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Determination of nutrient uptake and nitrogen use efficiency of direct seeded rice (*Oryza sativa*) at different integrated nutrient management practices under irrigated condition of Jharkhand

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Abstract
A field experiment on direct seeded rice was conducted during kharif 2017 and 2018 at Rice Research Farm, Birsa Agricultural University, Kanke, Ranchi to know the response of integrated nutrient management in direct seeded rice (*Oryza sativa*). The soil was clay loam in texture, acidic in nature with mean pH 5.97, mean EC 0.30, low in available N (mean value 223.81 kg/ha), medium in P (mean value 23.35 kg/ha) & K (mean value 169.44 kg/ha) and low in organic carbon (mean value 0.39%). The experiment comprised ten treatments viz. control (no fertilizer or manure), 50% RDF, 75% RDF, 100% RDF, 50% RDF +50% N through FYM, 50% RDF + 50% N through vermicompost, 75% RDF +25% N through FYM, 75% RDF+25% N through vermicompost, 100% RDF +25% N through FYM and 100% RDF +25% N through vermicomposting were laid out in randomized block design with three replications.

Keywords: Farm yard manure, INM, nitrogen use efficiency, nutrient uptake, vermicompost

Introduction
Rice is the staple food for more than 65% of the people and it provides employment and livelihood security to 70% of Indian population. In India, rice is grown on 43.86 million hectares, with an annual production of about 104.90 million tonnes and productivity of about 2585 kg/ha (DAC, 2018) [3]. It is grown in highly diverse conditions starting from below sea levels to hill as high as > 2000 meters. Major share of rice is cultivated during *kharif* season. A small share of rice is grown in *Rabi/* summer season with assured irrigation. In Jharkhand, it is the most widely cultivated cereal crop during rainy season. Food grain production has to be doubled by 2050 to meet the needs of ever increasing population. It means there is need to give more emphasis for increasing productivity of rice in sustainable way. Direct seeded rice (DSR) is one of the resource conservation technologies which requires less labour and tends to mature faster than transplanted crops (Chauhan and Johnson 2012) [2]. The direct seeded rice is also reported to enhance N use efficiency (NUE) and so can have low emission of greenhouse gases. Green revolution has essentially brought spectacular increase in food grain production, but continuous use of NPK fertilizers had developed secondary and micro nutrient deficiencies due to lesser/restricted use of organic manures.

Since last few decades, intensive cropping systems with the use of high yielding varieties of crops harnessed the native soil fertility, which is posing a threat to the sustainable crop production, besides rampant nutrient deficiencies. Farmers generally use high analysis fertilizers, which add a few major nutrient into the soil, whereas, plants absorb all necessary nutrients for their growth and development. However, farmers are using the sub-optimal levels of fertilizers. This results in poor soil fertility with varied degree of deficiency of nutrients. Integrated nutrient management refers to the maintenance of soil fertility and of plant nutrient supply at an optimum level of sustaining the desired productivity through optimization of the benefits from all possible sources of organic and inorganic components in an integrated manner. It has multifaceted potential for the improvement of plant performance and resource efficiency while also enabling the protection of the environment and resource quality (Wu and Ma 2015) [11].

It is well documented that organic manures are good complimentary sources of nutrients and improve the efficiency of the applied mineral nutrients on one hand and improve soil physical and biological properties on the other hand (Chaudhary *et al.* 2004) [1]. Under INM practices, the losses through leaching, runoff, volatilization, emissions and immobilization are minimized, while high nutrient use efficiency is achieved. INM has been reported to be the best method to improve N use efficiency, reduce de nitrification losses, straw & grain yield and harvest index in direct seeded rice. Keeping these points in view, the present investigation was undertaken to assess the response of integrated nutrient management practices in direct seeded rice in medium land under irrigated condition of Jharkhand.

