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Research Paper

Influence of integrated use of fertilizers and manures on SRI grown rice (*Oryza sativa*) and their residual effect on succeeding wheat (*Triticum aestivum*) in calcareous soil

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ABSTRACT

A field experiment was conducted during 2007–08 to 2009–10 at the experimental farm of Rajendra Agricultural University, Pusa (Bihar), to assess the direct effect of integrated use of different levels of N through chemical and organic fertilizer on system of rice intensification (SRI)-grown rice (*Oryza sativa* L.), and residual effect on succeeding wheat [*Triticum aestivum* (L.) emend.Fiori & Paol.]. The experiment was conducted in randomized-block design involving 3 organic sources (FYM, vermicompost and poultry manure) at 2 levels, viz. 25 and 50% of recommended dose of nitrogen, (RDN) i.e. 120 kg N/ha and 5 levels of chemical fertilizer nitrogen (0, 50, 75, 100 and 125 % RDN). Maximum plant height (102 cm), leaf-area index (5.04), panicles/m^2 (266), grains/panicle (121), grain yield (6.0 t/ha) and straw yield (5.4 t/ha) were recorded with application of poultry manure @ 50% RDN, which was significantly superior to its lower dose and no organic treatments. The maximum uptake of N, P and K by rice was recorded with poultry manure @ 50% RDN treatment. In case of chemical fertilizer N, maximum value of plant height, LAI, grains/panicle, grain and straw yields were recorded at 125% RDN, which was significantly superior over its lower levels including control except 100% RDN. Poultry manure @ 50% RDN also recorded maximum net returns and benefit: cost ratio.

Key words : FYM, Nitrogen, Poultry manure, Rice, SRI, Vermicompost

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Rice is grown extensively in Bihar as staple food crop and plays a pivotal role in agricultural economy of the state. Crop is crucial for food security and social stability. The productivity of rice has been stagnant in the state during the last decade and so. In Bihar rice is grown round the year under different ecosystems and occupies about 3.2 million ha of area with an average productivity of about 1.5 t/ha. Productivity of rice is relatively poor in Bihar with narrow profit margins. Under certain situations, cost of cultivation exceeds the net realization, making it an unprofitable. Yield enhancement has been the major agronomical challenge which has to come through increased productivity in the back drop of looming water crisis, shrinking land area etc. To achieve sustainable yield increases to meet the growing demand of the state population, it is essential to enhance the productivity of rice in the state. To augment the rice production, the idea of system of rice intensification (SRI) has been conceptualized wherein integrated use of all possible locally available resources are used to create synergy. The SRI is an agro-ecological methodology for increasing the productivity of irrigated rice by changing the management of plants, soil, water and nutrients for synergistic interactions leading to higher grain yield. It is suitable to poor farmers who have relatively more labour than land and capital. It is fairly a reliable way of obtaining higher yields leading to sustainable agriculture.

Apart from improved varieties and irrigation, limited use of organic manure and imbalance in use of chemical fertilizer leading to the emergence of multiple nutrient deficiencies are major constraints in realizing higher yield. Nutrient-management strategies should be aimed at achieving the twin goals of fertilizer economy and sustainability. The negligence to the conservation and use of organic sources for nutrients has not only exhausted soil nutrient reserves but also resulted in an imbalance among the available nutrients leading to soil problems

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(Satyanarana *et al*., 2002). Integration of inorganic and organic sources such as vermicompost, poultry manure, farmyard manure and their efficient management has shown promise in sustaining the productivity and soil health besides meeting part of crop nutrient requirement (Chaudhary *et al.,* 2011). Of late, lots of poultry farms are coming up even in the rural areas and thus producing substantial amount of poultry manure. Organic manures are an integral component of SRI. Since location-specific study on integrated nutrient management in SRI is lacking, a study was undertaken to evaluate the various integrated nutrient management package on growth and yield of SRI-grown rice.

