JOURNAL OF PURE AND APPLIED MICROBIOLOGY, Dec. 2016. Vol. **10**(4), p. 2857-2861

Integrated Nitrogen Management in Direct Seeded Upland Rice Under Vertisole of Maharashtra (*Oryza sativa* L.)

Neha Sharma[1], A.V. Dahiphale[2] and G.S. Ghorpade[1]

[1]Department of Agronomy, College of Agriculture, Kolhapur - 416 004, India.
[2]Department of Agronomy, College of Agriculture, Dapoli - 412 715, India.

http://dx.doi.org/10.22207/JPAM.10.4.47

(Received: 14 July 2016; accepted: 18 September 2016)

A field experiment was conducted at college of agriculture, Kolhapur on medium black soils during *kharif*, 2014 to study the effect integrated nitrogen management in growth, yield, nutrient uptake and economics of upland paddy. The organic fertilizers *viz*., FYM, vermicompost, castor cake, neem cake were combined with inorganic fertilizers. The result revealed that application of 75% RDN through inorganic fertilizer + 25% N through castor cake (T_6) recorded significantly higher values of growth and yield attributing characters resulting into higher grain and straw yields and nutrient uptake by paddy and it was on par with 75% RDN through inorganic fertilizer + 25% N through vermicompost (T_4) and GRDF(T_1). Application of 75% RDN through inorganic fertilizer + 25% N through castor cake and 75% RDN through inorganic fertilizer + 25% N through vermicompost were comparable in respect gross and net monetary returns and also the B:C ratio was maximum in these treatments.

Keywords: Paddy, integrated nitrogen management, inorganic fertilizer, organic manures.

Rice is the staple food for about 50 per cent of the world's population that resides in Asia, where 90 per cent of the world's rice is grown and consumed. It is planted on about one-tenth of the earth's arable land and is the single largest source of food energy to half of humanity.

Fertilizer is one of the inputs which bring quantum jump in the yield of rice. The nutrient uptake by rice plant is different from other field crops. To improve the production efficiency of rice and to synchronize the application of nutrients with the demand of the plant, it is necessary to apply required dose of NPK fertilizers, along with other organic and biofertilizer inputs. Continuous and an inappropriate use of only chemical fertilizers in intensive cropping system results into imbalance of nutrients in the soil had deleterious effect leading to decline in productivity due to limitation of one or more of micro-nutrients (Nambiar and Abrol, 1989).

The integrated nutrient supply system is the most logical concept for managing long-term soil fertility and productivity (Ramesh *et al*. 2009). It brings about equilibrium between degenerative and restore activities in the ecosystem (Upadhyay *et al*. 2011). Among the major nutrients, nitrogen application is essential to obtain the higher yields in rice. It deserves special status among the major nutrient and is the "*Mineral of life*" for rice (Yadav and Meena 2014). It is one of the most important and essential nutrient which directly influences the growth, development, yield and quality of rice.

An integrated nutrient management in which both organic manures and inorganic fertilizers are used simultaneously is the most effective method to maintain a healthy and sustainably productive soil. To achieve food security through sustainable agriculture, the requirement for fixed nitrogen must be increasingly

* To whom all correspondence should be addressed.

met by biological nitrogen fixation rather than by industrial nitrogen fixation. In view of this, the present field experiment was planned on the integrated nitrogen management in upland paddy at Kolhapur, during *kharif* season of 2014.

