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EFFECT ON SOIL FERTILITY WITH ZINC AND IRON FERTILIZATION IN MAIZE (*ZEA MAYS* L.)

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ABSTRACT

An experiment was conducted during *Kharif* season at SVPUAT, Meerut, to know the effect of Zinc and Iron on the soil fertility under the maize. The experiment consisted of eight treatments viz.,T_1, Control (NPK 120:60:60); T_2, T_1 + Soil applied Zn and Fe each@ 5 kg/ha; T_3, T_1 + Soil applied Zn and Fe each@ 10 kg/ha; T_4, T_1+Soil applied Zn and Fe each@ 20 kg/ha; T_5, T_1 + Soil applied Zn and Fe each @10 kg/ha + vermicompost (1.5 t/ha); T_6, T_1 + Vermicompost @ 1.5 t/ha; T_7, T_1+Soil applied Zn and Fe each @ 5 kg/ha + foliar spray each @ 0.1% at tasseling stage; T_8, T_1+Foliar spray Zn and Fe each @ 0.1% at 25 DAS and at tasseling stage in Randomize Block Design with three replications. After harvesting the slight variation was observed in availability of N, P, K, Zn, Fe and OC. Availability improved over their initial value, with additional application of vermicompost over NPK. The maximum available NPK and OC recorded with the application of T_5 (T_1 + Soil applied Zn and Fe each @10 kg/ha + vermicompost 1.5 t/ha) was found significantly higher than all treatments except T_6. The maximum DTPA extractable zinc and iron was recorded with the application of T_4 (T_1+Soil applied Zn and Fe each@ 20 kg/ha). The pH and EC had no effect on soil fertility by different treatments. Therefore, soil application of NPK, Zn, Fe and vermicompost increased the soil NPK, Zn, Fe and OC.

***Keywords*: EC, Iron, Maize, Vermicompost and Zinc**

Introduction

Maize (*Zea mays* L.) is one of the world's mainly essential cereal crops, after wheat and rice, and is grown extensively in India. As it is a C_4 plant, it has a very high yielding potential, therefore it is regarded as the miracle crop and the queen of cereals, following rice and wheat, maize is the most significant food crop with the average productivity of 2.96 t ha^{-1}. Maize can be cultivated effectively on a wide range of soils, as of loamy sand near clay loam. Soils among high organic matter substance, a high-water holding capability, and neutral pH are ideal for better production. Maize can be harvested in all season, including the monsoon, post-monsoon, wintry weather, and spring. This is partially attributed to less whole food intake and nutritional diversity in sub-Saharan Africa poorer soil quality, and fewer options for top soil fertility managing in small holder systems. Plants absorb zinc

(Zn) as the divalent Zn^{2+} cation. It was one of the first micronutrients identified as required for plants and is frequently cited as a limiting factor in increasing production. Zinc, in general, impacts protein synthesis in plants and is hence regarded as the most important micronutrient. Zinc deficiency is a common agricultural problem, especially in high pH soils with low zinc levels. Iron is a micronutrient that is necessary by practically all livelihood creatures since it is concerned in metabolic actions such as DNA synthesis, photosynthesis and respiration. The basic causes of iron chlorosis are an imbalance between the solubility of iron in soil and the plant life need for iron. In India, a study of 2.52 lakh surface soil samples obtained from various sections of the country found that zinc deficiency was prevalent in diverse soils (Vasuki, 2010).

