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Effect of Different Manurial Practices on Soil Physical and Chemical Properties under Sri Method of Rice Planting

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A B S T R A C T

The field experiment was conducted during kharif and rabi season of 2106 to study the effect of different manurial practices on rice yield and soil physical and chemical properties under SRI method of rice planting. The field experiment was laid out in Randomized block design with 6 treatments replicated thrice. The treatments include incorporation of 100% RD (80:40:40 $N:P_2O_5:K_2O$ Kg/ha) with 10t FYM/ha in T_1, 100% RD with 5t FYM /ha, green manure and biofertilizer in T_2, STBR (soil test based fertilizer recommendation) with 10t FYM/ha in T_3, STBR with 5t FYM/ha, green manure and biofertilizer in T_4, 100% RD in T_5 and 100% organic in T_6. The results revealed that treatment treated with STBR with 5tFYM/ha, green manure and biofertilizer showed best result in grain and straw yield and also in the nutrient uptake and in available nitrogen, phosphorous and potassium.

Introduction

Rice is the staple food for more than half of the world's population and plays a vital role in food security of many countries. More than 90% of the global production and consumption of rice is in Asia (IRRI 1997). Due to increasing population, India has to increase the rice production without affecting our natural resources to our future generation. As, rice cultivation requires large quantity of water, due to scarcity of water SRI cultivation is best method for management of water and for higher productivity.

It is well known that intensive cultivation has led to a rapid decline in organic manures and nutrient levels and effecting soil properties. So, now a day integrated nutrient management is necessary to improve soil health and environment.

Therefore the present study was conducted to know the effect of different manorial practices on soil physical and chemical properties under SRI cultivation of rice.

Materials and Methods

SRI cultivation rice plants are transplanted singly and with wide spacing in a square pattern, radically reducing plant population. This practice which differs from usual practice which assume more plants will give more

yield, gives the plants root system more room to grow (Thakur *et al.,* 2010). Soil fertility being enhanced by the combination of plant-soil- water- nutrient- microbial interactions supported by SRI practices, making otherwise unavailable nutrient available through microbiological process (Uphoffs, 2003). Hence it is ideally suitable for resource poor farmers.

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The field experiment was laid out in Randomized block design with 6 treatments replicated thrice.

The treatments include incorporation of 100% RD (80:40:40 N:P_2O_5:K_2O Kg/ha) with 10t FYM/ha in T_1, 100% RD with 5t FYM /ha, green manure and biofertilizer in T_2, STBR with 10t FYM/ha in T_3, STBR with 5t FYM/ha, green manure and biofertilizer in T_4, 100% RD in T_5 and 100% organic in T_6.

The recommended dose was 80:40:40 N, P_2O_5, K_2O Kg/ha and Daincha used as green manure crop and *Azospirillium* 10kg/ha used as biofertilizer.

In both seasons growth parameters like plant height, tillers/ hill, number of effective tillers /square meter, number of grain per panicles, %filled grains were calculated.

The soil samples were collected before plantation (Table 1) and after harvest at depth of 0-15cm. soil samples were analysed for pH, organic carbon, available nitrogen, phosphorous and potassium and physical properties were determined by following the method described by Jackson (1967) and Lindsay and Norvell (1978).

Results and Discussion

Growth and yield

In SRI cultivation application of organic amendments in conjunction with inorganic fertilizers resulted in positive correlation between number of tiller/plant and number of grain per panicles (Thiyagarajan, 2007). The results showed that higher grain and straw yield was obtained in the plot treated with Soil test based fertilizer recommendation along with 5t FYM/ha, green manure and biofertilizer (Table 1) in both kharif and rabi season. The Treatments T_2 also showed good results in grain and straw yield after T_4. The plots treated with only organic and only inorganic fertilizer showed less yield compared to other treatments.

Nutrient uptake

In SRI cultivation, the nutrient uptake was greater due to its wider growth of roots compared to conventional method of cultivation. The uptake of nitrogen, phosphorous and potassium was found highest in the treatment treated with Soil test based fertilizer recommendation along with 5tFYM/ha, green manure and biofertilizer and on par result was found in the treatment treated with 100% RD with 5tFYM /ha, green manure and biofertilizer (Table 2).