MATERIALS AND METHODS

A field experiment was conducted during 2007–08 to 2009–10 at experimental farm, Rajendra Agricultural University, Pusa, Bihar. The soil was silty loam in texture with pH 8.2 and 262, 27 and 130 kg/ha available N, P and K, respectively. The experiment was carried out in randomized block design replicated thrice with 35 treatments involving 3 sources of organic manures, viz. farmyard manure (FYM), vermicompost (VC) and poultry manure (PM) adopting 2 rates, i.e. 25 and 50% recommended dose of nitrogen (RDN) and 5 levels of nitrogen, i.e. 0, 50, 75, 100 and 125% RDN through urea. The recommended dose of N (100%) was 120 kg N/ha.

The organic manures were applied as per their nutrient content on oven-dry weight basis. Composite sample from each manure was collected 1 week before application to plots and were analyzed for nutrient composition. The FYM, vermicompost and poultry manure contained 0.48, 1.83 and 2.1% N; 0.21, 0.62 and 1.93% P_2O_5; and 0.48, 1.19 and 1.83% K_2O respectively. Organic manures were applied as per treatment at sowing and mixed thoroughly in top soil layer. A uniform dose of 60 kg P_2O_5/ha through single superphosphate and 40 kg K_2O/ha through muriate of potash along with 25 kg $ZnSO_4$/ha was applied at the time of transplanting. Nitrogen was applied in 3 equal splits–one-third each at transplanting, active tillering and panicle-initiation stage. Potash was applied in 2 equal splits, 60% at transplanting and 40% at panicle-initiation stage. Twelve days old seedlings of rice (cv. 'Rajendra Mahsuri') were transplanted at 25 cm × 25 cm spacing in the first week of July and harvested during the second week of November during all the years of experimentation. All the principles of system of rice intensification (SRI), viz. single seedling, wider spacing, shallow transplanting, saturation, etc. were strictly followed. Growth and yield parameters were recorded as per standard procedures.

To study the residual effects, wheat (cv. 'HD 2733') was sown during the last week of November each year. Only recommended dose of N, P_2O_5 and K_2O (120:60:40) were applied through urea, single superphosphate and muriate of potash respectively. Out of which full dose of P and K was uniformly applied in all the plots before sowing of wheat. Nitrogen was used in 3 equal splits, i.e. at seeding, after first irrigation and at boot stage. Need-based cultural operations were followed. The crop was not infested by any major insect-pests and diseases. However, Thimet 10 G @ 12 kg/ha was applied as a prophylactic measure against insect-pests and diseases. Soil samples were collected from the surface layer (0–20 cm) from all the plots before treatment applications and after rice harvesting. Economics of rice cultivation as influenced by organic manures, chemical fertilizer and integrated nutrient management were calculated by considering the prevailing market price of rice grain and straw and different inputs.

RESULTS AND DISCUSSION

Growth attributes

There was a significant improvement in growth attributes of rice owing to application of different sources and levels of N. Each successive increase in either form of nitrogen significantly increased plant height and leaf area index (LAI). Plant height and LAI is an important index for assessment of crop performance. Integration of different organic manures with various levels of fertilizer nitrogen markedly enhanced plant height and LAI over organic and inorganic alone (data not given). Application of poultry manure @ 50% RDN (recommended dose of nitrogen), remaining at par with other organics at same level, recorded significantly maximum plant height compared to no organic manure and lower doses of organics. More or less similar trend was observed in LAI. The application of nitrogen fertilizer levels had significant effect on plant height and LAI. Application of N at increasing rates brought substantial improvement in these parameters and consequently the application of 125% RDN recorded the highest plant height and LAI over 50, 75 and 100% RDN (Table 1). Enhanced values of growth attributes in the treatment where higher dose of organic sources were fertilized with fertilizer N might be due to minimal loss of nitrogen in case of organic sources and nitrogen was available to the crop for longer period. Combination of organic and fertilizer nitrogen ensure the initial fast release of N and subsequently at slower rates, so as to keep pace with the rice crop growth (Chaudhary *et al*., 2011). Organic manures supply almost all the essential nutrients for growth and development of plants thereby helping in production of new tissues and development of new shoots ultimately increasing the plant height and LAI.

