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Effect of Integrated Nutrient Management (INM) on Soil Properties and Nutrients Uptake by Aromatic Rice (*Oryza sativa* L.)

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A B S T R A C T

Field experiment for growth, yield and quality of scented rice, variety Pusa Basmati 1 was carried out at Instructional farm, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya during kharif season 2018.The treatment were included inorganic and organic combination viz. T1 (100:40:30 kg ha-1 N2, P2O5, K2O) kg ha-1 ,T2 (75% NPK + 25% N through vermicompost),T3 (75% NPK + 25% N through FYM), T4(50% NPK+25%N through vermicompost FYM), T5 (50% NPK + 50% N through FYM), T6 (50%NPK + 50% N through vermicompost), T7 (125% NPK (RDF) T8 (100% NPK + 25% N through FYM) T9 (100% NPK + 25% vermicompost). The treatment were replicated thrice in Randomized Block Design. The experimental soil was silty loam in texture having pH 8.20, EC 0.31, OC 0.24, available N:137.18, P2O5: 14.80, and K2O:255.20 kg ha-1.The crop was transplanted in second week of July and harvesting in second week of Nov.2018. the maximum available nitrogen (165kg ha^{-1}) , phosphorus (16.00 $kgha^{-1}$) and potash (300.60 kg ha^{-1}) was recorded in the treatment T_9 (100% NPK + 25% N through vermicompost) which was significantly superior over rest of the treatments and minimum available nitrogen (135.00 kg ha^{-1}), phosphorus (12.35 kg ha^{-1}) and potassium (205 kg ha^{-1}) was recorded in treatment T_5 (50% NPK + 50% N through FYM). The maximum organic carbon contend (0.45%) was noted in T_5 (50% NPK + 50% N through FYM) and P^H, EC was fined non significant.

Introduction

Rice (*Oryza sativa* L.) is the most important staple food crop in the World. It is the rich source of energy and contains reasonable amount of protein (6-10%), carbohydrate (70-80%), minerals (1.2-2.0 %) and vitamins (Riboflavin, Thiamine, Niacin and Vitamin E). More than 90 per cent of the world's rice is grown and consumed in Asia (rice bowl of the world), where 16 per cent of the earth's people and two third of world's poor live. It is the major food of the world's human population inhabiting the humid tropics and subtropics. Rice is grown in the tropical and sub-tropical regions of the world. The global requirement of rice will be about 880 million tonnes by 2050 (FAO, 2014).

These problems have become a big challenge to the scientific community and this necessitating for new research agenda. The fertilizer usage mostly depends on its availability, cost and subsidy and is rarely decided by local recommendations. The current NPK fertilizer consumption ratio is 10:2.9:1 as against optimal ratio of 4:2:1. This imbalance in nutrient application by farming community resulted in emergence of multi nutrient deficiencies. Their management at the farm level is a real challenge at present and in future. The neglected nutrient deficiencies would only aggravate the situation by jeopardizing the productivity as well as sustainability.

The wide scale adoption of rice-wheat system has ushered in an increase in agricultural production, but this intensive system over a period of time and nature of the crops has set declining yield trends as well as deterioration in soil productivity even with optimum use of fertilizers[1]. Hence, for restoration of soil productivity, there is an urgent need to look forward to other options like crop residues incorporation for supplying plant nutrients. The adverse effect of incorporation of rice and wheat straw can be counteracted by integrating organic with crop residues[7].

The impact of increased inorganic fertilizer use on crop production has been large, but ever increasing cost of energy is an important constraint for increased use of inorganic fertilizer (Alim, 2012). It is widely recognized that neither use of organic manures alone nor 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. Therefore, in order to make the soil well supplied with all the plant nutrients in the readily available form and to maintain good soil health, it is necessary to use organic manures in conjunction with inorganic fertilizers to obtain optimum yield[4]. Integrated nutrient management increases the yield and nutrient uptake (Mohanty *et al.*, 2013).

Materials and Methods

The present investigation entitled "Effect of integrated nutrient management (INM) on soil fertility, yield, quality and economics of aromatic rice (*Oryza sativa* L.) var. Basmati" **w**as carried out at Instructional farm, Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya during *kharif* season 2018.The chemical properties of the soil were determined in laboratory of the department of Soil Science. The experimental site falls under sub tropical region in Indo-Gangetic plains and situated at 24.4^0-26.47^0 N latitude and 82.12^0-83.98^0 E longitude with an altitude of 113 meters from mean sea level. The mean annual rainfall is 1085.6 mm recording about 90%in monsoon season only.

