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Effect of Nutrient Management on Yield and Yield Attributes of Rice Based Cropping System in Tambaraparani Command Area

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Abstract: A field experiment was conducted to develop a system approach nutrient management package for advance kar season rice based cropping system in Tambaraparani command area. The nutrient treatments were imposed only to rice crops and no manure/fertiliser applied to rice fallow blackgram. The nutrient management packages adapted to advance kar season rice consisted of green manure alone, 100% NPK with and without green manuring along with control. In pishanam season rice, various graded level of fertiliser treatments were adapted. Application of green manure along with recommended NPK recorded higher grain yield and yield attributes of advance kar season rice. The residual effect of integrated nutrient treatments adopted to advance kar rice increased the grain yield and yield attributes of rice fallow blackgram. Combined application of green manure and 100% NPK fertiliser to advance kar season rice, raising rice fallow blackgram preceding to pishanam season rice and application of 100% NPK fertiliser to pishanam season rice recorded higher yield and yield attributes, which was on par with 75% recommended NPK to pishanam season rice, which recorded higher benefit: cost ratio.

Key words: Cropping system, nutrient management, pulse crop, rice, yield

INTRODUCTION

Rice is the main crop in Tambaraparani command area, which is regularly grown during South West (kar) and North East (pishanam) monsoon seasons. Over a long time, advance kar rice cultivation is also being practiced to an area of 10,800 ha at the tail end areas and rice-pulses/fallow-rice cropping sequence is followed during advance kar, rice fallow and pishanam seasons. Nutrient management in cropping systems differ from that in monocropping, requiring consideration of such factors as kind and quantity of fertilisers applied and their carryover effects, characteristics of the previous crops and effects of legumes in the cropping system and their effect on nutrient build up and depletion in the long run^[1]. Organic sources of nutrients applied to the preceding crop benefit the succeeding crop to a great extent and the system productivity becomes sustainable through integrated use of organic and inorganic sources of nutrients^[2]. Green manure incorporation effectively substitutes the inorganic nitrogen by 20-50%^[3]. Growing a legume and incorporating the residues in the soil is not only increases the system productivity, but also reduces

the quantity of chemical fertiliser to the succeeding crop^[4]. Therefore, a system approach to nutrient management in rice based cropping system has become more relevant. In this context, the present study was undertaken to develop a system approach nutrient management practices for advance kar season 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% 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 (C₁), Rice-Fallow-Rice (C₂)] and eight nutrient management packages along with control. The nutrient treatments were imposed only to rice crops and no manure/fertiliser applied to rice fallow

blackgram except 2% DAP spray. The treatments for advance kar season rice were:

- F₁ to F₆: i.e., Green manure @ 6.25 t ha⁻¹ + 100% NPK (120:38:38 kg ha⁻¹),
- F₇: 100% NPK,
- F₈: Green manure @ 10 t ha⁻¹,
- F₉: control.

The treatments for pishanam season rice were:

- F₁: 100% NPK (150:50:50 kg ha⁻¹);
- F₂: 75% NPK;
- F₃: 50% NPK;
- F₄: 100% N+No P and K;
- F₅: 100% N+50% P and K;
- F₆: 100% N+75% P and K;
- F₇: 100% NPK;
- F₈: No fertiliser and
- F₉: Control

The rice varieties, ASD 16 (Short duration) and ADT 39 (Medium duration) were used in advance kar and pishanam seasons, respectively. After the harvest of advance kar rice, blackgram, ADT 3 was sown in the same plot without disturbing the layout. Fertiliser Nitrogen was applied in four splits i.e. 40% as basal, 20% each at active tillering, panicle initiation and flowering stage. Entire P fertiliser was applied basally. Fertiliser K was applied in three splits viz., 50% as basal, 25% each at active tillering and flowering stage.