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Yield attributes

Yield attributes of rice, viz. number of panicles/m^2, grains/panicle and test weight were significantly affected due to application of different organics and fertilizer N at different levels (Table 1). In general, organics at higher levels (50% RDN) gave significantly higher values of yield attributes than that with lower levels (25% RDN) and no organics. Among the different sources of N substitution, maximum values of yield attributes were obtained with treatment in which 50% of N was substituted through poultry manure. However, it remained statistically at par with other sources, viz. vermicompost and FYM at their same level of application. The application of nitrogen fertilizer level had significant effect on yield attributes up to 100% RDN, though the maximum value was recorded at 125 % RDN.

The enhanced early vegetative growth in terms of higher plant height, LAI resulted in more panicle which consequently increased the number of panicle bearing tillers significantly. Stimulated vegetative growth on account of adequate and prolonged supply of essential nutrients receiving organic at 50% RDN in addition to fertilizer N at 100 or 125% RDN manifested itself in increased number of panicles, grains/panicle and test weight. It is a well established fact that addition of organic manure improves the physical and biological properties of soil. Reduced bulk density (BD) causing less penetration impedance may be responsible for better root development thereby producing higher yield attributes. Banwasi and Bajpai (2006) and Singh *et al.* (2010) also reported beneficial effect of organics.

Yield

Different treatment combinations had marked differences in the productivity of rice. Application of poultry manure @ 50% RDN recorded significantly higher grain and straw yields over all other treatments including its lower level (25% RDN). The increase in grain yield was 10.93% and 1.97% at the same level of FYM and vermicompost, respectively while it was 25.88% over no organic where only chemical fertilizer was applied.

Inadequate and imbalanced plant nutrients interfered with normal function, which ultimately resulted in lower growth and yield of rice. The increase in grain yield under the influence of poultry manure was largely a function of improved growth and consequently increased yield attributes. Application of N at increasing rates brought substantial improvement in grain and straw yields of rice and the application of 125% RDN recorded the highest grain and straw yield over 50, 75 and 100% RDN. However, the significant increase was only up to 100% RDN. Beyond this, when fortified with organic manure, grain and straw yields were reduced due to crop lodging. This was particularly more noticeable when fortified with poultry manure and vermicompost as than to FYM. Integrated approaches of organic and inorganic nutrient management have shown

Table 1. Growth parameters, yield attributes, yield and economics of rice grown under system of rice intensification (pooled data over 3 years)

Treatment	Plant height (cm)	Panicles/ m^2	LAI at flowering	Grains/ panicle	Test weight (g)	Grain yield (t/ha)	Straw yield (t/ha)	Cost of cultivation (× 10^3 ₹ /ha)	Net returns (× 10^3 ₹ /ha)	Benefit: cost ratio
Nitrogen through organic fertilizer										
Control (no organic)	93	249	4.50	110	22.1	4.77	6.67	20.1	19.9	0.99
FYM @ 25% RDN	97	255	4.87	109	22.3	5.04	7.05	22.5	19.8	0.88
FYM @ 50% RDN	100	258	4.96	114	22.9	5.41	7.56	24.9	20.5	0.82
PM @ 25% RDN	99	261	4.92	115	22.9	5.53	7.73	20.8	25.6	1.24
PM @ 50% RDN	102	266	5.02	121	23.8	6.00	8.40	21.4	28.9	1.35
VC @ 25% RDN	98	257	4.92	115	22.6	5.42	7.58	23.4	22.1	0.94
VC @ 50% RDN	102	264	5.04	119	23.9	5.88	8.23	26.7	22.7	0.85
SEm±	0.83	3.01	0.05	1.7	0.28	0.12	0.18			0.04
CD (P=0.05)	2.4	9.4	0.14	5.2	0.83	0.34	0.56			0.11
Nitrogen through chemical fertilizer										
Control	90	216	4.51	86	22.3	3.07	43.61	20.3	5.5	0.27
50% RDN	98	250	4.93	109	22.7	4.73	66.75	22.9	16.8	0.73
75% RDN	101	270	4.97	123	23.3	5.92	82.91	23.3	26.4	1.13
100% RDN	101	280	4.98	127	23.6	6.67	92.64	23.6	32.3	1.37
125% RDN	104	280	5.11	129	23.1	6.78	94.23	23.9	32.9	1.37
SEm±	0.73	2.68	0.04	1.6	0.28	0.94	1.6			0.04
CD (P=0.05)	2.1	8.0	0.12	5.0	0.82	2.78	5.1			0.10

