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Effect of zinc and iron ferti-fertification on growth, yield and economics of baby corn (*Zea mays* L.)

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Abstract
A field experiment was conducted during *Kharif*, 2017 to study the effect zinc and iron as soil and foliar application on growth, yield and economics of baby corn at IFS Unit, MARS, Raichur, Karanataka. The experiment consisted of ten treatments and laid out in Randomized Complete Block Design with three replications. The results revealed that significantly higher plant height (201.96 cm), leaf area (80.92dm^2 plant^{-1}), total dry matter (132.95g plant^{-1}), green cob (14.12 t ha^{-1}) and stover yield (29.42 t ha^{-1}), gross returns (Rs. 241278 ha^{-1}), net returns (Rs.199127 ha^{-1}) and B:C (4.72) with soil application of $ZnSO_4$ @ 25 kg ha^{-1}, foliar application of $ZnSO_4$ @ 0.5 %, soil application of $ZnSO_4$ @ 25 kg ha^{-1} + foliar application of $ZnSO_4$ @ 0.5 % which shows on par result with soil application of $ZnSO_4$ @ 25 kg ha^{-1} and $FeSO_4$ @ 10 kg ha^{-1} and soil application of $ZnSO_4$@ 25 kg ha^{-1} + foliar application of $ZnSO_4$ @ 0.5%. Application of both zinc and iron as soil and foliar significantly increase growth and yield of baby corn as compared to control.

Keywords: Zinc, Iron, foliar application and baby corn

Introduction
Baby corn, unfertilized young cob harvested 2-3 days after silk emergence. Now a day's baby corn is attracting people's preference as vegetable due to enhancement of standard of living and shift in dietary habit from non-vegetarian to vegetarian. Growth and development of the crop plants are directly related to their genetic constitution, though environmental factors and cultural practices do influence it through their direct and indirect impact on different metabolic process of the plants. Thus, agricultural production being consequence of an integrated interaction effect of soil-water-fertilizer-climate continuum, which requires a wise full and scientific management of this complex system and this is quite crucial for enhancing crop productivity on sustainable basis. Among the various inputs, mineral nutrition of plants is the key input for making maximum contribution of crop productivity. Therefore, there is prompt effort to increase and stabilize crop production but also to enhance the nutrient use efficiency, which shows great influence on crop production. The productivity of baby corn entirely depends on extent of successful completion of crop growth for exploiting their full genetic potential and properly integrated with environmental conditions in which it is grown. However, role of balanced and adequate nutrition is recognized as one of the important factors in realizing the maximum yield of baby corn. Role of micronutrients (zinc & iron) for effective progression of plant ontogeny and crop yield improvement need to be studied on growth and yield of the baby corn.

Material and Methods
A field experiment was conducted under protective irrigation during *Kharif*, 2017 at IFS unit, MARS, UAS, Raichur. The experiment was comprised of 10 treatments *viz*., soil application of $ZnSO_4$@ 25 kg ha^{-1}, foliar application of $ZnSO_4$ @0.5 %, soil application of $ZnSO_4$@ 25 kg ha^{-1}+ foliar application of $ZnSO_4$ @ 0.5 %, soil application of $FeSO_4$ @ 10 kg ha^{-1}, foliar application of $FeSO_4$ @0.5 %, soil application of $FeSO_4$@ 10 kg ha^{-1}+foliar application of $FeSO_4$ @0.5 %, soil application of $ZnSO_4$@ 25 kg ha^{-1} and $FeSO_4$ @ 10 kg ha^{-1}, foliar application of $ZnSO_4$ and $FeSO_4$@ 0.5 % each, soil application of $ZnSO_4$@ 25 kg ha^{-1} and $FeSO_4$ @ 10 kg ha^{-1}+ Foliar application of $ZnSO_4$and $FeSO_4$@ 0.5 % each and was Control (RDF) (150:75:37.5 of NPK) was laid out in Randomized Complete Block Design (RCBD) with three replications. Sowing was done by placing the seeds and maintaining 45 cm x 20 cm spacing using rope. Half of recommended dose of nitrogen, entire dose of phosphorus and potassium in the form of urea, diammonium phosphate and muriate of potash, respectively to

all the treatments. Zinc as $ZnSO_4$ @ 25 kg ha^{-1} and iron as $FeSO_4$ @ 10 kg ha^{-1} were applied to the respective plots as per the treatments at the time of sowing. Foliar application of 0.5 % $ZnSO_4$ and $FeSO_4$ each at 30 and 45 DAS were applied as per the treatments. Zinc and iron each @ 1.35 kg ha^{-1} and lime at 0.70 kg were dissolved in 350 litres of water and sprayed through knapsack sprayer. Solution was sprayed uniformly on surface of the leaves. Fertilizers were applied 4-5 cm deep and 5 cm away from the seed as a basal dose. Nitrogen 25 percent in the form of urea was top dressed at knee height stage and pre tassel stage. Growth and yield parameters were recorded from five randomly selected plants in each treatment; green cob and stover yield (kg $plot^{-1}$) was calculated from whole plot and converted into kg ha^{-1}, besides economics were worked out.

