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Studies on productivity, nutrient uptake and economics of wet season rice under IPNS in rice-based fodder cropping systems

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ABSTRACT

Productivity, nutrient uptake and economics of wet season rice under IPNS (Integrated plant nutrient supply system) in rice-based fodder cropping systems were studied during 2002 and 2003 in red lateritic soil. Pooled data over two years revealed that various yield attributes, yield and NPK uptake of rice significantly increased when rice was succeeded by berseem in rice-berseem sequence. Application of 50% recommended dose (RD) of NPK (RD= 60-30-30 kg ha^{-1} of N-P_2O_5-K_2O) + dhaincha @ 10 t ha^{-1} produced significantly higher yield attributes, yield and NPK uptake of rice among different nutrient management practices. This treatment produced the highest grain yield (4.495t ha^{-1}) over 100% RD of NPK (4.201 t ha^{-1}) and 50% RD of NPK +FYM @ 10 t ha^{-1} (4.122 t ha^{-1}). Rice-berseem, sequence, along with 50% RD of NPK +dhaincha @ 10 t ha^{-1} in rice only provided the highest gross return (Rs. 29,915 ha^{-1}), net return (Rs. 17,860 ha^{-1}) and return rupee^{-1} invested (2.48) in comparison to rice in rice-oats, rice-fenugreek and rice-lathyrus systems.

Key words: *Wet season rice, IPNS, fodder crops, cropping systems*

The intensive external input oriented agriculture, a part of green revolution strategy, has depleted soil fertility considerably in all the major agricultural production systems. This has resulted in the declining trend of total production from the same land, diminishing response in increase of food grain to applied fertilizer nutrients. This stagnation in agricultural productivity is often attributed to degradation of soil due to various biotic and abiotic stresses on soil owing to high input agriculture (Wang *et al*., 2003). More emphasis is now being paid on integration of organic inputs with mineral sources of nutrients to sustain the soil health and maintain thereby the productivity levels of agricultural soils. Application of such organic materials not only increases the nutrient status of agricultural soils but also helps improve physical, chemical and biological properties of soil towards betterment of soil quality and increase in fertilizer use efficiency (Dick and Gregorich, 2004). In the present investigation, an attempt has been made to study the productivity and economics of wet season rice under IPNS in the rice-based fodder cropping systems.

MATERIALS AND METHODS

The experiment was conducted during wet season of 2002 and 2003 on red and lateritic belt of West Bengal to study the yield, nutrient uptake and economics of rice under integrated plant nutrient supply system (IPNS) in rice-based fodder cropping sequences. The experimental soil was sandy loam in texture, slightly acidic in reaction (pH 5.96), low in available nitrogen (221.9 kg ha^{-1}) and potassium (160.3 kg ha^{-1}) and medium in available phosphorus (38.2 kg ha^{-1}). The trial, consisting of twelve treatment combinations [viz. four rice-based cropping systems (rice-oats, rice-berseem, rice-fenugreek and rice-lathyrus) and three levels of nutrient management;100% RD of NPK, 50% RD of NPK +dhaincha@ 10 t ha^{-1} and 50% RD of NPK + FYM @ 10 t ha^{-1}], was a factorial experiment in a randomized block design with three replications. In rice, dhaincha (*Sesbania aculeata* L.) was grown ex-situ and incorporated as green manure at 40 days after sowing but 14 days before transplanting of rice and farmyard manure was incorporated into the soil at 28 days before transplanting. Out of the total RD of NPK in rice (60-30-30 kg ha^{-1} of N-P_2O_5-K_2O), ¼ of N and full quantity of P_2O_5 and K_2O (through urea, SSP and MOP) were applied as basal. The rest of N was top dressed in two splits; ½ at active tillering and ¼ at panicle initiation stage. The rice cv. IR36 was

transplanted with 25 day-old seedlings in 20 cm x 15 cm spacing with three seedlings hill^{-1}. Experimental data were pooled and analyzed statistically following the standard methods. Economics of different treatments were estimated as per the prevailing market prices.