RDN, Recommended dose of nitrogen: 120 kg/ha; FYM, farmyard manure; PM, poultry manure; VC, vermicompost

an increased efficiency of N fertilizer in rice (Satyanarayna *et al.,* 2002).

Interaction

Interaction effect of organic N and fertilizer N on grain yield of rice was found significant. In general, poultry manure @ 50% RDN with 90 kg N/ha, vermicompost @ 50% RDN with 90 kg N/ha and FYM @ 50% RDN with 120 kg N/ha were at par with no organic N along with 150 kg N/ha (Table 2), indicating a saving of 60 kg N each for PM and vermicompost and 30 kg N/ha for FYM. Moreover, addition of 50 or 25% RDN either through poultry or vermicompost with 75 or 100% RDN fertilizer gave almost equal yield of rice to that of 125% RDN fertilizer treatment resulting a saving of 25–50 kg N/ha by poultry manure or vermicompost. Thus combined application of chemical and organic fertilizer play crucial role due to their synergistic effect.

This might be owing to the effect of synchronized release of plant nutrients throughout the rice crop through slow mineralization process under favourable physical environment and inorganic nutrients have positive influence on source sink relationship in terms of higher plant height and LAI ultimately yield was increased (Khan *et al.*, 2006).

Nutrient uptake

The total uptake of nitrogen, phosphorus and potassium in rice was significantly influenced by the application of various sources of organic and fertilizer N (Table 3). Organics not only contribute through supplying additional plant nutrients but also help in increasing solubility of native soil nutrients leading to adequate transformation of nutrients to developing plant. As a result, almost all yield attributes were significantly influenced by poultry manure, vermicompost and FYM alone and combined with chemical fertilizer. Total N, P and K uptake was significantly higher for poultry manure @ 50% RDN over FYM and no-organic while remaining at par with vermicompost at same level. Increase in nitrogen uptake due to poultry manure, vermicompost and FYM at @ 50% RDN over no-organic was 37.53%, 39.57% and 19.41% respectively. Similar pattern were observed for P and K. Increase in each successive level of nitrogen up to 125% RDN significantly increased the NPK uptake by rice. Increase in nitrogen uptake owing to 50, 75, 100 and 125% RDN over the control was to the tune of 58.69%, 101.47%, 130.68% and 141.34% respectively. Similar results were observed for P and K.

This may be accounted for improved soil environment, encouraged root proliferation and root surface absorption zone, which in turn increased grain and straw yield (Sharma, 2002).

Post-harvest soil-nutrient status

The fertilizer and organic manure treatment improved the physical properties like bulk density and organic carbon of soil, and available N, P and K content of soil (Table 3). Soil bulk density decreased from 1.55 Mg/m^3 to 1.48 Mg/m^3 in organic-treated plots. Organic sources alone and their integration with chemical fertilizer N showed higher enhancement in soil organic-carbon vis-à-vis sole chemical fertilizer N treatment or control over the initial value. Among the 3 organic manures, alone and in combination with RDN, FYM recorded the significantly maximum value of organic carbon content (0.54) which was 12.5% higher over no organic and 3.85 and 1.89% higher over vermicompost and poultry manure. This improvement might be the result of direct addition of organic manure and its beneficial effect on crop roots (Banwasi and Bajpai, 2006). Organic matter has solublizing effect on some mineral compounds present in soil and brings about the conversion of numbers of chemical elements to available form. In case of available nitrogen, vermicompost @

