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# EFFECT OF ZINC FERTILIZER APPLICATION ON YIELD ATTRIBUTES AND YIELD OF FINGER MILLET (*Eleusine coracana* (L.) GAERTN)

**KOMMADI SRAVANI[1], A. V. NAGAVANI[2], D. SUBRAMANYAM[3] AND A. PRASHANTHI[4]**

1, 2 & 3 Dept. of Agronomy, S.V. Agricultural College, ANGRAU, Tirupati – 517502. Chittoor (District), Andhra Pradesh. 4 Dept. of Soil Science and Agricultural Chemistry, S.V. Agricultural College, Tirupati.

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## ABSTRACT

A field experiment was conducted during *k harif* 2017 on sandy loam soil of S. V. Agricultural College wetland farm, Tirupati campus of Acharya N.G. Ranga Agricultural University to study the effect of zinc fertilization in combination with organic and inorganic sources of nutrients in finger millet. Yield attributes and yield was significantly influenced by the application of zinc in combination with either inorganics or integration of both inorganics and organics. Application of 100 per cent RDF through inorganics + Soil application of $ZnSO_4$ @ 50 kg $ha^{-1}$ produced significantly higher yield attributes (number of earheads $m^{-2}$, number of fingers $earhead^{-1}$, earhead length, earhead weight, grain weight $earhead^{-1}$and thousand grain weight) and yield (grain yield, straw yield and harvest index). However, it was comparable with application of 75 per cent RDF through inorganics + 25 per cent RDF through FYM + Soil application of $ZnSO_4$ @ 50 kg $ha^{-1}$ and both were significantly superior over the rest of the treatments tried.

**KEY WORDS:** Finger millet, zinc application, inorganics, organics, yield

## INTRODUCTION

Finger millet (*Eleusine coracana* (L.) Gaertn) is a major food crop of the semi-arid tropics of Asia and Africa and has been an indispensable component of dryland farming systems. It is recently re-emerging as a vital dietary food crop, owing to increased public awareness due to its high nutritional value, high fibre with proteins, minerals, essential amino acids in general and in particular to micronutrients availability. Finger millet is an excellent source of protein, fat and minerals (calcium, iron and phosphorous), relative to rice, corn and sorghum. The protein content of finger millet grain varies from 6 to 14 per cent with an average value of 7.3 per cent (Mbithi-Mwikya *et al*., 2002). It is a rich source of carbohydrates with estimated values of 70 to 76 per cent based on the whole grain.

Finger millet is being increasingly incorporated in breakfast cereals, beverages and infant foods which make it an important crop that deserves attention for fortification of its grain with zinc. Finger millet requires considerable amount of zinc for its growth and grain development. Increasing zinc concentration in food crops, results in better crop production and improved human health which is an important global challenge. Zinc deficiency reduces not only the yield and quality of grain but also nutritional quality of human diet. Agronomic manipulation (Ferti-fortification) is a quicker and faster approach to increase zinc concentration in finger millet. Agronomic fortification of zinc is the application of zinc nutrient rich fertilizers to soil or foliage to increase both grain yield and zinc concentration in edible crop parts and thus increases the intake of zinc by consumers (Carvalho and Vasconcelos, 2013; Chattha *et al.,* 2017). Agronomic fortification of crops is faster and quick rewarding for a country like India, where 48 per cent of soils are zinc deficient and good yield response of crops to zinc are reported from all over the country.

*Correspondingauthor,E-mail: kommadisravani61@gmail.com

## MATERIAL AND METHODS

The experiment was conducted during *kharif*, 2017 at S. V. Agricultural College wetland farm, Tirupati campus of Acharya N.G. Ranga Agricultural University. The soil of the experimental field was sandy loam in texture, slightly alkaline in soil reaction (pH 7.9), low in organic carbon (0.25 %) and available nitrogen (125 kg $ha^{-1}$), medium in available phosphorus (11.7 kg $ha^{-1}$) and available potassium (223.3 kg $ha^{-1}$) and sufficient in available zinc (1.02 mg $kg^{-1}$).

The experiment was laid out in Randomized Block Design (RBD) with eight treatments and replicated thrice. The treatment are $T_1$ (100% RDF through inorganics), $T_2$ (100% RDF through inorganics + Soil application of $ZnSO_4$ @ 50 kg $ha^{-1}$), $T_3$ (100% RDF through inorganics + Foliar nutrition of $ZnSO_4$ @ 0.5% twice at flowering), $T_4$ (100% RDF through Farmyard Manure), $T_5$ (100% RDF through FYM + Soil application of $ZnSO_4$ @ 50 kg $ha^{-1}$), $T_6$ (100% RDF through FYM + Foliar nutrition of $ZnSO_4$ @ 0.5% twice at flowering), $T_7$ (75% RDF through inorganics + 25% RDF through FYM + Soil application of $ZnSO_4$ @ 50 kg $ha^{-1}$) and $T_8$ (75% RDF through inorganics + 25% RDF through FYM + Foliar nutrition of $ZnSO_4$ @ 0.5% twice at flowering). The recommended dose of fertilizer is 60-40-30 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$.

