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Effect of Zinc Application on available N, P, K and Zn content of Soil under Wheat Crop

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Abstract: The present investigation was conducted during *Rabi* season of 2019. A pot experiment was conducted in net house with 12 treatments ; 6 zinc levels (0,10,20,30,40,50 kg Zn / ha) as soil application and 6 levels of zinc (0,10,20,30,40,50 kg / ha) as soil application + 0.5 % foliar application. Standard methods of observation, analysis of soil and plant samples and appropriate statistical methods for the analysis of data were used. Soil pH, EC, Organic C, available N, P, K and Zn content in soil were analyzed. It was observed that available nitrogen, phosphorous and potassium content of soil were not affected by zinc application but zinc content was enhanced by zinc levels.

Keywords- Zinc, Nitrogen, Phosphorous, Potassium

I. INTRODUCTION

Wheat (*Triticum aestivum* L.) is the second most important staple food next to rice, consumed by nearly 35% of the world population and providing 20% of the total food calories. Wheat occupies about 32% of the total acreage under cereals in the world. In India, wheat is mainly grown in the states of Uttar Pradesh, Madhya Pradesh, Punjab, Rajasthan, Haryana, Bihar, Maharashtra, Karnataka and Gujarat. Globally, probable demand for wheat by the year 2020 is forecast at around 950 million tonnes per year. This target will be achieved only, if global wheat production is increased by 2.5% per annum. The importance of micronutrients application in increasing crop production has been recognized in India and it is becoming evident that without the use of the micronutrient, it is not possible to get the maximum benefits of NPK fertilizers and high yielding varieties of wheat [1].

Zinc is an essential micronutrient for plant growth and is absorbed by the plant roots in the form of Zn^{2+}. It is involved in hydrogenase and carbonic anhydrase, synthesis of cytochrome and the stabilization of ribosomal fractions and auxin metabolism. Zinc fertilization has been widely used to alleviate Zn deficiency in crops in recent years. Application methods include direct soil amendment, pre-sowing seed soaking and foliar spray. Zinc is easily immobilized in the soil solution due to high soil pH; therefore, foliar Zn application is generally the most effective means for increasing grain Zn concentrations [2].

Zinc mobility in phloem is relatively high, at least in wheat [3, 4]. High consumption of cereal-based foods over long periods may induce Zn deficiency problems, resulting in severe health complications such as impairments in physical development, immune system and brain function and hidden hunger or malnutrition [5]. In India 26% population are suffering from zinc deficiency [6]. [7] also estimates that Zn is the 5th leading cause of illness in low income countries.

II. METHOD AND MATERIALS

A pot experiment was conducted with 12 treatments with wheat in alluvial soil during 2019. Treatment are T_1- 0 kg Zn/ ha soil application ,T_2 -10 kg Zn / ha soil application, T_3-20 kg Zn / ha soil application,T_4-30 kg Zn/ ha soil application,T_5-40 kg Zn / ha soil application,T_6-50 kg / ha soil application,T_7-0 kg Zn/ha soil application +0.5 % foliar application,T_8-10 kg Zn/ha soil application + 0.5 %foliar application,T_9-20 kg Zn/ha soil application+0.5 %foliar application,T_{10}-30 kg Zn/ha soil application+0.5 %foliar application,T_{11}-40 kg Zn/ ha soil application +0.5% foliar application,T_{12}-50 kg Zn / ha soil application+0.5 % foliar application.

Soil moisture was maintained the field capacity by regular weighing the pots. Irrigation was given throughout the experiment period to keep the soil moist.

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The soil pH and electrical conductivity (EC) were measured in 1:2 soil water suspension [8], organic carbon by wet oxidation with H_2SO_4 + $K_2Cr_2O_7$ [9], available by alkaline-$KMnO_4$ oxidizable N method [10], available P by 0.5M $NaHCO_3$ extraction method[11](Olsen *et al.*, 1954), available K [12]and, DTPA extractable Zn by Diethylenetriamine penta acetic acid (DTPA) reagent (0.005 M DTPA).