Results and Discussion

The results obtained were significantly differed with zinc and iron fertilization treatments. Growth attributes *viz.,* plant height, leaf area and dry matter production of baby corn differed significantly due to zinc and iron fertilization (Table 1). Soil application of $ZnSO_4$@ 25 kg ha^{-1} and $FeSO_4$ @ 10 kg ha^{-1} + foliar application of $ZnSO_4$ and $FeSO_4$@ 0.5 % each (T_{10}) recorded higher growth attributes *i.e.* higher plant (cm), leaf area (dm^2) and dry matter production (g $plant^{-1}$) (201.96, 80.92 and 132.95, respectively) which was on par with soil application of $ZnSO_4$@ 25 kg ha^{-1} and $FeSO_4$ @ 10 kg ha^{-1} (T_8) (200.50, 79.86 and 131.51, respectively) and soil application of $ZnSO_4$@ 25 kg ha^{-1} + foliar application of $ZnSO_4$ @ 0.5% (T_4) (191.92, 76.65 and 130.84, respectively). Whereas control (T_1) treatment resulted lower growth attributes. Similar finding were reported by Pareek *et al.* (2009) [1], Tiwana and Chaudhary (2009) [4]. Significant increase in plant height was observed due to soil and foliar application of zinc and iron along with RDF was probably due to increase in cell, cell enlargement, internodal elongation and plant metabolism there by promoting vegetative growth which is positively correlated to the productive potentiality of plant and corroborates with the results of Rakesh kumar and Bohra (2014) [2].

Higher yield of green cob and stover yield of baby corn (Table 2) was found with soil application of $ZnSO_4$@ 25 kg ha^{-1} and $FeSO_4$ @ 10 kg ha^{-1} + foliar application of $ZnSO_4$ and $FeSO_4$@ 0.5 % each (T_{10}) (14.12 and 29.42 t ha^{-1}, respectively) which was on par with soil application of $ZnSO_4$@ 25 kg ha^{-1} and $FeSO_4$ @ 10 kg ha^{-1}(T_8) (13.38 and 27.98 t ha^{-1}, respectively) and soil application of $ZnSO_4$@ 25 kg ha^{-1} + foliar application of $ZnSO_4$ @ 0.5% (T_4) (12.83 and 27.59 t ha^{-1}, respectively). The increase in the yield could be due to favourable nutritional environment in rhizosphere and continuous supply of micronutrients (Zn and Fe) to the crop and higher absorption of nutrients by plant (Yadav and Chhipa, 2007) [5] which influence photosynthesis, assimilation and translocation of photosynthates from source (leaves) to sink (cob).

The higher gross returns, net returns and benefit cost ratio (Rs. 241278 ha^{-1}, 199127 $ha^{-1}$and 4.72, respectively) (Table 3) were obtained with soil application of $ZnSO_4$@ 25 kg ha^{-1} and $FeSO_4$ @ 10 kg ha^{-1} + foliar application of $ZnSO_4$ and $FeSO_4$@ 0.5 % each (T_{10}) followed by soil application of $ZnSO_4$@ 25 kg ha^{-1} and $FeSO_4$ @ 10 kg ha^{-1} (Rs. 228738 ha^{-1}, 188254 ha^{-1} and 4.65, respectively) (T_8) and soil application of $ZnSO_4$@ 25 kg ha^{-1} + foliar application of $ZnSO_4$ @ 0.5 % (Rs. 219981 ha^{-1}, 178010 ha^{-1} and 4.24, respectively) (T_4). While lowest gross return, net return and benefit cost ratio is observed in control (T_1). These results are positively corroborated with findings of Singh *et al.,* 2010 [3] and Rakesh kumar and Bohra (2014) [2].

From this study, it was inferred that combined application zinc and iron gives better result. Mean-while soil and foliar application these micronutrients along with recommend dose of fertilizer gives higher growth and yield of baby corn.

