the~~ application of spacing 30 x 10 cm recorded maximum grain weight (4.5 g). Similar findings were found by **Gondal et al. (2017)**.

Comment [B6]: •Have a separate section to make clearer as follows

3.2. Yield attributes

- 3.2.1. Number of effective tillers
- 3.1.2. Number of ear head per plant
- 3.1.3. Test weight

Table 2 Effect of zinc and plant geometry on yield attributes of kharif Finger millet

Treatment details	Effective tillers per m ²	No of ear-head per plant	Test weight (g)
zinc@2kg/ha+30x10 cm	240	4.5	3.77
zinc@2kg/ha+20x10 cm	350	4.2	3.67
zinc@2kg/ha+40x10 cm	160	3.5	3.57
zinc@4kg/ha+30x10 cm	333.33	5.6	4.03
zinc@4kg/ha+20x10 cm	280	6.2	4.10
zinc@4kg/ha+40x10 cm	220	4.6	3.70
zinc@6kg/ha+30x10 cm	466.66	7.1	4.50
zinc@6kg/ha+20x10 cm	450	6.7	4.13
zinc@6kg/ha+40x10 cm	213.33	4.6	3.97
F- test	S	S	S
SEm (±)	16.28	0.26	0.06
CD (5%)	48.81	0.79	0.19

3.3 Yield

~~Yield~~ ~~The yield~~ of Finger millet was measured in terms of grain yield, stover yield, ~~and~~ harvest index. Treatment with application of zinc 6 kg/ha + 30 x 10 cm was recorded maximum Grain yield (3.23 t/ha) which was significantly superior over all other treatments and treatment with ~~the~~ application of zinc 6 kg/ha + 20 x 10 cm (3.13 t/ha) which was statistically at par with the treatment with zinc 6 kg/ha

Formatted: Left, Space After: 0 pt

+ 30 x 10 cm. Optimum An optimum planting pattern is the prerequisite for proper utilization of growth resources and ultimately to exploit the potential productivity of any crop. The higher grain yield was recorded from the interaction effect of 30 cm spacing (2214.4 kg/ha). Similar findings were reported by **Nigus and Birhanu (2018)**. Treatment with the application of zinc 6 kg/ha + 30 x 10 cm was recorded maximum stover yield (4.30 t/ha) which was significantly superior ~~ever all~~ overall treatments and treatments with the application of 6 kg/ha + 20 x 10 cm (4.29) is statistically at par with the treatment of zinc 6 kg/ha + 30 x 10 cm. More plant population owing to closer spacing at 30 x 10 cm might have contributed to maximum plant dry matter production and number of leaves which ultimately enhanced the straw yield. Similar findings have also been reported earlier by **Rajesh (2011) and Kalaraju et al. (2011)**. Treatment with the application of zinc 6 kg/ha + 30 x 10 cm which was recorded a maximum Harvest index (42.72%) which was significantly superior over all other treatments and treatment with the application of zinc 6 kg/ha + 20 x 10 cm (42.58 %), which were statistically at par with treatment with zinc 6 kg/ha + 30 x 10 cm. This was mainly due to an increase ~~of in~~ grain yield with an optimum straw yield which in turn resulted in a higher harvest index. These results were in conformity with the findings of **Kumar et al. (2019)**.

Table 3 Effect of zinc and plant geometry on yield of kharif Finger millet

Treatment details	Grain yield (t/ha)	Stover yield (t/ha)	Harvest index (%)
zinc@2kg/ha+30x10 cm	2.53	3.99	38.82
zinc@2kg/ha+20x10 cm	2.29	3.95	36.72
zinc@2kg/ha+40x10 cm	2.24	3.91	36.48
zinc@4kg/ha+30x10 cm	2.87	4.12	41.06
zinc@4kg/ha+20x10 cm	2.96	4.17	41.55
zinc@4kg/ha+40x10 cm	2.39	3.97	37.23
zinc@6kg/ha+30x10 cm	3.23	4.30	42.72
zinc@6kg/ha+20x10 cm	3.13	4.29	42.58
zinc@6kg/ha+40x10 cm	2.67	4.07	39.58
F- test	S	S	S
SEm (±)	0.04	0.01	0.33
CD (5%)	0.12	0.03	1.00

What is SEm and CD stands for? Write it in long form as footnote. Do the same for the above tables.

4. CONCLUSION

From the above findings it is concluded that zinc 6 kg/ha + spacing 30x10 cm was found more productive in terms of growth, yield attributes and yield.

5. FUTURE SCOPE

As there was less research happened in the field, further research should be done to obtain proper results and help farmers to choose better performing hybrid. Since the findings are based on the research done in one season, further trails are needed to confirm the results of this experiment.

6. REFERENCE

Amare Fufa and Etagegnehu, G.M. (2016). Weed Control Practices and Inter-Row Spacing Influences on Weed Density and Grain Yield of Finger millet (*Eleusine coracana* L. Gaertn) in the Central Rift Valley of Ethiopia. *International Journal of Agriculture and Forestry* 3(9).

Andrew Korir., Peter Kamau. and David Mushimiimana. (2018). Effect of fertilization and spacing on growth and grain yields of finger millet (*Eleusine coracana* L. Gaertn) In Ainmoi, Kericho

Comment [B7]:

Very weak conclusion. Please, revise it again and insert more elaborative ideas to convince readers.

Comment [B8]: This recommendation is not part of your study? Why you are interested?

Country, Kenya. *International Journal of Advanced Research and Publications* (2): 2456-9992.

- Dadhich, L. K., and A. K. Gupta, (2005). Growth and yield of fodder pearl millet as influenced by sulphur, zinc and intercropping with cowpea. *Fertiliser News*; **50**(3): 55-57.
- Gupta, A. K., 2014, Effect of nitrogen and zinc fertilizer on yield and nutrient content in pearl millet (*Pennisetum glaucum* L.) under guava based agri-horti system. M. Sc. (Ag) Thesis. Banaras Hindu Univ., Varanasi.
- Jakhar, S.R. and Sinhg, M. and Balai, C.M. (2006). Effect of farm yard manure, phosphorus and zinc levels on growth, yield, quality and economics of pearl millet. *Indian Journal of Agricultural Sciences*.**76**(1): 58-61.
- Prakasha, G., Kalyana Murthy, K.N., Prathima, A.S. and Rohani Meti N. (2018). Effect of spacing and nutrient levels on growth attributes and yield of finger millet (*Eleusine coracana* L.) cultivated under guni planting method in red sandy loamy soil of Karnataka, India. *International Journal of Current Microbiology and Applied Sciences* **7**: 2319-7706.
- Shinggu C.P., Dadari, S.A., Shebayan, J.A.Y., Adekpe, D.I., Mahadi, M.A., Mukhtar, A. and Asala, S.W. (2009). Influence of Spacing and Seed Rate on Weed Suppression in Finger millet (*Eleusine coracana* gaertn). *East Journal of Scientific Research* **4**(4): 267-270.

UNDER PEER REVIEW