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EFFECTS OF DIFFERENT ORGANIC SOURCES OF NUTRITION ON NUTRIENT UPTAKE, YIELD ATTRIBUTES AND ECONOMICS OF *ORYZA SATIVA* L.

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Abstract

RDF + vermicompost @5 mt/ha + *Trichoderma* compost @ 7.5 kg/ha significantly increased the yield attributes, yield attributes *viz.*, panicle length (25.05 cm), Panicle weight (3.50 g), number of panicle (133.20 m^{-2}), test weight (22.93 g), grain yield (54.0 q/ha), straw yield (70.0 q/ha), harvest index (43.56%). It also increased the number of grain (18.90 kg/ha) and straw (10.50 kg/ha) over control.

Rice (*Oryza sativa* L.) is a staple food for more than 60% of the world's population and plays a vital role in the economic and social stability of the world. India is the second largest producer of rice only after China. In India, area under cultivation of rice is around 45.0 mha with production of 106.29 million tonnes (Anon. 2014). Uttar Pradesh is the largest rice growing state after West Bengal, India in which it is raised over an area of about 5.29 mha with the production of 14.41 million tonnes (Anon. 2014) which is 13.80% of total Indian rice production. The conjunctive application of organics with inorganic sources of nutrient reduces the dependence on chemical inputs and it not only acts as a source of nutrient but also provides micronutrient as well as modifies the soil physical behaviour and increases the efficiency of applied nutrients (Pandey *et al*. 2007). Utilization of indigenous organic sources, *viz*. farmyard manure (FYM), obnoxious weeds and green leaf manures may serve as alternatives or supplements to chemical fertilizers, and help in increasing the productivity of the rice-based cropping system in all zones of the country. Organic manures play a vital role in sustaining higher productivity in intensive agriculture and irrigated rice in particular. Complementary use of organic and biological source of plant nutrient along with chemical fertilizer is of great importance for the maintenance of soil health and productivity. However, the availability of organic manures like compost, FYM, green manure and crop residue is a major limiting factor for their use. It is widely recognized that neither the use of organic manures alone nor the chemical fertilizers can achieve the sustainability of the yield under the modern intensive farming. Contrary to detrimental effects of inorganic fertilizers, organic manures are available indigenously which improve soil health resulting in enhanced crop yield. However, the use of organic manures alone may not meet the plant requirement due to presence of relatively low levels of nutrients. Therefore, in order to make the soil well supplied with all the plant nutrients readily available form and to maintain good soil health, it is necessary to use organic manures in conjunction with inorganic fertilizers to obtain optimum yields (Sarangi *et al.* 2013). Results have also shown that integrated nutrients management increases the yield and nutrient uptake (Mohanty *et al*. 2013). The efficiency of nutrient use may be raised by the combined use of organic and inorganic fertilizers. Organic fertilizers not only act as the source of

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nutrients, but also provide micronutrients and modify soil-physical behaviour as well as increase the efficiency of applied nutrients. Integration of organic sources such as vermicompost and FYM may also help in the restoration of soil health (Pillai *et al.* 2007).

The field experiment was conducted during rainy season in 2014-15 at the Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, located at an elevation of 18.93 m MSL in class IV of land capability with a moisture deficit index of –02 to –40. The geographical situation of the farm is 25º18’ N latitude, 88º03’ E . The soil of experimental site was sandy clay loam, neutral in reaction (pH 7.5), low in organic carbon (0.34%), available nitrogen (198.45 kg/ha), medium in available phosphorus (23.64 kg/ha and) available potassium (206.4 kg/ha). The experiment was laid out in randomized block design having 12 treatments *viz.*, control (T_1), 100% RDF (T_2), T_2 + FYM @ 5 mt/ha (T_3), T_2 + vermicompost @ 5 mt/ha (T_4), T_2 + press mud @ 5 mt/ha (T_5), T_3 + *Trichoderma* compost @ 2.5 kg/ha (T_6), T_3 + *Trichoderma* compost @ 5.0 kg/ha (T_7), T_3 + *Trichoderma* compost @ 7.5 kg/ha (T_8), T_4 + *Trichoderma* compost @ 2.5 kg/ha (T_9), T_4 + *Trichoderma* compost @ 5.0 kg/ha (T_{10}), T_4 + *Trichoderma* compost @ 7.5 kg/ha (T_{11}), T_5 + *Trichoderma* compost @ 2.5 kg/ha (T_{12}), T_5 + *Trichoderma* compost @ 5.0 kg/ha (T_{13}), T_5 + *Trichoderma* compost @ 7.5 kg/ha (T_{14}) and replicated thrice. Recommended fertilizer 120 : 60 : 60 kg/ha of N, P_2O_5 and K_2O, respectively as per recommendation were applied through urea, DAP and muriate of potash as per treatments. Half dose of nitrogen and full dose of phosphorus and potassium were applied basally. Remaining half N dose was applied in two equal splits once at tillering and the rest panicle initiation stages. However, vermicompost, *trichoderma* compost, FYM and press mud were applied at the time of transplantation. Seedlings of 25 days of ‘MTU 7029’ rice were transplanted, keeping 2 - 3 seedlings/hill at 20 × 15 cm spacing on 30 June in 2014 under puddle conditions. The crop was harvested at the mid of November**.** The other agronomic practices were followed as per standard recommendations**.**