III. RESULTS AND DISCUSSION

The data on pH ,E C and organic carbon content of soil was given in Table 1 while available nitrogen, phosphorus, potassium and zinc content in soil after harvest of wheat crop as influenced by zinc levels has been presented in Table 2.

A. pH

The data (Table 1) revealed that zinc levels had non- significant effect on pH of soil, highest pH was recorded with treatment T_1 (30 kg soil Zn ha^{-1} + 0.5% $ZnSO_4$ spray) as7.10 followed by T_9 (20 kg soil Zn ha^{-1} + 0.5% $ZnSO_4$ spray) as 7.17, T_8 (10 kg soil Zn ha^{-1} + 0.5% $ZnSO_4$ spray) as 7.23 and control T_1 (0 kg soil Zn ha^{-1}) as 7.27.

B. Electrical conductivity (dS/m)

It was observed that zinc levels had non- significant effect on electrical conductivity of soil of wheat .EC was recorded with treatment T_{10} (30 kg soil Zn ha^{-1} + 0.5% $ZnSO_4$ spray) as 0.20 dS/m followed by T_9 (20 kg soil Zn ha^{-1} + 0.5% $ZnSO_4$ spray) as 0.23 dS/m, T_8 (10 kg soil Zn ha^{-1} + 0.5% $ZnSO_4$ spray) as 0.23 dS/m .

C. Organic carbon (%)

The data (Table 1) revealed that zinc levels had non- significant effect on organic carbon of soil of wheat. A 0.32% Organic carbon was recorded with treatment T_{10} (30 kg soil Zn ha^{-1} + 0.5% $ZnSO_4$ spray) as followed by T_9 (20 kg soil Zn ha^{-1} + 0.5% $ZnSO_4$ spray) as 0.32%, T_8 (10 kg soil Zn ha^{-1} + 0.5% $ZnSO_4$ spray) as 0.32%. There was no significant variation among all treatments.

D. Available nitrogen content (kg/ha)

All zinc levels treatments marked no significant variation in nitrogen content (Table 2). Maximum nitrogen content (218.00 kg/ ha) was reported with treatment T_{10} (30 kg Zn ha^{-1} + 0.5% $ZnSO_4$ spray) and minimum nitrogen content was noted with control T_2 and T_3 (10and 20 kg soil Zn ha^{-1}) as 199.67 kg/ha. However, treatment T_{10} showed superiority over control.

E. Available phosphorous content (kg/ha)

The data (Table 2) showed that zinc levels treatments did not cause variation in phosphorous content. Maximum phosphorous content was noted with treatment T_{11} and T_{12} (40 and 50 kg Zn ha^{-1} + 0.5% $ZnSO_4$ spray) as 17.93 kg/ha, T_9 (20 kg soil Zn ha^{-1} + 0.5% $ZnSO_4$ spray) as 17.73 kg/ha, T_8 (10 kg soil Zn ha^{-1} + 0.5% $ZnSO_4$ spray) as 17.47 kg/ha and minimum phosphorous content was noted with control T3 (20 kg soil Zn ha^{-1}) as 17.14 kg/ha. No significant variation among all treatments was observed.

F. Available potassium content (kg/ha)

All zinc levels treatments did not affect available potassium content during year of investigation (Table 2). Maximum potassium content was noted with treatment T_3 (20 kg Zn ha^{-1}) as 218 kg/ha, T_9 (20 kg soil Zn ha^{-1} + 0.5% $ZnSO_4$ spray) as 217.33 kg/ha, T_8 (10 kg soil Zn ha^{-1} + 0.5% $ZnSO_4$ spray) as 213.00 kg/ha and minimum potassium content was noted with control T_5 (0 kg soil Zn ha^{-1}) as 203.33 kg/ha. However, treatment T_{10} showed superiority over control.

