



Research article

RESIDUAL SOIL FERTILITY AND PRODUCTIVITY OF RICE (*ORYZA SATIVA* L.) AS INFLUENCED BY DIFFERENT ORGANIC SOURCES OF NITROGEN

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ABSTRACT: A field experiment was conducted at the Agricultural College Farm, Bapatla, during *kharif* 2012-13 to find out the residual soil fertility and productivity of rice as influenced by different organic sources of nutrients viz., poultry manure, FYM, neemcake and vermicompost. The experimental results indicated that maximum yield of rice was recorded with recommended dose of fertilizers which was on a par with 50% RDN as basal +50% at 10 days before PI stage through poultry manure. Among different organic manure treatments, application of 100% RDN through FYM recorded highest amount of NPK in soil after harvest, followed by application of 50% RDN as basal +50% at 10 days before PI stage through FYM which were however, on a par with each other. The lowest amount of NPK in soil after harvest was recorded with the application of recommended dose of chemical fertilizers followed by 100% RDN through poultry manure.

Key words: Organic manures, rice, yield, residual soil fertility status

INTRODUCTION

Rice (*Oryza sativa* L.) occupies a pride place among the food crops cultivated in India which has the largest area among rice growing countries and stands second in the production. In India, during the past three decades, intensive agriculture involving high yielding varieties of rice has led to heavy withdrawal of nutrients from the soil. Further, imbalanced use of chemical fertilisers 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. 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, vermicompost and neemcake deserves priority for sustained production and better utilization in organic rice production [3]. Application of organic manures, improves the availability of macronutrients. Hence, an experiment was conducted to study the different sources and time of application of organic manures on productivity and residual soil fertility status after harvest of rice (*Oryza sativa* L.)

MATERIALS AND METHODS

A field experiment was conducted on clay loam soil of Agricultural College Farm, Bapatla, during *kharif*, 2012. The experiment was laid out in a randomized block design with three replications. The soil of the experimental site was clay loam in texture, slightly alkaline in reaction (pH 7.9), with 0.43 % organic carbon and 210.0, 29.0 and 385.0 kg ha⁻¹ of N, P and K respectively. The experiment consisted of nine treatments viz., 100% RDN through inorganic sources (120:60:40 kg N, P₂O₅, K₂O)(T₁), 100% RDN through poultry manure (10 days before puddling) (T₂), 100% RDN through FYM (10 days before puddling) (T₃), 100% RDN through Neem cake (10 days before puddling) (T₄), 100% RDN through vermicompost (10 days before puddling) (T₅), 50% RDN as basal +50% at 10 days before PI stage through poultry manure (T₆), 50% RDN as basal +50% at 10 days before PI stage through FYM (T₇), 50% RDN as basal +50% at 10 days before PI stage through neem cake (T₈), 50% RDN as basal +50% at 10 days before PI stage through vermicompost (T₉). Well decomposed poultry manure, FYM, neemcake and vermicompost with 2.0 %, 0.5%, 2.5 % and 1.2 % N, respectively were used as organic sources for nitrogen. Based on the equal N basis, required quantities of organic manures were incorporated in the soil 10 days before puddling. In the treatment T₁, recommended doses of 120:60:40 kg ha⁻¹ of N, P and K in the form of urea (46% N), single super phosphate (16% P₂O₅) and murate of potash(60% K₂O) were applied to the rice crop.

The nitrogen was applied in three splits *i.e.* 1/2 as basal, 1/4 at maximum tillering and 1/4 at panicle initiation stages. Entire dose of phosphorus was applied basally before sowing. Half of the potassium was applied basally and remaining half was applied at maximum tillering stage. The popular rice variety, BPT-5204 (Samba Mahsuri) was raised. Thirty day old seedlings were transplanted using two seedlings hill⁻¹ on 17-08-12 with a spacing of 20 cm × 15 cm. Recommended agronomic practices and plant protection measures were followed.

RESULTS AND DISCUSSION

Yield

The highest grain and straw yields (5856 and 6902 kg ha⁻¹) of rice were obtained with the application of 100% RDN through fertilizer (T₁), which was however, on a par with 50% RDN as basal+50% at 10 days before PI stage through poultry manure (T₆) but proved significantly superior to the rest of the treatments (Table 1). Highest yield obtained with recommended dose of chemical fertilizer was due to better growth and yield attributes recorded which in turn, resulted in increase of rice yields compared to added levels of N in organic form [6]. The supremacy of poultry manure might be due to higher nitrogen content in poultry manure which is much readily available as compared to other organic manures. Similar results were also reported by [5,8,10]. Application of different organic sources had no significant effect on the harvest index of rice crop. However, harvest index ranged between 45.9 and 43.2.

