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Effect of nutrient management on grain yield and nutrient uptake of *advance kar* rice based cropping system in Tambaraparani Command Area

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Abstract : Integrated application of green manure @ 6.25 t ha^{-1} and 100 per cent NPK fertilizer enhanced the nutrient uptake and recorded higher grain yield of *advance kar* rice. The residual effect of integrated nutrient managements adopted to *advance kar* rice increased the nutrient uptake and grain yield of rice fallow blackgram. Combined application of green manure and 100 per cent NPK fertilizer to *advance kar* rice, raising rice fallow blackgram preceding to *pishanam* rice and application of 100 per cent NPK fertilizer to *pishanam* rice recorded higher nutrient uptake, grain yield and soil available nutrients, which was on par with 25 per cent lesser P and K and 25 per cent lesser NPK to *pishanam* rice. The results indicate that reduction of 25 per cent NPK fertilizer to *pishanam* rice can be achieved through adoption of green manuring along with recommended NPK to *advance kar* rice and cropping blackgram preceding to *pishanam* rice without reduction in yield.

Key words: Nutrient management, Rice, Rice fallow blackgram, Cropping system

Introduction

Rice is the main crop in Tambaraparani command area of Tamil Nadu, India. It is normally raised during *kar* (June-Sep) and *pishanam* (Oct - Feb) season. Over a long time, a crop called 'advance kar' is also raised in the tail end areas of the command from April to July with the help of summer flows in the river and also the water released from the Papanasam Power house, which are not utilized in the upper channels during April and May and second crop of rice is cultivated only during *pishanam* season. Hence, the rice lands of this tract are cropped with one pulse crop (blackgram) or fallowed in between these two rice crops (Aug -Oct). In general, crop production research has been focusing attention on individual crop disregard to the fact that each crop is only a component of cropping system. Nutrient prescription for individual crop is usually made based on the response of the crop without considering the cropping system as a whole, which proves often uneconomic. The most common approach in developing the fertilizer schedule for an intensive cropping system should have an understanding of the component crop, their nutrient uptake pattern, soil contribution and differential response of crops to nutrients (Barker and Francis, 1986). Generally, the succeeding crop raised in the same field utilizes a portion of the nutrient left over in the soil. Such effects of fertilizer including organic manure are to be taken into consideration, while determining the fertilizer schedule for a cropping system. Green manuring with leguminous crop helps in reducing mining

Table 1. Effect of Integrated Nutrient Management on *advance kar* rice

Treat-ment	Grain yield (kg ha^{-1})			Nutrient uptake (kg ha^{-1}) at harvest								
				Nitrogen			Phosphorus			Potassium		
	C_1	C_2	Mean	C_1	C_2	Mean	C_1	C_2	Mean	C_1	C_2	Mean
F_1	4895	4835	4865	74.46	73.37	73.92	13.64	13.82	13.73	91.59	87.00	89.29
F_2	4884	4944	4914	72.77	73.14	72.96	13.48	15.58	14.53	90.92	92.57	91.74
F_3	4965	4885	4925	75.58	75.34	75.46	15.97	15.24	15.60	92.05	91.50	91.77
F_4	4920	4850	4885	73.78	72.28	73.03	14.37	13.83	14.10	89.02	89.92	89.47
F_5	4903	4973	4938	74.70	75.70	75.20	15.28	15.49	15.38	88.18	90.07	89.12
F_6	4890	4910	4850	72.57	72.33	72.45	13.88	14.08	13.98	91.17	86.59	88.88
F_7	4495	4545	4520	69.39	69.32	69.36	14.03	14.65	14.34	84.27	85.25	84.76
F_8	3449	3508	3479	51.37	52.84	52.11	10.94	9.78	10.36	64.39	66.03	65.21
F_9	2900	2830	2865	44.54	43.36	43.95	8.39	7.94	8.16	53.23	52.82	53.02
Mean	4478	4465	67.68	67.52		13.33	13.38		77.20	82.41		

	SEd	CD (0.05)	SEd	CD (0.05)	SEd	CD (0.05)	SEd	CD(0.05)
C	48	NS	0.62	NS	0.08	NS	0.90	NS
F	10	207	1.31	2.66	0.17	0.35	1.91	3.88
CXF	144	NS	1.85	NS	0.25	NS	2.70	NS

Table 2. Residual effect of nutrient treatments adopted to *advance kar* rice on blackgram