Materials and Methods

A field experiment on direct seeded rice was conducted during *kharif* 2017 and 2018 at Rice Research Farm, Birsa Agricultural University, Kanke, Ranchi. Soil samples from 1-50 cm were collected from different locations of the experimental plot and analyzed. The soil was clay loam in texture, acidic in nature with bulk density of 1.38 Mg/m^3. The mean soil pH was 5.97. The initial soil analysis indicated that it was low in available N (mean value 223.81 kg/ha), medium in P (mean value 23.35 kg/ha) & K (mean value 169.44 kg/ha) and low in organic carbon (mean value 0.39%). The total rainfall received in rice crop period was 521.4 mm during 2017 949.7 mm during 2018. Mean weekly relative humidity at 7 AM and 2 PM recorded in rice crop period was 83.1/58.2 & 82.6/66.2 per cent during 2017 and 2018. The experiment was carried out in randomized block design with ten treatments and three replications. The treatments included were, T_1 - control (no fertilizer or manure), T_2 - 50% RDF, T_3 - 75% RDF, T_4 - 100% RDF, T_5 - 50% RDF +50% N through FYM, T_6 - 50% RDF + 50% N through vermi compost, T_7 - 75% RDF +25% N through FYM, T_8 - 75% RDF+25% N through vermi compost, T_9 - 100% RDF +25% N through FYM and T_{10} - 100% RDF +25% N through vermi compost. Rice (var. – Sahbhagi dhan) was sown by using seed rate of 60 kg/ha on 22 June and 24 June in 2017 and 2018 respectively at 20 cm x 10 cm spacing. The seed was placed at about 3-4 cm depth. A week after sowing of rice crop, gap sowing was done wherever it was felt necessary. Well decomposed FYM and vermi compost were incorporated in soil 15 days before sowing of rice as per treatment. The quantity of organic manure was calculated on the basis of nitrogen content (%). Nutrient content in used organic materials are given in table- 1. The crop was fertilized with recommended doses of fertilizers viz. 80:40:20 kg N, P_2O_5, K_2O /ha. Half dose of N and full dose of P_2O_5 and K_2O were applied as per treatment through Urea, DAP and MOP as basal application just before sowing of rice and balance N were top – dressed in 2 equal splits – one fourth at active tillering (30- 35 DAS) and the remaining one – fourth at panicle – initiation (60- 65 DAS) stage of the crop. During course of investigation, the crop was harvested at full maturity, the border rows all around the plots were harvested first and then the plants from the net plots were harvested. The harvested produce was tied into bundles, numbered and left out in the field to dry for a week. After threshing, proper cleaning and winnowing, the grain weight of each plot was recorded at 14% moisture. Straw from each plot was dried and weighed. The N- use efficiency parameters viz. agronomic efficiency, physiological efficiency and apparent N recovery were worked out. Plant NPK uptake were also estimated. All the data were subjected to analysis of variance (ANOVA) as per the standard procedures and comparison of treatment means was made by critical difference (CD) at 5% probability.

Results and Discussion

Effect on nutrient uptake

Uptake of nutrients of rice crops and its adequate availability in soil is essential for proper growth and development of plants ultimately for optimum yield. Total nitrogen uptake by rice crop was significantly influenced by the different treatments of integrated nutrient management (Table. 2). 100% RDF + 25% N through VC recorded maximum value of total nitrogen uptake by rice (94.46 kg/ha) and significantly higher than 50% RDF (61.07 kg/ha), 75% RDF (70.30 kg/ha), 100% RDF (78.12 kg/ha), 50% RDF + 50% N through FYM (72.52 kg/ha) and 50% RDF + 50% N through VC (75.18 kg/ha) but comparable to the rest treatments. Among all treatments, control found minimum total N uptake (35.25 kg/ha) by rice which was significantly lower than other all treatments. In case of total phosphorus and potassium uptake by rice crop, same treatment showed maximum value of that (Table. 2). Nutrient uptake by rice crop increased significantly with integration of inorganic fertilizers and organic manures over application of inorganic fertilizers alone. This might be due to the fact that the trend of nutrient uptake was same as yield data of different treatments. The enhanced uptake of these nutrients in the corresponding treatments could be due to the increased and sustained availability of nutrients through inorganic fertilizers and organic manures. The increased uptake by rice might be due to improvement in physical, chemical and biological properties of soil through application of inorganic fertilizers and organic manures under INM. Similar results were found by Kumar *et al.* (2012) [8] & Dhanushkodi and Kannathasan (2012) [5].

