Annals of Plant and Soil Research 20(1): 69–72 (2018)

Effect of organic and inorganic sources of nutrient on productivity, nutrient uptake and economics of rice (*Oryza sativa L.*)

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Received: October, 2017; Revised accepted: January, 2018

ABSTRACT

A field experiment was conducted at Instructional Farm of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U.P.) during Kharif season of 2013 to evaluate the effect of organic and inorganic sources of nutrient on productivity and nutrient uptake of rice (Oryza sativa L.). Twelve treatments comprised with different integrated modules of organic, inorganic and biofertilizer combinations were evaluated in randomized block design with three replication. The results revealed that the various integrated nutrient management modules significantly influenced the yield, economics and nutrient uptake by rice. Among integrated modules, application of 100% RDF resulted in maximum yield (60.61 grain and 78.86 q ha^{-1} straw) and nutrient uptake followed by 75% RDF+ 25% N (FYM+GM+BGA). The increases in grain and straw yield of rice due to 100% RDF were 165.1 and 108.2% over control, respectively. The corresponding increases in grain and straw yields due to 75% RDF + 25% N (FYM + GM + BGA) were 162.2 and 106.8 per cent. The highest net return (Rs. 78,409.00) and benefit: Cost ratios (2.80) were obtained with 100% RDF that was closely followed by 75% RDF+ 25% N FYM+GM+BGA.

Key words: INM, yield, economics, nutrient uptake, rice

INTRODUCTION

Rice is one of the important cereal food crop for more than half of the world's population The global requirement of rice by 2050 AD world by 800 million tones, which is 26% higher than the present level of production. The area and production of rice in the state is about 13.84 mha and 14.00 mt, respectively with productivity of 2358 kgha^{-1}**.** The ever-increasing population of the country is forcing the planners to produce more and more with ever shrinking natural resources. Continuous use of high analysis fertilizers accelerated the mining of micro and secondary nutrients, which brought down the productivity. Declining trend in productivity due to continuous use of chemical fertilizers alone has been observed. Therefore, emphasis should be to optimize the use of chemical fertilizers and to improve their use efficiency. Enhancing the productivity and soil fertility to feed the ever-growing population from shrinking natural resources. It is impossible to attain the potential yields of crops without external supply of the nutrients through combination of inorganic and organics. The combined use of fertilizer, organic and biofertilizers increase the productivity of crops with significant residual effect in soil. In addition to saving of available nutrients integrated nutrient management aims for efficient and judicious use of all the major sources of plant nutrients in an integrated manner. Therefore the combined use of organic manures and inorganic fertilizer help in maintaining yield stability through correction of marginal deficiencies of secondary and micronutrients enhancing efficiency of applied nutrients and providing favourable soil physical condition (Kumar *et al.* 2017). Keeping this view, the present study was conducted to achieve the suitable INM modules on rice (*Oryza sativa* L.) productivity and uptake of nutrients and economics.

MATERIALS AND METHODS

The field experiment was conducted at Student's Instructional farm of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad during *Kharif*, 2013. The treatments consisting of chemical fertilizers with different combination of organics (FYM, green manure and BGA) were. T_{1-} control, T_2-100% RDF, T_3-75% RDF, T_4-50% RDF, T_5-75% RDF + 25% N-FYM, T_6-75% RDF +25% N-GM, T_7-75% RDF +25% N-FYM + GM, T_8-75% RDF + 25% N-FYM + FYM+GM and T_{12}-50%RDF + 50% N-FYM + GM + BGA, T_9-50% RDF + 50% N-FYM, T_{10}-50% RDF + 50% N-GM, T_{11}-50% RDF + 50% N-GM + BGA were evaluated in Randomized block