Table 1: Influence of organic manures on grain yield (kg ha⁻¹), straw yield (kg ha⁻¹) and harvest index (%) of rice

Treatments		Grain yield (kg ha ⁻¹)	Straw yield (kg ha ⁻¹)	Harvest Index (%)
T ₁	100% RDN through inorganic sources (120:60:40 kg N,P ₂ O ₅ ,K ₂ O)	5856	6902	45.9
T ₂	100% RDN through poultry manure (10 days before puddling)	5102	6136	45.4
T ₃	100% RDN through FYM (10 days before puddling)	2796	3661	43.3
T ₄	100% RDN through Neem cake(10 days before puddling)	3548	4534	43.9
T ₅	100% RDN through vermicompost (10 days before puddling)	4338	5234	44.7
T ₆	50% RDN as basal + 50% at 10 days before PI stage through poultry manure	5665	6704	45.8
T ₇	50% RDN as basal + 50% at 10 days before PI stage through FYM	2685	3530	43.2
T ₈	50% RDN as basal + 50% at 10 days before PI stage through neem cake	3580	4538	44.1
T ₉	50% RDN as basal + 50% at 10 days before PI stage through vermicompost	4340	5360	44.8
	SEm (±)	249.0	255.0	2.0
	CD (P=0.05)	748	765	NS
	CV (%)	10.3	9.0	7.9

Soil available nutrients

Among different organic manure treatments, application of 100% RDN through FYM (T₃) recorded highest amount of NPK in soil after harvest, followed by application of 50% RDN as basal +50% at 10 days before PI stage through FYM (T₇) which remained on a par with each other (Table 2). The lowest amount of NPK in soil after harvest was recorded with the application of recommended dose of chemical fertilizers (T₁) followed by 100% RDN through poultry manure (T₂). When FYM is added to the soil complex, nitrogenous compounds break down slowly and make steady N supply throughout the crop growth period. This might have attributed to more availability and vis-à-vis subsequent uptake by the crop. The FYM might have helped to improve the soil physical, chemical and biological properties leading to overall improvement in soil health in the long run. Similar views were expressed by Mondal [7] and Bandyopadhyay and Bandyopadhyay [1].

Higher availability of soil Phosphorus in T₃ might be due to coating of sesquioxides by organic materials thus reduced the phosphorus fixing by soil [2] and release of carbon dioxide and organic acids solubilising the native soil Phosphorus [11]. Similar results were observed by Ganal and Singh [4]. The beneficial effect of FYM on available potassium might be due to the reduction of potassium fixation, solubilisation and release due to the interaction of organic matter with clay besides the direct potassium addition to the potassium pool of soil. Similar results were reported by Tandon, [12].

Lower available nitrogen in inorganic fertiliser plots might be due to higher grain and straw yields of crop, which resulted in extraction of most of the soil nutrients. These results are in agreement with that of Siddaram [9]. From the present investigation, it can be concluded that use of 50 % recommended dose of nitrogen as basal +50% at 10 days before PI stage through poultry manure or 100% RDN through poultry manure is one of the cheap and efficient sources of nitrogen which can be an efficient substitute for chemical fertilizer in order to get higher yield and profitability of rice. Further, use of different organic manures (FYM, vermicompost and poultry manure) which are being produced in the farm itself reduces the cost of cultivation and increases the available nitrogen, phosphorus and potassium status in soil after harvest of rice crop.

Table 2: Influence of organic manures on residual soil fertility status after harvest of rice

	Treatments	Soil available nutrients (kg ha ⁻¹)		
		Nitrogen	Phosphorus	Potassium
T ₁	100% RDN through inorganic sources (120:60:40 kg N,P ₂ O ₅ ,K ₂ O)	180.4	20.5	355.4
T ₂	100% RDN through poultry manure (10 days before puddling)	208.3	30.5	398.4
T ₃	100% RDN through FYM (10 days before puddling)	296.1	59.4	493.5
T ₄	100% RDN through Neem cake(10 days before puddling)	265.6	50.7	460.3
T ₅	100% RDN through vermicompost (10 days before puddling)	236.7	42.1	430.8
T ₆	50% RDN as basal + 50% at 10 days before PI stage through poultry manure	201.5	27.6	388.3
T ₇	50% RDN as basal + 50% at 10 days before PI stage through FYM	287.4	57.3	486.4
T ₈	50% RDN as basal + 50% at 10 days before PI stage through neem cake	258.3	48.5	457.8
T ₉	50% RDN as basal + 50% at 10 days before PI stage through vermicompost	229.4	37.4	425.6
	SEm (±)	6.4	1.2	8.0
	CD (P=0.05)	19.3	3.7	23.9
	CV (%)	4.6	5.1	3.2
	Initial N, P ₂ o ₅ and K ₂ o status of the soil	210	29	385

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