The greater nutrient uptake with SRI cultivation method suggest that rice plant grown with such practices were capable of taking up significantly more nutrients (Table 3). Such uptake indicates that there might be some possible increase of available nitrogen due to a higher mineralization of organic nitrogen. Regarding the indigenous soil phosphorous supply, there was increase in the phosphorous uptake which reflected a greater capacity of plants cultivated with SRI method to access and take up phosphorous.

Table.1 Initial status of soil

S. NO	Parameters	values
1	Textural class	Loamy sand
2	pH	5.48
3	OC (%)	0.56
4	Avl. N(Kg/ha)	88
5	Avl.P(Kg/ha)	39.33
6	Avl.K(Kg/ha)	120.6

Table.2 Effect of different manurail practices on grain and straw yield of both Kharif and Rabi season

treatments	Grain yield kharif (q/ha)	Grain yield rabi (q/ha)	Straw yield kharif (q/ha)	Straw yield rabi (q/ha)
T_1: 100% RD(80:40:40 $N:P_2O_5:K_2O$Kg/ha) with 10tFYM/ha	36.67	36.11	34.66	41.66
T_2: 100% RD with 5tFYM/ha, green manure and biofertilizer	49.00	33.60	55.55	44.99
T_3: STBR with 10tFYM/ha	43.55	39.15	43.33	42.22
T_4:STBR with 5tFYM/ha, green manure and biofertilizer	50.67	43.05	57.11	48.60
T_5: 100% RD	30.67	33.33	36.67	38.88
T_6 : 100% organic	38.41	25.83	46.22	31.94
CD (0.05)	11.16	6.24	11.34	4.33
CV (%)	15.23	10.66	14.0	5.97

Table.3 Effect of different manural practices on total N, P, K uptake of both Kharif and Rabi season

Treatments	Total Nitrogen uptake in kharif (kg/ha)	Total Nitrogen uptake in rabi(kg/ha)	Total Phosphorous uptake in kharif(kg/ha)	Total Phosphorous uptake in rabi (kg/ha)	Total Potassium uptake in Kahrif (kg/ha)	Total Potassium uptake in Kharif (kg/ha)
T_1: 100% RD(80:40:40 N:P_2O_5:K_2OKg/ha) with 10tFYM/ha	53.66	71.25	15.47	13.07	81.85	78.84
T_2: 100% RD with 5tFYM /ha, green manure and biofertilizer	83.20	72.37	22.23	14.80	116.23	111.63
T_3: STBR with 10tFYM/ha	71.44	68.58	20.24	14.91	109.46	133.72
T_4:STBR with 5tFYM/ha, green manure and biofertilizer	73.89	94.88	21.92	19.71	129.61	136.82
T_5: 100% RD	46.73	78.60	12.92	12.80	81.46	106.81
T_6 : 100% organic	63.45	47.47	12.72	14.38	95.66	85.60
CD (0.05)	NS	16.10	NS	1.57	NS	12.04
CV (%)	18.19	13.36	21.81	6.53	18.43	6.11

Table.4 Effect of different manural practices on soil physical and chemical properties of Kharif season

Treatments	pH (1: 2.5)	Organic carbon (%)	Available Nitrogen (kg/ha)	Available phosphorous (kg/ha)	Available potassium (kg/ha)	Bulk density (g/cc)	Porosity (%)
T_1: 100% RD(80:40:40 N:P_2O_5:K_2OKg/ha) with 10tFYM/ha	5.28	0.73	188	21.60	112.47	1.52	36.33
T_2: 100% RD with 5tFYM /ha, green manure and biofertilizer	5.21	0.82	188	33.17	101.87	1.46	41.03
T_3: STBR with 10tFYM/ha	5.44	0.61	156	19.37	69.40	1.52	40
T_4: STBR with 5tFYM/ha, green manure and biofertilizer	5.21	0.61	156	27.67	70.27	1.47	37.00
T_5: 100% RD	5.42	0.67	151	19.27	88.67	1.50	37.67
T_6 : 100% organic	5.47	0.77	174	32.97	75.87	1.50	36
CD (0.05)	NS	NS	13.41	19.63	NS	NS	NS
CV (%)	7.16	20.25	18.47	28.93	28.52	3.43	8.81

Table.5 Effect of different manural practices on soil physical and chemical properties of Rabi season

