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Effects of integrated nutrient management on chemical properties of soil in maize (*Zea mays* L.) Var. Kirtiman Saurabh

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Abstract
The field experiment was carried out at Department of Soil Science, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad, India during *kharif season* (July to Novomber) of 2015-16. The experiment was laid out in 3×3 factorial randomized block design with 9 treatments in 3 replications. Treatment T_8- L_2F_2 (120:60:60:20 kg ha^{-1} + 10 t ha^{-1}: 200 gm/10kg seed) was to be best in pH, EC, O.C., available nitrogen (kg ha^{-1}), phosphorus (kg ha^{-1}), potassium (kg ha^{-1}) and zinc (kg ha^{-1}) which were as 7.30, 0.25, 0.85, 301.76, 27.91, 178.63, 0.58 respectively. Soil chemical properties as available N, P, K and Zn were found to be significant but pH, EC and O. C. were found to be non-significant.

Keywords: NPK, zinc FYM, soil chemical properties, maize

Introduction
Maize is one of the important cereal crops in the world agricultural economy both as food grains for human and fodder and feed for cattle and poultry. Maize grain contains about 72% starch, 10% protein, 4.8% oil, 5.8% fibre, 3.0% sugar and 1.7% ash (Choudhary, 1993). Along with this, it is rich in vitamin A, vitamin E, nicotinic acid, riboflavin and contains fairly high phosphorus than rice and sorghum. Its fodder and hay contain 7-10% protein, 15-36% fibre, 2.09 to 2.62% ether extract, 0.42-0.70% Calcium, 0.28-0.29% phosphorus, 0.45% Magnesium, 1.34% Potassium and 56% carbohydrate, therefore, it has very nutritive fodder and hay. Besides food grain, fodder and feed, it has prime importance in textile, starch and dye industries (Rai 2006).

Maize rank third in global cereal scenario after wheat and rice, but in India it stands in fourth position following Rice, Wheat and Sorghum. The higher yield potentiality of maize cannot be manifested upto the brim due to several biotic and abiotic factors among which poor nutritional management is the prime one. Being an exhaustive crop especially the improved and hybrids, respond positive significance to applied nutrients. Application of nitrogen upto 180 kg ha^{-1} was found to be most beneficial for grain and total biomass production of maize as well as the monetary returns (Maurya *et al.*, 2004).

The organic sources besides supplying N, P and K also make unavailable sources of elemental nitrogen, bound phosphates, micronutrients, and decomposed plant residues into an available form to facilitate to plant to absorb the nutrients. But, it is also the fact that optimum yield level of maize production can’t be achieved by using only organic manures because of their low nutrient content. Efficacy of organic sources to meet the nutrient requirement of crop is not as assured as mineral fertilizers, but the joint use of chemical fertilizers along with various organic sources is capable of improving soil quality and higher crop productivity on long- term basis. Highest productivity of crops in sustainable manner without deteriorating the soil and other natural resources could be achieved only by applying appropriate combination of different organic manures and inorganic fertilizers (Chandrashekara *et al*., 2000).

Nitrogen is a vitally important for plant nutrient. Nitrogen is essential constituent of protein and is present in many other compound of great physiological importance in plant metabolism. Nitrogen is called a basic constituent of life. Nitrogen also impart vigorous vegetative growth dark green colour to plant and it produce early growth of maize. Nitrogen governs the utilization of potassium, phosphorus and other elements in maize crop. (Singh *et al*., 2010) [10].

Phosphorus has a great role in energy storage and transfer and closely related to cell division and development of maize. Phosphorus is a constituent of nucleic acid, phytin and phospho-lipid. Phosphorus compound act as “energy currency” within plants. Phosphorus is essential for transformation of energy, in carbohydrate metabolism, in fat metabolism, in respiration of plant and early maturity of maize.(Singh *et al.*, 2010) [10].

Potassium play important role in formation of protein and chlorophyll and it provide much of osmotic "pull" that draw water into plant roots. Potassium produces strong stiff straw in maize and reduce lodging in maize. Potassium imparts increase vigour and disease resistance to plant (Singh *et al.*, 2010) [10].

