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Long Term Effect of Inorganic and Organic Sources of Nutrients on Soil Physical Properties and Productivity of Direct Seeded Rice (*Oryza sativa* L.) - MTU1010 under Rainfed Midland Situation at Bastar Palteau Zone

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A B S T R A C T

A long term field experiment was conducted since *kharif* 2015 for evaluating the effect of inorganic and organic sources of nutrients on soil physical properties and productivity on direct seeded rice (*Oryza satia* L.) – MTU1010 under rainfed midland situation at Bastar plateau zone at S. G. College of Agriculture and Research Station, Jagdalpur, Chhattisgarh. Random block design was used with twelve treatments and four replications to carry out experiment. The full recommended dose of fertilizer for rice crop was 100kg ha^{-1} Nitrogen, 60 kg/ha phosphorus and 40 kg/ha. FYM along with 100% RDF (100kg/ha Nitrogen, 60 kg/ha phosphorus and 40 kg/ha) plus lime 3 q/ha and ZnSO4 @ 25 kg/ha over six years of continued application resulted significant increase in K and WHC and decrease in BD and hence resulted in productivity of rice.

Introduction

In India a pride place is occupied by rice (*Oryza sativa* L.) among all the food crops cultivated. India is among one of the largest producers in the world for agricultural production. It ranks second in the world for rice production. Very large amount of nutrient removal from Indian soil taken place in these years due to involving high yielding rice varieties within intensive agriculture. It can be seen increase in application of inorganic nutrient sources day by day enabling soil to deteriorate in terms of physical, chemical and biological properties.

Application of organic sources of nutrients along with fertilizers has improved soil properties as well as maintained good soil health besides improving the availability of other nutrients to plants and hence productivity also.

Materials and Methods

A field experiment was conducted during *kharif* 2019 at long term field trial of dryland farm of Shaheed Gundadhur College of Agriculture and Research Station Jagdalpur, village Kumhrawand, District Bastar, State Chhattisgarh. The experiment was conducted in random bock design with twelve treatments which were T_1 control, T_2 100% recommended dose of fertilizer (100:60:40 kg/ha), T_3 (100% PK), T_4 (100% NK), T_5 (100% NP), T_6 (100% NPK+5 t FYM), T_7 (100% NPK+5 t FYM+ $ZnSO_4$@25kg/ha), T_8 (100% NPK+5 t FYM+ $ZnSO_4$@25kg/ha + Lime 3 q/ha), T_9 (50% NPK), T_{10} (50% NPK + 5 t FYM), T_{11} (50% NPK + 5 t FYM+ $ZnSO_4$@25kg/ha) and T_{12} (50% NPK + 5 t FYM+ $ZnSO_4$@25kg/ha+ Lime 3 q/ha) replicated four times. The parameters and their procedures for estimation are given below.

Soil pH

Soil pH estimated making soil suspension of 1:2.5 one percent is soil sample which is dissolved in 2.5 percent of distilled water. The pH was estimated using glass electrode pH meter. This method was described by Piper (1967).

Organic carbon

The organic carbon was estimated by Walkley-Black chromic acid wet oxidation method. Walkley and Black in 1934 gave this method of organic carbon estimation.

Available nitrogen (N)

Available nitrogen in soil samples were estimated using alkaline $KMnO_4$ method given by Subbiah and Asija using KELPLUS nitrogen auto analyzer (Model: KEL PLUS-ELITE EX).

Available phosphorus (P)

Available phosphorus in the soil samples were determined using Bray-1 method (1954). The samples were run in the double beam UV-VIS Spectrophotometer at 660 nm after making standard curve.

Available potassium (K)

Available potassium in soil sample was estimated as firstly by shaking the sample with neutral normal ammonium acetate for 5 minutes (Hanway and Heidle, 1952) and extract collected is used to estimate available potassium by flame photometer.

Sulphur (S)

The method is based on precipitation of barium sulphate. It is possible to estimate 0.5 ppm sulphate sulphur value in soil by this method. Available sulphur content was determined turbidimetrically based on the precipitation of barium sulphate.

Results and Discussion

pH

The different treatments were not statistically influencing the soil pH. The range of the soil pH was 6.13 to 6.79.

The maximum (6.79) value of pH recorded in 50% NPK + 5 t FYM+ $ZnSO_4$@25kg/ha + Lime 3 q/ha (T_{12}) where as the minimum (6.13) value of pH 100% NPK (100;60;40 kg/ha) (T_2). Comparing the initial soil pH (6.39) which was studied during the beginning of the experiment there was slight increase in soil pH which was observed in all treatments. The pH increase was due to neutralizing effect of lime in the field.

