

## Effect of integrated NPK management on the productivity of rice–rice cropping sequence under Cauvery Delta region

T. Sathesh Kumar, S.Natarajan\*, and K. Arivazhagan

Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalainagar–608 002, Tamil Nadu, India

### ABSTRACT

The performance under graded levels of fertilizers and in combination with green leaf manure (GLM) and Farmyard manure (FYM) was studied with rice hybrids ADTRH-1 in a rice-rice cropping sequence. It was observed that 125% recommended dose of fertilizer (100:50:50 NPK) +6.25 t GLM gave the highest grain yield (5.67 and 5.96 t ha<sup>-1</sup>), highest nutrient uptake and return per rupee invested (2.10 and 2.20), the yield advantage being 52 per cent compared RDF (100:50:50 NPK).

**Key words:** Rice, cropping sequence, green leaf manure, farm yard manure

Hybrid rice technology in one of the options to augment rice productivity. However, hybrid rice requires heavy input of chemical fertilizers, the use of which over a period of time results in pollution hazard and has led to a declining trend in the productivity of rice (Nambiar and Abrol, 1991). Hence a field experiment was conducted to study the response of hybrid rice to graded levels of NPK through integrated plant nutrient management on order to supplement the chemical fertilizer with bio-organic sources to enable preserve soil quality and obtain high productivity.

Field experiment was conducted at the experimental farm, Department of Agronomy, Annamalai University, Annamalainagar, Tamil Nadu in two seasons viz., February to June, 2004 (Late Navarai) and October to February, 2005 (Thaladi). The soil was clay loam analysing 238 kg ha<sup>-1</sup> available N, 23.5kg ha<sup>-1</sup> available P, 318.7 kg ha<sup>-1</sup> available K and pH 7.3. Four graded levels of fertilizers viz., 100% recommended dose of fertilizer RDF 100:50:50 NPK, 75% RDF, 125% RDF and 150% RDF alone and in combinations with 12.5 t ha<sup>-1</sup> farmyard manure (FYM) or 6.25 t ha<sup>-1</sup> green leaf manure (GLM) were compared along with a control (No fertilizer) treatment. The experiment was carried out in a randomized complete block design with three replications. The RDF was 150: 50: 50 NPK kg ha<sup>-1</sup>. N and K were applied in

3 splits viz., 50 % at basal, 25 % at tillering and 25 % at panicle initiation stage and entire quantity of phosphorus and potassium were applied at basal. FYM and GLM were applied 10 days before rice planting on weight basis. The GLM used in the study was *Sesbania rostrata* with a nutrient analysis of 3.3% N, 0.6% P and 1.2% K. Rice hybrid (ADTRH-1 115 days duration) was used for the experiment. Observations were recorded on tiller number m<sup>-2</sup>, rice grain yield (t ha<sup>-1</sup>) NPK uptake at harvest stage and post harvest NPK soil status for both the crop seasons.

Highest tiller production of 441 and 459 m<sup>2</sup> in the first season and second season respectively was obtained with 125% RDF + 6.25 t ha<sup>-1</sup> GLM. Similar tiller number was obtained with 150% RDF + 6.25 t ha<sup>-1</sup> GLM (Table 1). 100% RDF gave lesser number of tillers viz., 349 m<sup>2</sup> and 375 m<sup>2</sup> in the first season (Late Navarai) and second season (Thaladi) respectively. Combined application of organics and inorganics resulted in higher tiller production compared to inorganic fertilizers alone in rice crop (Syed Nazeer Peeran and Sree Ramulu, 1995).

Grain yield significantly increased up to 125% in recommended dose of fertilizer treatment (Table 1). Highest grain yield (5.67 and 5.96 t ha<sup>-1</sup> in first and second seasons respectively) was recorded under combined application of 125% RDF and 6.25 t ha<sup>-1</sup>

**Table 1. Effect of integrated nutrient management in rice-rice cropping sequence**

Treatment	Tillers Number (m <sup>-2</sup> )			Grain yield (t ha <sup>-1</sup> )			Nutrient uptake (kg ha <sup>-1</sup> )						Post harvest soil NPK (kg ha <sup>-1</sup> )					
	Late Navarai		Thaladi	Late Navarai		Thaladi	Late Navarai			Thaladi			Late Navarai			Thaladi		
	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K
Control	244	278	2.06	1.96	53.85	9.25	56.25	52.65	10.11	52.62	148.64	9.16	252.44	144.36	9.06	251.72		
100% (RDF)	249	375	3.83	3.90	91.02	21.16	93.87	101.25	25.90	98.05	194.85	13.15	292.06	192.13	13.05	288.76		
75% (RDF)	301	331	2.94	3.01	71.02	15.45	79.05	83.95	20.05	84.95	191.26	11.60	287.16	188.75	11.37	283.43		
125% (RDF)	397	421	4.82	4.88	108.92	27.05	107.95	118.95	31.65	110.34	198.25	14.95	295.36	197.15	14.88	293.16		
150% (RDF)	404	425	4.91	4.98	110.91	27.95	109.65	121.05	32.05	111.22	202.35	16.55	298.67	201.22	16.53	297.13		
12.5t (FYM)	267	299	2.34	2.41	59.05	11.95	69.92	67.35	15.33	74.32	205.95	18.55	302.42	207.16	18.28	301.36		
6.25t (GLM)	284	316	2.58	2.70	64.82	13.85	74.05	75.05	17.92	80.15	209.02	19.95	306.76	210.96	20.05	304.81		
100%RDF+	366	391	4.17	4.28	96.82	23.11	98.87	106.95	27.55	101.95	218.65	24.95	317.84	222.86	24.83	316.36		
12.5t FYM	317	346	3.15	3.31	78.21	17.55	84.05	90.35	22.22	89.05	211.86	21.65	310.66	215.12	21.75	308.12		
75%RDF+	418	438	5.24	5.51	119.11	30.92	114.05	127.05	33.85	116.02	223.45	27.08	322.24	228.04	27.56	322.16		
12.5t FYM	420	442	5.36	5.62	120.21	31.35	115.15	128.35	34.15	117.72	224.65	27.90	323.13	229.16	28.05	324.04		
150%RDF+	381	407	4.48	4.59	102.92	25.05	103.15	112.55	29.55	105.95	219.95	25.75	318.75	223.96	25.76	318.05		
6.25 t GLM	333	361	3.48	3.61	84.92	19.22	88.25	97.15	24.10	93.85	215.15	23.15	314.54	219.16	23.23	311.44		
75%RDF+	435	455	5.67	5.96	127.42	33.95	119.95	134.65	36.05	122.32	228.05	29.16	326.73	232.96	29.95	328.16		
6.25 t GLM	441	459	5.78	6.12	129.62	34.26	121.06	136.75	36.75	124.36	229.16	29.78	327.56	234.26	30.24	329.86		
150%RDF+	10	8	0.19	0.21	4.2	1.2	3.0	4.4	1.1	2.8	2.3	1.1	2.2	2.4	1.2	2.4		
6.25 t GLM																		

