Asian Jr. of Microbiol. Biotech. Env. Sc. Vol. 23, No. (2) : 2021 : 265-268

ISSN-0972-3005

EFFECT OF FOLIAR APPLICATION OF IRON AND ZINC ON GROWTH AND YIELD OF FINGER MILLET (*ELEUSINE CORACANA* L)

SAI DIVYA. B[1*], RAJESH SINGH[2] AND WASIM KHAN[3]

Department of Agronomy, Naini Agriculture Institute, SHUATS, Prayagraj 211 007, Uttar Pradesh, India

(Received 13 March, 2021; Accepted 10 April, 2021)

Key words: *Finger millet, Iron, Zinc, yield, Economics*

Abstract – A field experiment was conducted during *kharif* season 2020 at CRF (Crop research Farm), Department of Agronomy, SHUATS, Prayagraj, (UP.). The soil of the experimental field is sandy loam in texture, low in organic carbon and medium available nitrogen, phosphorus and low in potassium. The treatments consisted Zinc (through foliar application) *viz.,* 0.2% $ZnSO_4$, 0.4% $ZnSO_4$ and 0.6% $ZnSo_4$ and (Iron through foliar application) are given at 20,40,60 Days interval viz., Control, 0.2% $FeSO_4$ and 0.5% FeSO4 whose effect is observed A field experiment was conducted during kharif 2020 at CRF (Crop Research in finger millet (MR-1). The experiment was laid out in Randomized Block Design with ten treatments replicated thrice the treatment with application of 0.6% $ZnSO_4$+0.5% $FeSO_4$ recorded significantly higher plant height (82.9cm), number of tillers/plant (7.87), plant dry weight (22.1g), effective tillers/plant (6.68), grain yield (3.93t/ha) and stover yield (6.03 t/ha) also recorded highest in the treatment 0.6% $ZnSO_4$+ 0.5% $FeSO_4$.

INTRODUCTION

Finger millet is vital small millet grown in India. It is staple food in many hilly regions of the country. It is grown both grain and forage grains are rich in minerals and are the richest source of calcium used in many preparations. Finger millet (*Eleusine coracana* L) is a crucial small millet crop grown in India and has the pride of place characterized by highest productivity among millets. Small-seeded grains belonging to different variety of annual grasses that are cultivated primarily as grain crops on marginal lands in dry areas in temperate, subtropical and tropical regions are collectively referred as millets. They are the foremost important cereals of semi-arid zones of the planet and are staple food for many people in Africa and Asia, (Thippeswamy *et al.,* 2016). Finger millet was domesticated in western Uganda and the Ethiopian highlands at least 5000 years ago before introduction to India approximately 3000 years ago (Dida *et al*., 2008), It is called ragi , because the inflorescence resembles the fingers of a person's hand. Finger millet is locally referred to as ragi and mandua (India). Ragi is usually referred to as "Nutritious millet" because the grain is nutritionally superior to several cereals (rice, corn and sorghum) providing proteins, minerals, iron, calcium and vitamins in abundance. When consumed as food, it provides a sustaining diet, especially for people doing diligence. Straw makes valuable fodder for both draught and milch animals. Finger millet is taken into account as wholesome food for diabetic patients. Grain can also be malted and flour of the malted grain is employed as cakes or porridge and a nourishing food for infants and invalids (Chaturvedi and Srivastava, 2008). Since the advent of green revolution in Asia, cultivation of yielding genotypes, improved agricultural mechanization and production of macronutrient fertilizers with low impurities of trace elements has resulted in higher crop yields per unit area with greater depletion of plant available micronutrients. Deficiencies of vitamin A, iron and iodine are widespread in developing countries including India. Zinc deficiency is now recognized together of the foremost 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 defence factor in detoxification of highly toxic oxygen free radicals (Andreini *et al.,* 2009). Camark (2008), 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 flowers of zinc 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). Iron is an essential plant nutrient required for electron transport in photosynthesis. Increased cropping intensity coupled with changes in the soil and fertilizer management practices have altered the iron status and availability. Further, iron deficiency is more severe in calcareous soils with low Fe availability due to high soil pH Cropping systems of 200 to 300% intensity deplete the soil iron due to higher crop production. Thus, Fe deficiency is aggravated further as farmers don't apply it externally and its mining occurs. However, application of iron fertilizers may overcome its deficiency in soil and increase crop yields which will subsequently increase crop productivity and income of the farmers (Vikash *et al.,* 2015).

