Effect oOf Zinc Levels aAnd Plant Geometry oOn Growth aAnd Yield Oof 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 sSoil of experimental plot was sandy loam in texture. The tTreatments consisted of T_1- Zn @ 2kg/ha + 30 cm x 10 cm, T_2- Zn @ 2kg/ha + 20 cm x 10 cm, T_3- Zn @ 2kg/ha + 40 cm x 10 cm, T_4- Zn @ 4kg/ha + 30 cm x 10 cm, T_5- Zn @ 4kg/ha + 20 cm x 10 cm, T_6- Zn @ 4kg/ha + 40 cm x 10 cm, T_7- Zn @ 6kg/ha + 30 cm x 10 cm, T_8- Zn @ 6kg/ha + 20 cm x 10 cm, T_9- Zn @ 6kg/ha + 40 cm x 10 cm. The An 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 m^2-(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 + and crop sown at 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 spikes that resembles a first 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 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 potential yield of improved genotypes. The secret of boosting its yields mainly lies indue to suitable planting method and proper application ofly fertilizersing the crop. Proper sowing method is one of the important nonmonetary inputs in crop production, which affects the crop growth, yield and quality to greater extent. Method of establishment play an important role to exploit all available resources for growth as it provides optimum growing conditions. Transplanting is an economically and environmentally ideal alternateive to seeding.

The development of cropping systems such as appropriate inter-row spacing will help crop themselves to compete with weed. Several reports indicatesd that crops planted in narrow row spacing suppress weed growth more than when planted in wider row spacing. Zinc is essential element for crop production and optimal size of fruitgrain, also it required in the carbonic enzyme which present 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 nucleic acid protein, cell membrane and also exerts vital role in various physiological functions viz., cCell growth, division, maturation and reproduction, Ddark adaptation, night vision, wWound healing, host immunity, tTaste acuity, mMaintenance of pregnancy, fetal growth etc (**Alam *et al.*, 2010, Alloway, 2008**).

2. MATERIALS AND METHODS

The experiment was carried out during *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 25.75^0 N latitude, 87.19^0 E longitude and at an altitude of 98m above mean sea level. Prayagraj has a sub-tropical and semi-arid climatic condition, with both extremes of temperature, *i.e.*, winter and summer. The soil of the experiment field contains soil Ph pH of about 6.9, available nitrogen 278.93

Formatted: Font: Not Bold

Formatted: Indent: Left: -0.05"

Formatted: Highlight

Comment [A1]: Follow journal pattern while giving references in running text and in bibliography

Formatted: Highlight

Formatted: Highlight

Formatted: Highlight

Formatted: Highlight

Formatted: Highlight

Formatted: Indent: Left: 0.05"

Kg/ha, available phosphorus 10.8 Kg/ha, available pPotassium 206.4 Kg/ha. The experiment was laid out in Randomized Block Design (RBD) with three replications and nine treatments: T_1- Zn@2kg/ha+30 x10cm, T_2- Zn@2kg/ha+20 x10cm,T_3- Zn@2kg/ha+40 x10cm, T_4- Zn@4kg/ha+30 x10cm, T_5- Zn@4kg/ha+20 x10cm, T_6- Zn@4kg/ha+40 x10cm, T_7- Zn@6kg/ha+30 x10cm, T_8- Zn@6kg/ha+20 x10cm, T_9- 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 spacing of 30×10 cm with an area of 3 × 3 m for each plot. One quadrate was harvested in every plot for the determination of results and data was subjected to statistical analysis separately by using analysis of variance technique. The difference among treatment means was compared by using least significant difference test at 5% probability levels.