Zinc play important role in the correct functioning of manyenzyme systems, the synthesis of nucleic acids and auxins (plant hormones) metabolisms, protein analysis andnormal crop development and growth (Mengel and Kirkby, 1982, Havlin *et al.*, 2006). Phosphorus and zinc,though essential for plant growth, are antagonistic to eachother in certain circumstances, such as when P is suppliedin high levels and Zn uptake becomes slower orinadequate (Mengel and Kirkby, 1979). This may be as aresult of slower rate of translocation of Zn from roots totops, i.e. zinc accumulation in the roots and lower Znuptake (Stukenholtz *et al.*, 1966). Plants absorb Zn in the form of Zn^{2+}. The functional role ofZn includes auxins metabolism, nitrogen metabolism, influence on the activitiesof enzymes, cytochrome c synthesis and stabilization of ribosomal fractions andprotection of cells against oxidative stress (Tisdale *et al.*, 1997; Obata *et al*., 1999). Poor growth, interveinalchlorosis and necrosis of lower leaves are thecommon symptoms of Zn deficiency in field crops (Paramasivan *et al.,* 2011).

Materials and Methods

The field experiment laid out at the Soil Science Research Farm, SHIATS-Deemed to be University. Allahabad during Kharif season (July-November) 2015-2016. The experimental site is located in the sub – tropical region with 25^0 27^1 N *latitude* 81^0 51^1 E longitudes and 98 meter the sea level *altitudes.* The experiment was laid out in a 3^2 RBD factorial design with three levels NPK,Zn and FYM with nine treatments, each consisting of three replicates. The total number of plots was 27 Maize (*Zea mays L*) var.Kirtiman Saurabh were sown in Kharif Season plots of size 2 x 2 m with row spacing 50 cm and plant to plant distance 20 cm. The Soil of experimental area falls in order of Inception and is alluvial in nature; both the mechanical and chemical analysis of soil was done before starting of the experiment to ascertain the initial fertility status. The soil samples were randomly collected from 0-15cm depths prior to tillage operations. The treatment consisted of nine combination of inorganic source of fertilizers T_0 (N:P:K:Zn 0:0:0:0 kg ha^{-1}+ FYM 0 t ha^{-1}: Azotobacter 0 gm /10kg seed), T_1 (N:P:K:Zn 0:0:0:0 kg ha^{-1}+ FYM 5 t ha^{-1}: Azotobacter 10 gm /10kg seed), T_2 (N:P:K:Zn 0:0:0:0 kg ha^{-1}+ FYM 10 t ha^{-1}: Azotobacter 200 gm /10kg seed), T_3 (N:P:K:Zn 60:30:30:10 kg ha^{-1}+ FYM 0 t ha^{-1}: Azotobacter 0 gm /10kg seed), T_4 (N:P:K:Zn 60:30:30:10 kg ha^{-1}+ FYM 5 t ha^{-1}: Azotobacter 100 gm /10kg seed), T_5 (N:P:K:Zn 60:30:30:10 kg ha^{-1}+ FYM 10 t ha^{-1}: Azotobacter 200 gm /10kg seed), T_6(N:P:K:Zn 120:60:60:20 kg ha^{-1}+ FYM 0 t ha^{-1}: Azotobacter 0 gm /10kg seed), T_7(N:P:K:Zn 120:60:60:20 kg ha^{-1}+ FYM 5 t ha^{-1}: Azotobacter 100 gm /10kg seed), T_8(N:P:K:Zn 120:60:60:20 kg ha^{-1}+ FYM 10 t ha^{-1}: Azotobacter 200 gm /10kg seed).

Chemical analysis

The chemical analysis of soil pre sowing was done for pH, EC, % organic carbon, available Nitrogen, Phosphorus and Potassium. The results and various methods employed are represented under the following table.

