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Effect of organic nutrient management on productivity and economics of scented rice

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ABSTRACT

Field experiments were conducted at Ranchi, Jharkhand to study the effect of organic nutrient management on productivity and economics of scented rice indicated that scented rice (Birsamati) grown with 100:21.8:20.8 Kg NPK ha^{-1} through inorganic fertilizer produced maximum grain (3.95 t ha^{-1}) and straw yield (5.55 t ha^{-1}), net return (39,557 ₹ ha^{-1}), and benefit: cost ratio (3.62), with higher value of yield attributing characters. Among various organic sources, use of green manuring @ 5 t ha^{-1} + farm yard manure @ 10 t ha^{-1} produced maximum grain (3.28 t ha^{-1}) and straw yield (4.35 t ha^{-1}), maximum net return (35,975 ₹ ha^{-1}) and benefit: cost ratio (2.61) compared to rest of the organic treatments.

Key words: *scented rice, organic nutrient management, yield, yield attributes, economics*

Modern chemical based agricultural practices have led to several new challenges, like decline in productivity, degradation of soil and water resources, diminishing biodiversity and increase in environmental pollution. Under such situation organic nutrient management has significant role in improving crop productivity and soil fertility. Organic nutrient management involves substantial use of green manure, compost, oil cakes, agro-industrial wastes, crop residues and biofertilizers either alone or in combination inorganic sources. Green manuring offers the twin benefits of soil quality and fertility enhancement while meeting a part of nutrient need of crops. Organic matter provides regulated supply of nitrogen by releasing it slowly resulting in increased yields of rice (Sharma, 2002). Crop residues have potential for improving soil and water conservation, sustaining soil productivity and enhancing crop yields. Renewable sources like biofertilizer may also play an important role in improving the nutrient supply capacity for achieving higher yield and maintained soil health besides providing non-polluting environment. Hence, the present investigation was carried out to find out the suitable organic nutrient management practice for higher productivity and economic return of scented rice.

MATERIALS AND METHODS

A field experiment was carried out at Birsa Agricultural University Farm, Ranchi during 2006 and 2007. The soil of the experimental field was sandy loam in texture (59.4% sand, 21% silt and 19.6 % clay) with bulk density 1.5 Mg m^{-3}, pH 6.1, organic carbon 0.47%, available N, P and K 280, 24 and 200 kg ha^{-1} respectively . Ten treatments consisting of organic as well as inorganic nutrients alone or in combination, *viz*. control, recommended dose of fertilizer (RDF) (100:21.8:20.8 kg N:P:K ha^{-1}), green manuring (GM) @ 10 t ha^{-1}, GM @ 5t ha^{-1} + paddy straw (PS) @ 10 t ha^{-1}, GM @ 5t ha^{-1} + farmyard manure (FYM) @ 10 t ha^{-1}, Karanj (*Pongamia pinnata* (L.) Pierre) cake (KC) @ 2.5 t ha^{-1}, vermicompost (VC) @ 2.5 t ha^{-1}, GM @ 5t ha^{-1} + FYM @ 5t ha^{-1} + Blue green algae(BGA) @10kg ha^{-1}, GM @ 5t ha^{-1} + FYM @ 5 t ha^{-1} + Azotobacter (*Azotobacter chroococcum*) @ 500g ha^{-1}, GM @ 5t ha^{-1} + phosphorus solublising bacteria (PSB) @ 5kg ha^{-1} were laid out in randomized block design replicated 4 times. Dhaincha (*Sesbania aculeata*), FYM, PS, KC and VC contained 2.46-0.03-0.32, 0.53-0.12-0.42, 0.41-0.04-0.99, 3.9-0.44-0.42, 2.9-0.39-1.2% N-P-K,

