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Effect of different organic sources of nitrogen on concentration and uptake of nutrients in scented rice (*Oryza sativa* L.)

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Abstract
A field experiment was conducted at Research cum Instructional Farm, IGKV, Raipur during *kharif* 2014 and 2015 to study the effect of different organic sources of nitrogen on concentration and uptake of nutrients in scented rice. The six (6) treatments of nitrogen of organic sources *viz.* 100% N through 1/3 vermicompost+1/3 FYM+1/3 poultry manure at basal (N_1), 100% N through vermicompost at basal (N_2), 100% N through poultry manure at basal (N_3), 100% N through 1/2 poultry manure as basal + 1/2 vermicompost at 30 DAT (N_4), 100% N through 1/2 vermicompost as basal+ 1/2 vermicompost at 30 DAT (N_5) and Control - No application of any nutrients (N_6) were tested in randomized block design with four replications. The grain**,** straw and total nitrogen, phosphorus and potassium uptake by scented rice were significantly highest noted under treatment 100% N through 1/3 Vermicompost+1/3 FYM+1/3 poultry manure at basal (N_1), which was at par to treatment 100% N through 1/2 poultry manure as basal + 1/2 vermicompost at 30 DAT (N_4).

Keywords: Scented rice, organic farming, nutrient uptake

Introduction

Rice (*Oryza sativa* L.) is the most important and extensively cultivated food crop, which provides half the daily food for one of every three persons on the earth. In Asia alone, more than two billion people obtain 60 to 70 per cent of their energy intake from rice and its derivatives (Sangeetha *et al.*, 2013) [11]. Rice is grown in more than a hundred countries, with a total harvested area of approximately 158 m ha, producing more than 700 mt annually (CGIAR, 2016). Total rice crop area is 45.5 m ha, production is 105.31 mt and average productivity is 2393 kg ha^{-1} of India (Banjara, 2016) [2]. However, area under rice (35.85 lakh ha in 2001-02 to 37.56 lakh ha in 2014-15) is increasing but the productivity of rice (2050 kg ha^{-1} in 2014-15) of Chhattisgarh (Anonymous, 2016) [1]. The area under scented rice varieties is increasing day by day with the opening of the world market as well as increased domestic consumption due to their premium quality (Singh *et al.*, 2008) [13]. Scented rice occupies a pivotal position in world because of their high quality and therefore earns premium prices. In India, during the past three decades, intensive agriculture involving high yielding varieties of rice has lead to heavy withdrawal of nutrients from the soil. Further, imbalanced use of chemical fertilizers by farmers has also deteriorated soil health and declines soil organic carbon content, which is threat to sustainability. Nitrogen is commonly the most limiting nutrient for crop production in the major world’s agricultural areas and therefore, adoption of good N management strategies often results in large economic benefits to farmers. Use of organic manures in present agriculture is increasing day by day, because of its utility not only improving the physical, chemical and biological properties of soil but also maintaining the good soil health and supplying almost all essential plant-nutrients for growth and development of crop plants. So, it is time to look for measures to stimulate sustainability in production of rice on long- term basis. Organic manures like FYM, poultry manure and vermicompost deserves priority for sustained production and better utilization in organic rice production (Dahiphale *et al.*, 2003) [6]. Organic farming is also preferred because of increasing consumer demand for safe, high quality, ethical organic foods and good monetary returns. Organic farming is not only beneficial for the human health but it also encourages the chemical, physical and biological properties of soil.

Organic manures provide better and improved growth of soil microbe due to addition of various types of organic matter like FYM, vermicompost, poultry manure, neem oil cake etc. Nutrient released from the FYM not only increases nutrient availability but also enhances the translocation of more photosynthates from source to sink and improved the yield attributing characters (Janaki, 2004) [8]. Vermicompost as an appropriate cost-effective organic fertilizer can be used as a suitable alternative in the sustainable agriculture and organic cultivation (Sumner, 2000) [14]. Poultry manure is an excellent source of nutrients and can be incorporated into most nutrient management programs. Keeping this in view, the present investigation was conducted to study the effect of organic sources of nitrogen on concentration and uptake of nutrients in organically grown scented rice.