The observations recorded during the course of investigation were tabulated and analyzed statistically to draw a valid conclusion. The data were analyzed as per the standard procedure for ANOVA (Gomez and Gomez 1984). The significance of treatments was tested by ‘F’ test (Variance ratio). Standard error of mean (SEm±) was computed in all cases. The difference in the treatment mean was tested by using critical difference (CD) or LSD at 5% level of probability.

Nutrient uptake, removal in grain and straw of the crop were calculated in kg/ha in relation to yield/ha following the formula of Jackson (1973).

Nutrient uptake (kg/ha) = Nutrient content (%) × yield (q/ha)

Results revealed that the application of organic sources of nutrient increased the yield attributes and yield. Application of 100% RDF + vermicompost @ 5 mt/ha + *Trichoderma* compost @ 7.5 kg/ha, significantly recorded higher yield attributes *viz.*, number of panicle/m^2 (133.20), panicle length (25.05 cm), panicle wt. (3.50 g) and 1000 grain wt. (22.93 g), followed by treatment 100% RDF + vermicompost @ 5 mt/ha+ *Trichoderma* compost @ 5 kg/ha and significantly superior over control. The minimum yield attributes *viz.*, number of panicle/m^2 (107.47), panicle length (18.18 cm), panicle wt. (2.67 g) and 1000 grain wt. (21.50 g) were recorded in control. Similar findings were also reported by Chaudhary *et al.* 2011.

Significantly higher grain yield (54 q/ha), straw yield (70 q/ha) were recorded under 100% RDF + vermicompost @ 5 mt/ha + *Trichoderma* compost @ 7.5 kg/ha. Integration of organic sources might have increased the N content of the plants which ultimately influenced the protein yield favourably and these findings have been closely conformed by Gandhi and Sivakumar

(2010), Sangeeta *et al.* (2010). Minimum grain yield (3.9 t/ha) and straw yield (5.8 t/ha) were recorded under control. The maximum grain and straw yield was due to marked improvement in dry matter accumulation, yield attributes and greater nutrient content and their uptake by rice crop. These findings are in direct conformity with Meena (2011), Singh *et al.* (2000).

Table 1. Effects of different organic sources on yield and yield attributes of rice crop.

Treatments	Panicle length (cm)	Panicle weight (g)	Number (panicle/ m^2)	Test weight (g)	Grain yield (q/ha)	Straw yield (q/ha)	Harvest index (%)
T_1	18.18	2.67	107.47	21.50	39.00	58.00	40.27
T_2	19.33	2.75	111.23	21.63	40.00	59.90	40.04
T_3	20.00	2.88	116.30	21.90	41.30	61.00	40.38
T_4	20.33	2.95	118.42	22.00	42.00	61.60	40.54
T_5	19.62	2.80	113.83	21.80	40.83	60.45	40.31
T_6	22.03	3.21	124.53	22.43	46.17	65.30	41.42
T_7	23.00	3.28	125.50	22.53	48.20	66.00	42.26
T_8	23.80	3.34	127.47	22.63	49.00	67.67	42.00
T_9	24.03	3.39	129.70	22.73	51.85	68.20	43.24
T_{10}	24.10	3.45	131.43	22.90	52.90	69.33	43.28
T_{11}	25.05	3.50	133.20	22.93	54.00	70.00	43.56
T_{12}	20.95	3.02	120.18	22.10	43.33	62.50	40.90
T_{13}	21.03	3.08	121.63	22.20	44.12	63.13	41.13
T_{14}	21.46	3.10	123.04	22.30	45.07	64.00	41.33
SEm $\pm$	0.54	0.06	0.80	0.08	0.56	1.12	0.55
C.D. (p = 0.05)	1.57	0.18	2.31	0.23	1.63	3.27	NS