MATERIALS AND METHODS

A field experiment in randomized block design which consists of 11 treatments with three replications was conducted at Post Graduate Research Farm, College of Agriculture, Kolhapur during *kharif*, 2014. The experimental site was located at 16^0 42' North latitudes and 74^0 14' East longitudes with average annual rainfall of 1057 mm. The soil of experimental field was medium black (vertisols) with 90 cm depth, slightly alkaline pH (7.7), low in organic carbon content (0.36%), medium in available N (272 kg $ha^{-1)}$, available P_2O_5 (19 kg ha^{-1}), available K_2O (242 kg ha^{-1}). The seeds of paddy variety *Indrayani*, which matures in 135-140 days and yields about 40-45 q ha^{-1} was sown at 2nd fortnight of June at a distance of 22.5 cm between the lines in each plot with seed rate of 60 kg ha^{-1} direct seeded unpland condition. The treatment comprised of T_{1-} GRDF (RDF [100:50:50 kg NPK ha^{-1}] + 10 t FYM ha^{-1}), T_{2-} 100% RDN (through inorganic fertilizer), T_{3-} 75% RDN through inorganic fertilizer + 25%N through FYM, T_{4-} 75% RDN through inorganic fertilizer + 25%N through vermicompost, T_{5-} 75% RDN through inorganic fertilizer + 25%N through neem cake, T_{6-} 75% RDN through inorganic fertilizer + 25%N through castor cake, T_{7-} 75% RDN through inorganic fertilizer +12.5%N through FYM+ 12.5%N through vermicompost, T_{8-} 75% RDN through inorganic fertilizer +12.5%N through FYM+ 12.5%N through neem cake , T_{9-} 75% RDN through inorganic fertilizer +12.5%N through FYM+ 12.5%N through castor cake , T_{10-} 75% RDN through inorganic fertilizer + seed treatment with Azotobacter + PSB , T_{11-} No fertilizer . At the time of sowing, 40 per cent nitrogen, full dose of P_2O_5 and of K_2O was applied as basal dose. The remaining 60 per cent nitrogen was applied in two splits at 30 and 60 DAS. The quantity of FYM required for each plot was calculated as per the treatments based on the nutrient content and applied uniformly 15 days before sowing to all the plots and mixed in to the soil. The quantity of vermicompost, neem cake and castor cake applied at the time of sowing as per treatment to each plot. The data on different growth and yield attributes were recorded and analysed statistically as per the standard procedure suggested by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Effect on growth parameters

All the growth characters *viz.*, plant height, number of tillers per meter row length, number of functional leaves, leaf area and dry matter production per plant were found significantly higher with an application of 75%

Table 1. Effect of integrated nitrogen management treatments on growth parameters of paddy at harvest

Treatments	Plant height (cm)	Number of tillers per meter row length	Number of functional leaves	leaf area per plant (dm^2)	dry matter production per plant (g)
T_1	73.80	65.41	24.90	9.90	24.16
T_2	72.17	62.43	22.13	9.37	21.65
T_3	69.86	59.48	22.53	8.32	21.72
T_4	73.46	67.58	25.93	10.00	25.40
T_5	70.73	61.99	23.26	9.53	23.14
T_6	75.44	70.95	26.86	10.42	26.35
T_7	68.73	60.88	22.80	8.55	20.20
T_8	69.40	65.04	23.46	9.08	23.51
T_9	68.66	62.88	22.60	8.84	21.84
T_{10}	65.77	57.87	22.20	6.95	21.15
T_{11}	60.28	50.42	20.13	6.55	18.42
S.E. ±	1.06	1.94	0.69	0.27	0.57
C.D.at 5%	3.14	5.74	2.03	0.80	2.57

RDN through inorganic fertilizer + 25% N through castor cake (T_6) as compared to remaining treatments and it was on par with 75% RDN through inorganic fertilizer + 25% N through vermicompost (T_4) and GRDF (T_1) at harvest. Enhanced value of growth parameters in the treatment T_6 was due to minimal loss of nitrogen in case of organic sources and nitrogen was available to the crop for longer period.

Effect on yield and yield attributes

Yield and yield attributes of paddy *viz*., grain and straw yields, number of panicles per meter row length, panicle length, number of grains per panicle, test weight and panicle weight were significantly influenced by different integrated nitrogen management treatments. Among the different sources of N substitution, significantly higher values of yield and yield attributes were obtained with 25% N was substituted through castor cake i.e. (T_6). However it was on par with 75% RDN through inorganic fertilizer + 25% N through vermicompost (T_4) and GRDF (T_1). The application of nitrogen through combination of organic and inorganic sources had significant

Table 2. Effect of integrated nitrogen management treatments on yield and yield attributing characters of paddy at harvest

