

Productivity and economics of rice groundnut cropping system under integrated nutrient management

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ABSTRACT

The field experiments were conducted during *kharif* and *rabi* seasons of 1998-99 and 1999-2000 at the Agronomy Farm, College of Agriculture, Dapoli, dist. Ratnagiri to study the effect of integrated nutrient management on the fertility status, productivity and economics of rice (*Oryza sativa* L.) – groundnut (*Arachis hypogaea* L.) cropping system. Application of 50% recommended dose of NPK through fertilizers + 50% N substitution either through glyricidia or FYM to rice recorded higher grain yield. Groundnut supplied with 75% recommended dose of fertilizers preceded by 50 % RDF + 50 % N substitution through FYM to rice registered significantly higher pod yield. In rice – groundnut sequence, maximum net returns and benefit cost ratio were observed due to application of 100% RDF to both the crops. The total uptake of N, P, K by the crops increase significantly with the increased in the dose of fertilizers over control whereas combined use of inorganic fertilizers registered the highest value with organic manures. Among the organic manures the overall performance of green manure was the best, followed by farmyard manure. Judicious use of organic manures like FYM and glyricidia with inorganic fertilizers improved the availability of NPK in the soil significantly.

Key words : Rice-groundnut, Integrated nutrient management

INTRODUCTION

Rice - groundnut sequential cropping plays a significant role in total productivity of crops in Konkan region of Maharashtra. The fertilizer needs of a crop in a cropping system mainly depend upon the characteristics of the preceding crops and kind and quantities of fertilizers applied to them. Continuous unbalance use of fertilizers in intensive cropping system leads to decreases in crop yields, imbalance of nutrients in soil and adverse effect on soil. Thus, there is a vast scope for increasing nutrient supply through use of organic manures, green manures and adoption of proper crop sequences and these together can contribute significantly to the required nutrient pool.

Therefore, there is a need for systematic approach of nutrient supply to the system as a whole to increase the fertilizer use efficiency and economizing the use of costly mineral fertilizers by accounting the residual effect of the applied fertilizers and preceding crops. An experiment was therefore, conducted to evaluate the productivity and economics of rice-groundnut crop sequence under integrated nutrient supply system and its influence on fertility dynamics of soil.

MATERIALS AND METHODS

The field experiment was conducted during the rainy (*kharif*) and winter (*rabi*) seasons of 1998-99 and 1999-2000 at Agronomy farm, College of Agriculture, Dapoli,

dist. Ratnagiri. The soil of experimental plot was clay loam in texture with pH 6.36, organic carbon 1.30 g kg⁻¹; and the available nitrogen 295.22 kg⁻¹, phosphorus 12.96 kg⁻¹ and potassium 105.03 kg⁻¹. There were 11 treatment combinations (Table 1) replicated thrice in Randomized Block Design. Rice (var. Sahyadri) and groundnut (var. Konkan tapora) were grown as the test crop. The recommended dose of fertilizer was 100:50:50 N, P and K kg ha⁻¹ for rice and 25:50:0 N, P and K kg ha⁻¹ for groundnut. The treatment comprised application of different combinations of inorganic and organic sources of nutrients to rice and inorganic sources to groundnut. The grain and straw of rice and haulm, kernel and shell of groundnut samples were analyzed for their N content by Kjeldahl method. The samples were digested in diacid (HNO₃, HClO₄, 4:1) mixture. Phosphorus was estimated in diacid digest by vanadomolybdo phosphoric yellow colour method. The extract was used for determination of potassium by flame photometer. The soil samples collected were analyzed for available N by alkaline permanganate method, P by Brays method and K by flame photometer after extraction with 1 N NH₄OAC (pH 7.0). Data on grain and straw yield, total productivity/ha/year (grain and biomass), gross monetary returns, net monetary returns and benefit: cost ratio were obtained from the cropping sequence during two years and their mean. Economics of fertilizer application in the cropping system was worked out.