Material and Methods

An experiment was conducted at meteorological observatory, Department of Soil Science and Agricultural Chemistry of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P), during 2017-18 under M.Sc. degree programme. The experiment consist of 8 treatment viz., T_1, Control (NPK 120:60:60); T_2, T_1 + Soil applied Zn and Fe each@ 5 kg/ha; T_3, T_1 + Soil applied Zn and Fe each@ 10 kg/ha; T_4, T_1+Soil applied Zn and Fe each@ 20 kg/ha; T_5, T_1 + Soil applied Zn and Fe each @10 kg/ha + vermicompost (1.5 t/ha); T_6, T_1 + Vermicompost @ 1.5 t/ha; T_7, T_1+Soil applied Zn and Fe each @ 5 kg/ha + foliar spray each @ 0.1% at tasseling stage; T_8, T_1+Foliar spray Zn and Fe each @ 0.1% at 25 DAS and at tasseling stage and maize hybrid 'ADV 755' were replicated 3 time, observation on different soil parameters *viz.,* available NPK, Zn, Fe, OC, pH and EC. Soil samples collected from each experimental pot with 0-15 cm depth, first air dried and then grind using wooden roller. The soil was then passed throughout 2 mm sieve. Available nitrogen (mg kg^{-1}) in soil was determined by the similar procedure followed by (Kumar *et al.*, 2021). Available phosphorus (mg kg^{-1}) in the soil was extracted by 0.5 M Sodium bicarbonate ($NaHCO_3$) was determined by Ascorbic acid method (Olsen et al 1954). Available potassium (mg kg^{-1}) in the soil was extracted by 1N neutral ammonium acetate and extracted by Flame photometer (Hanway and Heidel, 1952). Available Zinc and Iron in the soil was extracted by DTPA and Fe in the extract was determined by Atomic Absorption Spectrophotometer (Kumar et al 2021). Electrical conductivity was measured in 1:2.5 soil: water suspension with the help of EC meter (Eijkelkamp-18.28) and expressed in dS m^{-1} (Kumar *et al.*, 2022). The pH was determined with the help of glass electrode of a pH meter (Eijkelkamp-18.28) in 1:2.5 soils: water suspension (Kumar et al 2022). Organic carbon was estimated by (Walkley and Black, 1934). The data related to each character of the crop were analyzed statistically by using the standard method of Analysis of variance technique (Gomez and Gomez, 1984).

Results and Discussion

Residual soil fertility

The data is concerning the effect of different micronutrients treatments on various soil parameters *viz.*, available NPK, Zn, Fe, pH, EC and Organic Carbon were presented in table 1. The available nitrogen, available phosphorus, available zinc and available iron (mg kg^{-1}) were significantly ($p \leq 0.05$) varied from 74.67 to 98.19, 6.60 to 8.40, .67 to 1.03 and 1.90 to 2.14 and available potash (mg kg^{-1}) was non-significantly ($p \leq 0.05$) varied from 88.00 to 91.17 respectively. The best treatment for available NPK, Zn and Fe, were T_5 (T_1 + Soil applied Zn and Fe each @10 kg/ha + vermicompost @ 1.5 t/ha). The data is concerning the effect of different macro-micronutrients and vermicompost treatments on various soil parameters *viz.*, DTPA extractable Zn and Fe were presented in table 1. The DTPA extractable Zn (mg kg^{-1}) was varied from 0.66 to 1.03. The best treatment for available Zn was T_4 T_1+Soil applied Zn and Fe each@ 20 kg/ha. The DTPA extractable Fe (mg kg^{-1}) was varied from 1.90 to 2.17. The best treatment for available Fe was T_4 T_1+Soil applied Zn and Fe each@ 20 kg/ha. The soil applied Zn and Fe each @10 kg/ha + vermicompost (T_5) was found significantly better result in respect to DTPA extractable iron as compared to soil applied Zn and Fe each @ 10 kg/ha (T_3) and soil applied Zn and Fe each @ 5 kg/ha + foliar spray each @ 0.1% at tasseling stage (T_7). The increase availability of micronutrients with the Vermicompost addition maybe due to the production of different organic acids which will chelate these micronutrients, related results were also reported by (8) and (9). The data is concerning the effect of different micronutrients treatments on various soil parameters *viz.*, Soil pH, Soil EC and Soil Organic Carbon were presented in table 2. The soil pH was significantly ($p \leq 0.05$) varied from 7.20 to 7.63. The neutral soil Ph is found in treatment no. 6. (T_1 + Vermicompost @ 1.5 t/ha) followed by control. The soil EC (µs) and Organic carbon (%) were non-significantly ($p \leq 0.05$) varied from 0.28 to 0.35 and 4.30 to 4.64 respectively. Soil Organic carbon and soil EC were non-significantly higher in T_5 followed by T_6 whereas lower in T_1. Although organic carbon buildup was noticed in the treatments receiving vermicompost. It is a proven fact that application of organic manure improves the carbon content in soil. In the said treatments biomass was higher therefore their residues left in the soil will also contribute in organic carbon. The data was concerning the effect of different macro-micronutrients and vermicompost treatments on various soil parameters *viz*., pH and EC were presented in table 2. The pH and EC does not influence by the different treatments. Although pH reduced was noticed in the treatments receiving vermicompost. It is a proven fact that application of organic manure decreased the pH in soil. The electrical conductivity was done not influenced by different treatments.