Table 2. Interaction effect of organic and chemical fertilizer sources of N on grain yield (t/ha) of rice (pooled data over 3 years)

N through chemical fertilizer	No organic	N through organic fertilizer						Mean
		FYM		Poultry manure		Vermicompost		
		25 % RDN	50 % RDN	25 % RDN	50 % RDN	25 % RDN	50 % RDN	
Control	1.96	2.66	2.96	3.26	3.92	3.09	3.64	3.07
50% RDN	3.92	4.03	4.53	4.72	5.73	4.60	5.62	4.73
75% RDN	5.12	5.16	5.69	6.11	6.91	5.80	6.62	5.92
100% RDN	6.09	6.22	6.63	7.02	6.98	6.80	6.91	6.67
125% RDN	6.73	7.11	7.23	6.52	6.45	6.78	6.63	6.78
Mean	4.77	5.04	5.41	5.53	6.00	5.42	5.88	3.07
SEm±	0.15							
CD (P=0.05)	0.47							

RDN, Recommended dose of nitrogen: 120 kg/ha

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50% RDN recorded the maximum value followed by poultry manure at the same level. Application of poultry manure @ 50% RDN resulted in the highest available P status of the soil. Application of poultry manure @ 50% RDN also recorded higher value of available potassium in soil. The buildup of NPK status in the soil may be accounted for higher mineralization of soil organic matter and greater mobilization of soil P owing to release of native P by solublizing effect of organic manures.

Economics

Under organic sources of nutrient, maximum cost of cultivation (₹26,685) was recorded under vermicompost @ 50% RDN, while net returns (₹28,971) and benefit: cost ratio were under poultry manure @ 50% RDN. Under fertilizer N, maximum cost of cultivation (₹23,954), net returns and benefit: cost ratio were recorded under 125% RDN. The variation in the cost of cultivation under different treatments were recorded due to variable cost of organic sources and fertilizer N. Grain and straw yields were the major factors which caused differences in net returns.

Residual effect on wheat

Residual effect of organic treatments applied in rice was observed in succeeding wheat. Leaf area index, panicles/m^2 and grains/panicle were significantly higher under organic treatment as compared to no organic source (Table 4). The enhanced early vegetative growth in terms of higher LAI resulted in more panicle which consequently increased the number of panicle-bearing tillers significantly. Stimulated vegetative growth of wheat on account of adequate and prolonged supply of essential nutrients in treatments of organic resulted into higher dry matter production and translocation, and the conversion of photosynthates into reproductive parts (Sharma *et al*., 2009). Maximum panicles were observed in treatment having FYM @ 50% RDN, being 14.4% higher over no-organic source. Other sources of organic, viz. Poultry manure and vermicompost also registered significantly more panicle/m^2 over no organic. Yield enhanced due to FYM, poultry and vermicompost @ 50% RDN was to the tune of 51.7%, 46.2% and 48.1% over no organic. Thus, the carry-over effect of organic treatments was quite apparent on succeeding wheat. The findings corroborate the report of Gill (2006) and Khurana *et al.*, (2008). Among the different levels of fertilizer N, maximum yield of 34.0% q/ha was recorded with 125% RDN applied to the rice and it was significantly superior to 50 and 75% RDN, and control while remaining statistically at par with 100% RDN.

The increases in grains yield of wheat might be owing to the increased availability of essential nutrients to the crop resulting from the cumulative effect of organic sources at nutrient applied to the preceding rice and RDF applied to wheat.