Treatments	panicles m^{-1}row length	Panicle length	Grains $panicle^{-1}$	1000 grain wt.	Panicle weight (g)	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})
T_1	57.44	21.53	108.40	22.08	2.13	50.44	94.48
T_2	53.51	20.33	107.84	21.36	2.07	47.46	89.21
T_3	52.73	19.46	95.66	19.31	1.72	44.54	87.46
T_4	57.90	21.90	115.86	22.03	2.36	51.75	98.57
T_5	53.20	20.73	106.56	21.67	1.99	48.88	90.51
T_6	63.24	23.03	120.40	23.56	2.46	57.38	104.60
T_7	52.55	20.80	103.66	20.06	1.92	46.62	87.89
T_8	56.08	20.76	106.13	21.76	2.19	49.10	90.20
T_9	52.97	20.06	103.17	20.80	1.90	48.35	88.31
T_{10}	49.21	19.367	84.61	20.16	1.84	44.85	82.67
T_{11}	42.21	17.20	58.38	18.23	1.04	32.80	66.45
S.E. ±	1.98	0.59	3.57	0.63	0.13	2.76	4.28
C.D.at 5%	5.84	1.76	10.54	1.86	0.38	8.16	12.63

Table 3. Effect of integrated nitrogen management treatments on Nitrogen, Phosphorus and Potassium uptake by grain and straw

Treatments	Nitrogen kg ha^{-1}			Phosphorous kg ha^{-1}			Potassium kg ha^{-1}		
	Grain	Straw	Total	Grain	Straw	Total	Grain	Straw	Total
T_1	61.76	68.49	130.25	12.18	16.03	28.21	7.95	135.89	143.85
T_2	58.76	65.67	124.43	12.59	15.35	27.94	7.59	131.95	139.54
T_3	51.67	61.62	113.30	11.69	13.61	25.30	6.37	123.41	129.78
T_4	64.13	72.96	137.09	13.40	17.10	30.51	8.31	146.93	155.25
T_5	59.98	66.50	126.49	12.77	15.42	28.19	7.09	124.75	131.85
T_6	71.33	79.15	150.48	15.63	18.17	33.80	9.33	155.74	165.07
T_7	56.25	61.89	118.14	10.48	14.96	25.45	7.61	118.14	125.76
T_8	59.79	64.17	123.97	11.25	15.15	26.41	7.75	131.69	139.44
T_9	58.32	61.50	119.82	10.86	14.23	25.09	7.30	119.05	126.35
T_{10}	51.98	57.44	109.41	9.12	13.27	22.39	6.65	111.45	118.10
T_{11}	37.03	42.67	79.70	6.26	9.94	16.20	4.39	84.97	89.36
S.E. ±	3.64	2.76	4.25	1.54	0.85	2.05	0.62	8.02	7.95
C.D.at 5%	10.74	8.14	12.54	4.54	2.52	6.05	1.84	23.66	23.45
	57.36	63.82	121.19	11.48	14.84	26.32	7.30	125.81	133.12

effect on yield and yield attributes as compared to inorganic fertilizer alone.

The higher grain and straw yield of paddy under integrated nitrogen management was mainly be due to significant improvement in growth and yield attributes resulting into higher grain yield of paddy. The results corroborated with those reported by Meena *et al.* (2014), Barik *et al*. (2006), Chaudhary *et al*.(2011), Yadav and Meena (2014).

Effect on nutrient uptake by paddy

The total uptake of nitrogen, phosphorus and potassium by paddy was significantly influenced by different integrated nitrogen management treatments. The total uptake of nitrogen recorded significantly the highest with application of 75% RDN through inorganic fertilizer + 25% N through castor cake (150.48 kg ha^{-1}) as compared to rest of treatments. Application of 75% RDN through inorganic fertilizer + 25% N through castor cake (33.80 kg ha^{-1}) recorded significantly higher total uptake of phosphorous over rest of the treatments and it was on par with 75% RDN through inorganic fertilizer + 25% N through vermicompost (T_4) (30.51 kg ha^{-1}), 100% RDN (T_2) (27.94kg ha^{-1}), 75% RDN through inorganic fertilizer + 25% N through neem cake (T_5) (28.19 kg ha^{-1}) and GRDF (T_1) (28.21 kg ha^{-1}). The total uptake of potassium was significantly higher in 75% RDN through inorganic fertilizer +25% N through castor cake (165.07 kg ha^{-1}) over rest of the treatments. However, this was on par with 75% RDN through inorganic fertilizer + 25% N through vermicompost (T_4) (155.25 kg ha^{-1}) and GRDF (T_1) (143.85 kg ha^{-1}).