Conclusion

On the basis of one year pot experiment, it can be concluded that for the availability of NPK and OC in soil from maize crop field the basal as well as soil application of zinc and iron is best option, however for the quantity the basal application of zinc and iron @10 kg/ha + vermicompost (1.5 t/ha). The Zn and Fe in soil from maize crop field the basal application of zinc and iron is best option, however for the quantity the basal application of zinc and iron @ 20 kg/ha each alongwith NPK is better. So, the development of Zn and Fe nourishment in crops lies not only on intrinsic soil property but also on farmer executive practices which influence soil organic matter and nitrogen dynamics.

Table 1. Effect of zinc and iron fertilization on Available nitrogen, phosphorus, potash, zinc and iron at harvest of surface soil

Treatments	Available Macronutrient (mg kg^{-1})			Available Micronutrient (mg kg^{-1})	
	N	P	K	Zn	Fe
T_1	74.67 ± 9.83^{b}	6.60 ± 0.09^{b}	88.00 ± 2.60^{a}	0.67 ± 0.06^{f}	1.90 ± 0.10^{c}
T_2	74.29 ± 2.88^{b}	6.70 ± 0.27^{b}	87.83 ± 0.76^{a}	0.76 ± 0.03^{cde}	2.00 ± 0.08^{abc}
T_3	73.55 ± 5.99^{b}	6.80 ± 0.41^{b}	87.67 ± 3.75^{a}	0.84 ± 0.05^{bc}	2.12 ± 0.13^{ab}
T_4	74.48 ± 1.48^{b}	6.79 ± 0.54^{b}	87.50 ± 2.78^{a}	1.03 ± 0.03^{a}	2.17 ± 0.16^{a}
T_5	98.19 ± 2.53^{a}	8.40 ± 0.25^{a}	91.17 ± 4.65^{a}	0.92 ± 0.07^{b}	2.14 ± 0.06^{a}
T_6	96.51 ± 13.59^{a}	8.20 ± 0.74^{a}	91.00 ± 3.18^{a}	0.82 ± 0.04^{cd}	2.06 ± 0.04^{abc}
T_7	72.80 ± 2.80^{b}	6.78 ± 0.34^{b}	88.00 ± 3.04^{a}	0.74 ± 0.04^{def}	2.04 ± 0.10^{abc}
T_8	75.23 ± 1.17^{b}	6.74 ± 0.40^{b}	87.67 ± 1.04^{a}	0.68 ± 0.04^{ef}	1.94 ± 0.12^{bc}
SEm±	3.633	0.203	1.869	0.027	0.062
CD (P= 0.05)	10.89	0.609	NS (5.603)	0.08	0.185

Table 2. Effect of zinc and iron fertilization on soil pH, soil EC and soil organic carbon at harvest of surface soil

Treatments	pH, EC and Organic carbon in soil		
	pH	EC (dSm^{-1})	Organic carbon (g kg^{-1})
T_1	7.20 ± 0.10^{b}	0.28 ± 0.01^{a}	4.30 ± 0.21^{a}
T_2	7.30 ± 0.29^{ab}	0.30 ± 0.07^{a}	4.34 ± 0.17^{a}
T_3	7.33 ± 0.34^{ab}	0.30 ± 0.03^{a}	4.33 ± 0.26^{a}
T_4	7.63 ± 0.30^{a}	0.32 ± 0.01^{a}	4.32 ± 0.35^{a}
T_5	7.40 ± 0.10^{ab}	0.35 ± 0.08^{a}	4.64 ± 0.14^{a}
T_6	7.10 ± 0.10^{b}	0.33 ± 0.03^{a}	4.60 ± 0.13^{a}
T_7	7.30 ± 0.10^{ab}	0.29 ± 0.01^{a}	4.34 ± 0.22^{a}
T_8	7.23 ± 0.14^{b}	0.29 ± 0.03^{a}	4.32 ± 0.26^{a}
SEm±	0.120	0.024	0.134
CD (P= 0.05)	0.36	NS (0.073)	NS (0.402)

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