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Table 1: Details of treatments and symbols used

Symbol	Treatments	
	Kharif (Rice)	Rabi (Groundnut)
T ₁	No organic manures, No chemical fertilizers	No organic manures, No chemical fertilizers
T ₂	50% recommended NPK through fertilizers	75% recommended NPK through fertilizers
T ₃	50% recommended NPK through fertilizers	100% recommended NPK through fertilizers
T ₄	75% recommended NPK through fertilizers	75% recommended NPK through fertilizers
T ₅	100% recommended NPK through fertilizers	100% recommended NPK through fertilizers
T ₆	100% recommended NPK through fertilizers	75% recommended NPK through fertilizers
T ₇	75% recommended NPK through fertilizers	100% recommended NPK through fertilizers
T ₈	50% recommended NPK through fertilizers + 50% N through FYM	75% recommended NPK through fertilizers
T ₉	75% recommended NPK through fertilizers + 25% N through FYM	100% recommended NPK through fertilizers
T ₁₀	50% recommended NPK through fertilizers + 50% N through Glyricidia	75% recommended NPK through fertilizers
T ₁₁	75% recommended NPK through fertilizers + 25% N through Glyricidia	100% recommended NPK through fertilizers

RESULTS AND DISCUSSION

The results obtained from the present investigation are presented below:

Effect of INM on yield (q ha⁻¹):

The application of 50 % RDF and 50 % nitrogen either through glyricidia (T₁₀) or FYM (T₈), 75 % RDF + 25 % N through glyricidia (T₁₁) or FYM (T₉), 100 % RDF (T₅ and T₆) proved significantly superior over rest of the treatments during both the years but the differences between former six treatments were in similar order. The beneficial effect in respect of grain yield was more prominent with 50 % recommended NPK through fertilizer + 50 % N substitution through glyricidia (71.64 q/ha) which recorded 105.41 % higher grain yield compared to that of 100 % recommended NPK. Glyricidia leaves contained 2.7 % nitrogen and had a narrow C: N ratio of about 13. Besides having low lignin and polyphenolic content, glyricidia decomposed rapidly in the soil and mineralized nitrogen tends to become available with 10 to 15 days after incorporation. Thus, an integrated nutrient management of green leaf manuring with glyricidia and 50 % recommended NPK dose helped to reduce 50 % recommended dose of fertilizer. Patnaik *et al.* (1989) and Nambiar *et al.* (1992) also reported similar results. Same trend was found in case of rice straw yield during both the years.

The application of 50 % recommended NPK through fertilizer + 50 % N through glyricidia (T₁₀) recorded 192.22 % and 198.06 % higher grain and straw yield of hybrid rice during 1998 and 1999 over control (T₁), respectively. It was closely followed by 50 % recommended NPK through fertilizer + 50 % nitrogen through FYM (T₈), 75 % recommended NPK + 25 % N

through glyricidia (T₉) or FYM (T₁₁). Chavan *et al.* (1990), Powar and Mehta (1997) also reported similar observations.

The beneficial effect in respect of dry pod yield and haulm yield was more prominent with application of 75 % recommended NPK (T₁₀) through fertilizer which was probably due to residual effect of organic manures applied to previous rice crop. Thus, there is possibility to economize 25 % NPK fertilizers for succeeding crop under rice – groundnut sequence. It was closely followed by 100 % RDF (T₉). The increase in dry pod yield and haulm yield (Table 2) due to 75 % recommended NPK was to the tune of 214.52 % and 220.10 % during 1998 and 1999, respectively over control. Kathmale (2000) reported the similar results.

Effect of INM on economics of rice-groundnut sequence:

Rice grown with application of 100 % recommended NPK (T₅ and T₆) proved highly remunerative compared to all other treatments recording a net profit of Rs. 15,357.25 /ha and 15,168.46 /ha, respectively followed by T₁₁. The application of 75 % RDF (T₈) proved highly remunerative recording net returns of Rs. 16,413.68 /ha and high B : C ratio (1.82) as compared to rest of the treatments.

