RESEARCH ARTICLE

EFFECT OF ORGANIC AND INORGANIC SOURCES OF NUTRIENT ON PRODUCTIVITY, NUTRIENT UPTAKE AND ECONOMICS OF RICE (*ORYZA SATIVA* L.)

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Received-21.01.2016, Revised-28.01.2016

Abstract: A field experiment was conducted at Instructional Farm of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U.P.) during the *Kharif* 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. The various integrated nutrient management modules significantly influenced the yield, economic and nutrient uptake by rice. Among integrated modules the application of 100% RDF received maximum yield (60.61 grain and 78.86 straw q ha^{-1}) and nutrient uptake followed by 75% RDF+ 25% N (FYM+GM+BGA). The highest net return (78,409.00) and benefit: cost ratio (2.80) was computed under treatment T_2- 100% RDF which was closely followed by 75% RDF+ 25% N (FYM+GM+BGA).

Keywords: INM yield, Economic and nutrient uptake of 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. In India it is grown over an area 43.95 million hectare with a production of 106.54 million tones in 2013-14 *Anonymous* (2014). The area and production of rice in the state is about 13.84 mha and 14.00 mt, respectively with productivity of 2358 $kgha^{-1}$ *Anonymous* (2014). 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 also improved the soil organic carbon and nutrient status of the soil. 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.

MATERIAL AND METHOD

The field experiment was conducted at Student's Instructional farm of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad during *Kharif*, 2013 to explore the possibility of substituting fertilizer with FYM, Green manure (Dhaincha) and biofertiliser (Blue green algae) is an integrated manner for the crop. The treatment consisting of chemical fertilizer with different combination of organics (FYM, Green manure and BGA) viz. 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 + GM + BGA), T_9 (50% RDF + 50% N-FYM), T_{10} (50% RDF + 50% N-GM), T_{11} (50% RDF + 50% N-FYM+GM) and T_{12} (50%RDF + 50% N-FYM + GM + BGA) were comprised in Randomized Block replicated as thrice. The experimental soil was silty loam in texture having pH (1:25) 8.58, EC 0.41dSm^{-1}, Organic Carbon 2.40 g kg^{-1}, Available Nitrogen 170.50, Phosphorus 08.81, Potassium 215.52, Sulphur 8.97 kg ha^{-1} and Zinc 0.63 mg kg^{-1}. FYM, green manure (Dhaincha) and BGA were applied as per treatment. 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. Whereas half dose of nitrogen 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 equally at tillering and panicle initiation stages. The farm yard manure was applied before fifteen days of transplanting and zinc sulphate was applied in the last plough. The seedling

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were transplanted with spacing of 20 x 10cm all the cultural practices were followed to raise a good crop. The grain and straw yield were recorded at maturity. The soil samples were collected as initial before and after harvest of the crop and analysed for chemical properties by following standard methods (Jackson, 1973). The plant samples were collected N, P, K, S and Zn content (Jackson, 1973) and nutrient uptake by grain and straw was computed. The experimental data were statistically analyzed using MSTATC. Economics and cost benefit: cost ratio was calculated by dividing gross income with total cost of cultivation.

RESULT 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} during the year of investigation whereas the straw yield for the same period 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 and 61.66 q ha^{-1}) were recorded with the application of T_2 (100% RDF) which was closely followed by T_8 (75% RDF + 25% N-FYM + GM + BGA) and significantly superior over the treatment T_1 (control), T_3 (75% RDF), T_4 (50% RDF) and T_9 (50% RDF + 50% N-FYM) and statistically at par with treatment T_5 (75% RDF + 25% N- FYM), T_6 (75% RDF +25% N-GM), T_7 (75% RDF +25% N-FYM + GM), T_{10} (50% RDF + 50% N-GM), T_{11} (50% RDF + 50% N-FYM+GM) and T_{12} (50%RDF + 50% N-FYM+ GM + BGA). The minimum grain yield (22.86 and 23.01q ha^{-1}) was recorded with control, during both year of experimentation. This could be attributed to decomposition of succulent green manure, FYM and biological fixation, which favored 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 observation of Sharma and Gupta (2001), Singh, *et al.* (2002), Khursheed *et al.* (2013), Khairnar and Thakur (2011).

Nutrients uptake

The uptake of N, P, K, S and Zn by grain at different integrated nutrient modules f fertilizers, FYM, green manure and biofertiliser ranged 26.28 – 78.79, 5.7-20.60, 11.20 – 44.85, 2.97 – 10.03 kg $ha^{-1}$and 36.10 – 128.25 g ha^{-1}. The straw yield of rice followed the same trends as grain yield with each of the treatments. The nutrient (N, P, K, S and Zn) uptake after the application of RDF alone in combination of FYM, green manure and biofertiliser are presented in table 2. The highest uptake of these nutrients was recorded in the treatment 100% RDF followed by T_8 (75% RDF + 25% N-FYM + GM + BGA) which were significantly superior in potassium content over 75 %, 50% RDF application and control. There was significant rise in nutrient uptake in rice grain and straw were also influence 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 all the nutrients were present in balanced proportion; it might be responsible for increasing the nutrients uptake by crop. This might be due to the high nutrient 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 recorded in T_2 treatment and the lowest in T_1 (control). Similar results was obtained by Singh *et al.* (2008) who reported green manure was the N-Fixing and its application increase the grain and straw yield as well as nutrients uptake by rice crop.