3. RESULTS AND DISCUSSION

Formatted: Indent: Left: -0.05"

3.1 Growth attributes

Growth parameters of finger millet were measured in terms of Pplant height (cm), number of tillers per plant, plant dry weight (g/plant) at harvesting were shown in the (Table 1). Maximum plant height (95.49 cm) was recorded with application of zinc 6 kg/ha + and crop sown at 30 x 10 cm sSpacing which was significantly superior over all other treatments and statistically *at par* with treatment of zinc 6 kg/ha + and crop sown at 20 x 10 cm sSpacing (94.71 cm) and zinc 4 kg/ha + and crop sown at 20 x 10 cm sSpacing (93.27 cm). At Aall the stages, of plant growth, plant height was found to be increased in plant density. The spacing 30 cm a part rows resulted in taller plant height as compared to other rows spacing this may be due to the competition between plants for light within dense plant population. Also, high plant density could reduce light intensity within plant canopy and encourage IAA synthesis and increase stem elongation. The similar findings were reported by **E. A. Ali (2011).** Highest number of tillers was recorded with treatment of application of zinc 6 kg/ha + and crop sown at spacing 30 x 10 cm (9.86) which were significantly superior over all other treatments and treatment with application of zinc 6 kg/ha + and crop sown at spacing 20 x 10 cm (9.66), zinc 2 kg/ha + and crop sown at spacing 30 x 10 cm (9.22) which were statistically *at par* with treatment of 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 findings were reported by **Andrew Korir *et al.* (2018).** Highest dry weight was recorded with treatment of application of zinc 6 kg/ha + and crop sown at spacing 30 x 10 cm (21.98) which were significantly superior over all other treatments and treatment with application of zinc 6 kg/ha + and crop sown at spacing 20 x 10 cm (21.64), which were statistically *at par* with treatment of 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 accordance with the earlier findings of **Borale *et al.* (2002) and Rajesh (2011)**.

Formatted: Font: Italic

Formatted: Highlight

Formatted: Font: Italic

Formatted: Highlight

Formatted: Font: Italic

Formatted: Highlight

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

Formatted: Indent: Left: -0", First line: 0", Space After: 0 pt

Treatment details (Zinc application + spacing)	Plant height (cm)	No. of tillers	Plant dry weight (g/plant)
zinc@2kg/ha+30×10 cm	90.58	9.22	19.70
zinc@2kg/ha+20×10 cm	85.98	8.88	18.98
zinc@2kg/ha+40×10 cm	86.92	8.55	18.27
zinc@4kg/ha+30×10 cm	92.74	8.87	20.53
zinc@4kg/ha+20×10 cm	93.27	9.21	20.76
zinc@4kg/ha+40×10 cm	89.92	8.96	19.35
zinc@6kg/ha+30×10 cm	95.49	9.86	21.98
zinc@6kg/ha+20×10 cm	94.71	9.66	21.64
zinc@6kg/ha+40×10 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 ~~f~~Finger millet was measured in terms of number of effective tillers per m^2, number of ear-head per plant~~-~~, test weight (g) at harvesting was shown in the table 2. Treatment with application of zinc 6 kg/ha ~~+~~ and crop sown at 30 x 10 cm spacing was recorded maximum number of effective tillers per m^2 (466.66) which was significantly superior over all other treatments and treatment with of application of zinc 6 kg/ha ~~+~~ and crop~~–~~sown at 20 x 10 cm (450) which was statistically *at par* with the treatment with zinc 4 kg/ha ~~+~~ and crop sown at 20 x 10 cm spacing. Due to wider spacing there is good aeration and produce 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 ~~+~~ and crop sowing at 30 x 10 cm spacing 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 ~~+~~ and crop sowing at 20 x 10 cm spacing (6.70) which was statistically *at par* with the treatment with zinc 6 kg/ha ~~+~~ and crop sowing at 30 x 10 cm spacing. Plant spacing 30 x 10 cm provides 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 recording better growth and yield attributes. Closer row spacing 30 cm produced highest number of ear head. The similar findings were reported by **Gondal *et al.* (2017).** Treatment with application of zinc 6 kg/ha ~~+~~ and crop sowing at 30 x 10 cm spacing was recorded maximum test weight (4.50 g) which was significantly superior over all other treatments. The increase grain weight may be due to application of spacing 30 x 10 cm recorded maximum grain weight (4.5 g). Similar findings were found by **Gondal *et al.* (2017).**