respectively. In both the years, Dhaincha (*Sesbania aculeata*) as green manure crop was grown using 50 kg seed ha^{-1} during May in separate plots till 60 days and then harvested, weighed, chopped and incorporated as per treatments one day before transplanting in the puddled field. Likewise, paddy straw was chopped into small pieces and applied one day before transplanting of rice. FYM, KC and VC were also applied one day before transplanting of rice. BGA was inoculated @ 10 kg ha^{-1}. Roots of rice seedlings were dipped in *Azotobacter* suspension @ 500g ha^{-1} overnight before transplanting. Bacterial culture (500 g) was mixed with 1,000 ml Jiggary solution, which was then diluted to 10 liter with water and inoculation was done by dipping the roots of rice seedlings in the solution. The RDF were applied through urea, single super phosphate and muriate of potash. Half of the N and full dose of P and K were applied at the time of puddling while remaining N was applied in three equal splits *i.e*., at early tillering, late tillering and panicle initiation stage. Twenty five days old seedlings of "Birsamati" scented rice were transplanted on 4th August during both the years, at a spacing of 20 cm x 10 cm. The economic parameters like net returns and benefit cost ratio were worked out by using prevailing market price of inputs and outputs.

RESULTS AND DISCUSSION

Application of RDF resulted in highest panicle m^{-2} (322), grains $panicle^{-1}$ (97) and 1000 grain weight (22.3g) which was significantly superior to all other treatments. Among various organic sources, application of GM @ 5t ha^{-1} + FYM @ 10 t ha^{-1} produced significantly higher panicle m^{-2} (290), grains $panicle^{-1}$ (88) and 1000 grain weight (22.1 g) than rest of the organic treatments (Table 1). Unfertililized control treatments recorded the lowest yield attributes. This is in accordance with findings of Ram Krishna *et al*. (2007). Farmyard manure might have supplied the minerals and hormones and worked as catalyst increasing the yield attributes. Organic materials acting as a slow release source of N, are expected to more closely match the N demand of rice.

Yield is the manifestation of various yield components. Application of RDF produced maximum grain and straw yield which was higher by 20.09% and 27.59% than the best organic nutrition treatment of GM @ 5t ha^{-1} + FYM @ 10 t ha^{-1} (Table 1). Application of GM @ 5t ha^{-1} + FYM @ 10 t ha^{-1} produced 26.59 %, 32.15% and 37.50 % higher grain and 33.85%, 37% and 39.9 % straw yield than GM @ 5t ha^{-1} + PS @ 10 t ha^{-1}, GM @ 5 t ha^{-1} + FYM @ 5 t ha^{-1} + BGA @ 10

Table 1. Yield attributes, grain, straw yield and harvest index of scented rice as influenced by nutrient management (mean of 2 years)

Treatment	Panicles m^{-2}	Grains $panicle^{-1}$	1,000 grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index(%)
Control	119.5	42	18.09	0.81	1.35	37.50
RDF (100:21.8:20.8 kg N:P:K ha^{-1})	322	97	22.35	3.95	5.55	41.55
GM @ 10t ha^{-1}	218.5	67	21.70	2.42	3.11	44.00
GM @ 5t ha^{-1} + PS @ 10t ha^{-1}	231	70.5	22.07	2.60	3.25	44.40
GM @ 5t ha^{-1} + FYM @ 10t ha^{-1}	289.5	88	22.12	3.29	4.35	43.05
KC @ 2.5t ha^{-1}	168	60	21.44	1.72	2.41	41.60
VC @ 2.5t ha^{-1}	161.5	60	21.39	1.67	2.35	41.55
GM @ 5t ha^{-1} + FYM @ 5t ha^{-1} + BGA @ 10kg ha^{-1}	226	69	21.96	2.49	3.18	24.33
GM @ 5t ha^{-1}+BGA@10 kg ha^{-1}+*Azotobacter* @ 500 g ha^{-1}	159	57.5	21.09	1.65	2.30	41.85
GM@5t ha^{-1} + PSB @ 5kg ha^{-1}	151.5	56.25	20.68	1.58	2.27	41.10
CD (P<0.05)	18.31	6.14	0.35	0.34	5.03	NS

RDF - recommended dose of fertilizer, GM - green manuring, KC - Karanj cake, VC - vermicompost

kg ha^{-1} and GM @ 10 t ha^{-1}, respectively. Mankotia (2007) also reported higher yield of rice due to in-situ green manuring with dhaincha and with application of farmyard manure. Values of harvest index were not altered too much due to different treatment.