Effect of INM on nutrient uptake:

The data presented in Table 3 indicate that all the treatment showed significant increase in the uptake of N, P and K compared with the control under rice – groundnut sequence. Application of 50 % recommended NPK through fertilizers + 50 % N through glyricidia noted maximum nitrogen uptake followed by 50 % recommended NPK through fertilizers + 50 % N through

Table 2 : Production potential and economics of rice-groundnut crop sequence (mean data of 1998-2000)

Symbol	Treatments	Rice				Groundnut				
		Yield (q/ha)	Straw yield (q/ha)	Net profit (Rs./ha)	B:C ratio	Treatments	Dry pod yield (q/ha)	Haulm yield (q/ha)	Net profit (Rs./ha)	B:C ratio
T ₁	Control	37.27	37.17	1840.80	1.08	Control	10.38	26.92	2714.69	1.19
T ₂	50 % RDF	53.89	56.13	9153.14	1.34	75 % RDF	13.59	35.96	6847.56	1.39
T ₃	50 % RDF	55.26	57.21	9824.77	1.36	100 % RDF	17.68	48.43	11955.38	1.62
T ₄	75 % RDF	62.30	64.56	12806.22	1.45	75 % RDF	13.96	36.72	7857.94	1.42
T ₅	100 % RDF	68.52	70.64	15357.25	1.51	100 % RDF	19.15	53.12	13744.50	1.69
T ₆	100 % RDF	68.14	70.28	15168.46	1.50	75 % RDF	14.13	37.70	7649.31	1.44
T ₇	75 % RDF	63.06	65.26	13482.34	1.47	100 % RDF	18.94	50.22	13281.00	1.68
	50% RDF+50 % N through FYM	70.37	72.37	12035.84	1.34	75%RDF	21.65	57.77	16413.68	1.82
	75 % RDF+25 % N through FYM	69.36	71.13	13639.00	1.42	100 % RDF	20.10	54.38	14887.50	1.74
	50 % RDF+50 % N through Glyricidia	71.64	73.62	12668.28	1.35	75 % RDF	20.78	56.82	15925.56	1.78
T ₁₁	75 % RDF+25 % N through Glyricidia	70.07	72.55	14029.73	1.43	100 % RDF	19.53	53.46	14196.50	1.71
	'F' test	Sig.	Sig.				Sig.	Sig.		
	S.E. ±	0.91	0.91				0.94	1.66		
	C.D. (P=0.05)	2.51	2.52				2.78	4.89		

FYM which were similar with each other. This might be due to slow and continuous supply of nutrients to rice plant. Sahrawat (1982) reported similar results. P and K uptake by grain and straw also showed the similar trend during both the years.

Significantly higher nitrogen uptake by groundnut kernel and haulm was observed due to application of 75 % RDF followed by 100 % RDF, but the differences

between these two treatments were of similar magnitude. P and K uptake by groundnut kernel and haulm showed superiority of the same during both the years. Reddy *et al.* (1983) reported the similar results.

Effect of INM on available nutrients:

The available NPK status of soil after harvest of rice and groundnut showed that all the fertilized plots had

Table 3 : Total uptake of N, P and K (kg/ha) by rice and groundnut crop. (mean data of 1998-2000)

Sr. No.	Treatments	Rice			Groundnut			
		N	P	K	Treatments	N	P	K
T ₁	Control	45.685	9.535	51.3	Control	60.245	2.345	31.365
T ₂	50 % RDF	76.33	17.225	91.885	75 % RDF	91.095	5.385	47.735
T ₃	50 % RDF	80.035	18.56	94.015	100 % RDF	126.415	9.57	66.355
T ₄	75 % RDF	103.235	25.53	112.06	75 % RDF	93.68	5.595	48.795
T ₅	100 % RDF	125.885	32.65	130.175	100 % RDF	137.13	11.225	72.4
T ₆	100 % RDF	126.27	32.175	127.93	75 % RDF	94.55	5.77	49.695
T ₇	75 % RDF	107.34	25.8	113.805	100 % RDF	131.435	10.09	68.775
T ₈	50% RDF+50 % N through FYM	133.3	32.185	129.53	75%RDF	156.8	13.925	80.05
T ₉	75 % RDF+25 % N through FYM	128.585	30.41	128.635	100 % RDF	144.94	12.3	75.185
T ₁₀	50 % RDF+50 % N through Glyricidia	139.12	36.22	135.9	75 % RDF	153.175	13.67	79.485
T ₁₁	75 % RDF+25 % N through Glyricidia	132.415	32.75	131.065	100 % RDF	142.87	12.48	74.985
	'F' test	Sig.	Sig.	Sig.		Sig.	Sig.	Sig.
	S.E. ±	3.23	1.4465	3.463		5.09	0.775	2.3
	C.D. (P=0.05)	9.585	4.4425	10.2705		15.11	2.305	6.84