Table.1 Effect of manures and fertilizer on soil physico-chemical properties

Treatment	pH	OC%	Available N(kg/ha)	Available P (kg/ha)	Available K (kg/ha)	Available S (kg/ha)
Control	6.56	0.62	197.5	19.14	143.9	23.5
100%NPK	6.13	0.71	248.0	26.75	171.3	29.6
100%PK	6.43	0.60	173.8	31.91	183.2	28.8
100%NK	6.34	0.64	220.4	22.21	178.0	24.5
100%NP	6.41	0.63	224.9	30.33	140.4	27.5
100%NPK+5t FYM	6.58	0.79	281.4	30.21	194.0	36.6
100%NPK+5t FY$ZnSo_4$@25kg/ha	6.45	0.83	285.8	28.77	190.0	40.6
100%NPK+5t FYM+ $ZnSo_4$@25kg/ha + Lime 3 q/ha	6.78	0.82	263.7	29.31	181.1	35.9
50%NPK	6.25	0.82	204.8	26.08	158.0	27.8
50%NPK + 5t FYM	6.58	0.80	256.1	30.60	182.2	37.7
50%NPK + 5t FYM+ $ZnSo_4$@25kg/ha	6.60	0.79	269.4	30.35	181.1	43.0
50%NPK + 5t FYM+ $ZnSo_4$@25kg/ha + Lime 3 q/ha	6.79	0.85	254.8	31.05	180.4	41.9
CD (5%)	NS	NS	74.8	5.10	11.51	5.48
CV %	5.03	8.25	21.3	5.48	5	4.71