Economics

Economic yield and added benefits as influenced by integrated nutrient management use of chemical fertilizer, organic manure and biofertilizer on rice have been calculated and presented in table 1. The highest grain and straw yield of 60.61 and 78.86 q ha^{-1} recorded in T_2 (100% RDF) give the highest maximum grass income 10, 2451.00 followed by T_8. This is due to higher production of grain and straw. The highest net return 78,409.00 was found under treatment T_2- 100% RDF which was closely followed by T_8- 75% RDF+25%N-FYM,GM and BGA 77,085.00 this variation might be due to higher cost of cultivation. Which varied in the treatment this trend in economic return is mainly due to the treatment effect on the grain and straw yield of rice. Higher benefit cost ratio 2.80 was also computed with the treatment T_2-100% RDF which was closely followed by T_8. 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.

Table 1. Effect of integrated nutrient management on yield and Economic of various treatment combinations in rice crop.

Treatments	**Grain yield (tha^{-1})**	**Straw yield (tha^{-1})**	**Total cost of cultivation (□. ha^{-1})**	**Gross return (□ . ha^{-1})**	**Net return (□ . ha^{-1})**	**Benefit : cost ratio**
T_1 – Control	22.86	37.87	17873	41079	25100	1.40
T_2 - 100% RDF	60.61	78.86	27985	102451	78409	2.80
T_3 - 75% RDF	51.41	67.21	25261	86996	65096	2.58
T_4 - 50% RDF	40.40	55.34	22733	69122	49156	2.16
T_5 - 75% RDF + 25% N-FYM	55.01	74.47	29761	93854	67817	2.28
T_6 - 75% RDF +25% N-GM	56.82	76.37	28754	96777	71842	2.50
T_7 - 75% RDF +25% N-FYM + GM	58.76	78.12	29257	99824	74473	2.55
T_8 - 75% RDF + 25% N-FYM + GM + BGA	59.96	78.35	28625	101744	77085	2.69
T_9 - 50% RDF + 50% N-FYM	52.72	71.91	31733	90109	61972	1.95
T_{10}- 50% RDF + 50% N-GM	54.07	73.53	29718	92350	66309	2.23
T_{11}- 50% RDF + 50% N-FYM+GM	56.51	75.21	30726	96026	69061	2.25
T_{12}- 50%RDF + 50% N-FYM + GM + BGA	57.98	77.08	29453.5	98798	73249	2.49
SEm±	2.39	3.02	-	-	-	-
C.D. at 5%	7.02	8.86	-	-	--	-

Table 2. Effect of integrated nutrient management on yield and nutrient uptake by grain in rice crop.

Treatments	**Nutrient Uptake (kg ha^{-1})**									
	Nitrogen		**Phosphorus**		**Potassium**		**Sulphur**		**Zinc (g ha^{-1})**	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
T_1 – Control	26.28	15.52	5.715	2.69	11.2	39.76	2.97	3.56	36.1	43.32
T_2 - 100% RDF	78.79	40.21	20.6	8.04	44.85	100.16	10.03	8.99	128.25	122.55
T_3 - 75% RDF	62.72	31.58	15.42	5.51	32.39	78.64	7.71	6.86	90.48	92.08
T_4 - 50% RDF	47.26	24.90	10.9	4.15	21.41	60.87	5.66	5.53	66.74	69.73
T_5 - 75% RDF + 25% N-FYM	67.66	35.74	17.05	6.18	35.21	88.62	8.25	7.74	102.1	105.9
T_6 - 75% RDF +25% N-GM	71.02	37.43	18.18	6.95	37.5	93.17	8.52	8.02	105.86	110.51
T_7 - 75% RDF +25% N-FYM + GM	72.77	39.33	18.48	7.17	39.85	95.63	9.24	8.25	115.7	116.24
T_8 - 75% RDF + 25% N-FYM + GM + BGA	76.05	39.94	19.45	7.91	42.45	98.68	9.43	8.54	123.7	120.09
T_9 - 50% RDF + 50% N-FYM	64.13	34.55	14.99	6.04	33.62	84.13	7.76	7.62	93.95	98.88
T_{10}- 50% RDF + 50% N-GM	66.86	36.10	15.92	6.32	35.56	88.24	7.96	7.94	96.62	101.69

T_{11}- 50% RDF + 50% N-FYM+GM	71.05	37.39	17.2	6.77	38.86	92.51	8.88	8.27	103.7	107.02
T_{12}- 50%RDF + 50% N-FYM + GM + BGA	73.5	39.31	18.23	7.48	41.6	95.58	9.12	8.71	114.40	112.31
SEm±	2.40	1.67	0.69	0.30	1.60	3.41	0.40	0.20	3.98	2.93
C.D. at 5%	7.04	4.90	2.02	0.88	4.69	9.99	1.16	0.59	11.68	8.60

CONCLUSION

The integrated nutrient management practices brought considerable improvement in the available N, P, K, S and Zn status in soil. The integration of inorganic fertilizers coupled with FYM, green manure and biofertilizer can sustain the rice grain productivity. Therefore it could be recommended that the application of FYM, GM and biofertilizer would not only improve the productivity and income but would also maintain the soil health. However, there are indications that over time, the application of FYM, GM and BGA alone will improve soil fertility levels.

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