The experiment was conducted in randomized block design in three replications with 9 treatments. The treatments consisted of different sources of organic manures and inorganic fertilizer viz., T_1 (100:40:30 kg ha^{-1} N_2, P_2O_5, K_2O) kg ha^{-1}, T_2 (75% NPK + 25% N through vermicompost),T_3(75% NPK + 25% N through FYM), T_4 (50%NPK+25%N through vermicompost FYM), T_5 (50% NPK + 50% N through FYM), T_6 (50% NPK + 50% N through vermicompost), T_7 (125%

NPK (RDF) T_8 (100% NPK + 25% N through FYM) T_9 (100% NPK + 25% vermicompost). The experimental soil was silty loam in texture having p^H 8.20, EC 0.31, OC 0.24, available N:137.18, P_2O_5: 14.80, and K_2O:255.20 kg ha^{-1}.The crop was transplanted in second week of July and harvesting in second week of Nov.2018.

Nitrogen, phosphorus, potassium uptake by crop

Nitrogen uptake

The percentage of nitrogen content in grain and straw was multiplied with grain and straw yield to obtain nitrogen uptake in grain and straw, respectively.

Phosphorus uptake

The percentage of phosphorus content in grain and straw was multiplied with grain and straw yield to obtain phosphorus uptake in grain and straw, respectively.

Potassium uptake

The percentage of potassium content in grain and straw was multiplied with grain and straw yield content in straw to obtain potassium in grain and plant, respectively.

Physico-chemical properties of soil

Soil texture

Soil texture was determined with the help of triangular method (Lyon *et al.*, 1933).

Chemical properties

Soil pH

pH was determined with the help of glass electrode pH meter in 1:2.5 soil water suspension as described by Jackson (1973).

Electrical Conductivity (EC) dSm^{-1}

Electrical conductivity was determined with the help of conductivity bridge using 1:2.5 soil water suspension as described by Jackson (1973

Organic carbon (OC) in soil

Organic carbon was determined following Walkley and Black's rapid titration method as advocated by Jackson (1973).

Analysis of available N, P and K in soil

Available nitrogen

The available nitrogen content in the soil sample was determined by alkaline permanganate method as described by Subbiah and Asija (1956).

Available phosphorus

The available phosphorus content in the soil sample was determined by Olsen's method (Olsen *et al.*, 1954)

Available potassium

The available potassium content in the soil sample was determined by flame photo meter by the method as described by Jackson (1973).

Results and Discussion

Uptake studies

Nitrogen, Phosphorus and Potassium content in grain and straw

Maximum nitrogen, Phosphorus and Potassium content in grain (1.36%), (0.82%) and (0.48%) as well as in straw (0.26%), (0.16%) and (1.50%) was noted in treatment T_9 (100% NPK + 25% N through vermicompost) which was statistically at par with T_7 (125%RDF), T_8 (100% NPK +25% N through FYM), and T_1 (100%NPK) and significantly superior over rest of treatments. The Minimum nitrogen, Phosphorus and Potassium content in grain (1.23%), (0.74%) and (0.43%) as well as in straw (0.23%), (0.10%) and (0.43%) was noted in T_5 (50% NPK + 50% N through FYM). Similar finding was observed by Mitra and Mandal (2012), Sengar *et al.*, (2000), Sarkar and Singh (1997) and Rakesh *et al.*, (2009) and Sharma *et al.*, (2013) (Table 1–4).

Table.1 Effect of various treatments on NPK Content in rice

Treatments		Nutrient content in grain (%)			Nutrient content in straw (%)		
		N	P	K	N	P	K
T_1	100% NPK (100:40:30 kg ha^{-1} N, P_2O_5, K_2O)	1.30	0.78	0.46	0.25	0.15	1.43
T_2	75% NPK + 25% N through vermicompost	1.29	0.77	0.45	0.25	0.10	1.42
T_3	75% NPK + 25% N through FYM	1.27	0.76	0.45	0.24	0.12	1.39
T_4	50% NPK + 25% N through vermicompost + FYM	1.26	0.75	0.44	0.24	0.11	1.38
T_5	50% NPK + 50% N through FYM	1.23	0.74	0.43	0.23	0.10	1.35
T_6	50% NPK + 50% N through vermicompost	1.25	0.75	0.44	0.24	0.10	1.37
T_7	125% NPK(RDF)	1.33	0.80	0.47	0.25	0.15	1.46
T_8	100% NPK + 25% N through FYM	1.34	0.80	0.47	0.25	0.16	1.47
T_9	100% NPK + 25% N through vermicompost	1.36	0.82	0.48	0.26	0.15	1.50
	SEm$\pm$	0.022	0.016	0.007	0.006	0.011	0.034
	CD at 5%	0.065	0.048	0.022	0.017	0.033	0.103

Table.2 Effect of various treatments of the uptake by nitrogen, phosphorus and potassium in grain and straw of the rice