RESULTS AND DISCUSSION

Advance kar rice: The cropping system treatments were effected only after the harvest of advance kar rice. As such, the treatment difference and interaction effect for cropping system were not significant in advance kar rice. Hence, the treatmental difference between nutrient treatments adapted during advance kar rice alone is presented (Table 1). The value of the treatment i.e. green manure with NPK used under result and discussion of advance kar rice and blackgram is the mean value of first six treatments, as the treatments from F₁ to F₆ are the same for advance kar rice. Yield and yield attributes of rice

differed significantly with different treatments (Table 1). Combined use of green manure @ 6.25 t ha⁻¹ and recommended NPK enhanced the yield attributes viz., 481 productive tillers m⁻², 91.7 filled grains/panicle and grain yield of 4.90 t ha⁻¹ as compared to application of 100% NPK or green manure alone. The lowest grain yield of 2.87 t ha⁻¹ was registered with absolute control. Thousand-grain weight (test weight) did not differ significantly with the treatments. Increase in rice grain yield owing to green manure incorporation may be attributed to release of nutrients to soil slowly for longer duration after decomposition, resulting in better plant growth and yield contributing characters as reported by Patra *et al.*^[5].

Rice fallow blackgram: The residual effect of nutrient treatments adopted to advance kar season rice significantly influenced the yield and yield components of blackgram (Table 2). Application of green manure and 100% recommended NPK to advance kar season rice recorded higher pods/plant (32.3), seeds/pod (5.3) and grain yield of 334 kg ha⁻¹ as compared to 100% NPK alone, which recorded the grain yield 295 kg ha⁻¹. Similar results were also reported by Pradhan and Mondal^[6] who reported that integrated use of organic sources and chemical fertiliser often leave a substantial residual effect on succeeding crop in the system.

Pishanam season rice: Different nutrient management packages adopted for advance kar season rice-based cropping system and raising blackgram in between advance kar and pishanam season rice exerted significant influence on yield and yield attributes of pishanam season rice (Table 3). Inclusions of blackgram in the cropping system increased the productive tillers of 412 m⁻² and filled grains of 80.1/panicle, which resulted in higher grain yield of 4.57 t ha⁻¹ of succeeding pishanam rice. This result was in accordance with Subbian^[7] who reported that inclusion of grain legumes like cowpea and blackgram as rice fallow crops could increase the yield of succeeding rice by 10%. The yield of rice was reduced (4.22 t ha⁻¹) when rice was sown after fallow than after legume.

Table 1: Effect of nutrient management on yield attributes and yield of advance kar rice

Treatments	Productive tillers (m ⁻²)			No. filled grains/panicle			Thousand grain weight (g)			Grain yield (t ha ⁻¹)		
	C ₁	C ₂	Mean	C ₁	C ₂	Mean	C ₁	C ₂	Mean	C ₁	C ₂	Mean
F ₁	485	482	483	92.4	91.2	91.8	24.2	24.2	24.2	4.89	4.84	4.87
F ₂	475	479	477	90.9	92.0	91.5	24.2	24.3	24.3	4.88	4.94	4.91
F ₃	483	477	480	92.5	91.5	92.0	24.3	24.4	24.3	4.96	4.89	4.93
F ₄	484	483	483	92.9	92.5	92.7	24.2	24.2	24.2	4.92	4.85	4.89
F ₅	481	484	482	90.1	91.3	91.1	24.2	24.3	24.3	4.90	4.97	4.94
F ₆	478	482	480	91.0	92.0	91.5	24.3	24.2	24.2	4.89	4.91	4.85
F ₇	453	447	450	87.4	86.4	86.9	23.9	24.0	24.0	4.49	4.55	4.52
F ₈	349	353	351	67.2	66.0	66.6	23.8	23.8	23.8	3.45	3.51	3.48
F ₉	291	286	289	54.5	55.5	55.0	23.8	23.7	23.7	2.90	2.83	2.87
Mean	442	441	-	84.3	84.2	-	24.1	24.1	-	4.48	4.46	-

Table 2: Residual effect of nutrient treatment on yield attributes and yield of rice fallow blackgram