Treat-ment	Grain yield (kg ha^{-1})	Nutrient uptake (kg ha^{-1}) at harvest		
		Nitrogen	Phosphorus	Potassium
F_1	334	32.73	3.59	18.96
F_2	340	33.52	3.54	18.87
F_3	331	33.15	3.39	18.77
F_4	329	32.59	3.48	18.19
F_5	335	32.98	3.57	18.31
F_6	337	32.78	3.51	18.91
F_7	295	27.85	3.08	16.56
F_8	256	23.65	2.71	14.51
F_9	195	17.89	2.06	11.05
SEd	14	0.46	0.05	0.28
CD(0.05)	30	0.94	0.11	0.54

Note : F_1 to F_6 : Green manure @ 6.25 t ha^{-1} + 100% NPK (120:38:38 kg ha^{-1})
F_7 :100% NPK; F_8 : Greenmanure @ 10 t ha^{-1}; F_9 : Control

the nutrient from the soil and also to build the soil nutrients to certain level. Growing a legume in the cropping system enriches the soil through atmospheric N fixation and extraction of less soluble soil P, making it eventually available to other crops. Research work on the system approach nutrient management in *advance kar* rice based cropping system is limited. In this context, the study was undertaken to find out the appropriate nutrient management practice for *advance kar* rice based cropping system in Tambaraparani command area of Tamil Nadu.

Materials and Methods

A field experiment was conducted at Agricultural College and Research Institute, Killikulam, Tamil Nadu during *advance kar* (Apr - Jul), rice fallow (Aug - Oct) and *pishanam* seasons (Oct - Feb) of 2000 and 2001. The soil of the experimental field was sandy, clay loam having organic carbon 0.53 per cent with pH 7.2, available N, P and K *viz.*, 252,19 and 244 kg ha^{-1} respectively. The experiment was laid out in a Factorial Randomized Block Design and replicated thrice. The treatments were two cropping system [Rice - Blackgram - Rice (Ci); Rice - Fallow - Rice (C_2)] and eight nutrient management packages along with control. The nutrient treatments were imposed only to rice crops and no manure / fertilizer applied to rice fallow blackgram except DAP spray. The treatments for *advance kar* rice were F_1 to F_6 i.e., Green manure @ 6.25 t ha^{-1} + 100%'NPK (120:38:38 kg ha^{-1}); F_7, 100% NPK; F_8, Green manure @ 10 t ha^{-1}; F_9, control. The treatments for *pishanam* rice were F_1, 100% NPK (150 : 50 : 50 kg ha^{-1}); F_2, 75% NPK ; F_3, 50% NPK ; F_4, 100% N + No P & K ; F_5, 100% N + 50% P & K ; F_6, 100% N + 75% P & K ; F_7, 100% NPK ; $F_{8)}$ No fertilizer; F_9, control. The rice varieties, ASD 16 and ADT 39 were used in *advance kar* and *pishanam* seasons respectively. After the harvest of *advance kar* rice, blackgram variety, ADT 3 was sown in the same plot without disturbing the layout. Fertilizer Nitrogen was applied in four splits i.e. 40 per cent as basal, 20 per cent each at active tillering, panicle initiation and flowering stage. Entire P fertilizer was applied basally. Fertilizer K was applied in three splits *viz.*, 50 per cent as basal, 25 per cent each at active tillering and flowering stage. All other need based cultural operations were practised for both *advance kar* and *pishanam* rice.

Results and Discussion

Advance kar rice

The grain yield and nutrient uptake of *advance kar* rice varied significantly due to various nutrient treatments (Table 1). Integrated use of green manure @ 6.25 t ha^{-1} and full dose of recommended NPK enhanced grain yield (4896 kg ha^{-1}) than 100 per cent NPK alone (4520 kg ha^{-1}) or green manure alone (3479 kg ha^{-1}). Beneficial effects of integrated nutrient package on growth, yield attributes and nutrient uptake of rice led to higher grain yield. The similar result, was also reported by Tiwari *et al.* (1980). Incorporation and decomposition of green manure has a solublising effect of N, P and K and micronutrients in the soil and thus resulted in increased nutrient uptake of rice (Goswami *et al.*, 1988).

Blackgram

The residual effect of nutrient treatments adopted to *advance kar* rice significantly altered the grain yield and nutrient uptake of blackgram (Table 2). Integrated nutrient management adopted to the preceding rice crop increased grain yield (329 - 340 kg ha^{-1}) of blackgram compared to NPK alone (295 kg ha^{-1}) and green manure alone (256 kg ha^{-1}) as reported by Saraf and

Table 3. Effect of nutrient treatments adopted to *advance kar* rice and rice fallow blackgram on *pishanam* rice.