Significantly maximum N:P:K content of grain (1.63:0.280:0.321% N:P:K ha^{-1}), straw (0.655:0.121: 1.79% N:P:K ha^{-1}) and total nutrient uptake (84.3: 14.8: 90.4 N: P: K kg ha^{-1}) was recorded with recommended dose of fertilizer (Table 2). This may be due to excessive mining of nutrients for producing higher grain and straw yield. Similar observation was reported by Reddy *et al*. (2005). Among various organic sources, application of GM @ 5t ha^{-1} + FYM @ 10 t ha^{-1} had significantly higher N:P:K content of grain (1.51: 0.261 : 0.307 % N:P:K ha^{-1}), straw (0.630: 0.115 :1.84% N:P:K ha^{-1}) and total nutrient uptake (64.01: 11.78: 73.0 N: P: K kg ha^{-1}) than other organic treatments. This may be due to combined application of green manuring and farmyard manure, enhanced nutrient uptake by making linkages with a part of nutrient elements preventing the leaching and other losses.

Significantly highest net return (39557 ₹ ha^{-1}) and benefit : cost ratio (3.62) was recorded with application of recommended dose of fertilizer, thus resulted in higher monetary productivity (424.50 ₹ ha^{-1} day^{-1}) (Table 3). Among various organic sources, application of GM @ 5 t ha^{-1} + FYM @ 10 t ha^{-1} recorded net return of ₹ 35975 ha^{-1} with a benefit: cost ratio of 2.61 which was significantly superior to rest of the organic treatments. Further, application of recommended fertilizer dose gave 9.96 % higher net return than GM @ 5t ha^{-1} + FYM @ 10 t ha^{-1}. Similarly, application of GM @ 5t ha^{-1} + FYM @ 10 t ha^{-1} gave 41.22% and 41.46% higher net return than application of GM@5t ha^{-1} + FYM@ 5t ha^{-1} + BGA @ 10kg ha^{-1} and GM @ 10 t ha^{-1} respectively. However, use of vemicompost and karanj cake in place of green manuring, farmyard manure and biofertilizers gave less net return which was certainly due to higher cost of vermicompost and karanj cake than above mentioned organic sources. Singh *et al* (2006) have also observed that green manuring and farmyard manure @ 10 t ha^{-1} to rice both were economically viable for rice.

Scented rice (Birsamati) receiving Dhaincha green manuring @ 5 t ha^{-1} + farmyard manure @10 t

Table 2. N P K concentration and uptake in rice as influenced by organic nutrient management (mean of 2 years)

