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Short Communication

RESPONSE OF RICE TO INTEGRATED NITROGEN MANAGEMENT UNDER SRI METHOD OF CULTIVATION

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Rice (*Oryza sativa* L.), is the prince among the cereals as a premier food crop not only in India but also in the world. Uttar Pradesh is the largest rice growing state after West Bengal in the country, in which rice is being grown over an area of 6.69 m ha with production and productivity of 11.80 m tonnes and 2073 kg ha^{-1}, respectively. The system of rice intensification (SRI) is a new methodology, which has been used to increase yield and reduce water and mineral fertilizer consumption. The yield of SRI method relies on early transplant, wetting and drying of soil rather than the prolonged flooding practice in conventional rice system. Most SRI studies so far have involved small field trials comparing SRI methods with conventional method of rice cultivation. Yield differences between the SRI and conventional system are highly variable and potential of SRI method, which can increase yield by 50-100% (Termel *et al.* 2011). Nitrogen is one of the major nutrients which determine the growth and development of rice. It is an important constituent of many organic compounds and is known to improve the various morphological attributes in the rice because of higher synthesis of protoplasmic proteins and nucleic acid. It is also responsible for more leaf area and dry matter production due to higher rate of photosynthesis. The nitrogen management modules envisage use of FYM and green manures along with chemical fertilizers and opportunity to achieve long term sustainability in crop production systems (Reddy *et al.*, 2003). Green manuring and farmyard manuring may help in reducing the deleterious effects of rice cultivation on soil physical properties. Therefore a study was initiated to assess the effect of integrated use of nitrogen on rice under SRI method of cultivation.

A field experiment was conducted during *Kharif* season of 2012 at Instructional Farm of Narendra Deva University of Agriculture & Technology, Kumarganj, Faizabad (U.P.). The soil of the experimental field was silty loam in texture having pH 8.3, organic carbon 2.4 g $kg^{-1,}$ avail N 149, P13 and K 263 kg ha^{-1}.The seven treatments *viz.* T_1, Control, T_2, 100% N as fertilizer, T_3, 75% N as fertilizer+25% N as FYM, T_4,75% N as fertilizer + 25% N as green manure (Sesbania), T_5,50% N as fertilizer+25% N as FYM+25% N as green manuring, T_6,50% N as fertilizer+50% N as FYM and T_7, 100% N as FYM were tested in randomized block design with three replications. Nitrogen was applied as urea, FYM and green manure as per treatment. Phosphorus and potassium were applied in each plot @ 60 kg ha^{-1} through single superphosphate and muriate of potash respectively. The crop was planted on 12 July, 2012 at a spacing of 25 x 25 cm and it was raised under SRI method (early seedling and alternate drying and wetting condition). The grain and straw yields were recorded at harvest. Nitrogen content in grain and straw was determined by Kjeldahl method. Phosphorus and potassium were determined in di acid digest by vandomolybdophosphoric acid yellow colour method and flame photometer, respectively. The protein content in grain was worked out by multiplying the nitrogen content in grain with factor 6.25. The nutrient uptake was computed by multiplying the nutrient content in grain and straw with yield in respective treatments. The soil organic carbon and bulk density in post harvest soil was determined by adopting standard procedures.

The data (Table 1) revealed that the grain and straw yields were significantly increased with the combined application of inorganic fertilizer with green manure over application of FYM alone or combination with inorganic fertilizer. The highest grain (64.32 q ha^{-1}) and straw (81.00 q ha^{-1}) yield was recorded with 75%N as fertilizer + 25% N as green manure which was at par with 100% N as urea and significantly superior over the control , 75% N as fertilizer +25% N as FYM, 50%N as fertilizer + 25% N as FYM + 25% N as green manuring , 50% N as fertilizer + 50% N as FYM and 100% N as FYM. This might be due to improved physical condition of the soil by the application of green manure thereby improving the utilization of native as well as applied nutrients which ultimately improved the yield of the crop. These results corroborated with the findings of Premi and Kalia (2003). The minimum grain and straw yields were observed with control. The hulling and milling quality was influenced with combined application of organic and inorganic N.