Treat-ment	Grain yield (kg ha^{-1})			Nutrient uptake (kg ha^{-1}) at harvest								
				Nitrogen			Phosphorus			Potassium		
	C_1	C_2	Mean	C_1	C_2	Mean	C_1	C_2	Mean	C_1	C_2	Mean
F_1	5433	4988	5211	82.6	75.7	79.2	15.1	14.3	14.7	101.6	89.8	95.7
F_2	5266	4931	5099	78.6	72.8	75.5	14.6	15.5	15.1	98.3	92.2	95.2
F_3	4432	4107	4270	67.8	63.4	65.7	12.0	12.8	12.4	82.7	77.0	79.9
F_4	4343	3994	4188	65.8	59.7	62.8	12.8	11.4	12.1	79.5	74.3	76.9
F_5	4850	4464	4657	73.8	67.1	70.7	15.1	13.8	14.5	87.1	80.5	83.8
F_6	5347	4859	5103	79.6	72.8	76.2	15.2	14.2	14.7	99.9	87.2	93.6
F_7	4815	4577	4696	74.1	69.7	71.9	14.1	12.4	13.2	90.1	85.7	87.9
F_8	3655	3372	3514	54.3	50.9	52.6	11.5	9.4	10.5	68.1	63.6	65.8
F_9	2951	2704	2828	45.1	41.7	43.4	8.5	7.6	8.1	53.9	50.8	52.3
Mean	4570	4222		69.1	63.8		13.3	12.4		84.6	77.9	

	SEd	CD (0.05)	SEd	CD (0.05)	SEd	CD (0.05)	SEd	CD(0.05)
C	30	61	0.55	1.11	0.07	0.1	0.8	1.6
F	64	129	1.16	2.36	0.14	0.3	1.6	3.3
CXF	90	18	1.6	NS	0.2	NS	2.3	NS

Note : F_1 : 100% NPK (150:50:50 kg ha^{-1}); F_2 : 75% NPK; F_3 : 50% NPK; F_4 : 100% N + No P&K; F_5 : 100% N + 50% P&K; F_6 : 100% N + 75% P&K; F_7 : 100% NPK; F_8 : No fertilizer; F_9 : Control

Patil (1995). Integrated use of green manure and chemical fertilizers for realizing the yield potential of *advance kar* rice has sufficiently left soil nutrients. This was probably due greater quantities of residues in the soil, which in turn resulted in greater soil nutrients (Panda and Sahoo, 1989). Application of 100 per cent NPK along with green manure applied to *advance kar* rice recorded higher NPK uptake over 100 per cent NPK alone or green manure alone.

Pishanam rice

Nutrient management packages adopted for *advance kar* rice based cropping system and raising blackgram in between *advance kar* and *pishanam* season rice crops exerted significant influence on the grain yield of *pishanam* rice (Table 3). Growing blackgram prior to *pishanam* rice crop enhanced the grain yield of rice (4570 kg ha^{-1}). These type of reports are also available (Saraf and Patil 1995; and Subbian 2000). *Pishanam rice* raised after fallow recorded lower yield (4222 kg ha^{-1}). This finding is in conformity with Siddeswaran (1992). Growing a grain legume and incorporating the residues into the soil after harvesting the pods has not oniy increased the system productivity but also reduced the quantity of chemical fertilizer (Kundu and Pillai, 1992). Combined application of green manure and 100 per cent NPK applied to *advance kar* rice and 100 per cent NPK to *pishanam* rice and growing blackgram in between two rice crops (C_1F_1) recorded higher grain yield of 5433 kg ha^{-1}. This was comparable with the treatments, which received 25 per cent lesser P and K (5347 kg ha^{-1}) as well as 25 per cent lesser N, P and K (5266 kg ha^{-1}) at *pishanam* rice. The same trend was also found in nutrient uptake pattern of *pishanam* rice.

The carry over effect of integrated nutrient treatments adopted to *advance kar* rice and 100 per cent NPK to *pishanam* rice along with residual effect of blackgram resulted in high N and P status after *pishanam* rice. Higher quantities of N and P and residue addition resulted in lower drain of soil native N and P. Better growth of crops with higher nutrient supply resulted in increased uptake of K thus depleting the soil available K.

From the experimental results, it can be concluded that combined application of green manure @ 6.25 t ha^{-1} and 100 per cent NPK fertilizer to *advance kar* rice, raising rice fallow blackgram preceding to *pishanam* rice and application of 75 per cent NPK fertilizer to *pishanam* rice is the viable nutrient management package for *advance kar* rice based cropping system of Tambaraparani command area.

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