Table 1: Plant height, leaf area and dry matter production of baby corn as influenced by zinc and iron fertilization

Treatment	Plant height (cm)	Leaf area (dm^2)	Dry matter production (g $plant^{-1}$)
T_1: Control (RDF)	168.96	64.54	108.91
T_2: Soil application of $ZnSO_4$@ 25 kg ha^{-1}	185.09	71.01	127.78
T_3: Foliar application of $ZnSO_4$ @ 0.5 %	174.79	68.80	120.28
T_4: Soil application of $ZnSO_4$@ 25 kg ha^{-1} +Foliar application of $ZnSO_4$ @ 0.5%	191.92	76.65	130.84
T_5: Soil application of $FeSO_4$ @ 10 kg ha^{-1}	180.67	70.25	115.62
T_6: Foliar application of $FeSO_4$ @ 0.5 %	180.76	68.31	113.14
T_7: Soil application of $FeSO_4$@ 10 kg ha^{-1} +Foliar application of $FeSO_4$ @ 0.5 %	187.42	70.76	118.17
T_8: Soil application of $ZnSO_4$@ 25 kg ha^{-1} and $FeSO_4$ @ 10 kg ha^{-1}	200.50	79.86	131.51
T_9: Foliar application of $ZnSO_4$ and $FeSO_4$@ 0.5 % each	188.00	70.95	122.24
T_{10}: Soil application of $ZnSO_4$@ 25 kg ha^{-1} and $FeSO_4$ @ 10 kg ha^{-1} + Foliar application of $ZnSO_4$ and $FeSO_4$@ 0.5 % each	201.96	80.92	132.95
S. Em±	3.48	2.41	1.19
LSD(0.05)	10.35	7.16	3.53

Table 2: Green cob, stover yield and harvest index of baby corn as influenced by zinc and iron fertilization

Treatment	Green cob yield (t ha^{-1})	Green stalk yield (t ha^{-1})	Harvest index
T_1: Control (RDF)	9.91	22.38	30.63
T_2: Soil application of $ZnSO_4$@ 25 kg ha^{-1}	11.37	26.97	29.62
T_3: Foliar application of $ZnSO_4$ @0.5 %	11.01	23.35	32.02
T_4: Soil application of $ZnSO_4$@ 25 kg ha^{-1} +Foliar application of $ZnSO_4$ @ 0.5%	12.83	27.59	31.73
T_5: Soil application of $FeSO_4$ @ 10 kg ha^{-1}	10.72	25.28	29.77
T_6: Foliar application of $FeSO_4$ @0.5 %	11.34	24.34	31.67
T_7: Soil application of $FeSO_4$@ 10 kg ha^{-1} +Foliar application of $FeSO_4$ @0.5 %	11.29	25.91	30.22
T_8: Soil application of $ZnSO_4$@ 25 kg ha^{-1} and $FeSO_4$ @ 10kg ha^{-1}	13.38	27.98	32.33
T_9: Foliar application of $ZnSO_4$ and $FeSO_4$@ 0.5 % each	11.37	26.36	30.12
T_{10}: Soil application of $ZnSO_4$@ 25 kg ha^{-1} and $FeSO_4$ @ 10 kg ha^{-1} + Foliar application of $ZnSO_4$ and $FeSO_4$@ 0.5 % each	14.12	29.42	32.44
S. Em±	0.69	0.69	1.18
LSD(0.05)	2.06	2.05	NS

Table 3: Economics of baby corn as influenced by zinc and iron fertilization

Treatment	Cost of cultivation (Rs. ha^{-1})	Gross return (Rs. ha^{-1})	Net return (Rs. ha^{-1})	B:C ratio
T_1: Control (RDF)	39789	171015	131227	3.30
T_2: Soil application of $ZnSO_4$@ 25 kg ha^{-1}	40364	197455	157092	3.89
T_3: Foliar application of $ZnSO_4$ @0.5 %	41396	188475	147080	3.55
T_4: Soil application of $ZnSO_4$@ 25 kg ha^{-1} +Foliar application of $ZnSO_4$ @ 0.5%	41971	219981	178010	4.24
T_5: Soil application of $FeSO_4$ @ 10 kg ha^{-1}	39909	186144	146236	3.66
T_6: Foliar application of $FeSO_4$ @0.5 %	41341	194448	153107	3.70
T_7: Soil application of $FeSO_4$@ 10 kg ha^{-1} +Foliar application of $FeSO_4$ @0.5 %	41461	195240	153779	3.71
T_8: Soil application of $ZnSO_4$@ 25 kg ha^{-1} and $FeSO_4$ @ 10kg ha^{-1}	40484	228738	188254	4.65
T_9: Foliar application of $ZnSO_4$ and $FeSO_4$@ 0.5 % each	41456	196849	155393	3.75
T_{10}: Soil application of $ZnSO_4$@ 25 kg ha^{-1} and $FeSO_4$ @ 10 kg ha^{-1} + Foliar application of $ZnSO_4$ and $FeSO_4$@ 0.5 % each	42151	241278	199127	4.72
S. Em±	-	-	10675	0.26
LSD(0.05)	-	-	31715	0.77

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