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

Treatment details (Zinc application + spacing)	Effective tillers per m^2 (Nos)	No. of ear-head per plant	Test weight (g)
zinc@2kg/ha+30×10 cm	240	4.5	3.77
zinc@2kg/ha+20×10 cm	350	4.2	3.67
zinc@2kg/ha+40×10 cm	160	3.5	3.57
zinc@4kg/ha+30×10 cm	333.33	5.6	4.03
zinc@4kg/ha+20×10 cm	280	6.2	4.10
zinc@4kg/ha+40×10 cm	220	4.6	3.70
zinc@6kg/ha+30×10 cm	466.66	7.1	4.50
zinc@6kg/ha+20×10 cm	450	6.7	4.13
zinc@6kg/ha+40×10 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 of ~~f~~Finger millet was measured in terms of grain yield, stover yield, harvest index. Treatment with application of zinc 6 kg/ha ~~+~~ and crop sown at 30 x 10 cm spacing was recorded maximum

Formatted: Font: Italic
Formatted: Highlight
Formatted: Font: Italic
Formatted: Highlight
Formatted: Highlight
Formatted: Font: 11 pt, Italic
Formatted: Not Superscript/ Subscript

gGrain yield (3.23 t/ha) which was significantly superior over all other treatments and treatment with application of zinc 6 kg/ha +and crop sown at 20 x 10 cm spacing (3.13 t/ha) which was statistically *at par* with the treatment with zinc 6 kg/ha +and crop sown at 30 x 10 cm spacing. 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 application of zinc 6 kg/ha +and crop sown at 30 x 10 cm spacing was recorded maximum stover yield (4.30 t/ha) which was significantly superior over all treatments and treatments with application of 6 kg/ha +and crop sown at 20 x 10 cm spacing (4.29) is statistically *at par* with the treatment of zinc 6 kg/ha +and crop sown at 30 x 10 cm spacing. 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 application of zinc 6 kg/ha +and crop sown at 30 x 10 cm spacing which was recorded maximum hHarvest index (42.72%) which was significantly superior over all other treatments and treatment with application of zinc 6 kg/ha +and crop sown at 20 x 10 cm spacing (42.58 %), which were statistically *at par* with treatment with zinc 6 kg/ha +and crop sown at 30 x 10 cm spacing. This was mainly due to increase of grain yield with optimum straw yield which in turn resulted in higher harvest index. These results were in conformity with findings of **Kumar *et al.* (2019).**

Formatted: Font: Italic

Formatted: Highlight

Formatted: Font: Italic

Formatted: Highlight

Formatted: Font: Italic

Formatted: Highlight

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

Treatment details (Zinc application + spacing)	Grain yield (t/ha)	Stover yield (t/ha)	Harvest index (%)
zinc@2kg/ha+30×10 cm	2.53	3.99	38.82
zinc@2kg/ha+20×10 cm	2.29	3.95	36.72
zinc@2kg/ha+40×10 cm	2.24	3.91	36.48
zinc@4kg/ha+30×10 cm	2.87	4.12	41.06
zinc@4kg/ha+20×10 cm	2.96	4.17	41.55
zinc@4kg/ha+40×10 cm	2.39	3.97	37.23
zinc@6kg/ha+30×10 cm	3.23	4.30	42.72
zinc@6kg/ha+20×10 cm	3.13	4.29	42.58
zinc@6kg/ha+40×10 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

4. CONCLUSION

From the above findings it is concluded that zinc 6 kg/ha +and -crop sown at 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. REFERENCES

Comment [A2]: Follow journal pattern

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 Mushimiyimana. (2018). Effect of fertilization and spacing on growth and grain yields of finger millet (*Eleusine coracana* L. Gaertn) In Ainmoi, Kericho Coumtry, 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.