

Original Research Article

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Response of Integrated Nutrient Management on Yield and Economics of Rice (*Oryza sativa* L.)

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ABSTRACT

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The field experiment was conducted at AICRP IFS Research Farm, Krishi Nagar, Jawaharlal Nehru Krishi Vishwa Vidyalaya, and Jabalpur (MP), India during *kharif* season of 2016. The results revealed that yield attributes *viz.*, number of effective tillers/hill, length of panicle, number of grains/panicle, number of filled grains/panicle, number of unfilled grains/panicle, test weight and grain yield, straw yield and harvest index of rice were higher with application of 100% NPK through fertilizers as compared to 100% N through vermicompost, 75% N through vermicompost, farmers practice N:60, P:30 through fertilizers + 3 tonne FYM/ha, 50% N through vermicompost + 50% NPK through fertilizers, 75% N through vermicompost + 25% NPK through fertilizers and absolute control. Net returns (68749 ₹/ha) and B:C ratio (3.11) also maximum with application of 100% NPK through fertilizers.

Introduction

Rice (*Oryza sativa* L.) crop occupies the enviable prime place among the food crops cultivated around the world and remains as the most important staple food crop of the world (Krishnan *et al.*, 2011). It is major source of calories for 40 % of the world population. India is the second most populous

nation and the largest producer of rice in the world after China. In India, rice is covered 43.79 million ha acreage and contributing 116.42 million tonnes grain production with productivity of 2659 kg/ha (GOI, 2019). Cultivation of high yielding dwarf varieties high responsive to fertilizer and excess use of inorganic fertilizers has depleted the inherent soil fertility. Enhancing the rice productivity

through the appropriate nutrient management has been the main thrust of Indian rice policy. The decline or stagnation in yield has been attributed to nutrient mining and reduced use of organics (John *et al.*, 2001). Inorganic fertilizer is one of the key factors to increase the rice productivity. Rice yield and biomass increased rapidly due to increased use of chemical fertilizers. Several long-term experiments conducted all over India showed that a decrease in rice productivity due to continuous use of imbalanced chemical fertilizers. As a result, agricultural ecosystems remain in a state of chemical nutrient saturation, leading to huge nutrient losses through leaching, runoff, volatilization, emissions, immobilization and subsequent low nutrient use efficiency (Zang *et al.*, 2012). Integrated nutrient management (INM) aims to improve soil health and sustain high level of productivity and production (Prasad *et al.*, 1995). Singh and Kumar (2014) reported increased yield and nutrient use efficiency in rice with organics.

Organic supply of nutrients at the peak period of nutrient absorption also provide micro nutrients and modify soil-physical behavior as well as increase the efficiency of applied nutrients (Pandey *et al.*, 2007). Vermicompost means a casting of earthworms. It is a prime source of organic recycling of organic wastes and a good source of macro and micro nutrients in chelated form and fulfills the balanced nutrient requirement of plants at longer period. Vermicompost also helps in reducing C:N ratio and in increasing humus content of the soil and provide a wide range of nutrient in the readily available form to the plants, such as nitrate, soluble phosphorus exchangeable potassium, calcium, magnesium (Talashilkar *et al.*, 1999). The integrated use of use of organic and inorganic fertilizers has been reported not only to meet the nutrients need of the crop but also has been fund to sustain large scale productivity goals (Yadav

and Meena, 2014). In view of above fact study on integrated nutrient management was carried out for identifying most effective nutrient source and their optimum dose for harvesting higher yield of rice.

Materials and Methods

The field experiment was carried out at AICRP IFS Research Farm, Krishi Nagar, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (MP), India during *kharif* season of 2016. The soil of experimental field was sandy clay loam, neutral in reaction (pH 7.2) having 269.83 kg/ha available N (Alkaline permanganate method (Subbiah and Asija, 1956), medium in available phosphorus (12.7 kg/ha, Olsen's method (Olsen *et al.*, 1954 and medium in available potassium (283.3 kg/ha, Flame photometric method (Metson, 1956) in 0-15 cm soil depth at the start of the experiment.