design as three replications. The experimental soil was silty loam in texture having pH (1:25) 8.5, EC 0.41dSm^{-1}, organic carbon 2.40 g kg^{-1}, available nitrogen 170 kg ha^{-1}, phosphorus 8.8 kg ha^{-1}, potassium 215 kg ha^{-1}, sulphur 8.9 kg ha^{-1} and zinc 0.63 mg kg^{-1}. FYM, green manure (Dhaincha) and BGA were applied as per treatments. FYM, green manure and BGA were incorporated before transplanting of rice seedling and BGA crust was applied uniformly in the plots 5-7 days after transplanting. The half dose of nitrogen, and entire dose of phosphorus, potash and zinc were applied as basal application in the form of urea, diammonium phosphate, muriate of potash and zinc sulphate, respectively, Remaining half dose of nitrogen was applied in two splits at tillering and panicle initiation stages. The seedlings were transplanted with spacing of 20 x 10cm. All the cultural practices were followed to raise a good crop. The grain and straw yields were recorded at maturity. The plant samples were analysed N, P, K, S and Zn content. The N content in grain and straw samples was determined by Kjeldahl method (Jackson 1973). The grain and straw samples were wet digested with niyric acid and perchloric acid and P in digest was determined by vomadata phosphomolybdate yellow colour method, K by flamephotometer, S by tubiditimetric method and Zn on atomic absorption spectrophotometer. The nutrient uptake was calculated by multiplying nutrient concentration values with the grain and straw yield data. The economics of the treatments was worked out in terms of B:C ratio and net returns on prevailing market price of inputs and output.

RESULTS AND DISCUSSION

Growth and yield attributes

It is evident from the data (table-1) that the grain yield ranged from 22.86 to 60.61 q ha^{-1} whereas the straw yield ranged from 37.87 to 67.21 qha^{-1}. Grain and straw yields were significantly influenced by the application of fertilizers alone or in combination with FYM, green manuring and biofertilizer over the control. The maximum grain yield (60.61 q ha^{-1}) was recorded with the application of 100% RDF followed by 75% RDF + 25% N-FYM + GM + BGA. These increases in yields with 100% RDF as fertilizers could be attributed to higher values of growth and yield attributes. Application of 100% RDF increased the grain and straw yield of rice by 165% and 108.2% over control, respectively. The corresponding increases in grain and straw yield due to 75% RDF + 25% N FYM + GM + BGA were 162.2 and 106.8 per cent. Thus, both the treatments (100% RDF and 75% RDF + 25% NFYM + GM + BGA) were at par in respect of rice production (Kumar *et al.* 2017, Jat and Singh, 2017). The minimum grain yield (22.86 q ha^{-1}) was recorded with control. This could be attributed to decomposition of succulent green manure, FYM and biological fixation, which favoured for greater release of nutrients and their continuous availability in soil for sustaining higher grain and straw yield of rice. The findings are in agreements with the observations of Khursheed *et al.* **(2013),** Kumar *et al.* (2017).

Table 1: Effect of integrated nutrient management on yield and economic of various treatments in rice crop

Treatments	Grain yield (tha^{-1})	Straw yield (tha^{-1})	Gross return (Rs. ha^{-1})	Net return (Rs. ha^{-1})	Benefit : cost ratio
T_1 – Control	22.86	37.87	41079	25100	1.40
T_2 - 100% RDF	60.61	78.86	102451	78409	2.80
T_3 - 75% RDF	51.41	67.21	86996	65096	2.58
T_4 - 50% RDF	40.40	55.34	69122	49156	2.16
T_5 - 75% RDF + 25% N-FYM	55.01	74.47	93854	67817	2.28
T_6 - 75% RDF +25% N-GM	56.82	76.37	96777	71842	2.50
T_7 - 75% RDF +25% N-FYM + GM	58.76	78.12	99824	74473	2.55
T_8 - 75% RDF + 25% N-FYM + GM + BGA	59.96	78.35	101744	77085	2.69
T_9 - 50% RDF + 50% N-FYM	52.72	71.91	90109	61972	1.95
T_{10}- 50% RDF + 50% N-GM	54.07	73.53	92350	66309	2.23
T_{11}- 50% RDF + 50% N-FYM+GM	56.51	75.21	96026	69061	2.25
T_{12}- 50%RDF + 50% N-FYM + GM + BGA	57.98	77.08	98798	73249	2.49
SEm±	2.39	3.02	-	-	-
C.D. (P=0.05)	7.02	8.86	-	--	-