Fig.1 Effect of manure and fertilizer on soil pH

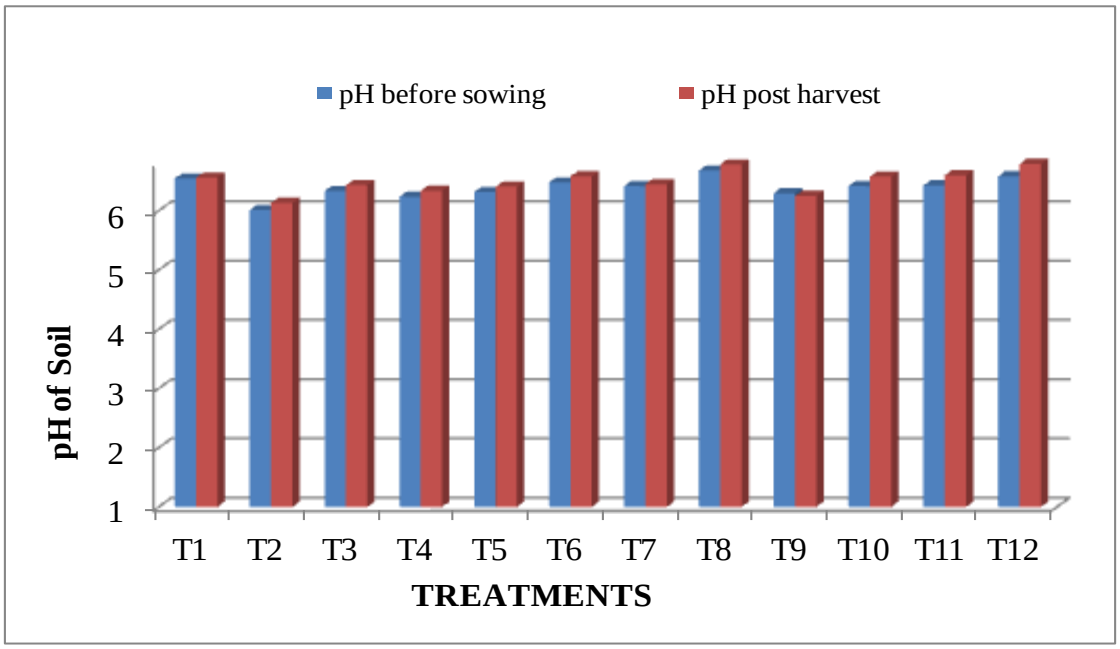


Fig.2 Effect of manure and fertilizer on soil available nitrogen

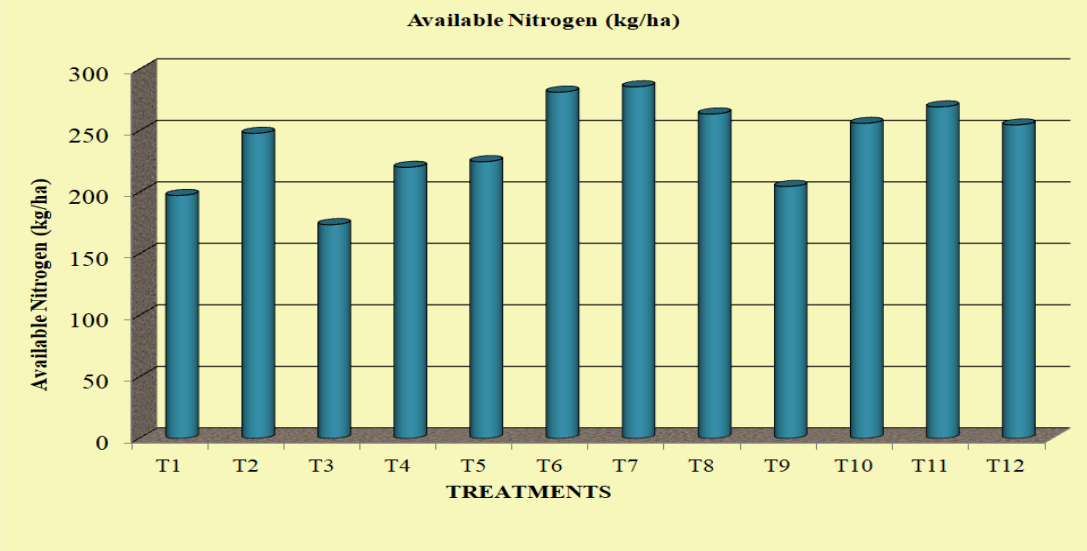