Effect on Nitrogen use efficiency

The pooled mean of two years revealed that N use efficiency differed significantly due to different treatments of integrated nutrient management (Table 2). Based on pooled data of rice grain yield, significantly higher agronomic use efficiency of N (25.58 kg grain/kg N added) was recorded with the application of 50% RDF which remained *at par* with 75% RDF (22.54 kg grain/kg N added), 75% RDF + 25% N through FYM (22.52 kg grain/kg N added) and 75% RDF + 25% N through VC (24.90 kg grain/kg N added). The minimum agronomic use efficiency was noticed with 50% RDF + 50% N through FYM treatment (17.45 kg grain/kg N added). The application of 50% RDF recorded maximum value of physiological use efficiency (49.52 kg grain/ kg N uptake) and significantly superior to 100% RDF, 75% RDF + 25% N through FYM, 75% RDF + 25% N through VC, 100% RDF + 25% N through FYM and 100% RDF + 25% N through VC but *at par* with 75% RDF (48.28 kg grain/ kg N uptake), 50% RDF + 50% N through FYM (46.80 kg grain/ kg N uptake) and 50% RDF + 50% N through VC (46.11 kg grain/ kg N uptake). In case of apparent nitrogen recovery, application of 75% RDF + 25% N through VC (54.90%) showed significantly higher value. This might be due to the combined use of organic manure and N fertilizer that maintains a continuous N supply, checks losses and thus helps in more efficient utilization of the applied N. These findings were also supported by Sarkar (2015) [10] and Dwivedi *et al*. (2016) [6].

Effect on yield and harvest index

Balanced fertilization is indispensible in rice to supplement nutrients in accordance with the demand of crops for insuring higher productivity without having deleterious effect on soil health. The integrated nutrient management showed great impact on yield of grain and straw. The yields were significantly superior under the combined use of inorganic fertilizers and organic manures over the use of inorganic fertilizers (Table. 3). The grain and straw yield were significantly influenced by integrated nutrient management practices. The average grain yields ranged from 17.59 q/ha in the control treatment to 43.90 q/ha in 100% RDF + 25% RDN through VC and straw yields ranged from 28.69 q/ha to 64.05 in the control and 100% RDF + 25% RDN through FYM respectively. The maximum grain yield (43.90 q/ha) was recorded from 100% RDF + 25% RDN through VC , which was significantly higher to other treatments except 100% RDF + 25% RDN through FYM, 75% RDF + 25% RDN through FYM or VC. 100% RDF + 25% RDN through FYM produced maximum straw yield which was significantly *at par* with 100% RDF + 25% RDN through VC and 75% RDF + 25% RDN through FYM or VC. Harvest index was also significantly influenced by integrated nutrient management under pooled analysis. The increased grain yield can also be ascribed to the effect of adequate availability of nitrogen, phosphorus and potassium in soil solution, cause increase in root growth, thereby increasing uptake of nutrients. This might be due to the fact that increased absorption of nutrients and their assimilation It is also important to note that better and increased availability of nitrogen under integrated use of inorganic fertilizers and organic manures may perhaps led to increased to grain yield and hence harvest index. The results are in conformity with those obtained by Naing *et al.* (2010) [9] and Das *et al.* (2010) [4].

Effect on economics

Economics is the major consideration of the farmers while taking decision regarding the adoption of new technology. Hence cost of cultivation, net return and benefit: cost ratio were computed for different treatments. Amongst the different treatments of integrated nutrient management, 100% RDF + 25% RDN through VC fetched maximum net return (48496/ha), but the highest benefit – cost ratio was obtained under 75% RDF + 25% RDN through VC. However, net return was at par with 100% RDF + 25% RDN through FYM and 75% RDF + 25% RDN through VC, while the benefit – cost ratio was at par with 100% RDF + 25% RDN through VC. It might be due to increase in value of yield was more as compared to the cost of inorganic fertilizer and organic manure. Kulkarni (2012) [7] have reported that with integrated application of inorganic fertilizers and organic sources of nutrients had higher net return and benefit - cost ratio than either of its application alone.

Table 1: Nutrient content in different organic manures used during 2017-18 and 2018-19

Organic manures	N (%)		P (%)		K (%)	
	2017	2018	2017	2018	2017	2018
FYM	0.61	0.64	0.28	0.31	0.50	0.53
Vermicompost	2.11	2.10	0.50	0.48	0.54	0.51

Table 2: Effect of integrated nutrient management practices on total N, P and K uptake and nitrogen use efficiency of direct seeded rice. (Pooled data of two years)

Treatments	N uptake (kg/ha)	P uptake (kg/ha)	K uptake (kg/ha)	Agronomic N-use efficiency (kg grain/kg N added)	Physiological N-use efficiency (kg grain/kg N uptake)	Apparent N recovery (%)
T_1: Control	35.25	6.68	40.32	-	-	-
T_2: 50% RDF	61.07	11.53	67.39	25.58	49.52	51.62
T3: 75% RDF	70.30	13.36	78.53	22.54	48.28	46.73
T4: 100% RDF	78.12	14.80	83.51	19.33	45.09	42.87
T5: 50% RDF+50% NFYM	72.52	13.62	80.65	17.45	46.80	37.27
T6: 50% RDF+ 50% NVC	75.18	13.99	82.43	18.42	46.11	39.93
T7: 75% RDF+25% NFYM	84.89	15.78	92.82	22.52	45.84	49.63
T8:75% RDF+25% NVC	90.16	17.13	96.54	24.90	45.36	54.90
T9:100% RDF+25% NFYM	92.22	17.30	98.43	20.46	44.89	45.57
T10:100% RDF+25% NVC	94.46	17.84	99.20	21.04	44.43	47.36
SE m±	3.23	0.96	4.30	1.03	1.15	2.53
CD at 5%	9.59	2.87	12.77	3.08	3.42	7.53