Treatments	No. of pods/plant	No. of seeds/pod	100 grain weight (g)	Grain yield (kg ha ⁻¹)
F ₁	32.3	5.3	3.6	334
F ₂	32.9	5.4	3.5	340
F ₃	32.0	5.3	3.5	331
F ₄	31.8	5.2	3.5	329
F ₅	32.4	5.3	3.5	335
F ₆	32.6	5.4	3.5	337
F ₇	28.7	4.9	3.4	295
F ₈	24.9	4.6	3.4	256
F ₉	18.2	4.5	3.4	195
CD (0.05)	3.0	0.5	NS	30

Table 3: Effect of nutrient management and cropping system on pishanam rice and benefit: cost ratio of cropping system

Treatments	Productive tillers (m ⁻²)			No. of filled grains/panicle			Thousand grain weight (g)			Grain yield (t ha ⁻¹)			B:C ratio of cropping system		
	C ₁	C ₂	Mean	C ₁	C ₂	Mean	C ₁	C ₂	Mean	C ₁	C ₂	Mean	C ₁	C ₂	Mean
F ₁	476	452	464	93.3	87.6	90.4	18.25	18.05	18.15	5.43	4.99	5.21	2.55	2.44	2.50
F ₂	467	444	455	91.0	85.6	88.3	17.98	18.24	18.11	5.27	4.93	5.10	2.56	2.51	2.54
F ₃	403	372	388	76.9	71.3	74.1	18.22	17.90	18.06	4.43	4.12	4.27	2.43	2.33	2.38
F ₄	397	362	380	75.8	69.3	72.5	18.15	17.94	18.04	4.38	3.99	4.19	2.39	2.29	2.34
F ₅	432	404	418	83.5	77.5	80.5	17.85	18.15	18.00	4.85	4.46	4.66	2.46	2.39	2.43
F ₆	472	447	456	92.8	86.7	89.8	18.24	18.14	18.19	5.35	4.86	5.10	2.55	2.45	2.50
F ₇	436	415	426	84.2	79.4	81.8	18.12	18.02	18.07	4.82	4.58	4.70	2.31	2.29	2.30
F ₈	352	318	335	66.5	59.5	63.0	17.79	17.91	17.85	3.66	3.37	3.51	2.05	2.01	2.03
F ₉	274	255	265	57.2	51.3	54.3	17.75	17.76	17.76	2.95	2.70	2.83	1.71	1.65	1.68
Mean	412	385	-	80.1	74.2	-	18.03	18.01	-	4.57	4.22	-	2.33	2.26	-

Combined application of green manure and 100% NPK applied to advance kar rice and 100% NPK to pishanam rice and growing blackgram in between two crops recorded higher yield of 5.21 t ha⁻¹ and yield attributes viz., productive tillers of 464 m⁻² and filled grains of 90.4/panicle. This was comparable with the treatments, which received 25% lesser P and K as well as 25% lesser N, P and K at pishanam season rice. This could be the fact that green manuring and growing legume in the cropping system supplements the nutrients without adversely affecting the system productivity as reported by Sharma and Mitra^[6].

Benefit: Cost ratio: In advance kar season rice based cropping system, application of green manure and 100% NPK to advance kar season rice and raising rice fallow black gram prior to pishanam rice and application of 75% recommended NPK to pishanam rice recorded maximum benefit:cost ratio (2.56) as compared to 100% recommended NPK to pishanam rice (2.55) due to saving of 25% inorganic fertiliser in advance kar rice based cropping system.

CONCLUSIONS

It may be concluded from this experiment that combined application of green manure @ 6.25 t ha⁻¹ and 100% recommended NPK to advance kar season rice, raising rice fallow blackgram preceding to pishanam season rice and application of 75% of recommended NPK to pishanam season rice is the viable nutrient management package for getting higher income through higher yield with saving of 25% inorganic fertiliser for advance kar rice

based cropping system in Tambaraparani command area of Tamil Nadu.

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