Material and methods

Field experiment was carried out at Research cum Instructional Farm, IGKV, Raipur during *kharif* 2014 and 2015. The soil of experimental field was *'Vertisols'* which is locally known as '*Kanhar'*. The soil was neutral in reaction and medium in fertility levels having low in N, medium in P and high in K. The six treatments of organic sources of nitrogen *viz.* 100% N through 1/3 vermicompost+1/3 FYM+1/3 poultry manure at basal (N_1), 100% N through vermicompost at basal (N_2), 100% N through poultry manure at basal (N_3), 100% N through 1/2 poultry manure as basal + 1/2 vermicompost at 30 DAT (N_4), 100% N through 1/2 vermicompost as basal+ 1/2 vermicompost at 30 DAT (N_5) and Control - No application of any nutrients (N_6) were tested on scented rice cultivar 'Indira Sugandhit Dhan-1' in randomized block design with four replications. All the organic sources of nutrients *i.e*. FYM, vermicompost and poultry manure were applied before transplanting and in split doses as per the treatments in respective plots to fulfill the nutrient requirement of 80:50:30 kg N: P_2O_5:K_2O ha^{-1}. The N, P and K content of different available organic manure/sources were determined in laboratory and accordingly, required quantity were applied in different treatment on the basis of nitrogen content (%) of organic sources**.** P was supplemented through rock phosphate (22% P_2O_5 grade) after adjusting the quantity of P supplied through manures. Entire quantity of all sources was applied as per the treatment on N basis four days before the transplanting.

Results and Discussion

Nutrient concentration (%) in grain and straw of scented rice

The major nutrient concentration (%) *viz.,* N, P and K in grain and straw of scented rice were influenced by different treatments of organic sources of nitrogen are presented in Table 1. The findings of organic sources of nitrogen revealed that significantly highest nitrogen concentration in grain and straw were registered under 100% N through 1/3 vermicompost + 1/3 FYM + 1/3 poultry manure at basal (N_1), which was found at par to 100% N through vermicompost at basal (N_2), 100% N through poultry manure at basal (N_3), 100% N through 1/2 poultry manure as basal + 1/2 vermicompost at 30 DAT (N_4) and 100% N through 1/2 vermicompost as basal + 1/2 vermicompost at 30 DAT (N_5). However, significantly highest phosphorus and potassium concentration in grain and straw were registered under 100% N through poultry manure at basal (N_3) might be due to poultry manure have higher P and K content as compared to other sources of organic manures. The synergistic effect that existed between N and P would have promoted P content in grain and straw due to increased N content. The split application provides a steady availability of N that promotes the translocation of P from the vegetative organs to the grain which might be increased P content of rice grain and straw. The increased P uptake coupled with its higher P content in grain and straw by the combined application might be due to its solubilization effect on the native phosphorous. This is in confirmation with the views of Dahiya and Singh (1980) [7].