The uptake of nutrients by rice crop was affected significantly due to various treatments. The uptake of N, P, K, S and Zn by grain at different integrated nutrient modules ranged from 26.2 to 78.7, 5.7 to 20.6, 11.2 to 44.8, 2.9 to 10.0 kg $ha^{-1}$and 36.1 to 128.2 g ha^{-1} respectively. The highest uptake of these nutrients was recorded with 100% RDF as compared to 50% RDF. Application of 75% RDF + 25% N-FYM + GM + BGA also resulted in significantly higher uptake of nutrients by rice crop over other combined treatments. There was significant rise in nutrient uptake in rice grain and straw with various organic treatments. FYM was the excellent source of N and its application increased the grain and straw yield as well as nutrient uptake of rice. It might be due to favorable soil condition which enhanced nutrient availability and nutrient uptake as well as a better growth and activity of roots. The application of FYM, green manure and BGA might be responsible for increasing the nutrient uptake by grain and straw. Use of chemical fertilizer might be responsible for increasing the nutrients uptake by crop. Similar finding was observed by Pandey *et al.* (2007), Rakesh *et al.* (2009), Lal and Sharma (2013). The organic manure recorded comparatively lower uptake of N, P, K, S and Zn as compared to integration of organic manure with inorganic fertilizer. (Sowmya *et al.* 2011). The highest nutrient uptake was recorded in T_2 (100% RDF) treatment and the lowest in T_1 (control). Similar results were reported by Singh *et al.* (2008).

Table 2: Effect of integrated nutrient management on nutrient uptake by rice crop

Treatment	Nitrogen		Phosphorus		Potassium		Sulphur		Zinc (g ha^{-1})	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
T_1 -	26.2	15.5	5.7	2.6	11.2	39.7	2.9	3.5	36.1	43.3
T_2 -	78.7	40.2	20.	8.0	44.8	100.1	10.0	8.9	128.2	122.5
T_3 -	62.7	31.5	15.4	5.5	32.3	78.6	7.7	6.8	90.4	92.0
T_4 -	47.2	24.9	10.9	4.1	21.4	60.8	5.6	5.5	66.7	69.7
T_5 -	67.6	35.7	17.0	6.1	35.2	88.6	8.2	7.7	102.1	105.9
T_6 -	71.0	37.4	18.1	6.9	37.5	93.1	8.5	8.0	105.8	110.5
T_7 -	72.7	39.3	18.4	7.1	39.8	95.6	9.2	8.2	115.7	116.2
T_8 -	76.0	39.9	19.4	7.9	42.4	98.6	9.4	8.5	123.7	120.0
T_9 -	64.1	34.5	14.9	6.0	33.6	84.1	7.7	7.6	93.9	98.8
T_{10}-	66.8	36.1	15.9	6.3	35.5	88.2	7.9	7.9	96.6	101.6
T_{11}-	71.0	37.3	17.2	6.7	38.8	92.5	8.8	8.2	103.7	107.0
T_{12}-	73.5	39.1	18.2	7.4	41.6	95.5	9.1	8.7	114.4	112.3
SEm±	2.40	1.67	0.69	0.30	1.60	3.41	0.40	0.20	3.98	2.93
C.D. (P=0.05)	7.04	4.90	2.02	0.88	4.69	9.99	1.16	0.59	11.68	8.60

Economics

The highest grain and straw yield of 60.61 and 78.86 q ha^{-1} was recorded in T_2 (100% RDF) which fetched the highest maximum gross income of Rs 10, 2451.00 ha^{-1} followed by T_8. This is due to higher production of grain and straw. The highest net return of Rs 78,409.00 ha^{-1} was recorded under 100% RDF closely followed by 75% RDF+25%N-FYM,GM and BGA (Rs. 77,085.00 ha^{-1}). This trend in economic return is mainly due to the treatment effect on the grain and straw yield of rice. Higher benefit: cost ratio of 2.80 was also computed with 100% RDF. Moreover, if the improvement in soil physico-chemical and biological properties are considered, the incorporation of organic manure and biofertilizer would be much more beneficial compared to inorganic fertilizer. Baishya *et al.* (2015) also reported similar results.

It may be concluded from the present study that application of 75% RDF + 25% N FYM + GM + BGA was found to be beneficial in increasing the production of rice crop. The results clearly indicate the need of integrated use of 75% RDF + 25% N FYM + GM + BGA to meet the nutrient requirement of rice for sustaining the higher productivity and profitability.

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