Table 3: Effect of integrated nutrient management practices on productivity and economics of direct seeded rice. (Pooled data of two years)

Treatments	Productivity and harvest index			Economics		
	Grain yield (q/ha)	Straw yield (q/ha)	Harvest index (%)	Total cost of cultivation (₹/ha)	Net returns (/ha)	B:C ratio
T_1: Control	17.59	28.69	37.99	22583	9541	1.42
T_2: 50% RDF	30.38	45.99	39.77	24845	29923	2.20
T3: 75% RDF	34.49	51.67	40.03	25576	36502	2.43
T4: 100% RDF	36.92	54.44	40.41	27107	39169	2.44
T5 : 50% RDF+50% NFYM	35.04	53.17	39.72	32091	31103	1.97
T6 : 50% RDF+ 50% NVC	36.01	54.13	39.95	31492	33358	2.05
T7: 75% RDF+25% NFYM	40.11	60.93	39.69	29599	42753	2.44
T8:75% RDF+25% NVC	42.49	63.18	40.21	29299	47581	2.63
T9:100% RDF+25% NFYM	43.17	64.05	40.26	30730	47336	2.53
T10:100% RDF+25% NVC	43.90	63.88	40.73	30430	48946	2.60
SE m±	1.92	2.34	0.17	--	1339	0.03
CD at 5%	5.69	6.95	0.53	--	3977	0.09

Conclusion

On the basis of above findings, it may be concluded that the application of 75% RDF + 25% N through vermi compost was the best for significantly higher nutrient uptake, nitrogen use efficiency, yield and monetary benefit from direct seeded rice in sustainable manner.

References

1. Chaudhary DR, Bhandary SC, Shukla, LM. Role of vermicompost in sustainable agriculture: A review, Agricultural Review 2004; 25(1):29-39.
2. Chauhan BS, Johnson DE. Growth response of direct seeded rice to oxadiazon and bispyribac sodium in aerobic and saturated soils, Weed Science. 2012;59(1):119-122.
3. DAC. 2018 www.indianstat.com.
4. Das D, Patro H, Tiwari RC, Shahid M. Effect of organic and inorganic sources of N on yield attributes, grain yield and straw yield of rice (Oryza sativa). Research Journal of Agronomy. 2010;4(2):18-23.
5. Dhanushkodi V, Kannathasan M. Importance of industrial waste in maximizing the yield of rice and its effect on soil fertility in coastal region. International Journal of Research in Chemistry and Environment. 2012;2(3):21-25.
6. Dwivedi BS, Singh VK, Meena MC, Dey A, Datta SP. Integrated Nutrient Management for enhancing N use efficiency. Indian Journal of fertilizers. 2016;12:62-71.
7. Kulkarni MV. Effect of INM on physico-chemical properties of soil under transplanted and drilled rice (*Oryza sativa* L.) in South Gujarat conditions. M.Sc (Agri.) Thesis submitted to Navasari Agricultural University, Navasari; c2012.
8. Kumar M, Yaduvanshi NPS, Singh Y. Effects of Integrated Nutrient Management on rice yield, nutrient uptake and soil fertilizer status in reclaimed sodic soils. Journal of Indian Society of Soil Sciences. 2012;60(2):132-137.
9. Naing A, Banterng P, Polthanee A, Trelo-Ges V. The effect of different fertilizers management strategies on growth and yield of upland black glutinous rice and soil properties. Asian Journal of plant sciences. 2010;9(7):414-422.
10. Sarkar S. Management practices for enhancing fertilizer use efficiency under rice-wheat cropping system in the Indo-Gangatic plains. Innovare Journal of Agricultural Sciences. 2015;3:5-10.
11. Wu W, Ma B. Integrated nutrient management (INM) for sustaining productivity. Nutrient use efficiency and environmental impact: A review. Science Total Environment; c2015. p. 415-427.