Grain, straw and total nutrient uptake by scented rice

The data on grain, straw and total major nutrient *viz.* nitrogen, phosphorus and potassium uptake as influenced by different organic sources of nitrogen are presented in Table 2. Among the different organic sources of nitrogen treatments, significantly highest grain**,** straw and total nitrogen, phosphorus and potassium uptake by scented rice were found under treatment 100% N through 1/3 vermicompost+1/3 FYM + 1/3 poultry manure at basal (N_1), but it was at par to 100% N through ½ poultry manure at basal + ½ N through vermicompost at 30 DAT (N_4). Further, control plot (N_6) recorded the lowest major nutrient *viz.* nitrogen, phosphorus and potassium uptake by scented rice. Nitrogen uptake by crop is function of total biomass produced and percent nitrogen concentration in the biomass. The differences in uptake in grain and straw due to different treatments were associated mainly with yield differences and partly with nitrogen content in grain and straw. Application of organic manures serves sufficient nutrient for better photosynthesis led to higher uptake of nitrogen in grain as well as straw, which ultimately resulted in total uptake of N. The higher NPK uptake may be due to higher yield received in those treatments reported by Kumar *et al.* (2013) [9]. Similar finding were also reported by Satish *et al.* (2011) [12] and Ramalakshmi *et al.* (2012) [10]. Higher nutrient content and early nutrient availability with integration of various organic manures might have helped in improved biomass, which in turn increased the uptake of N, P and K. Application of organic manures enhance microbial activity that release different organic acid which help in solubilization of native soil nutrients and makes available for the uptake by plants. Organic manures provides regulated supply of nutrients by releasing them slowly and there by increases nutrient availability and corresponding uptake by plant (Bisht *et al.,* 2013) [4]. An increasing uptake of K in grain and straw may be due to applied organic N sources released more $NH4^+$ -N and $NO3^-$ -N in soil which may occupied the selective exchange sites in the 2:1 layer clay minerals and replaced the K+ from exchange sites thereby registered the highest available K in soil solution concentration leading to higher absorption by rice. It may be due to similar ionic radii of both N and K ions. The control treatment showed comparatively lowest N P and K uptake. Bindra and Thakur (1996) [3] reported an increased N, P and K uptake in grain and straw due to manuring.

Table 1: Nutrient concentration in grain and straw at harvest of scented rice as influenced by different organic sources of nitrogen (mean of two years)

Treatment	Nutrient concentration (%)					
	Nitrogen		Phosphorus		Potassium	
	Grain	Straw	Grain	Straw	Grain	Straw
N_1 - 100% N through 1/3 vermicompost+1/3 FYM + 1/3 poultry manure at basal	1.38	0.35	0.24	0.081	0.36	1.46
N_2 - 100% N through vermicompost at basal	1.34	0.33	0.22	0.073	0.34	1.40
N_3 - 100% N through Poultry manure at basal	1.35	0.32	0.25	0.083	0.38	1.50
N_4 -100% N through ½ poultry manure at basal + ½ N through vermicompost at 30 DAT	1.36	0.34	0.24	0.080	0.37	1.44
N_5 -100% N through ½ vermicompost at basal + ½ vermicompost at 30 DAT	1.33	0.31	0.23	0.075	0.35	1.42
N_6 – Control	1.28	0.26	0.21	0.067	0.31	1.25
SEm±	0.01	0.01	0.01	0.001	0.01	0.01
CD (P=0.05)	0.03	0.03	0.02	0.002	0.02	0.04

Table 2: Nutrient uptake by scented rice as influenced by different organic sources of nitrogen

Treatment	Nutrient uptake (kg ha^{-1})								
	Nitrogen			Phosphorus			Potassium		
	Grain	Straw	Total	Grain	Straw	Total	Grain	Straw	Total
N_1 - 100% N through 1/3 vermicompost+1/3 FYM + 1/3 poultry manure at basal	54.55	24.02	78.57	9.29	5.55	14.83	14.31	100.71	115.03
N_2 - 100% N through vermicompost at basal	46.84	19.06	65.89	7.64	4.16	11.81	11.93	80.51	92.43
N_3 - 100% N through Poultry manure at basal	47.40	19.20	66.60	8.42	4.95	13.37	13.24	89.80	103.05
N_4 -100% N through ½ poultry manure at basal + ½ N through vermicompost at 30 DAT	51.77	22.86	74.63	9.11	5.33	14.44	14.04	95.95	110.00
N_5 -100% N through ½ vermicompost at basal + ½ vermicompost at 30 DAT	47.48	18.99	66.46	8.32	4.56	12.88	12.36	85.81	98.18
N_6 – Control	27.95	10.83	38.78	4.59	2.80	7.39	7.16	57.98	65.14
SEm±	1.41	0.48	1.43	0.23	0.11	0.26	0.32	1.91	1.82
CD (P=0.05)	4.25	1.44	4.29	0.69	0.33	0.79	0.97	5.74	5.48

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