FYM was applied on nitrogen equivalent basis, phosphorus and potassium are common to all the treatments. Farm yard manure was incorporated in marked plots as per treatments and its composition on dry basis was 0.51 per cent N, 0.25 per cent $P_2O_5$, 0.52 per cent $K_2O$. Fertilizer nitrogen was applied in two equal splits *i.e.* half at the time of transplanting and half at 30 days after transplanting. Entire dose of phosphorus and potassium were applied as basal at the time of transplanting. Zinc sulphate @ 50 kg $ha^{-1}$ was applied to soil as per the treatments at the time of transplanting, while foliar spray of zinc sulphate 0.5 per cent was applied twice at the time of flowering and ten days after flowering.

## RESULTS AND DISCUSSION

## YIELD ATTRIBUTES

Yield attributes *viz.,* number of earheads $m^{-2}$, number of fingers $earhead^{-1}$, earhead length, earhead weight, grain weight $earhead^{-1}$, thousand grain weight (Table 1) were significantly higher under $T_2$ (100% RDF through inorganics + Soil application of $ZnSO_4$ @ 50 kg $ha^{-1}$). However, it was comparable with $T_7$ (75% RDF through inorganics + 25% RDF through FYM + Soil application of $ZnSO_4$ @ 50 kg $ha^{-1}$). The yield attributes were at their lowest with $T_4$ (100% RDF through Farmyard Manure).

Zinc plays an important role in nitrogen metabolism and formation of chlorophyll and carbohydrate, which helps in maintaining photosynthetic activity for longer period and finally results in increased yield attributes of the crop (Mehta *et al.,* 2008; Pratap *et al.,* 2008). Zinc improved the yield attributes by improving the source and sink relationship through increased translocation of photosynthates towards reproductive system (Sammauria and Yadav, 2010).

Higher production of photosynthates due to sufficient assimilation of nutrients helps in vigorous plant growth, synthesis and translocation of carbohydrates to the reproductive parts and developing ears which resulted in better grain filling and grain weight leading to increased yield components (Chakraborty *et al.,* 2012).

## YIELD

Among the different nutrient management practices, higher grain yield, straw yield and harvest index (Table 2) was obtained with $T_2$ (100% RDF through inorganics + Soil application of $ZnSO_4$ @ 50 kg $ha^{-1}$), which was however, comparable with $T_7$ (75% RDF through inorganics + 25% RDF through FYM + Soil application of $ZnSO_4$ @ 50 kg $ha^{-1}$). The lowest grain yield, straw yield and harvest index of finger millet was obtained with $T_4$ (100% RDF through Farmyard Manure).

Participation of zinc in biosynthesis of indole acetic acid (IAA) and its role in initiation of primordial reproductive parts and translocation of photosynthates towards them are responsible for increased yield (Takaki and Kushizaki, 1970). Jyung *et al.* (1975) emphasized the role of zinc in starch formation owing to its influence on activity of starch synthetase enzyme and the author opined this mechanism as a possible reason for increase in grain yield. The increased yield due to zinc addition would be mainly due to the involvement of zinc in metalloenzyme system, regulatory functions and in auxin production. The favourable influence of applied zinc on yield may be due to its catalytic or stimulatory effect on most of the physiological and metabolic processes in plants (Mandal *et al.,* 2009).

The increase in straw yield might be attributed to continuous and uniform availability of both macro and micro nutrients at different phenological stages of crop, which improved the plant height, leaf area index, dry matter production contributing to the highest straw yield. Similar findings were reported by Vandana *et al.* (2009), Arulmozhiselvan *et al.* (2013) and Singh *et al.* (2014).

## CONCLUSION

In conclusion, it can be inferred from the investigation that though the performance of finger millet interms of productivity and profitability was found to be higher with 100 per cent RDF through inorganics + soil application of $ZnSO_4$ @ 50 kg ha$^{-1}$, keeping in view of sustainable soil fertility and availability of organics, application of 75 per cent RDF through inorganics + 25 per cent RDF through FYM + soil application of $ZnSO_4$ @ 50 kg ha$^{-1}$ seems to be promising, since decrease in yield and economic returns was not significant and have performed nearly equal with that of 100 per cent RDF through inorganics + soil application of $ZnSO_4$ @ 50 kg ha$^{-1}$.

