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RESEARCH PAPER

Effect of organic and inorganic nutrient management on nutrient uptake by rice (*Oryza sativa* L.)

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Abstract : The field experiment was carried out at AICRP IFS Research Farm, Krishi Nagar, Jawaharlal Nehru Krishi Vishwa Vidyalaya, and Jabalpur (MP), India during *Kharif* season of 2016. The study was carried out to evaluate the suitable organic and inorganic nutrient for rice crop. The results revealed that grain yield, straw yield and nutrient uptake *viz.*, nitrogen, phosphorus and potassium uptake by grain and straw of rice were higher with application of 100% NPK through fertilizers and 50% N through Vermicompost + 50% NPK through fertilizers, as compared to 100% N through Vermicompost, 75% N through Vermicompost, farmers practice N: 60, P: 30 through fertilizers + 3 tonnes FYM/ha, 75% N through Vermicompost + 25% NPK through fertilizers and absolute control.

Key Words : NPK, Vermicompost, Yield, Nitrogen, Phosphorus, Potassium

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INTRODUCTION

Rice (*Oryza sativa* L.) is one of the most important staple food crops of the world. It occupies the enviable prime place among the food crops cultivated around the world (Krishnan *et al.,* 2011). It is primary 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. Increasing 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

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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 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 and nutrient uptake by rice.

Material and Methods

The field experiment was carried out at AICRP IFS Research Farm, Krishi Nagar, Jawaharlal Nehru Krishi Vishwa Vidyalaya, and 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 tonnes 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 P_2O_5 and 40 kg K_2O 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

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

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 tonnes/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 tonnes/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.

Nutrient uptake :

The results (Table 1) revealed that nutrient uptake by rice crop significantly influenced by nutrient management treatments.

Nitrogen uptake:

Application of 100% NPK through fertilizers recorded significantly highest nitrogen uptake by grain and straw which was at par with 50% N through Vermicompost + 50% NPK through fertilizers as compared to 100% N through Vermicompost, 75% N through Vermicompost, farmers practice N: 60, P: 30 through fertilizers + FYM 3 tonnes/ha, 75% N through Vermicompost + 25% NPK through fertilizers and absolute control. Application of 100% NPK through fertilizers increases nitrogen uptake to the tune of 10.16, 27.69, 96.03, 63.28, 91.63 per cent by grain and3.76, 15.82, 36.17, 1.0 82.65 per cent by straw over 100% N through Vermicompost, 75% N through Vermicompost, farmers practice N: 60, P: 30 through fertilizers + FYM 3 tonnes/ ha, 75% N through Vermicompost + 25% NPK through fertilizers and absolute control, respectively.

Phosphorus uptake:

Application of 100% NPK through fertilizers at par with 50% N through Vermicompost + 50% NPK through

Table 1: Effect of nutrient management on yield and nutrient uptake by rice

Treatments	Nutrient uptake (kg/ha)						Yield (kg/ha)	
	Nitrogen		Phosphorus		Potassium		Grain	Straw
	Grain	Straw	Grain	Straw	Grain	Straw		
100% N through Vermicompost	37.67	43.53	19.03	14.30	10.17	109.83	2898	5020
75% N through Vermicompost	32.50	39.00	16.50	12.17	9.00	98.10	2506	4699
100% NPK through fertilizers	41.50	45.17	21.13	14.93	11.37	115.77	3233	5411
Farmers practice N:60, P:30 through fertilizers + 3 tonnes FYM/ha	21.17	33.17	10.23	11.03	5.43	85.33	1632	3436
50% N through Vermicompost + 50% NPK through fertilizers	40.60	44.93	20.33	14.47	11.20	113.10	3110	5272
75% N through Vermicompost + 25% NPK through fertilizers	39.03	44.73	20.03	14.40	10.43	111.20	3045	5229
Absolute control	14.23	24.73	7.53	8.33	4.30	63.47	1106	2544
SEm±	0.57	0.45	0.41	0.40	0.31	0.86	59.41	51.16
CD at 5%	1.77	1.39	1.27	1.24	0.96	2.65	183.17	159.40

Table 2: Effect of nutrient management on chemical properties of soils (after harvest of crop)

Treatment	Chemical properties of soil after experiment					
	pH	EC (dSm^{-1})	OC (%)	Available nitrogen (kg/ha)	Available phosphorus (kg/ha)	Available potassium (kg/ha)
100% N through Vermicompost	7.33	0.42	0.73	271.27	12.74	289.23
75% N through Vermicompost	7.20	0.40	0.71	269.72	12.72	286.36
100% NPK through fertilizers	7.23	0.40	0.72	269.70	12.73	286.94
Farmers practice N:60, P:30 through fertilizers + 3 tonne FYM/ha	7.27	0.40	0.72	269.34	12.72	284.29
50% N through Vermicompost + 50% NPK through fertilizers	7.27	0.42	0.72	270.64	12.73	285.92
75% N through Vermicompost + 25% NPK through fertilizers	7.23	0.41	0.71	269.91	12.73	289.46
Absolute control	7.20	0.41	0.71	269.90	12.72	283.98
SEm±	0.098	0.007	0.010	0.627	0.010	1.082
CD at 5%	NS	NS	NS	NS	NS	NS

fertilizers and registered significant highest phosphorus uptake by grain and straw as compared to 100% N through Vermicompost, 75% N through Vermicompost, farmers practice N: 60, P: 30 through fertilizers + FYM 3 tonnes/ha, 75% N through Vermicompost + 25% NPK through fertilizers and absolute control. Application of 100% NPK through fertilizers enhanced phosphorus uptake to the tune of 11.03, 28.06, 106.54, 5.49, 180.61 per cent by grain and 4.40, 22.67, 35.35, 3.68, 79.23 per cent by straw over 100% N through Vermicompost, 75% N through Vermicompost, farmers practice N: 60, P: 30 through fertilizers + FYM 3 tonnes/ha, 75% N through Vermicompost + 25% NPK through fertilizers and absolute control, respectively.

Potassium uptake:

Maximum potassium uptake by grain and straw were recorded by application of 100% NPK through fertilizers which was at par with 50% N through Vermicompost + 50% NPK through fertilizers as compared to 100% N through Vermicompost, 75% N through Vermicompost, farmers practice N: 60, P: 30 through fertilizers + FYM 3 tonnes/ha, 75% N through Vermicompost + 25% NPK through fertilizers and absolute control. Application of 100% NPK through fertilizers enhanced potassium uptake to the tune of 11.79, 26.33, 9.39, 9.01, 64.41 per cent by grain and 5.40, 18.01, 35.67, 4.10, 82.40 per cent by straw over 100% N through Vermicompost, 75% N through Vermicompost, farmers practice N: 60, P: 30 through fertilizers + FYM 3 tonnes/ha, 75% N through Vermicompost + 25% NPK through fertilizers and absolute control, respectively.

The variations in grain and straw yields as well as total biomass among different nutrient management as discussed earlier. The enhanced availability of essential plant nutrient under conjunctive use of 100% NPK through fertilizers as compared to absolute control and other nutrient management might have enhanced the uptake of NPK in grain and straw. Similar results were obtained by Jing *et al.* (2009), Kumar and Prasad (2010), Pooniya and Shivay (2011) and *Soni et al*. (2012).

Change in soil properties:

Data in Table 2 indicated that soil properties *viz.,* pH, Ec, organic carbon, available nitrogen, available phosphorus and available potassium did not influenced significantly due to application of organic manures and inorganic fertilizers in rice crop.

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 and nutrient uptake.

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