The experiment was laid out in randomized block design with three replications. There were seven nutrient management treatments viz. 100% N through vermicompost, 75% N through vermicompost, 100% NPK through fertilizers, farmers practice N:60, P:30 through fertilizers + 3 tonne FYM/ha, 50% N through vermicompost + 50% NPK through fertilizers, 75% N through vermicompost + 25% NPK through fertilizers and absolute control. The Recommended dose of fertilizer was 120 kg N, 60 P₂O₅ and 40 kg K₂O per hectare. Rice "Pusa Sugandha 1" seedling was transplanted in first week of July with 2 to 3 seedlings/hill of 21 day of age at spacing of 20 cm × 20 cm. Rice was irrigated frequently to maintain 2 – 3 cm standing water in all the plots. The irrigation was stopped 10 days before harvesting of crop. All the recommended package of practices was followed to raise the crop. The crop was harvested during first week of November, 2016.

Results and Discussion

Yield attributes and yield

The results (Table 1) revealed that yield attributes *viz.*, number of effective tillers/hill, length of panicle, number of grains/panicle, number of filled grains/panicle, number of unfilled grains/panicle, test weight and grain yield, straw yield and harvest index of rice influenced significantly by the nutrient management treatments.

Number of effective tillers/hill

Application of 100% NPK through fertilizers recorded significantly highest number of effective tillers/hill (9.89) which was at par with 50% N through vermicompost + 50% NPK through fertilizers and 75% N through vermicompost + 25% NPK through fertilizers as compared to 100% N through vermicompost, 75% N through vermicompost, farmers practice N:60, P:30 through fertilizers + FYM 3 tonne/ha and absolute control. Application of 100% NPK through fertilizers increases number of effective tillers/hill to the tune of 17.81, 20.31, 34.92 and 102.24 per cent over 100% N through vermicompost, 75% N through vermicompost, farmers practice N:60, P:30 through fertilizers + FYM 3 tonne/ha and absolute control, respectively.

Length of panicle

Application of 100% NPK through fertilizers recorded significantly highest length of panicle (30.4 cm) over 100% N through vermicompost, 75% N through vermicompost, farmers practice N:60, P:30 through fertilizers + FYM 3 tonne/ha, 50% N through vermicompost + 50% NPK through fertilizers, 75% N through vermicompost + 25% NPK through fertilizers, and absolute control. Percentage increase in length of

panicle to the tune of 11.50, 13.91, 11.93, 6.82, 5.51, 24.49 over 100% N through vermicompost, 75% N through vermicompost, farmers practice N:60, P:30 through fertilizers + FYM 3 tonne/ha, 50% N through vermicompost + 50% NPK through fertilizers, 75% N through vermicompost + 25% NPK through fertilizers and absolute control, respectively.

Number of grains/panicle

Maximum number of grains/ panicle (73.00) were recorded by application of 100% NPK through fertilizers which was at par with 50% N through vermicompost + 50% NPK through fertilizers, 75% N through vermicompost + 25% NPK through fertilizers, 100% N through vermicompost, 75% N through vermicompost as compared to farmers practice N:60, P:30 through fertilizers + FYM 3 tonne/ha and absolute control. Application of 100% NPK through fertilizers increases number of grains/ panicle to the tune of 4.82 and 15.26 over to farmers practice N:60, P:30 through fertilizers + FYM 3 tonne/ha and absolute control, respectively.

Number of filled/unfilled grains/panicle

Application of 100% NPK through fertilizers recorded significantly highest number of filled grains/panicle which was at par with 50% N through vermicompost + 50% NPK through fertilizers and 75% N through vermicompost + 25% NPK through fertilizers as compared to 100% N through vermicompost, 75% N through vermicompost, farmers practice N:60, P:30 through fertilizers + FYM 3 tonne/ha and absolute control. Whereas, lowest number of unfilled grains/panicle recorded by application of 100% NPK through fertilizers and absolute control have highest unfilled grains.