MATERIALS AND METHODS

The experiment was conducted during the *Kharif* season of 2020 at the Crop Research Farm, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Allahabad. The Crop Research Farm is situated at 250 57′ N latitude, 870 19′ E longitudes and at an altitude of 98 m above mean sea level. This area is situated on the proper side of the river Yamuna and by the other side of Allahabad City. All the facilities required for crop cultivation were available. The field trail was randomized block design with consisted of 10 treatments replicated thrice viz., T1: control (RDF),T2:0.2% Zinc sulphate + control, T3:0.2% Zincsulphate+0.2 ferrous sulphate, T4:0.2% Zincsulphate+0.5% Ferrous sulphate, T5:0.4% Zinc sulphate+control, T6:0.4% Zinc sulphate+0.5 ferrous sulphate, T7:0.4% Zinc sulphate+0.5 ferrous sulphate,T8:0.6% Zincsulphate+control, T9:0.6% Zinc sulphate+0.2% Ferrous sulphate, T10:0.6% Zinc sulphate +05% Ferrous sulphate. Finger millet was sown at the spacing of 22.5cm×8cm using a seed rate of 10 kg/ha. Iron and Zinc are given in the form of (ferrous sulphate and zinc sulphate) through foliar application at intervals of 20,40 and 60DAS Finger millet variety MR-1 was used during kharif season 2020.The Recommended dose of fertilizer is 60:30:30kg/ha NPK. Recommended dose of fertilizer was applied at the time of sowing in the form of urea, DAP and MOP the growth parameters were recorded at periodic intervals 20,40,60,80,100 DAS and at harvest from randomly selected plants from each treatment.

Chemical analysis of soil

collected soil samples were analyzed for organic carbon by rapid titration method (Sparks, 1996), Available nitrogen was estimated by alkaline permanganate method by Subbiah and Asija (1956), available phophorus by Olsen's method as outlined by Jackson (1973), available potassium was determined by using the flame photometer normal ammonium acetate solution and estimating by using flame photometer (ELICO Model) as outlined by Jackson (1973) and available $ZnSO_4$ was estimated by Atomic Absorption Spectrophotometer method as outlined by Lindsay and Norvell (1978).

Statistical analysis

The data recorded were different characteristics were subjected to statistical analysis by adopting Fishers the method of analysis of variance (ANOVA) as described by Gomez and Gomez (2010). Critical difference (CD) values were calculated the 'F' test was found significant at 5% level.

RESULTS AND DICUSSION

The present investigation was carried out at the crop Research Farm SHUATS to assethe effect of foliar application of Iron and zinc on finger millet through foliar application

Growth Parameters

Data present in the present Table 1. The results of the present investigation revealed that 0.6% $ZnSO_4$+0.5% $FeSO_4$, through foliar application significantly increased the plant height (89.2cm) at harvest stage as compared to all treatmentswhich was significantly at par with 0.6% $ZnSO_4$+0.2% $FeSO_4$ (83.2cm), Minimum plant height was recorded with control RDF (80.3 cm), Basically the

plant height was genetically controlled character but several studies indicated that plant height influenced by Iron and zinc. The foliar spray of Iron and Zinc increased the plant height. Satisha *et al.,* (2019) observed that change in levels and methods of application of zinc and iron from soil application to foliar application, the plant height gradually increased, which might be attributable to greater photosynthetic activity and chlorophyll synthesis due to Zn and iron fertilization resulted into better vegetative growth. The maximum dry weight was recorded in treatment 0.6% $ZnSO_4$+0.5% $FeSo_4$ through foliar application recorded highest at harvest (22.1g) as compared to all treatments in Table 1. Increase in plant dry weight might be attributed to the optimum and uniform availability of micronutrients in the entire growth period by means of application of nutrients through the soil. There was increased dry weight at successive stages of growth, with the Zinc and iron application according to earlier findings of Elayaraja and Singaravel (2012). The maximum number of tillers (7.87) was observed in 0.6% $Znso_4$+0.5% $Feso_4$ through foliar application it might due to the application of Zinc significantly affected total number of tillers. Increase in tillers/m^2 might be ascribed to adequate supply of Zn that might have increased the uptake and availability of other essential nutrients, which resulted in improvement of plant metabolic activities and finally increased the crop growth according to Pradhan *et al.,* (2016).