G. Available zinc content (kg/ha)

All zinc levels treatments caused marked variation in zinc content (Table 2). Maximum zinc content was noted with treatment T_6 (50 kg Zn ha^{-1}) as 0.58 kg/ha, T_9 (20 kg soil Zn ha^{-1} + 0.5% $ZnSO_4$ spray) as 0.54kg/ha, T_8 (10 kg soil Zn ha^{-1} + 0.5% $ZnSO_4$ spray) as 0.50kg/ha and minimum zinc content was noted with control T_1 (0 kg soil Zn ha^{-1}) as 0.46kg/ha.

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The data on available nitrogen, phosphorus, potassium and zinc in soil after harvest of wheat crop as influenced by zinc levels demonstrated that available nitrogen, phosphorus, potassium in soil after harvest of wheat crop could not differ significantly owing to application of zinc levels but zinc content marked significant variation.

The variation in residual nutrient content of soil is well known due to differential absorption of nutrient by plants. The nutrient profiles depend on the balance between influx and replenishment of ions and degree of soil nutrient depletion, which is related to the rate and amount of nutrients released from the soil solid phase to soil solution. Plants can mobilize large quantities of nutrients from the soil solution apart from applied nutrient. The data on available N, P and K status of soil after the harvest of wheat did not differ due to application of various treatments in experiment. All zinc levels non-significantly enhanced the available N, P and K status of soil after harvest of crop as compared to control. Similar findings were reported by [13, 14, and 15].

Table 1- Effect of zinc levels on pH, EC (dS/m) and organic C (%) of soil

Treatments	pH	EC(dS/m)	Organic Carbon (%)
	2019	2019	2019
T_1	7.27	0.23	0.31
T_2	7.10	0.21	0.29
T_3	7.07	0.23	0.30
T_4	7.23	0.22	0.29
T_5	7.07	0.20	0.31
T_6	7.20	0.23	0.34
T_7	7.12	0.23	0.32
T_8	7.23	0.20	0.32
T_9	7.17	0.20	0.32
T_{10}	7.10	0.21	0.32
T_{11}	7.11	0.01	0.30
T_{12}	7.10	0.03	0.34
SEm±	0.20	0.23	0.02
CD(at 5%)	0.40	0.21	0.05

Table 2-Effect of zinc levels on available N, P, K, and Zn content (kg/ha) in soil

Treatments	Available N(kg/ha)	Available P(kg/ha)	Available K(kg/ha)	Available Zn(kg/ha)
	2019	2019	2019	2019
T_1	203	17.22	215.67	0.46
T_2	199.67	17.5	212.33	0.51
T_3	199.67	17.14	218	0.55
T_4	209.33	17.27	213	0.59
T_5	211.33	17.27	203.33	0.65
T_6	212	17.53	216	0.69
T_7	205	17.74	214.67	0.45
T_8	217	17.47	213	0.5
T_9	213	17.73	217.33	0.54
T_{10}	218	17.43	215	0.58
T_{11}	205.33	17.93	211.33	0.63
T_{12}	216.67	17.93	213.33	0.68
SEm±	6.45	0.63	3.65	0.02
CD(at 5%)	NS	NS	NS	0.03

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Figure 1-Effect of zinc levels on available N content (kg/ha) in soil