This may be accounted for improved soil environment encouraged root proliferation and root surface absorption zone, which in turn increased grain and straw yield (Sharma, 2002)

Table 4. Effect of integrated nitrogen management treatments on economics of paddy at harvest

Treatments	Cost of cultivation (Rs ha^{-1})	Gross returns (Rs ha^{-1})	Net returns (Rs ha^{-1})	B:C ratio
T_1	55641	95196	39555	1.71
T_2	44352	89603	45251	2.02
T_3	50653	84464	33811	1.66
T_4	47502	97838	50335	2.06
T_5	49211	92153	42941	1.87
T_6	48236	108017	59781	2.24
T_7	49655	88054	38398	1.77
T_8	51100	92496	41395	1.81
T_9	51860	91038	39177	1.75
T_{10}	46655	84523	37867	1.81
T_{11}	42412	62405	19993	1.47
S.E. ±	-	4705.01	4705.01	-
C.D.at 5%	-	13879.74	13879.78	-

Economics

The gross and net returns (Rs.108017 and Rs.59781 ha^{-1}, respectively) were significantly higher with an application of 75% RDN through inorganic fertilizer + 25% N through castor cake (T_6) as compared to remaining treatments. However, gross returns were on par with 75% RDN through inorganic fertilizer + 25% N through vermicompost (Rs.97838 ha^{-1}) and GRDF (Rs.95196 ha^{-1}). While, the net returns were only on par with 75% RDN through inorganic fertilizer + 25% N through vermicompost (T_4) (Rs.50335 ha^{-1}). The B:C ratio was maximum under 75% RDN through inorganic fertilizer + 25% N through castor cake (T_6) (2.24) and closely followed by 75% RDN through inorganic fertilizer + 25% N through vermicompost (T_4) (2.06) The total cost of cultivation was maximum (Rs. 55,641 ha^{-1}) under treatment of GRDF (T_1) The lowest total cost of cultivation (Rs. 42,412 ha^{-1}) was obtained under control.

REFERENCES

1. Barik, A.K., Das, A., Giri, A.K. and Chattopadhyay, G.N. Effect of integrated plant nutrient management on growth, yield and production economics of wet season rice (*Oryza sativa*). *Indian J. of Agric. Sci.* 2006; **76**(11) : 657-660.
2. Chaudhary, S.K., Singh, J.P. and Jha, S. Effect of integrated nitrogen management on yield, quality and nutrient uptake of rice (*Oryza sativa*) under different dates of planting. *Indian J. of Agron*. 2011; **56**(3): 228-231.
3. Meena, M., Patel, M.V., Das, T. and Verma, H.P. Effect of organic sources and nitrogen levels on growth and yield of *kharif* rice (*Oryza sativa*) under SRI technique.*Agric. for Sustainable Development*. 2014; **2**(1) : 39-42.
4. Nambiar, K.M. and Abrol, I.P. Long term fertilizer experiment in India :An overview. Fertilizer News, 1989; **34**(4): 11-20.
5. Panse, V.G. and Sukhatme, P.V. Statistical Method for Agricultural Research workers. 1985, ICAR., New Delhi.
6. Ramesh, A., Panwar, N.R., Singh, A.B., and Ramanna, S. Production potent ial, nutrient uptake, soil fertility and economics of soyabean-rice based cropping system under organic, chemical and integrated nutrient management practices. *Indian J. of Agron*. 2009; **54**(3) : 278-283.
7. Sharma, S.N. Nitrogen management in relation to wheat residue management in rice. *Indian J. of Agric. Sci*. 2002; **72** : 449-52.
8. Upadhyay, V.B., Jain, V., Vishwakarma, S.K. and Kumar, A.K. Production potential, soil health,water productivity and economics of rice based cropping system under different nutrient sources. *Indian J. of Agron.* 2011; **56** (4) : 311-316.
9. Yadav, L. and Meena, R.N. Performance of aromatic rice (*Oryza sativa*) genotype as influenced by integrated nitrogen management. *Indian J. of Agron,* 2014; **59**(2): 251-255.