YIELD ATTRIBUTES AND YIELD

Grain Yield (t/ha), Biological Yield (t/ha), and Harvestindex (%)

Maximum No of effective tillers, Test weight, grain yield, biological yield and harvest index is presented in Table 2 Treatment with 0.6% $ZnSO_4$+0.5% $FeSO_4$ through foliar spray was recorded maximum No of effective tillers (6.68), Test weight (3.77g), Grain yield (3.93 t/ha), biological yield (6.03 t/ha), Harvest Index% (39.44). Increase on all grain yield parameters and biological yield when Zn and Fe were sprayed on foliage at tillering stage at Finger millet. Foliar application with Micro nutrients (Fe, B and Zn) might be due to their critical role in plant growth, involving in photosynthesis processes, respiration and other biochemical and physiological activities according to Zeidan *et al.,* (2010) and also Zinc have stimulating effect to increase in these growth characters was probably due to action of Zn in auxin metabolism, which leads to higher Hormonal activity at crop growth stages (Ghatak *et al.,* 2005). Application of $ZnSO_4$@10 kg/ha and iron Foliar @0.5% applications attained healthy and vigorous growth of crop, more seed setting and increased seed weight specially Zinc and Iron involved in increased synthesis enzymes like auxine biosynthesis Guggari *et al.,* (1995).

CONCLUSION

The present study clearly showed that the Foliar application of 0.6% $ZnSO_4$+0.5% $FeSO_4$ this leads to higher grain yield compare to the control (RDF). It can be concluded that for obtaining higher yield components with better quality of finger millet

Table 1. Effect of foliar application of Iron and Zinc on growth and yield of Finger Millet

Treatments	Growth Parameters		
	Plant Height (Cm.)	Dry weight (gm.)	No of tillers/plant
T1: Control (RDF)	80.3	18.8	6.13
T2: 0.2% Zinc sulphate + control	80.0	19.6	6.39
T3: 0.2% Zinc sulphate + 0.2% Ferrous sulphate	80.5	19.5	6.57
T4: 0.2% Zinc sulphate + 0.5% Ferrous sulphate	81.1	21.0	7.11
T5: 0.4% Zinc sulphate + control	81.0	20.1	6.86
T6: 0.4% Zinc sulphate + 0.2% Ferrous sulphate	80.7	20.7	7.25
T7: 0.4% Zinc sulphate + 0.5% Ferrous sulphate	81.9	21.2	7.44
T8: 0.6% Zinc sulphate + control	80.3	20.4	6.97
T9: 0.6% Zinc sulphate + 0.2% Ferrous sulphate	82.3	21.8	7.62
T10: 0.6% Zinc sulphate + 0.5% Ferrous sulphate	82.9	22.1	7.87
SEm (±)	0.38	0.23	0.09
CD (P=0.05)	1.13	0.69	0.29

Table 2. Effect of foliar application of Iron and Zinc on Growth and yield of Finger millet

Treatments	Yield Paramerts				
	Effective Tillers/plant	Test weight (g)	Grain yield (t/ha)	Stover yield t/ha	Harvest Index (%)
T1: Control (RDF)	5.31	3.77	3.27	5.47	37.54
T2: 0.2% Zinc sulphate + control	5.68	3.57	3.37	5.33	38.71
T3: 0.2% Zinc sulphate + 0.2% Ferrous sulphate	6.10	3.67	3.51	5.53	38.82
T4: 0.2% Zinc sulphate + 0.5% Ferrous sulphate	6.41	3.63	3.57	5.63	38.78
T5: 0.4% Zinc sulphate + control	5.90	3.73	3.53	5.64	38.50
T6: 0.4% Zinc sulphate + 0.2% Ferrous sulphate	6.41	3.57	3.70	5.76	39.11
T7: 0.4% Zinc sulphate + 0.5% Ferrous sulphate	6.42	3.67	3.67	5.77	38.87
T8: 0.6% Zinc sulphate + control	6.16	3.67	3.44	5.56	38.22
T9: 0.6% Zinc sulphate + 0.2% Ferrous sulphate	6.35	3.67	3.84	5.90	39.43
T10: 0.6% Zinc sulphate + 0.5% Ferrous sulphate	6.68	3.77	3.93	6.03	39.44
SEm (±)	0.15	0.06	0.05	0.05	0.15
CD (P=0.05)	0.46	0.19	0.17	0.16	0.46

foliar spray of Iron and Zinc was found more effective. This is due to proper metabolism and major source of providing nutrition, better cellular processes.

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