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Table 1: Effect of INM on yield and qualities of rice under SRI method cultivation

Treatment	Yield (qha^{-1})		Quality parameters			
	Grain	Straw	Hulling (%)	Milling (%)	Protein (%)	Protein yield (kg ha^{-1})
T_1. Control	41.88	56.13	69.3	66.0	7.00	293.1
T_2. 100 % N as fertilizer	60.98	80.17	71.6	66.6	8.18	498.8
T_3. 75 % N as fertilizer+25 % N as FYM	58.63	77.23	72.2	67.3	8.12	476.0
T_4. 75 % N as fertilizer+25 % N as GM	64.32	81.00	73.3	67.4	8.31	534.4
T_5. 50 % N as fertilizer+25 % N as FYM + 25 % N as GM	52.60	68.67	75.1	68.8	8.00	420.8
T_6. 50 % N as fertilizer +50 % N as FYM	48.00	65.91	75.4	69.4	7.87	377.7
T_7. 100 % N as FYM	45.64	60.73	76.3	70.2	7.12	324.9
SEm±	1.72	7.12	0.55	0.78	--	-
CD (P=0.05)	5.30	2.31	1.64	2.32	--	-

The maximum hulling (76.36%) and milling (70.25%) were observed with 100% N through FYM which was significantly superior over control. This might be due to higher accumulation of dry matter content resulting improved grain quality. The result is in close conformity with the findings of Premi and Kalia (2003).The protein content in grain was influenced with various treatments. The maximum protein content (8.31%) and yield (534.4 kg ha^{-1}) were recorded with 75% N through fertilizer + 25 % N as green manuring followed by 100% N as fertilizer. The minimum protein content (7.00%) and yield (293.1 kg ha^{-1}) were obtained with the control. This might be due to higher content of nitrogen by crop. Similar findings were observed by Dixit and Gupta (2000) and Rajeshwar and Khan (2008).

Table 2: Effect of INM on soil properties and nutrients uptake under SRI method cultivation

Treatments	Org. carbon (g kg^{-1})	N		P		K	
		Grain	Straw	Grain	Straw	Grain	Straw
T_1. Control	2.4	46.9	20.7	12.9	8.4	27.2	67.9
T_2. 100 % N as fertilizer	2.5	79.8	36.0	20.7	13.6	45.7	101.0
T_3. 75 % N as fertilizer+25 % N as FYM	2.8	76.2	33.2	19.3	13.1	45.1	95.7
T_4. 75 % N as fertilizer+25 % N as GM	2.9	85.5	37.2	22.5	14.5	49.5	102.0
T_5. 50 % N as fertilizer+25 % N as FYM + 25 % N as GM	3.0	67.3	28.8	16.8	10.9	36.8	81.7
T_6. 50 % N as fertilizer +50 % N as FYM	3.0	60.4	27.6	15.3	10.5	32.1	79.0
T_7. 100 % N as FYM	3.3	52.0	24.2	13.6	9.1	27.3	71.0
SEm±	0.1	3.13	1.17	1.16	0.48	1.48	2.52
CD (P=0.05)	0.3	9.34	3.59	3.50	1.45	4.46	7.76

It is obvious from the data that the highest uptake of N,P and K in grain and straw were computed under the treatment receiving 75% N through fertilizer + 25% N through GM which was significantly superior over control. This might be due to enhanced contents of nitrogen, phosphorus and potassium as well as improved grain and straw yields. These results are in close conformity with the findings of Dixit and Gupta (2000), Bindra and Thakur (1994) and Dasog *et al.* (2010). On the other hand, minimum N, P and K uptake was recorded under control due to lower yields.

Organic carbon was also influenced with combined application of organic and inorganic fertilizer. The maximum buildup of organic carbon (3.3 g kg^{-1}) was recorded with 100%N as FYM and minimum with control. This might be due to enhanced root growth leading to accumulation of more organic residues in the soil. These results are in close conformity with the findings of Kumar *et al.* (2001) who also reported that the application of FYM alone improved the organic carbon content in soil and reduced the bulk density of soil.

On the basis of results, it could be concluded that by substitution of 25% N as green manure or FYM was most effective in enhancing grain yield, nutrient uptake and maintaining the soil organic carbon in SRI method of rice cultivation.

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