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Influence of integrated nutrient management on yield, nutrient uptake and economics in rice-niger cropping sequence

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ABSTRACT

The effect of integrated management of chemical fertilizers and farmyard manure on crop productivity and profitability in rice-niger cropping sequence was studied at Jorhat, Assam during 2005-2006. Application of 75% recommended dose of fertilizers paste along with 25% N through FYM produced the highest yield and uptake of nutrients for both rice and niger crop. Maximum benefit: cost ratio for the sequence was recorded as 1.95 in treatment receiving 75% recommended dose of fertilizers along with 25% N through FYM and biofertilizer based integrated nutrient management package.

Key words: *Integrated nutrient management, productivity, rice, niger, cropping sequence*

Integrated nutrient management (INM) involves maintenance of soil fertility, sustainable agricultural productivity and improvment farmer's profitability through the combined use of chemical fertilizers, organic manures and biofertilizer etc. The nutrient use efficiency of applied mineral nutrients by the crop is markedly influenced by the presence of various organic manures. The beneficial effects of farmyard manure alone or in combination with fertilizers have been observed by Kumar *et al*. (2001). In view of this, the present study was conducted to evaluate the effect of integrated nutrient management on yield and nutrient uptake in rice-niger cropping sequence.

The field experiment was conducted at Jorhat, Assam during wet and dry seasons of 2005-2006. The experimental soil was having pH 5.00, organic carbon 0.45%, available nitrogen 169.35 kg ha^{-1}, available phosphorus 27.83 kg ha^{-1} and available potassium 140.00 kg ha^{-1}. The experiment was laid out in randomised block design (RBD) with 7 treatments 3 replications. The treatments consisted of control, recommended dose of fertilizer (RDF) at 60:20:40 kg N, P_2O_5 and K_2O hectare^{-1} for rice and 20:10:10 kg N, P_2O_5 and K_2O hectare^{-1} for niger, biofertilizer based INM package (at 3t FYM ha^{-1} + Azospirillum for rice/ Azotobacter for niger and phosphate solubilising bacteria dual culture at 3kg ha^{-1}+ Rock phosphate at 50% P_2O_5 of RDF+MOPat100%K_2O of RDF, 50% RDF + 50% N through FYM, 75% RDF + 25% N through FYM, 50% N (inorganic) + 50% N through FYM + PK (inorganic and adjusted) and 75% N (inorganic) + 25% N FYM + PK (inorganic and adjusted). The amount of P and K supplied through FYM was adjusted from the total amount of inorganic P and K required. The N, P and K content of FYM were 0.486%, 0.610%, 1.13%, respectively and the requirement was calculated accordingly. It was incorporated into the soil 15 days prior to transplanting of rice and sowing of niger crop as per the treatments. Biofertilizer was applied at 3 kg ha^{-1} before transplanting of rice following root dipped treatment and seed treatment in case of niger. Half of N, whole of P_2O_5 and K_2O were applied at transplanting. The remaining N was applied as top dressing in two splits, at the time of maximum tillering stage and panicle initiation stage. In case of niger, the whole of N, single P_2O_5 and K_2O were applied as basal in the soil at the time of sowing. Plant samples were collected prior to harvest and analyzed for N, P and K content of plants as per the standard procedures (Jackson, 1973). A medium duration wet season rice cv. Basundhara was transplanted on 11.07.05 and harvested on 08.11.05. The niger crop cv. NG-1 was sown on 01.12.05 and harvested on 20.03.06.

Integrated nutrient management brought about a significant variation on crop yield and nutrient uptake for both the crops of rice and niger. Grain and straw yields of rice were significantly influenced by the different treatments (Table1). Significantly higher grain yield (3.83 t ha^{-1}) and straw yield (4.93 t ha^{-1}) were recorded in the treatemnt 75% RDF + 25% N through FYM followed by the treatment 50% RDF + 50% N through FYM (Table 1). This could be attributed to decomposition of FYM, which favoured better nutrient availability coupled with higher assimilation of nutrients. The findings are in agreement with the observations of Sharma *et al.* (2001) and Singh *et al*. (2006).