Treatment	Nutrient concentration %						Nutrient uptake (kg ha^{-1})						Total nutrient uptake (Kg ha^{-1})		
	Grain			Straw			Grain			Straw			Grain+Straw		
	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K
Control	1.20	0.243	0.264	0.470	0.051	1.38	8.33	1.69	1.84	5.09	0.55	14.93	13.42	2.24	16.77
RDF (100:21.8:20.8 kg N:P:K ha^{-1})	1.63	0.280	0.321	0.655	0.121	1.79	55.22	9.49	10.88	29.08	5.36	79.49	84.30	14.84	90.37
GM @ 10t ha^{-1}	1.32	0.264	0.311	0.550	0.098	1.71	27.46	5.48	6.36	13.68	2.43	42.42	41.13	7.91	48.78
GM @ 5t ha^{-1} + PS @ 10t ha^{-1}	1.36	0.270	0.316	0.600	0.109	1.77	30.35	5.78	7.06	15.60	2.84	45.89	45.95	8.61	52.94
GM @ 5t ha^{-1} + FYM @ 10t ha^{-1}	1.51	0.276	0.325	0.630	0.115	1.84	42.09	7.78	9.17	21.92	4.00	63.86	64.01	11.78	73.03
KC @ 2.5t	1.49	0.261	0.307	0.590	0.104	1.68	22.20	3.84	4.52	11.38	2.01	32.39	33.58	5.85	36.91
VC @ 2.5t	1.36	0.258	0.305	0.575	0.105	1.66	19.53	3.71	4.37	10.81	1.97	31.11	30.34	5.67	35.48
GM @ 5t ha^{-1} + FYM @ 5t ha^{-1} + BGA @ 10kg ha^{-1}	1.36	0.269	0.314	0.600	0.108	1.74	29.06	5.75	6.71	15.24	2.74	44.07	44.30	8.49	50.78
GM@5tha^{-1}+BGA@10kgha^{-1} +Azotobacter@500gha^{-1}	1.33	0.253	0.276	0.590	0.070	1.52	18.80	3.59	3.91	10.91	1.28	27.81	29.71	4.87	31.36
GM @5t ha^{-1} + PSB @ 5kg ha^{-1}	1.29	0.255	0.278	0.575	0.073	1.48	17.54	3.46	3.78	10.41	1.33	26.73	27.94	4.79	30.51
CD (P<0.05)	0.56	0.003	0.001	0.021	0.002	0.012	3.23	0.33	0.30	2.86	0.18	3.29	6.00	0.40	3.25

RDF - recommended dose of fertilizer, GM - green manuring, KC - Karanj cake, VC - vermicompost

Table 3. Gross Return (₹ ha^{-1}), Net Return (₹ ha^{-1}), Benefit Cost Ratio and Monetary Productivity (₹ ha^{-1} day^{-1}) of scented rice as influenced by organic nutrient management.

Treatment	Cost of cultivation	Gross return	Net return	Benefit cost ratio	Monetary productivity
Control	8239.88	12817.00	4577.25	0.56	108.00
RDF (100:21.8:20.8 kg N:P:K ha^{-1})	10939.34	50496.50	39557.00	3.62	424.50
GM @ 10t ha^{-1}	11039.07	36470.00	25431.00	2.31	304.00
GM @ 5t ha^{-1} + PS @ 10t ha^{-1}	29789.07	38942.00	9153.00	0.31	321.50
GM @ 5t ha^{-1} + FYM @ 10t ha^{-1}	13789.07	49764.00	35975.00	2.61	411.50
KC @ 2.5t	23439.34	26260.50	2821.45	0.12	218.50
VC @ 2.5t	20939.34	25573.50	4634.25	0.22	213.00
GM @ 5t ha^{-1} + FYM @ 5t ha^{-1} + BGA @ 10kg ha^{-1}	11939.07	37414.00	25475.00	2.13	304.00
GM @5t ha^{-1}+ BGA @ 10 kg ha^{-1} + A*zotobacter* @ 500 g ha^{-1}	9989.07	25219.50	15230.50	1.53	208.50
GM @5t h^{-1} + PSB @ 5kg ha^{-1}	10289.07	24278.50	13989.50	1.36	201.00
CD (P<0.05)		4268.25	4268.50	0.31	35.49

Grain, ₹ 10000 t^{-1} (inorganic), ₹ 12,500 t^{-1} (organic); straw, ₹ 2,000 t^{-1} Green manuring, ₹ 250 t^{-1}; Farmyard manure, ₹ 400 t^{-1} Karanj cake, ₹ 6,000 t^{-1}, Vermicompost, ₹ 5,000 t^{-1}

RDF - recommended dose of fertilizer, GM - green manuring, KC - Karanj cake, VC - vermicompost

ha^{-1} was found to be most appropriate organic nutrient management system for higher productivity as well as profitability. Inorganic crop receiving recommended dose of fertilizers gave the highest productivity and profits.

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