Treatments	pH (1:2.5)	Organic carbon (%)	Available Nitrogen (kg/ha)	Available phosphorous (kg/ha)	Available potassium (kg/ha)	Bulk density (g/cc)	Porosity (%)
T_1: 100% RD(80:40:40 N:P_2O_5:K_2OKg/ha) with 10tFYM/ha	5.34	0.82	129.54	21.85	73.90	1.50	34.78
T_2: 100% RD with 5tFYM /ha, green manure and biofertilizer	5.19	0.70	159.74	32.34	62.10	1.47	39.13
T_3: STBR with 10tFYM/ha	5.24	0.71	166.12	26.96	66.10	1.50	37.28
T_4:STBR with 5tFYM/ha, green manure and biofertilizer	5.10	0.68	149.20	25.53	68.23	1.42	43.20
T_5: 100% RD	5.44	0.65	158.20	18.36	73.0	1.52	34.78
T_6 : 100% organic	5.33	0.70	156.63	27.59	72.03	1.43	40
CD (0.05)		NS	13.41	19.63	NS	NS	NS
CV (%)		20.25	18.47	28.93	28.52	2.23	10.23

It is possible that in addition to better nutrient supply, the changed root growth with SRI allows the plant to access subsoil phosphorous.

Soil physical properties

The soil physical properties also plays important role in availability of nutrients to crops and also in maintaining soil health which is useful for the growth of crops. So, the experiment also showed the effect of different manorial practices on soil physical properties. The results showed that the bulk density was found lowest in the treatment T_4 (Table 4) in which porosity is higher in both kharif and rabi season. The higher porosity is useful for the microorganisms which improves the mineralization rate and increase the availability of nutrients to the crop.

Soil chemical properties

Soil pH

Results revealed that continuous application of various organic manure and inorganic fertilizers resulted in decline of soil pH. The decline was more in organic manure plots over inorganic fertilizer alone. Mehdi *et al.,* (2011) also reported that long term application of organic manure reduced the soil pH due to various acid and acid forming complex were released during decomposition of organic material.

Organic carbon

The role of organic carbon content of soil in improving soil fertility and productivity has been well recognized from time immemorial and its maintenance in the soil is of almost concern under modern intensive farming.

The results showed that the organic carbon was more in the T_4 which is treated with STBR with 5tFYM/ha, green manure and biofertilizer and also treatment (Table 4) T_2 which is treated with 100% RD with 5t FYM /ha, green manure and biofertilizer showed good result after T_4. The least was found in the T_5 which received only recommended dose of fertilizer.

Available nitrogen

The increase in soil nitrogen might be due to direct addition of nitrogen through fertilizer and organic material and greater multiplication of soil microorganism, which converts organic based nitrogen to inorganic form (Bellakki and Badanur, 1997). Manjappa (1999) also founded that inclusion of organic manure enhanced the available nitrogen more compared to recommended dose of fertilizer alone. The application of organic manures could reduce nitrogen losses and conserve soil Nitrogen by mineralization, thus maintain continuous availability of nitrogen in entire life cycle of rice plant (Pandey, 2001).

The results showed that available nitrogen was found highest in T_2 in both kharif and rabi (159.74kg/ha) season and least was found in the treatment T_5.

Available phosphorous

The availability of phosphorous was found more in the treatment in T_2 in both kharif and rabi season. The least in available phosphorous was found in the treatment T_5 in both Kharif and Rabi season. This may be ascribed to greater mobilization of native soil phosphorous by reducing the phosphorous fixing capacity of soil minerals due to release of organic acids during decomposition process which ultimately increased the availability of phosphorous. Servamani *et al.,* (2011) reported that phosphorous content in soil increased the significantly by application of organic and bioinoculents in rice. Organic

acids released during decomposition of organic manure increased availability of phosphorous (Mendi *et al.,* 2011). The organic material form a protective cover on sesquioxide, these also reduce the phosphorus fixing capacity of soil, and hence increase availability of phosphorous status of soil (Singh *et al.,* 2006).

Available potassium

The results showed that the availability of potassium was more in the treatment T4 in both kharif and rabi season and least was found in the treatment t5. The organic manures have greater capacity to hold potassium in available form and reduced potassium fixation due to interaction of organic matter with clay (Mathur, 1997) (Table 5).

The present has concluded that incorporation of soil test based fertilizer recommendation along Ewith 5tFYM/ha, green manure and biofertilizer had showed best result in yield and nutrient availability under SRI cultivation of rice. The treatment (T2) treated with 100% RD along with 5tFYM/ha, green manure and biofertilizer also showed on par results as T4 in both yield and nutrient availability and was economically sound practice with higher rice yield under SRI cultivation

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