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Table 3. Nutrient uptake and soil properties as affected by different treatments (pooled data over 3 years)

Treatment	Nutrient uptake (kg/ha)			Available nutrient (kg/ha)			Bulk density (Mg/m^3)	Organic carbon (%)
	N	P	K	N	P_2O_5	K_2O		
Nitrogen through organic fertilizer								
Control (no organic)	91.2	16.2	94.5	257	25.8	127.2	1.55	0.48
FYM @ 25% RDN	98.7	17.1	100.8	267	28.1	130.8	1.51	0.51
FYM @ 50% RDN	108.8	19.1	110.1	270	28.9	133.6	1.48	0.54
PM @ 25% RDN	115.1	20.3	112.5	269	28.4	129.4	1.52	0.50
PM @ 50% RDN	125.4	22.8	124.8	272	29.0	132.2	1.50	0.53
VC @ 25% RDN	115.5	19.3	113.1	268	28.9	127.8	1.49	0.50
VC @ 50% RDN	127.2	21.7	125.2	273	30.5	130.2	1.48	0.52
SEm±	2.4	0.56	1.4	1.46	0.58	0.83	-	0.01
CD (P=0.05)	7.6	1.6	4.3	4.3	1.8	2.7	-	0.02
Nitrogen through chemical fertilizer								
Control	61.12	10.0	60.88	260	26.8	125.1	1.55	0.50
50% RDN	96.99	16.9	97.39	266	27.9	128.1	1.52	0.50
75% RDN	123.14	21.1	123.20	268	28.14	129.7	1.49	0.52
100% RDN	140.99	24.7	139.97	271	29.6	132.6	1.48	0.53
125% RDN	147.51	25.1	143.04	275	30.1	135.3	1.47	0.53
SEm±	2.51	0.54	1.35	1.42	0.50	0.73	–	0.01
CD (P=0.05)	7.20	1.40	4.10	4.10	1.50	2.30	–	0.02
Initial value				262	27.2	130.4	1.53	0.47

RDN, Recommended dose of nitrogen:120 kg/ha; FYM , farmyard manure; PM, poultry manure; VC, vermicompost

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Table 4. Residual effect of different treatments on yield and yield attributes, rice-grain-equivalent yield, net returns (× 10^3₹ /ha)/ha) and benefit: cost ratio of succeeding wheat and net returns (× 10^3₹ /ha)/ha) and benefit: cost ratio of cropping system (pooled data over 3 years)

Treatment	LAI (90 DAS)	Spikes/ m^2	Grains/ spike	Grain yield (t/ha)	Straw yield (t/ha)	Rice equivalent yield (t/ha)	System productivity (t/ha)	Wheat		Cropping system	
								Net returns (×10^3₹/ha)	Benefit: cost ratio	Net returns (×10^3₹/ha)	Benefit: cost ratio
Nitrogen through organic fertilizer											
Control (no organic)	3.22	292	26	2.25	3.17	2.91	7.68	9.9	0.6	29.8	0.81
FYM @ 25% RDN	3.45	312	29	2.66	3.60	3.43	8.47	14.5	0.87	34.3	0.88
FYM @ 50% RDN	4.88	334	36	3.43	4.63	4.41	9.82	23.4	1.41	43.9	1.06
PM @ 25% RDN	3.43	312	30	2.74	3.69	3.53	9.06	15.4	0.92	41.1	1.1
PM @ 50% RDN	4.87	332	35	3.30	4.43	4.25	10.27	21.9	1.31	50.9	1.34
VC @ 25% RDN	3.42	311	28	2.56	3.49	3.29	8.71	13.3	0.8	35.4	0.88
VC @ 50% RDN	4.85	331	36	3.34	4.52	4.30	10.20	22.4	1.35	45.1	1.04
SEm±	0.136	8.3	0.8	0.09	0.10	-	0.56	-	-	-	-
CD (P=0.05)	0.462	24.8	2.1	0.27	0.31	-	1.07	-	-	-	-
Nitrogen through chemical fertilizer											
Control	2.94	295	23	1.97	2.66	2.54	5.61	6.4	0.38	11.9	0.32
50% RDN	3.71	319	32	2.94	4.04	3.79	8.52	17.9	1.07	34.8	0.88
75% RDN	4.44	326	33	3.06	4.18	3.94	9.86	19.2	1.15	45.6	1.14
100% RDN	4.46	328	34	3.19	4.29	4.11	10.78	20.6	1.23	52.9	1.31
125% RDN	4.54	331	36	3.40	4.54	4.38	11.16	23.0	1.38	55.9	1.38
SEm±	0.132	7.8	0.6	0.08	0.10	-	0.50	-	-	-	-
CD (P=0.05)	0.448	22.9	1.6	0.23	0.30	-	-	-	-	-	-