Hence, it is recommended that 75 per cent RDF through inorganics + 25 per cent RDF through FYM + soil application of $ZnSO_4$ @ 50 kg ha$^{-1}$ is the best option for obtaining higher yield attributes and yield of finger millet for Southern Agro climatic zone of Andhra Pradesh.

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**Table 1. Yield attributes of finger millet as influenced by zinc fertilization practices**

| Treatments | Number of earheads $m^{-2}$ | Number of fingers $earhead^{-1}$ | Earhead length (cm) | Earhead weight (g) | Grain weight $earhead^{-1}$ (g) | 1000 grain weight (g) |
|---|---|---|---|---|---|---|
| **$T_1$ :** 100 per cent RDF through inorganics (60-40-30 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$) | 70.0 | 9.70 | 7.77 | 8.43 | 3.97 | 3.33 |
| **$T_2$ :** 100 per cent RDF through inorganics + Soil application of $ZnSO_4$ @ 50 kg $ha^{-1}$ | 78.0 | 11.00 | 9.00 | 9.90 | 4.37 | 3.60 |
| **$T_3$ :** 100 per cent RDF through inorganics + Foliar nutrition of $ZnSO_4$ @ 0.5 per cent twice at flowering | 74.7 | 10.00 | 8.00 | 8.80 | 4.13 | 3.50 |
| **$T_4$ :** 100 per cent RDF through Farmyard Manure (FYM*) | 54.0 | 8.40 | 6.80 | 6.70 | 3.40 | 2.77 |
| **$T_5$ :** 100 per cent RDF through FYM + Soil application of $ZnSO_4$ @ 50 kg $ha^{-1}$ | 57.3 | 8.70 | 6.93 | 7.30 | 3.50 | 2.93 |
| **$T_6$ :** 100 per cent RDF through FYM + Foliar nutrition of $ZnSO_4$ @ 0.5 per cent twice at flowering | 56.0 | 8.53 | 6.87 | 7.00 | 3.47 | 2.87 |
| **$T_7$ :** 75 per cent RDF through inorganics + 25 per cent RDF through FYM + Soil application of $ZnSO_4$ @ 50 kg $ha^{-1}$ | 76.7 | 10.90 | 8.87 | 9.67 | 4.30 | 3.53 |
| **$T_8$ :** 75 per cent RDF through inorganics + 25 per cent RDF through FYM + Foliar nutrition of $ZnSO_4$ @ 0.5 per cent twice at flowering | 72.7 | 9.83 | 7.90 | 8.53 | 4.00 | 3.43 |
| **SEm ±** | 2.68 | 0.28 | 0.24 | 0.25 | 0.15 | 0.10 |
| **CD (P = 0.05)** | 8.1 | 0.85 | 0.73 | 0.77 | 0.44 | 0.30 |

***FYM was applied on nitrogen equivalent basis**

**Table 2. Grain yield, Straw yield and Harvest index of finger millet as influenced by zinc fertilization practices**

| Treatments | Grain yield (kg ha$^{-1}$) | Straw yield (kg ha$^{-1}$) | Harvest index (%) |
|---|---|---|---|
| **$T_1$ :** 100 per cent RDF through inorganics (60-40-30 kg N, $P_2O_5$ and $K_2O$ ha$^{-1}$) | 2556 | 4347 | 37.0 |
| **$T_2$ :** 100 per cent RDF through inorganics + Soil application of $ZnSO_4$ @ 50 kg ha$^{-1}$ | 3354 | 4986 | 40.2 |
| **$T_3$ :** 100 per cent RDF through inorganics + Foliar nutrition of $ZnSO_4$ @ 0.5 per cent twice at flowering | 2778 | 4472 | 38.3 |
| **$T_4$ :** 100 per cent RDF through Farmyard Manure (FYM*) | 1875 | 3806 | 33.0 |
| **$T_5$ :** 100 per cent RDF through FYM + Soil application of $ZnSO_4$ @ 50 kg ha$^{-1}$ | 1958 | 3917 | 33.3 |
| **$T_6$ :** 100 per cent RDF through FYM + Foliar nutrition of $ZnSO_4$ @ 0.5 per cent twice at flowering | 1917 | 3861 | 33.2 |
| **$T_7$ :** 75 per cent RDF through inorganics + 25 per cent RDF through FYM + Soil application of $ZnSO_4$ @ 50 kg ha$^{-1}$ | 3153 | 4903 | 39.2 |
| **$T_8$ :** 75 per cent RDF through inorganics + 25 per cent RDF through FYM + Foliar nutrition of $ZnSO_4$ @ 0.5 per cent twice at flowering | 2625 | 4403 | 37.4 |
| **SEm ±** | 102.8 | 132.4 | 1.09 |
| **CD (P = 0.05)** | 312 | 402 | 3.3 |

***FYM was applied on nitrogen equivalent basis**