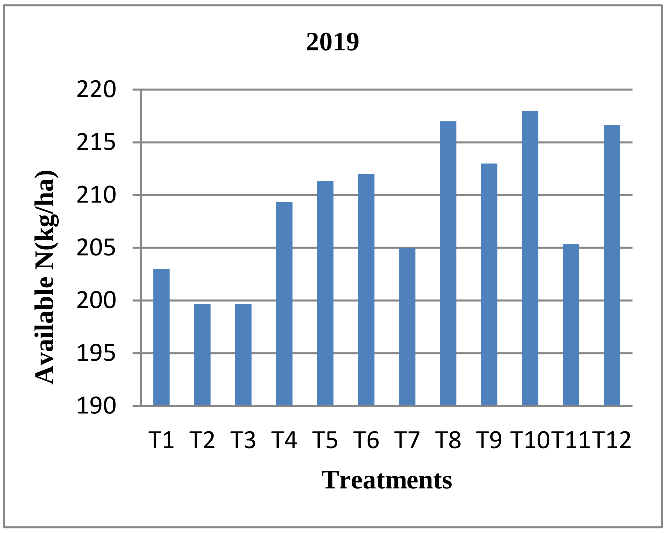

Figure 2-Effect of zinc levels on available P content (kg/ha) in soil

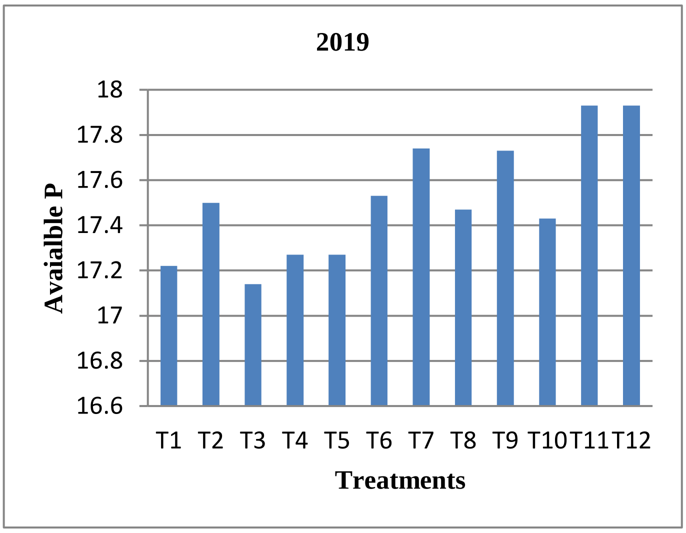

Figure 3-Effect of zinc levels on available K content (kg/ha) in soil

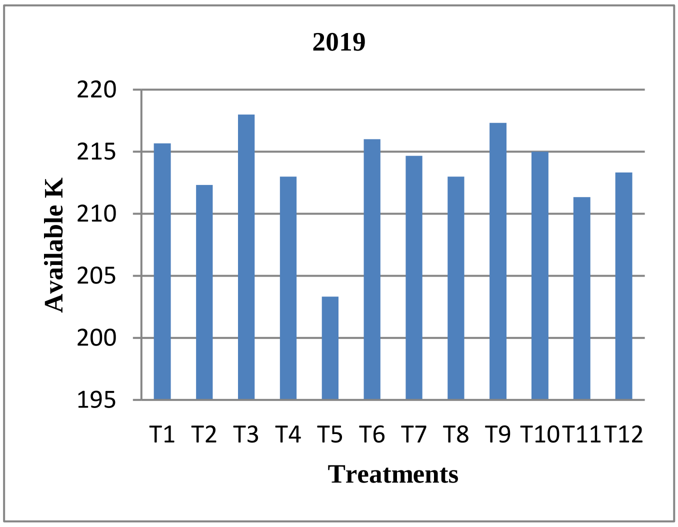

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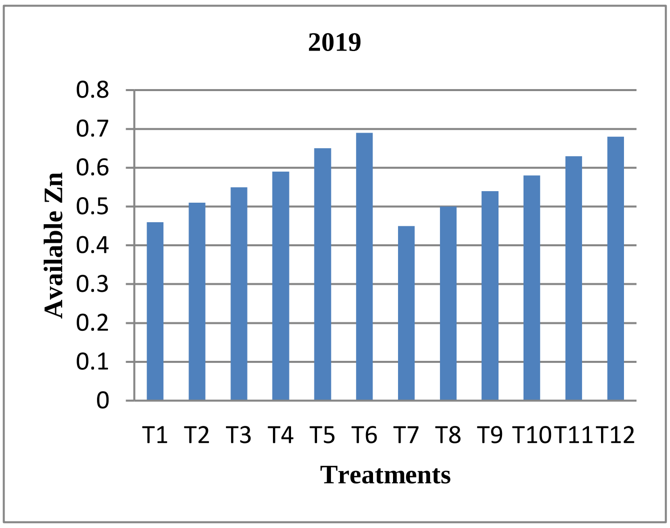
Figure 4-Effect of zinc levels on available Zn content (kg/ha) in soil



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