RDN, Recommended dose of nitrogen:120 kg/ha; FYM , farmyard manure; PM, poultry manure; VC, vermicompost

System productivity and economics

System productivity of the cropping system in terms of rice–grain-equivalent yield (RGEY), net returns and benefit: cost ratio was favourably influenced by the different organics and fertilizer N at different levels applied to rice. The RGEY was the maximum when 50% RDN was supplied through PM, being 33.7, 4.7 and 0.69% higher over the control and 50% RDN of FYM and vermicompost respectively. Successive increase in fertilizer levels up to 125% RDN applied to rice crop improved the RGEY, being 98.9, 30.9, 13.2 and 3.5% higher than the control 50, 75 and 100% RDN respectively. The net returns and benefit: cost ratio obtained from rice–wheat cropping system was also affected due to organics and N fertilizer doses. Maximum net returns and benefit: cost ratio were recorded with 50% RDN through poultry manure and 125% RDN through fertilizer.

Thus, it may be concluded that application of organics (poultry manure, vermicompost and FYM) at 50% RDN along with fertilizer N is best option for higher productivity and profitability of SRI grown rice without endangering the soil health. Combination of nutrients applied to rice crop had carry-over beneficial effects on succeeding wheat crop.

REFERENCES

Banwasi, R. and Bajpai, R.K. 2006. Influence of organic and inorganic fertilizer sources on soil fertility, yield and nutrient uptake by wheat crop in a rice–wheat cropping system. *Soil and Crops* **16**(2): 303–04.

Chaudhary, S.K., Singh, J.P. and Jha, S. 2011. Effect of integrated nitrogen management on yield, quality and nutrient uptake of rice (*Oryza sativa*) under different dates of planting. *Indian Journal of Agronomy* **56**(3): 228–31.

Gill, M.S. 2006. Sustaining high yield of rice–wheat system through site-specific nutrient management in Punjab. *Indian Journal of Fertilizer* **2**(5): 45–50.

Khan, Ubaid, Mishra, B., Panchauri, Puneet and Kumar, Yogesh. 2006. Effect of integrated nitrogen management on yield and nitrogen nutrition of irrigated rice (*Oryza sativa*). *Indian Journal of Agricultural Sciences* **76**(3): 176–80.

Khurana, H. S., Singh, B., Bovermann, A., Phillips, S. B., Siddu ,A. S. and Singh, Y. 2008. Site specific nutrient management performance in

rice–wheat cropping system. *Better Crops* **92**(4): 26–28.

Satyanarayna, V., Vara-prasad, P.V., Murthy, V.R.K. and Boote, K.J. 2002. Influence of integrated use of farm yard manure and inorganic fertilizers on yield and yield components of irrigated lowland rice. *Journal of Plant Nutrition* **25**(10): 2081–90.

Sharma R., Dahiya, S., Rathee, A., Singh, D., Nandool, J.K. and Malik, R.K. 2009. Effect of INM on growth, yield, economic and soil fertility in rice–wheat cropping system. *Indian Journal of Fertilizers* **5**(3): 31–34.

Sharma, S.N. 2002. Nitrogen management in relation to wheat (*Triticum aestivum*) residue management in rice (*Oryza sativa*). *Indian Journal of Agricultural Sciences* **72**: 449–52.

Singh, S.K., Kumar, D. and Lal, S.S. 2010. Integrated use of crop residues and fertilizers for sustainability of potato (*Solanum tuberosum*)-based cropping systems in Bihar. *Indian Journal of Agronomy* **55**(3): 203–08.

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