RDF = Recommended dose fertilizer; FYM=Farm yard manure; GLM=Green leaf manure

GLM, which was 18 per cent higher as compared to 125% RDF alone and 110 per cent over FYM/GLM alone. Integration of GLM with chemical fertilizers brought down the C:N ratio to 10:1 consequently resulting in additional mineralization and availability of N to the crop, to give a higher rice yield (Mahavishnan *et al.*, 2003).

Highest N uptake was recorded in crops treated with 125% RDF+ 6.25 t ha<sup>-1</sup> GLM (127.42 and 134.65 kg ha<sup>-1</sup> in the first and second seasons respectively) and it was 18 and 33 kg ha<sup>-1</sup> higher than 125%RDF and 100% RDF alone (Table 1). P and K uptake revealed a similar trend as that of N uptake. Integration of GLM resulting in increased nutrient uptake might have been through ammonification and release of organically bound phosphorus in rice crop (Yadavinder Singh *et al.*, 1991; Chakraborty *et al.*, 2001).

At the end of two crop seasons, post harvest soil N was highest with 150% RDF + 6.25 t ha<sup>-1</sup> GLM

(234.26 kg ha<sup>-1</sup>) and it did not differ significantly with 125% RDF + 6.25 t ha<sup>-1</sup> GLM (Table 1). However a significant reduction in soil N to a tune of 4 kg ha<sup>-1</sup> was noticed with 150% RDF + 12.5 t ha<sup>-1</sup> FYM / 125% RDF +12.5 t ha<sup>-1</sup> FYM, compared to the best treatment. 100% RDF showed a lower status of soil N (192 kg ha<sup>-1</sup>). Suresh and Ramsubba Reddy (2002) reported a positive effect of soil NPK through integrated application of organics with inorganic fertilizers.

The highest net return of Rs.17,848 and Rs.19,461 ha<sup>-1</sup> in the first and second seasons respectively was obtained with 125% RDF + 6.25 t ha<sup>-1</sup> GLM and this treatment also recorded the highest return rupee<sup>-1</sup> invested (Rs.2.10 and Rs.2.20 in the first and second seasons respectively) (Table 2). 100% RDF alone gave a net return of Rs.9,738 and Rs.10,161 while the return rupee<sup>-1</sup> invested was Rs.1.71 and 1.75 in the first and second season respectively. Highest net return could be possible through higher yields obtained with integration of cost effective organic sources of nutrients.

**Table 2. Effect of integrated nutrient management in rice-rice cropping sequence**

Treatments	Economics			
	Net return (Rs. ha <sup>-1</sup> )		Return per rupee invested	
	Late Navarai	Thaladi	Late Navarai	Thaladi
Control	2046	1496	1.19	1.14
100% Recommended dose fertilizer (RDF)	9738	10161	1.71	1.75
75% Recommended dose fertilizer (RDF)	5216	5513	1.40	1.43
125% Recommended dose fertilizer (RDF)	14766	15141	2.03	2.06
150% Recommended dose fertilizer (RDF)	14558	15016	1.97	2.00
12.5 t Farmyard manure (FYM)	2491	2828	1.20	1.23
6.25 t Green leaf manure (GLM)	3356	3966	1.26	1.31
100%RDF+12.5 t FYM	10468	4321	1.70	1.75
75%RDF+12.5 t FYM	10638	6078	1.75	1.43
125%RDF+12.5 t FYM	15961	17473	2.02	2.12
150%RDF+12.5 t FYM	15936	17376	1.98	2.07
100%RDF+6.25 t GLM	11651	12288	1.75	1.79
75%RDF+6.25 t GLM	6571	7278	1.44	1.49
125%RDF+6.25 t GLM	17848	19461	2.10	2.20
150%RDF+6.25 t GLM	17766	19656	2.05	2.16

\* Statistically not analysed

Integrated NPK management in rice-rice cropping sequence

T. Sathesh Kumar et al

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