Fig.3 Effect of manures and fertilizers on available phosphorus

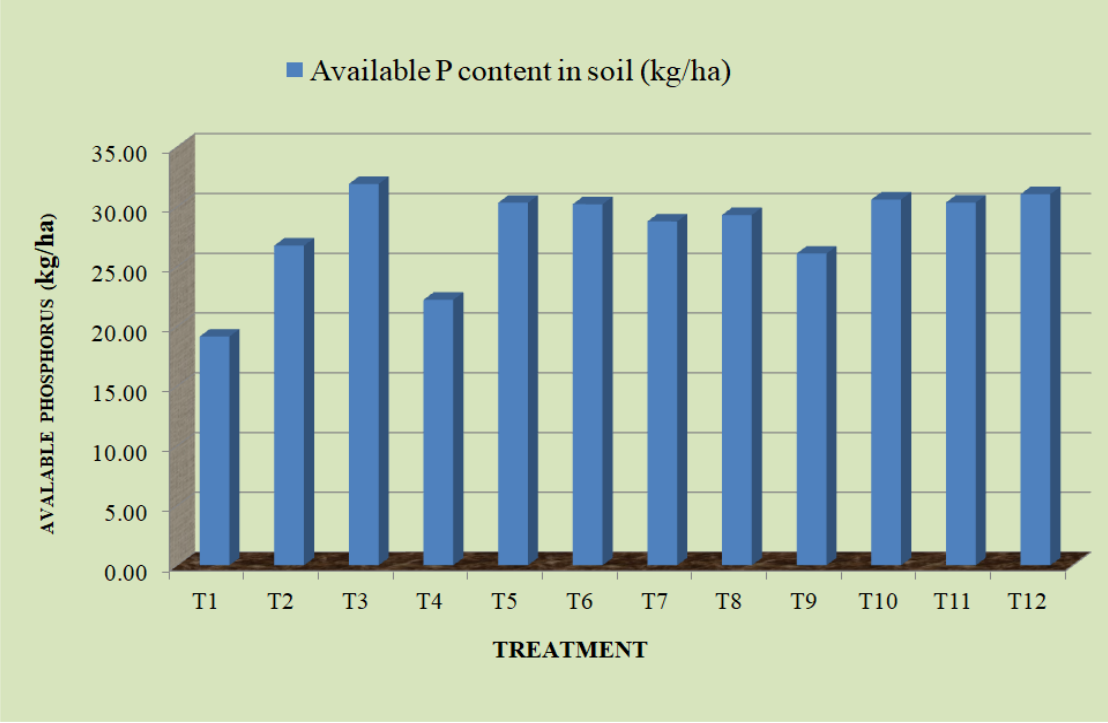


Fig.4 Effect of manure and fertilizer on soil available potassium

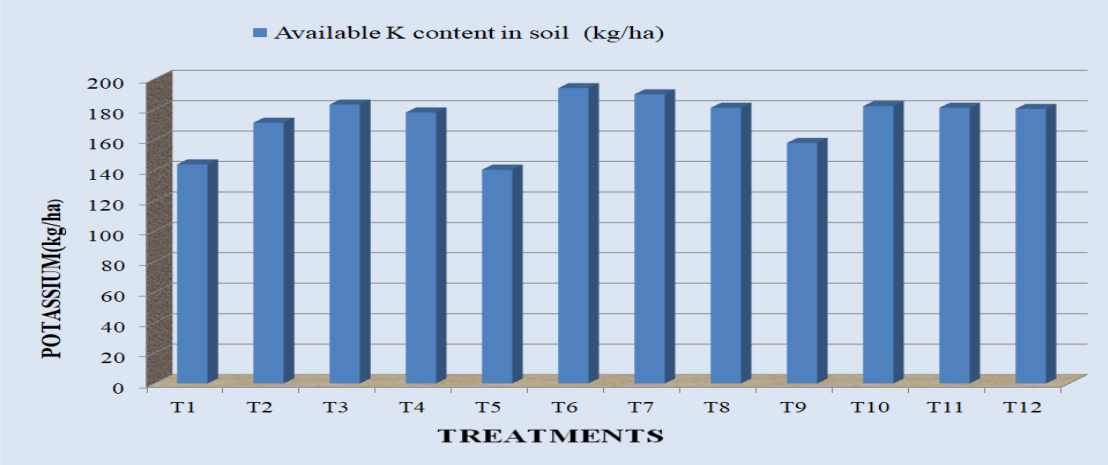
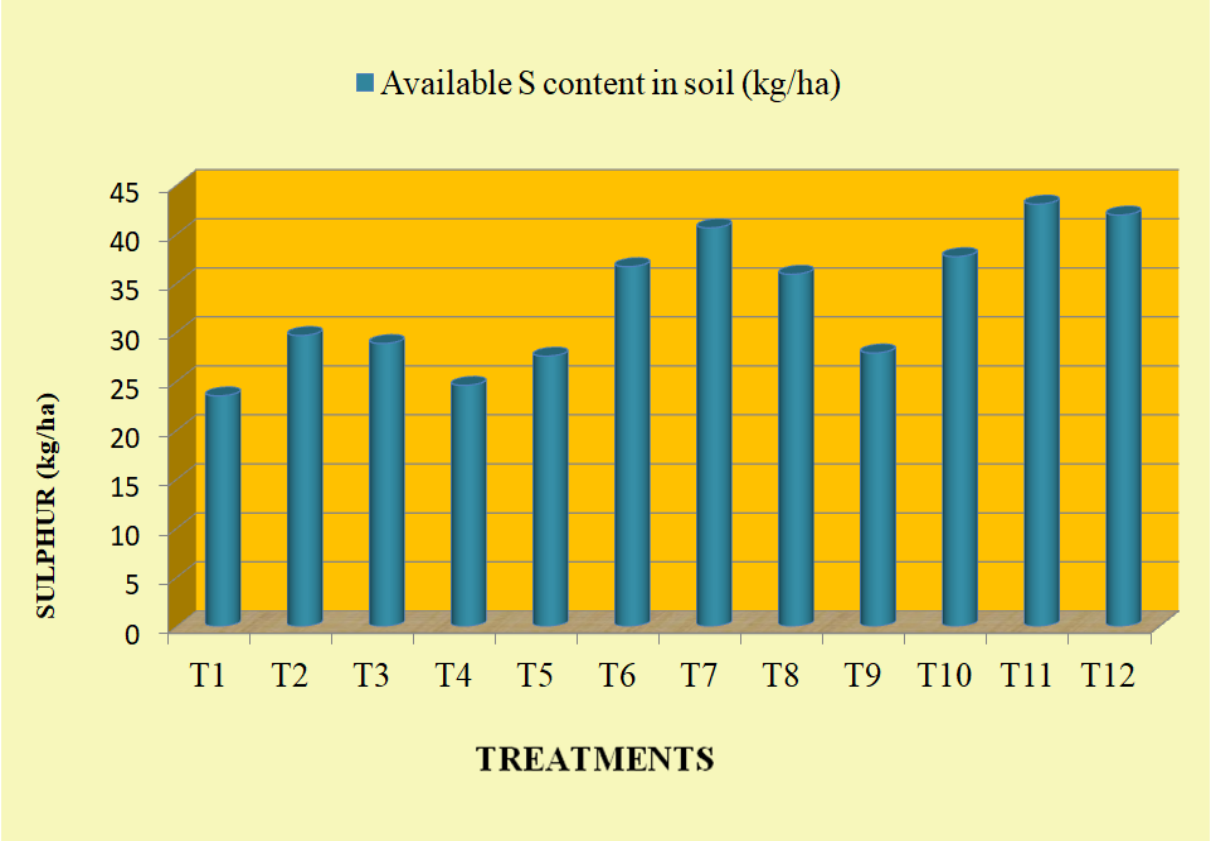