T_1 = Control, T_2 = 100% RDF, T_3 = T_2 + FYM @ 5 mt/ha, T_4 = T_2 + Vermi compost @ 5 mt/ha, T_5 = T_2 + Press mud @ 5 mt/ha, T_6 = T_3 + Trichoderma compost @ 2.5 kg/ha, T_7 =T_3+ Trichoderma compost @ 5.0 kg/ha, T_8 = T_3+ Trichoderma compost @ 7. 5 kg/ha, T_9 = T_4+ Trichoderma compost @ 2.5 kg/ha, T_{10} = T_4+ Trichoderma compost @ 5.0 kg/ha, T_{11} = T_4+ Trichoderma compost @ 7.5 kg/ha, T_{12} = T_5+ Trichoderma compost @ 2.5 kg/ha, T_{13} = T_5+ Trichoderma compost @ 5.0 kg/ha, T_{14} = T_5+ Trichoderma compost @ 7.5 kg/ha.

Among the organic sources the maximum gross return, net returns and and benefit: cost ratio were observed with application of 100% RDF+ vermicompost @ 5 t/ha + *Trichoderma* compost @7.5 kg/ha as compared to rest of the other treatments because of higher yield in this treatments. This might be due to lower C : N ratio of vermicompost helpful in release of nutrient in adequate amount quickly after application and reduces the N loss by the formation of organic mineral complexes as compared to FYM. However, The output : input was higher in vermicompost applied treatment as compared to FYM, this may be due to lower cost of cultivation in FYM and inorganic fertilizer applied treatments. These findings are in conformity with the results of Sarangi and Lama (2013).

Table 2. Effects of different organic sources on uptake of nutrients (N, P and K) by rice crop.

Treatments	Nitrogen uptake (kg/ha)		Phosphorus uptake (kg/ha)		Potassium uptake (kg/ha)	
	Grain	Straw	Grain	Straw	Grain	Straw
T_1	38.61	21.46	7.80	0.58	8.19	74.82
T2	40.80	23.96	8.80	1.00	8.80	77.87
T_3	44.19	32.34	9.50	1.83	9.50	81.13
T_4	45.78	27.72	10.08	2.46	10.50	82.54
T_5	42.88	25.39	8.98	1.61	7.35	79.19
T_6	55.40	33.96	13.39	5.22	13.39	94.69
T_7	58.80	36.96	14.46	5.94	14.46	97.02
T_8	61.74	39.24	15.52	7.47	15.19	100.13
T_9	66.37	41.65	17.28	8.87	17.11	103.94
T_{10}	69.83	43.70	17.99	9.71	17.99	105.86
T_{11}	72.41	45.47	18.90	10.50	18.90	108.47
T_{12}	48.53	28.75	10.83	3.13	11.27	85.00
T_{13}	50.29	30.30	11.47	3.79	11.91	87.12
T_{14}	52.72	31.37	12.17	4.49	12.62	90.45
SEm$\pm$	2.12	1.89	0.79	0.48	0.46	1.87
C.D. (p = 0.05	6.17	5.49	2.30	1.41	1.33	5.43

The cost of cultivation, gross return, net return and output - input ratio of the rice were influenced significantly by different organic sources of nutrition (Table 3).

Table 3. Effect of different organic sources application on economics of rice crop.

Treatments	Gross return/ha			Net return/ha	B : C ratio
	Grain	Straw	Total		
T_1	52650.0	20300.0	72950.0	34785.0	0.91
T2	54000.0	20965.0	74965.0	36800.0	0.96
T_3	55755.0	21350.0	77105.0	38940.0	1.02
T_4	56700.0	21560.0	78260.0	40095.0	1.05
T_5	55120.5	21157.5	76278.0	38113.0	1.00
T_6	62329.5	22855.0	85184.5	47015.0	1.23
T_7	65070.0	23100.0	88170.0	50005.0	1.31
T_8	66150.0	23684.5	89834.5	51669.0	1.35
T_9	69997.5	23870.0	93867.5	55702.0	1.46
T_{10}	71415.0	24265.5	95680.5	57515.0	1.51
T_{11}	72900.0	24500.0	97400.0	59235.0	1.55
T_{12}	58495.5	21875.0	80370.5	42205.0	1.11
T_{13}	59562.0	22095.5	81657.5	43492.0	1.14
T_{14}	60844.5	22400.0	83244.5	45079.0	1.18

It may be concluded that application of 100% RDF + vermicompost @ 5 t/ha + *Trichoderma* compost @7.5 kg/ha gives higher crop yield and higher productivity besides enhancing monetary returns.

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