Similar trend was also recorded in niger (Table 1). Application of 75 % RDF along with 25% N through FYM resulted in the highest seed yield (3.79 q ha^{-1}) and stover yield (16.30q ha^{-1}) and was at par with 50% RDF + 50% N through FYM. This higher yield might be attributed to integrated effect of all physico-

Table 1. Yield of rice and niger as affected by integrated nutrient management

Treatments	Rice (t ha^{-1})		Niger (t ha^{-1})		Cost of cultivation (Rs. ha^{-1})		Net return (Rs. ha^{-1})	Benefit: Cost ratio
	Grain yield	Straw yield	Seed yield	Stover yield	Rice	Niger		
Control	2.52	3.73	0.13	0.41	10069	2301	11368	1.92
100% RDF	3.04	3.91	0.22	0.61	11986	3248	14322	1.94
Biofertilizer based INM package	3.13	4.18	0.31	0.92	12379	4092	15712	1.95
50% RDF+ 50% N FYM	3.56	4.50	0.35	1.55	19382	5316	11575	1.47
75% RDF + 25% N FYM	3.83	4.94	0.38	1.63	15829	4282	19159	1.95
50% N (inorganic) + 50% N FYM + PK (inorganic and adjusted)	3.79	4.54	0.33	1.15	18875	5114	13644	1.57
75% N (inorganic) + 25% N FYM + PK (inorganic and adjusted)	2.81	4.14	0.26	1.05	15068	3978	9835	1.52
S.Ed (±)	0.242	0.256	0.030	0.129				
CD (P=0.05)	0.528	0.558	0.067	0.281				
CV (%)	9.16	7.34	13.21	15.10				

Table 2. Nutrient uptake of rice and niger as affected by integrated nutrient management in rice-niger sequence

Treatments	Rice						Niger					
	N uptake (kg ha^{-1})		P uptake (kg ha^{-1})		K uptake (kg ha^{-1})		N uptake (kg ha^{-1})		P uptake (kg ha^{-1})		K uptake (kg ha^{-1})	
	Grain	Straw	Grain	Straw	Grain	Straw	Seed	Stover	Seed	Stover	Seed	Stover
Control	28.27	11.91	4.01	3.72	8.59	55.15	2.97	7.09	0.82	0.52	0.41	1.71
100% RDF	37.68	12.87	5.89	4.65	10.96	58.53	4.81	10.81	1.52	0.81	0.69	2.60
Biofertilizer based INM package	43.80	15.03	6.23	5.42	11.85	63.90	7.39	16.68	2.18	1.23	1.03	4.05
50% RDF + 50% N FYM	49.12	17.08	8.17	6.73	15.30	74.17	8.79	28.56	2.50	2.09	1.18	6.90
75% RDF + 25% N FYM	54.81	20.75	9.20	8.36	18.02	84.48	9.96	30.65	2.77	2.29	1.33	7.40
50% N (inorganic) + 50% N FYM+ PK (less present in FYM)	52.73	18.77	8.33	7.24	15.94	76.27	8.37	21.23	2.30	1.58	1.13	5.21
75% N (inorganic) + 25% N FYM + PK (less present in FYM)	34.61	14.47	5.36	5.71	10.42	63.74	6.23	18.23	1.82	1.40	0.91	4.67
CD (P=0.05)	6.54	2.30	1.12	1.35	2.19	9.52	0.79	8.84	0.09	0.05	0.02	0.52

RDF - recommended dose of fertilizer; INM-integratted nutrient management; FYM- farm yard manure

chemical properties as well as available nutrient status of the soil, that facilitated in maintaining a better physical condition and steady supply of nutrients throughout the crop growth. Similar findings were also reported by Ram *et al.* (1992) and Paikray *et al.* (2001). Integrated nutrient treatments had pronounced influence in increasing uptake of nutrients (N, P and K) over control and recommended dose of fertilizer in both the crops (Table 2). Application of 75% RDF along with 25% N through FYM resulted in the highest N, P and K uptake by grain and straw of rice as well as seed and stover of niger crop. Better performance under these treatments might also be due to favourable soil environment, which encouraged better root proliferation and ensured higher nutrient uptake (Singh *et al.*, 2006).

Economics of rice-niger cropping sequence indicated that the highest benefit:cost ratio in the treatment receiving 75% RDF along with 25% N through FYM and biofertilizer based INM package. However, the higher net return (Rs.19159 ha^{-1}) was higher in plots treated with 75% RDF along with 25% N through the FYM The lowest benefit: cost ratio was recorded under treatment receiving 50% RDF along with 50% N through FYM. This might be due to huge quantity of FYM incorporation in soil along with inorganic fertilizers, which involved higher cost.

Thus the application of 75% RDF alongwith 25% N through FYM improved the crop yield of both rice and niger in rice-niger cropping sequence with higher net return and benefit:cost ratio.

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