

Effect of integrated nutrient supply on yield of rice (*Oryza sativa*) and soil fertility

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Abstract : An experiment was conducted during the rainy season of 1995 to 1998 to study the effect of integrated nutrient supply on yield of rice (*Oryza sativa*) and its residual effect on soil fertility. Conjunctive use of GM (*Sesbania aculeata*) with half the recommended dose of fertilizers (30:15:15 kg N,P and K ha⁻¹) recorded the highest grain yield (35.17 q ha⁻¹), harvest index (45.29) and benefit : cost ratio (1.55). However, this remained on par with full recommended dose of fertilizers (60:30:30 kg N, P and K ha⁻¹) and FYM @ 5 t ha⁻¹ + half the recommended dose of fertilizers. The soil fertility status significantly increased with the application of GM and FYM along with half the recommended NPK. Maximum reduction in soil fertility was observed in control treatment, while a considerable decrease was noticed under recommended dose of fertilizers alone.

Keywords: Integrated nutrient supply, Rice yield, Soil fertility.

Introduction

Application of nutrients is essential to realise the yield potential of high yielding varieties. But low recovery from fertilizers, high cost and low purchasing power of the farmers of Kalahandi district of Orissa state have kept the fertilizer application to rice crop at marginally low level. The concept of integrated nutrient management seeks to sustain soil fertility through an integration of different nutrient sources and their application methods that will produce maximum crop yield per unit input use (De Datta *et al.* 1990). The productivity of rice in Kalahandi district is as low as 11.2 q ha⁻¹ due to almost no application of manure and meagre use of fertilizers. Thus, the present experiment was undertaken to study the effect of integration of manure and fertilizers on rice yield, its economics and soil fertility over years.

Materials and Methods

The experiment was conducted at the Regional Research and Technology Transfer Station, Bhawanipatna, Kalahandi in the rainy seasons of 1995 to 1998. The soil was clay having pH 6.9, low total N (0.942%) and available P (8.5 kg ha⁻¹) and high available K (310 kg ha⁻¹). The experiment was laid out in Randomized Block Design with six treatments and four replications. The treatments were FYM @ 5 t ha⁻¹, green-manure (*Sesbania aculeata*) @ 25 kg seed ha⁻¹, FYM with 30:15:15 kg N, P and K ha⁻¹ (half the recommended dose), GM with 30:15:15 kg N, P and K ha⁻¹ (half the recommended dose) and 60:30:30 kg N, P and K ha⁻¹ alone (full recommended dose) along with an absolute control.

The green-manure crop was incorporated into soil 45 days after sowing and then final land preparation was done in all the four seasons. The farm-yard manure was applied basally in FYM treatments. In the fertilizer treatments, phosphorus was applied basally, nitrogen in three splits i.e., 25 per cent basal, 50 per cent after 20 days of planting and 25 per cent at panicle initiation stage and potash in two splits i.e., 50 per cent basally and 50 per cent at panicle initiation stage. Thirty days old seedlings of high yielding 'Lalar' rice was transplanted at a spacing of 20 cm X 15 cm on 28th, 26th, 31st and 25th July in the respective years. The precipitation received in the respective years was 1125 mm, 765 mm, 933 mm and 901 mm. The observed data were pooled for computation as the trend was identical for all four years of experimentation.

Results and Discussion

Yield attributes

The number of panicles per sq.m. was maximum for the treatment FYM + half the recommended dose of NPK. All other yield attributes like weight panicle⁻¹, total grain panicle⁻¹, filled grains panicle⁻¹ and test weight were higher (2.48, 89.26, 78.86 and 23.52 g respectively) in the treatment GM + half the recommended dose of NPK (Table 1). Prasad *et al.* (1990) opined that application of FYM or GM along with fertilizers increased the efficiency of fertilizers besides providing considerable amount of essential nutrients to the crop. However, all the yield attributes excepting filled grains

Table 1. Yield attributes and yield of rice as influenced by integrated nutrient supply (pooled of 4 years)