Treatments		Total uptake (kg ha^{-1}) Grain+Straw		
		Nitrogen	Phosphorus	Potassium
T_1	100%NPK (100:40:30 kg ha^{-1} N, P_2O_5, K_2O)	57.23	34.43	**88.58**
T_2	75% NPK + 25% N through vermicompost	55.83	30.94	**88.27**
T_3	75% NPK + 25% N through FYM	55.12	31.67	**90.25**
T_4	50% NPK + 25% N through vermicompost + FYM	52.48	29.59	**84.35**
T_5	50% NPK+50% N through FYM	50.18	28.18	**65.29**
T_6	50% NPK + 50% N through vermicompost	51.52	28.78	**66.64**
T_7	125% NPK (RDF)	64.96	38.99	**76.20**
T_8	100% NPK + 25% N through FYM	65.93	40.16	**77.19**
T_9	100% NPK + 25% N through vermicompost	67.88	40.26	**78.84**
	SEm$\pm$	2.15	1.25	**3.04**
	CD at 5%	**3.15**	**3.74**	**9.11**

Table.3 Effect of various treatments on availability of nutrients

Treatments		**Available nutrients (kg ha^{-1})**		
		N	**P**	**K**
T_1	100% NPK (100:40:30 kg ha^{-1} N, P_2O_5, K_2O)	155.00	12.35	**259.00**
T_2	75% NPK + 25% N through vermicompost	146.00	13.40	**255.00**
T_3	75% NPK + 25% N through FYM	142.00	13.30	**225.20**
T_4	50% NPK + 25% N through vermicompost + FYM	138.00	15.45	**215.80**
T_5	50% NPK + 50% N through FYM	135.00	14.90	**205.00**
T_6	50% NPK + 50% N through vermicompost	136.00	15.55	**220.60**
T_7	125% NPK (RDF)	160.00	15.85	**288.80**
T_8	100% NPK + 25% N through FYM	162.00	15.96	**297.00**
T_9	100% NPK + 25% N through vermicompost	165.00	16.00	**300.60**
	SEm$\pm$	2.02	0.45	**11.71**
	CD at 5%	**6.06**	**1.36**	**35.09**

Table.4 Effect of various treatments on soil properties

Treatments		**pH**	**EC(dSm^{-1})**	**OC (%)**
T_1	100% NPK (100:40:30 kg ha^{-1} N, P_2O_5, K_2O)	8.14	0.30	0.38
T_2	75% NPK + 25% N through vermicompost	8.13	0.29	0.40
T_3	75% NPK + 25% N through FYM	8.11	0.29	0.40
T_4	50% NPK + 25% N through vermicompost + FYM	8.09	0.28	0.44
T_5	50% NPK + 50% N through FYM	8.09	0.28	0.45
T_6	50% NPK + 50% N through vermicompost	8.10	0.28	0.44
T_7	125% NPK(RDF)	8.15	0.30	0.36
T_8	100% NPK + 25% N through FYM	8.11	0.30	0.41
T_9	100% NPK + 25% N through vermicompost	8.12	0.30	0.40
	SEm$\pm$	0.28	0.009	0.02
	C.D. (P=0.05)	NS	NS	0.05

Uptake nitrogen, phosphorus and potassium in grain and straw by the rice

Results showed that application of T_9 (100% NPK + 25% N through vermicompost) resulted highest total (grain + straw) nitrogen, Phosphorus and Potassium uptake (67.88 kg ha^{-1}), (40.26 kg ha^{-1}) and (78.84 kg ha^{-1}) which was statistically at par with T_7 (125 % RDF) and T_8 (100% NPK + 25% N through FYM). The lowest nitrogen uptake (50.18kgha^{-1}) was recorded in the treatment T_5 (50% NPK + 50% N through FYM). The lowest nitrogen, Phosphorus and Potassium uptake (50.18kgha^{-1}), (28.18kgha^{-1}) and (65.29kgha^{-1}) was recorded in the treatment T_5 (50%NPK+50% N through FYM).

Soil physico- chemical analysis

Available Nitrogen, Phosphorus and Potassium

The maximum available Nitrogen, Phosphorus and Potassium (165kg ha^{-1}), (16.00 kgha^{-1}) and (300.60 kg ha^{-1}) was recorded in the treatment T_9 (100% NPK + 25% N through vermicompost) which was significantly superior over rest of the treatments T_7 (125% RDF) and T_8 (100% NPK + 25% N through FYM) and significantly superior over rest of the treatments. The minimum available Nitrogen, Phosphorus and Potassium (135.00 kg ha^{-1}), (12.35 kg ha^{-1}) and (205 kg ha^{-1}) was recorded in treatment T_5 (50% NPK + 50% N through FYM).

Soil properties

The maximum organic carbon contend (0.45%) was noted in T_5 (50% NPK + 50% N through FYM) which was significantly superior over T_1 (100% NPK) and T_7 (125% NPK) and statistically at par with rest of the treatments. pH and EC of soil show different treatments could not decrease the significantly.

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