Table.1 Effect of nutrient management on yield attributes and yields of rice

Treatments	Effective tillers/hill	Length of panicle (cm)	Grains/panicle	Filled grains/panicle	Unfilled grains/panicle	Test weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest index (per cent)
100% N through vermicompost	8.44	26.94	71.00	59.67	11.33	22.20	2898	5020	36.6
75% N through vermicompost	8.22	26.37	70.33	58.67	11.67	21.80	2506	4699	34.7
100% NPK through fertilizers	9.89	30.04	73.00	63.33	9.67	22.57	3233	5411	37.4
Farmers practice N:60, P:30 through fertilizers + 3 tonne FYM/ha	7.33	25.69	70.00	58.33	12.00	21.50	1632	3436	32.2
50% N through vermicompost + 50% NPK through fertilizers	9.44	28.46	72.33	62.33	10.00	22.43	3110	5272	37.1
75% N through vermicompost + 25% NPK through fertilizers	9.22	28.12	71.33	60.67	10.67	22.27	3045	5229	36.8
Absolute control	4.89	24.13	63.33	50.33	13.00	20.00	1106	2544	30.03
SEm±	0.30	0.41	0.96	1.24	1.08	0.70	59.41	51.16	1.07
CD at 5%	0.94	1.26	2.97	3.84	3.19	2.17	183.17	159.40	3.31

Table.2 Effect of nutrient management on economics of rice

Treatments	Cost of cultivation (₹/ha)	Gross returns (₹/ha)	Net returns (₹/ha)	B: C ratio
100% N through vermicompost	41915	90956	49041	2.17
75% N through vermicompost	38915	78939	40024	2.03
100% NPK through fertilizers	32570	101319	68749	3.11
Farmers practice N:60, P:30 through fertilizers + 3 tonne FYM/ha	34057	51709	17652	1.52
50% N through vermicompost + 50% NPK through fertilizers	37842	97518	59676	2.58
75% N through vermicompost + 25% NPK through fertilizers	39878	95533	55655	2.40
Absolute control	29915	35215	5300	1.18

Test weight (g)

Application of 100% NPK through fertilizers recorded significantly highest test weight (22.57g) over absolute control but it was nearby 50% N through vermicompost + 50% NPK through fertilizers, 75% N through vermicompost + 25% NPK through fertilizers 100% N through vermicompost, 75% N through vermicompost, farmers practice N:60, P:30 through fertilizers + FYM 3 tonne/ha.

Yield

Results (Table 1) revealed that highest grain (2233 kg/ha) and straw (5411 kg/ha) yield were attained by application of 100% NPK through fertilizers which was at par with 50% N through vermicompost + 50% NPK through fertilizers over 100% N through vermicompost, 75% N through vermicompost, farmers practice N: 60, P: 30 through fertilizers + FYM 3 tonne/ha, 75% N through vermicompost + 25% NPK through fertilizers and absolute control. The percentage increase in grain yield (11.55, 29.01, 98.10, 06.74 and 92.31) and straw yield (77.88, 15.15, 57.47, 03.48 and 12.69) over 100% N through vermicompost, 75% N through vermicompost, farmers practice N: 60, P: 30 through fertilizers + FYM 3 tonne/ha, 75% N through vermicompost + 25% NPK through fertilizers and absolute control, respectively.

All the yield attributes and yield were higher with 100% NPK through fertilizers due slow release and continuous supply of nutrients in balance quantity throughout the various growth stages enables the rice plants to assimilate sufficient photosynthetic products and thus, increased the dry matter and source capacity resulted in increased of yield attributes and finally yields of grain and straw. The results showed that application vermicompost was not helpful in increasing

yield attributes and yield of rice. This might be due to its inability to supply nutrients as per demand of rice because of its slow release particularly at the early growth and development stages.

Harvest index

Application of 100% NPK through fertilizers recorded significantly highest harvest index (37.4 per cent) which was on par with 50% N through vermicompost + 50% NPK through fertilizers, 75% N through vermicompost + 25% NPK through fertilizers, 100% N through vermicompost, 75% N through vermicompost as compared to farmers practice N:60, P:30 through fertilizers + FYM 3 tonne/ha and absolute control.

Economics

Highest (Table 2) net returns (68749₹/ha) and B:C ratio (3.11) were recorded with application of 100% NPK through fertilizers as compared to 50% N through vermicompost + 50% NPK through fertilizers, 50% N through vermicompost + 25% NPK through fertilizers, 100% N through vermicompost, 75% N through vermicompost, farmers practice N:60, P:30 through fertilizers + FYM 3 tonne/ha and absolute control.

In conclusion on the basis of present experiment, it may be concluded that application of 100% NPK through fertilizers overall better than other treatments. It gives higher values of yield attributes and yield net returns (68749₹/ha) and B:C ratio (3.11) of rice.

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