RESULTS AND DISCUSSION

Rice-based fodder cropping systems significantly influenced the yield attributes (number of effective tillers m^{-2}) and grain and straw yields of rice (Table 1) though number of filled grains panicle^{-1} and test weight of rice were not significant. The highest grain yield of rice was achieved from rice-berseem system (4.295 t ha^{-1}). This was at par with rice in rice-fenugreek sequence (4.277 t ha^{-1}) but significantly higher than rice followed by lathyrus and oats. Rice in rice-oats system had the lowest grain yield. Different nutrient management practices in rice had significant response towards yield components and yield of rice. Application of 50% RD of N along with dhaincha green manure @ 10 t ha^{-1} produced the highest yield components and yield of rice over other nutrient management practices. The highest grain yield of rice was recorded in this treatment (4.495 t ha^{-1}) which was significantly higher than 100% RD of NPK (60-30-30) use (4.201 t ha^{-1}) and 50% RD of NPK+ FYM @10 t ha^{-1} (4.122 t ha^{-1}). Straw yield followed the same trend like grain production. Similar results were also reported by Bhandari *et al*. (1992), Katyal *et al*. (2002) and Singh *et al*. (2004) where 50% nitrogen substitution by green manuring had the highest grain yield of rice and was superior to FYM application. Rice-based fodder cropping systems along with integrated plant nutrient supply in wet season rice had significant interaction effect on productivity of rice.

Integrated plant nutrient supply (IPNS) in rice and different rice-based fodder cropping systems had significant influence on nutrient uptake of wet season rice as evidenced from pooled data (Table 2). The highest NPK uptake was found in rice of rice-berseem system. This was closely followed by rice in rice-fenugreek, rice-lathyrus and rice-oats systems. Rice in rice-oats system had the lowest uptake of NPK. Higher NPK uptake in rice of rice-berseem sequence was attributed to higher grain and straw production of rice in the system. Rice with 50% RD of N + dhaincha green manure @ 10 t ha^{-1} showed significantly the highest uptake of NPK than 100 % recommended dose and 50 % RD of NPK+FYM @ 10 t ha^{-1} .A significant interaction was found between cropping systems and integrated nutrient management towards phosphorus and potassium uptake of rice.

Production economics of wet season rice was influenced significantly by different rice-based cropping systems along with various nutrient management

Table 1. Effect of cropping systems and integrated nutrient management on yield attributes and yield of wet season rice at harvest (pooled data over two years)

Treatment	No. of effective tillers m^{-2}	No. of filled grains panicle $^{-1}$	Test weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
Cropping systems(C)						
Rice-oats	324.39	60.86	22.39	4.252	5.710	42.67
Rice-berseem	325.84	61.07	22.56	4.295	5.755	42.71
Rice-fenugreek	325.43	60.70	22.52	4.277	5.734	42.69
Rice-lathyrus	324.85	60.64	22.35	4.266	5.723	42.68
CD (P=0.05)	1.15	NS	NS	0.019	0.019	0.19
Nutrient management(N)						
100% RD of NPK (60-30-30)	322.37	60.55	22.46	4.201	5.661	42.58
50% RD of NPK + dhaincha @ 10 t ha-1	331.94	62.22	22.65	4.495	5.947	43.03
50% RD of NPK + FYM @ 10 t ha-1	321.11	59.68	22.27	4.122	5.583	42.45
CD (P=0.05)	1.00	0.43	0.18	0.016	0.017	0.17
Interaction (CXN)						
CD (P=0.05)	NS	NS	NS	0.032	0.032	-

NS, not significant

Table 2. Effect of cropping systems and integrated nutrient management on economics and nutrient uptake of wet season rice (pooled data over two years)