Table 4 : Available N, P and K (kg/ha) in the soil (mean data of 1998-2000)

Sr. No.	After rice harvest			After groundnut harvest				
	Treatments	N	P	K	Treatments	N	P	K
T ₁	Control	264.3	9.755	69.525	Control	267.535	8.44	61.425
T ₂	50 % RDF	292.95	13.76	80.81	75 % RDF	300.32	15.985	74.595
T ₃	50 % RDF	292.855	14.55	82.265	100 % RDF	300.475	17.2	77.08
T ₄	75 % RDF	300.815	17.135	85.125	75 % RDF	308.255	19.56	79.03
T ₅	100 % RDF	310.235	20.36	95.09	100 % RDF	318.71	23.75	90.14
T ₆	100 % RDF	310.53	20.18	93.95	75 % RDF	318.03	22.68	87.41
T ₇	75 % RDF	301.045	17.22	85.375	100 % RDF	309.3	20.2	80.295
T ₈	50% RDF+50 % N through FYM	347.89	21.95	147.195	75%RDF	369.075	27.86	143.005
T ₉	75 % RDF+25 % N through FYM	339.06	21.12	128.74	100 % RDF	351.34	25.11	124.185
T ₁₀	50 % RDF+50 % N through Glyricidia	354.435	17.5	145.61	75 % RDF	365.88	21.15	141.145
T ₁₁	75 % RDF+25 % N through Glyricidia	337.035	17.705	126.585	100 % RDF	345.54	20.75	121.78
	'F' test	Sig.	Sig.	Sig.		Sig.	Sig.	Sig.
	S.E. ±	2.58	0.835	0.905		3.06	1.155	1.115
	C.D. (P=0.05)	7.65	2.465	2.69		9.06	3.42	3.295

higher available NPK than the unfertilized plot during both the years (Table 3). Available nitrogen showed improvement with the highest availability under 50% recommended NPK through fertilizers + 50% N through glyricidia (T₁₀), closely followed by 50% recommended NPK through fertilizers + 50% N through FYM (T₈) after harvest of rice, while, 50% recommended NPK through fertilizers + 50% N through FYM showed increase in available phosphorus followed by 50% RDF + 50% N through glyricidia. The effect of glyricidia in this respect was inferior as compared to FYM which might be because of its low phosphate content (0.51 %) as compared to FYM (0.58 %). Available potassium showed slight depletion with 100% recommended NPK, but it was increased with 50% recommended NPK through fertilizers + 50% N through FYM as compared to initial status, followed by 50% recommended NPK through fertilizer + 50% N through glyricidia after harvest of rice. Mandal *et al.* (1985) recorded the similar results. There was improvement in N and P status after harvest of groundnut, but potassium status declined slightly due to application of chemical fertilizers alone. Further, it was noted that application of 75% RDF to groundnut preceded with 50% RDF + 50% N either through FYM or glyricidia showed improvement in available N followed by 100% RDF preceded with 75% RDF + 25% N through FYM or glyricidia. These results are in confirmatory with those reported by Kanwar and Prihar (1962).

Conclusion:

Though application of 100% NPK through fertilizers

alone registered the highest net profit of Rs. 29,101.76/ha under rice - groundnut crop sequence compared to 50% RDF + 50% N through FYM, the long term benefits in respect of soil fertility dynamics can not be neglected. The integrated use of green manuring with glyricidia and FYM to the extent of 50% N with 50 % RDF is a judicious blend to stabilize yield at maximum level without deteriorating soil health under rice – groundnut sequence in South Konkan zone of Maharashtra.

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