Treatment	Panicles/ Sq.m	Weight/ panicle (g)	Total grain/ panicle	Test grain/ panicle	Grain weight (g)	Grain yield (q ha ⁻¹)	Straw yield (q ha ⁻¹)	Harvest index	Benefit:cost ratio
T ₁	163.42	1.78	65.82	54.34	22.14	10.68	18.26	36.90	0.54
T ₂	243.93	2.02	73.46	64.18	22.82	20.64	32.42	38.90	0.99
T ₃	251.86	2.14	78.24	65.25	23.06	22.76	33.18	40.69	1.10
T ₄	303.34	2.46	85.53	70.28	23.45	32.12	40.63	44.15	1.38
T ₅	299.46	2.48	89.26	78.86	23.52	35.17	42.48	45.29	1.55
T ₆	285.37	2.40	85.67	69.47	23.26	33.95	43.86	43.63	1.46
CD	20.15	0.16	4.22	7.98	0.29	6.18	6.33	2.10	0.11

(P=0.05)

Details of treatments are given in Table 2.

Table 2. Residual N, P, K, organic carbon content and pH of soil as influenced by integrated nutrient management after 4 years

Treatment	pH	Organic Carbon (%)	Total Nitrogen (%)	Available Phosphorus (kg ha ⁻¹)	Available Potash (kg ha ⁻¹)
T ₁ Basic status	6.9	0.45	0.042	8.5	310.0
T ₁ Control (No manure or fertilizer)	7.0	0.41	0.036	7.9	276.6
T ₂ FYM @ 5 t ha ⁻¹	7.0	0.44	0.039	8.3	298.2
T ₃ GM @ 25 kg seed ha ⁻¹	6.9	0.48	0.042	8.4	306.8
T ₄ FYM @ 5 t ha ⁻¹ + 30:15:15 kg N, P and K ha ⁻¹ (half RD)	6.8	0.47	0.048	9.2	321.4
T ₅ GM @ 25 kg seed ha ⁻¹ + 30:15:15 kg N, P and K ha ⁻¹ (half RD)	6.6	0.50	0.052	9.6	326.5
T ₆ 60:30:30 kg N, P and K ha ⁻¹	6.8	0.42	0.040	8.1	306.2
CD (P=0.05)	NS	0.03	0.006	0.4	9.2

panicle⁻¹ remained statistically on par for the treatments GM + half the RD, FYM + half the RD and full dose of NPK alone.

Yield and economics

The grain yield was the highest with the treatment GM + half the recommended dose of NPK (35.17 q ha⁻¹). This may be due to the beneficial role of green manure in improving the soil physical conditions besides supplying

nutrients. Budhar and Palaniappan (1997) and Kalidurai and Kannaiyan (1990) reported that partial substitution with green manure recorded almost similar or comparable yield with that of full recommended dose through fertilizers. However, the yield of the treatment GM + half the RD was found to be on par with that of full RD (33.95 q ha⁻¹) and FYM + half the RD (32.12 q ha⁻¹). The control treatment registered the lowest grain yield (10.68 q ha⁻¹). As regards harvest

index, it was the highest for GM + half the RD (45.29) followed by FYM + half the RD (44.15) and full RD (43.63).

The net return per rupee invested for treatments GM + half the RD (1.55) and full RD (1.46) was significantly higher than other treatments. The minimum benefit : cost ratio was realised from the control treatment (0.54).

Soil fertility (Table 2)

After four years of experimentation the status of N, P, K, organic carbon and pH of soil was observed to change considerably. Although the pH of soil did not show significant difference among treatments, it was reduced from 6.9 to 6.6 in the treatment GM + half the RD. The decomposition of large quantity of biomass might have resulted in the release of free H⁺ causing reduction in pH. The organic carbon, total nitrogen, available phosphorus and available potash registered maximum increase in the treatment GM + half the RD. It is to record that leguminous green manures are known to improve soil conditions for enhanced and sustained rice production in wet season (IRRI, 1988). Application of FYM in conjunction with fertilizers has also been found to increase soil fertility significantly besides increasing rice yield. Similar result was reported

by Mishra (1974). The soil fertility status was the lowest for the control treatment. The organic carbon content and N, P and K status of soil were reduced under the application of NPK through fertilizers alone.

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