Treatment	Economics				Nutrient uptake		
	Cost of cultivation (Rs. ha^{-1})	Gross return (Rs. ha^{-1})	Net return (Rs. ha^{-1})	Return rupee^{-1} investment	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})
Cropping systems (C)							
Rice-oats	12538	28391	15878	2.28	72.90	27.66	99.85
Rice-berseem	12513	28665	16152	2.30	73.99	28.00	100.67
Rice-fenugreek	12513	28548	16035	2.29	73.81	27.84	100.30
Rice-lathyrus	12513	28477	15964	2.28	73.63	27.77	100.10
CD (P=0.05)	-	117.78	116.35	0.009	0.44	0.14	0.34
Nutrient management(N)							
100% RD of NPK (60-30-30)	12062	28073	16011	2.33	72.32	27.67	98.63
50% RD of NPK + dhaincha @ 10 t ha^{-1}	12054	29915	17860	2.48	77.81	29.47	104.32
50% RD of NPK + FYM @ 10 t ha^{-1}	13421	27572	14151	2.06	70.63	26.31	97.25
CD (P=0.05)	-	102.00	100.63	0.008	0.38	0.12	0.30
Interaction(CxN)							
CD (P=0.05)	-	NS	NS	0.017	NS	0.23	0.59

Note: Assuming labour cost @ Rs. 50/- day^{-1}, urea @ Rs. 5/- kg^{-1}, single super phosphate (SSP) @ Rs. 3.50 kg^{-1}, muriate of potash (MOP) @ Rs. 5/- kg^{-1}, cost of seed @ Rs. 8/- kg^{-1}, cost of FYM @ Rs. 150/- tonne^{-1}, selling price of paddy grain and straw @ RS. 5200/- and Rs. 1100/- tonne^{-1}, respectively

practices in rice as evidenced from pooled data (Table 2). Rice in rice-berseem sequence gave significantly higher gross return, net return and return per rupee investment over other cropping sequences. However, this was at par in gross return with rice in rice-fenugreek system. Net returns from rice followed by fenugreek, lathyrus and oats were similar to each other. Higher net return from rice in rice-berseem sequence was attributed to higher gross return from this system. Mohapatra and Dixit (2004) were also in conformity with these findings of higher net return from rice introducing green manuring in the system by reducing the cost of purchased inputs. Cropping systems and nutrient management had significant interaction towards return per rupee investment in rice.

Thus, rice-berseem sequence along with 50% RD of NPK + dhaincha green manure @ 10 t ha^{-1} in rice was superior to other rice-based fodder cropping systems and nutrient management practices in rice with respect to yield attributes, yield, NPK uptake and economics of wet season rice.

REFERENCES

Bhandari AL, Sood A, Sharma KN. and Rana DS 1992. Integrated nutrient management in a rice-wheat system. J Indian Soc Soil Sci 40: 742-747

Dick WA and Gregorich EG 2004. Developing and maintaining soil organic matter levels. (In) Managing Soil Quality: Challenges in Modern Agriculture pp.103-120. Schjonning, P Elmbolt S and Christensen, BT (Eds).CAB International, Willingford, UK.

Katyal V, Gangwar KS, Gangwar B and Anand KV 2002. Assessment of long-term effect of integrated nutrient supply on crop productivity and soil fertility in a rice-wheat cropping system.Oryza 39: 15-20

Mohapatra SC and Dixit L 2004. Integrated nutrient management for enhancing productivity and profitability of rice-toria cropping system. Abs. Nat. Symp. On Recent Advances in Rice-based Farming System. 17-19 Nov. 2004. CRRI, Cuttack, pp. 32

Singh SP, Subbaiah SV, Sree Devi B and Kumar RM 2004. Integrated nutrient management in rice-rice cropping system. Abs. Nat. Symp.On Recent Advances in Rice-based Farming Systems. 17-19 Nov. 2004, CRRI, Cuttack, pp. 36

Wang WJ, Dalal RC, Moody PW and Smith CJ 2003. Relationship of soil respiration to microbial biomass, substrate availability and clay content. Soil biol. Biochem 35:273-284