Table 3.5: Chemical analysis of soil

Particulars	Method employed	Results
Soil pH (1:2)	Glass electrode, pH meter (Jackson, 1958)	7.16
Soil EC (dS m^{-1})	EC meter (Digital Conductivity Meter) (Wilcox, 1950)	0.18
Organic Carbon (%)	(Walkley and Black's method 1947)	0.58
Available Nitrogen (kg ha^{-1})	Alkaline potassium permanganate method (Subbiah and Asija (1956)	280.26
Available Phosphorus (kg ha^{-1})	Colorimetric method (Olsen *et al*. 1954)	24.05
Available Potassium (kg ha^{-1})	Flame photometric method (Toth and Prince, 1949)	156.62
Available Zn (mg kg^{-1})	(Shaw and Dean 1952)	0.31

Results and Discussion

Response on pH and EC at 25 ˚C (dSm^{-1}) of soil after crop harvest

The result shows that the pH and EC shows that the maximum pH and EC at 25 ˚C (dSm^{-1}) of soil was found in T_{8-} (120:60:60:20 kg ha^{-1} + 10 t ha^{-1}: 200 gm/10kg seed) which were 7. 30, and 0.25 and minimum was found in T_{0-}(0:0:0:0 kg ha^{-1} + 0 t ha^{-1}: 0 gm/10kg seed). Which were 7.05 and 0.17. The interaction effect of NPK,Zn and FYM, Azotobacter on pH and EC was found non-significant.

Treatment	Ph (w/v)	EC (dSm^{-1})	Organic Carbon (%)	Nitrogen (Kg ha^{-1})	Phosphorous (Kg ha^{-1}.)	Potassium (Kg ha^{-1})	Zinc (mg Kg^{-1}.)
T_0	7.05	0.17	0.62	241.04	22.67	119.01	0.15
T_1	7.28	0.18	0.64	233.84	23.51	120.75	0.21
T_2	7.08	0.19	0.66	258.12	24.52	123.69	0.31
T_3	7.10	0.21	0.65	276.67	24.89	136.55	0.34
T_4	7.13	0.18	0.78	277.78	25.59	146.95	0.30
T_5	7.17	0.20	0.68	266.43	26.87	146.95	0.40
T_6	7.27	0.22	0.68	300.75	26.32	148.63	0.46
T_7	7.28	0.20	0.66	280.78	26.89	159.92	0.52
T_8	7.30	0.25	0.85	301.76	27.91	178.63	0.58
F-test	NS	NS	NS	S	S	S	S
S.Ed. (±)	0.539	0.034	0.121	6.749	0.488	2.207	0.010
C.D. (at 5%)	1.142	0.072	0.256	14.307	1.035	4.679	0.020

Response of organic carbon (%), available nitrogen, phosphorus, potassium and zinc (kg ha^{-1}) of soil after crop harvest

The result shows that the Maximum OC(%), available nitrogen, phosphorus, potassium and zinc (kg ha^{-1}) in soil were found in T8(120:60:60:20 kg ha^{-1} + 10 t ha^{-1}: 200 gm/10kg seed) which were 0.85, 301.76, 27.91, 178.63, 0.58 kg ha^{-1} respectively and minimum was found in T_{0}-(0:0:0:0 kg ha^{-1} + 0 t ha^{-1}: 0 gm/10kg seed) which were 0.62, 233.84, 22.67, 119.01, 0.15 kg ha^{-1} respectively. The interaction effect of NPK and Zinc was found in Significant but O.C. (%) was found in Non-Significant.

Conclusion

It is concluded that Treatment combination T8(120:60:60:20 kg ha^{-1} + 10 t ha^{-1}: 200 gm/10kg seed) was to be best in pH, EC (dSm^{-1}), O.C(%), available nitrogen (kg ha^{-1}), phosphorus (kg ha^{-1}), potassium (kg ha^{-1}) and zinc (kg ha^{-1}) which were as 7.30, 0.25, 0.85, 301.76, 27.91, 178.63, 0.58 respectively. Soil chemical properties as available N, P, K and Zinc were found to be significant but pH, EC, O C. (%) were found to be non-significant.

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