Fig.5 Effect of manure and fertilizer on soil available sulphur



Organic Carbon

The range of soil organic matter among the treatments after harvesting varies from.60 to.85%. The application of organic materials like lime and FYM showed increase in the soil organic matter as compared to initial soil organic matter content (.62%) studied during the starting of experiment. The maximum value of soil organic matter was recorded in

50% NPK + 5 t FYM+ $ZnSO_4$@25kg/ha + Lime 3 q/ha (T_{12}) while the minimum value (.60%) of soil organic matter was recorded in 100% PK (T_3).

Available nitrogen

Application of organic manures and inorganic fertilizers in combine form exhibited significant effect on the soil available nitrogen.

The highest amount (285.78 kg/ha) of available nitrogen estimated in 100% NPK+5 t FYM+ $ZnSO_4$@25kg/ha (T_7) next to it about 281.44 kg/ha of available nitrogen was estimated in 100% NPK+5 t FYM (T_6). The study of data shows that available nitrogen varied from 173.78 kg/ha under 100% PK (T_3) to 285.78 kg/ha under 100% NPK+ 5t FYM+ ZnSO4@25kg/ha (T7).

The lowest value of (173.78 kg/ha) available nitrogen in 100% PK (T_3) is due to mining of available nitrogen for long period. The results are in support with the estimations of Sahu (2017).

Available phosphorus in soil

The available potassium among treatments ranges from 19.14 (T_1) to 31.91 kg/ha (T_3).The maximum value of available phosphorus was recorded in 100% PK (T_3). While the minimum value of available phosphorus was recorded in control (T_1).

Statistically significant increase in value of available phosphorus was recorded among the treatments comparing to its initial value of available soil phosphorus which was studied during the beginning of experiment. Application of FYM with inorganic fertilizer showed no synergetic effect on availability of soil available phosphorus. The results are in support of Opala *et al.,* (2012).

Available Potassium in soil

Continuous application of FYM along with inorganic chemical fertilizers showed statistically significant effect on the value of available potassium content in soil. The range of available potassium content in soil among different treatments was 140.45 to 194.09 kg/ha. The maximum value (140.45 kg/ha) of available potassium content in soil was recorded in 100% NP (T_5). While the lowest value of soil available potassium (194.09) content was recorded in 100% NPK+5 t FYM (T_6). The results are in support of Wang *et al.,* (2001).

Available Sulphur in soil

The long term application of organic manure along with inorganic fertilizer results to influence the available sulphur content in soil. The highest value (43.07 kg/ha) of available sulphur content was recorded in 50% NPK + 5t FYM+ $ZnSO_4$@25kg/ha (T_{11}) which is relatively half dose of nutrient as compared to RDF. The lowest value (23.51 kg/ha) of available sulphur content in soil was recorded in control (T_1). Available sulphur content in soil ranges from 23.01 to 43.07 kg/ha. Integrated nutrient management of treatments (50% NPK + 5 t FYM+ $ZnSO_4$@25kg/ha) in which relatively half dose of nutrients was applied showed higher value of soil available sulphur content than. Long term incorporation of organic manure and inorganic fertilizer since 2014-15 is propitious to conserve available sulphur content in soil.

Long term application of organic and inorganic sources of nutrients in an integrated form resulted to influence the soil physico-chemical properties such as Nitrogen, Phosphorus, Potassium, and Sulfur in a significant level. Comparing the initial soil pH (6.39) which was studied during the beginning of the experiment there was slight increase in

soil pH which was observed in all treatments. The application of organic materials like lime and FYM showed increase in the soil organic matter as compared to initial soil organic matter content (.62%) studied during the starting of experiment.

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