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Yield and economics of rice (*Oryza sativa* L.) as affected 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 with an objective to know the production and profitability of rice under different organic sources of nutrients viz., poultry manure, FYM, neemcake, vermicompost and recommended NPK on yield and economics of rice. The results of the investigation revealed that maximum yield of rice and lower cost of cultivation, higher net returns and benefit cost ratio was recorded with recommended dose of fertilizers. Among the different organic sources higher net returns (Rs. 58170 ha^{-1}) and higher benefit cost ratio (2.9) was recorded with spilt application of poultry manure.

Keywords: Organic manures, rice, yield, net returns and benefit cost ratio

Introduction
With a view to reduce the high cost and indiscriminate use of chemical fertilizers resulting in various losses of nutrients leading to environmental pollution and unsustainable crop production, substitution of part of the chemical fertilizers with locally available organic sources such as farmyard manure, vermicompost, green manuring, crop residues, neem cake and poultry manure etc. is inevitable. In addition to supply of nutrients, organic sources improve the physical condition and biological health of soil, which inturn improves the availability of applied and native nutrients (Dick and Gregorich, 2004) [4]. 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 result in large economic benefits to farmers. Basal application of organic manures has low nitrogen use efficiency and higher losses due to leaching and denitrification etc. Hence, application of appropriate quantity of nitrogen in split doses will meet the crop nutrient demand at critical stages (10 days before panicle initiation) without causing much loss. Hence, using organic sources like FYM, poultry manure, vermicompost and neemcake is the right option for sustained production and better utilization in organic rice production (Dahiphale *et al.* 2003) [2]. Therefore an effort was made in the present trial to estimate the source of nitrogen that can be substituted by organic manures for obtaining comparable yields with 100% recommended dose of nitrogen through fertilizers to *kharif* rice.

Materials and methods
A field experiment was conducted on clay loam soils 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, 29 and 385 kg of N, P and K respectively ha^{-1}. The experiment consisted of nine treatments *viz*., 100% RDN through inorganic sources (120:60:40 kg N, P_2O_5, K_20)(T_1), 100% RDN through poultry manure (10 days before puddling) (T_2), 100% RDN through FYM (10 days before puddling) (T_3), 100% RDN through Neem cake (10 days before puddling) (T_4), 100% RDN through vermicompost (10 days before puddling) (T_5), 50% RDN as basal +50% at 10 days before PI stage through poultry manure (T_6), 50% RDN as basal +50% at 10 days before PI stage through FYM (T_7), 50% RDN as basal +50% at 10 days before PI stage through neem cake (T_8), 50% RDN as basal +50% at 10 days before PI stage through vermicompost (T_9).Well decomposed poultry manure, FYM, neemcake and vermicompost with 2.0%, 0.5%, 2.5% and 1.2% N respectively was 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 T_1, 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% $P_2 0_5$) and murate of potash (60% $K_2 0$) 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 potassium was applied basally and remaining half was applied at maximum tillering stage. The test rice variety, BPT-5204 (Samba Mahsuri) was used. Thirty day old seedlings were transplanted using two seedlings $hill^{-1}$ on 17-08-2012 with a spacing of 20 cm ×15 cm. Recommended agronomic practices and plant protection measures were followed.

Results and discussion

Table 1: Influence of organic manures on grain yield, straw yield 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_2O_5,K_20)	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

Yield

The highest grain and straw yield (5856 and 6902 kg ha^{-1}, respectively) of rice was obtained with the application of 100% RDN through fertilizer (T_1) which was however, on a par with 50% RDN as basal+50% N at 10 days before PI stage through poultry manure (T_6) but proved significantly superior to the rest of the treatments (Table 1).

Highest yield with recommended dose of chemical fertilizer was due to better growth and yield attributes there by resulted in increase of rice yields compared to added levels of N in organic form (Manivannan and Sriramachandrasekharan, 2009). Superior performance of poultry manure might be due to the fact that it can supply the nutrients in soluble form for a quite longer period by not allowing the entire soluble form into solution to come in contact with the soil and other inorganic constituents, thereby, minimizing the fixation and precipitation leading to better yield. This falls in line with the findings of Mohandas *et al. (*2008) [8], Harish *et al.* (2011) [6], Datta *et al*. (1994) [3] and Channabasavanna (2002) [1]. 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 2: Influence of organic manures on economics of rice

	Treatments	Gross returns (Rs.ha^{-1})	Cost of cultivation (Rs.ha^{-1})	Net returns (Rs.ha^{-1})	Returns per rupee investment
T_1	100% RDN through inorganic sources (120:60:40 kg N,P_2O_5,K_20)	78220	20050	58170	2.9
T_2	100% RDN through poultry manure (10 days before puddling)	68394	20285	48109	2.4
T_3	100% RDN through FYM (10 days before puddling)	38078	30285	7793	0.3
T_4	100% RDN through Neem cake (10 days before puddling)	48096	36285	11811	0.3
T_5	100% RDN through vermicompost (10 days before puddling)	58186	54285	3901	0.1
T_6	50% RDN as basal + 50% at 10 days before PI stage through poultry manure	75723	20285	55438	2.7
T_7	50% RDN as basal + 50% at 10 days before PI stage through FYM	36595	30285	6310	0.2
T_8	50% RDN as basal + 50% at 10 days before PI stage through neem cake	48456	36285	12171	0.3
T_9	50% RDN as basal + 50% at 10 days before PI stage through vermicompost	58460	54285	4175	0.1

Economics

Significantly lower cost of cultivation (Rs.20050 ha^{-1}), higher net returns (Rs. 58170 ha^{-1}) and returns per rupee invested (2.9) was registered (Table 2) with the application of recommended dose of chemical fertilisers, followed by 50% RDN as basal +50% at 10 days before PI stage through poultry manure (T_6).

Among the different treatments tested, T_1 gave significantly higher benefit cost ratio. This is due to higher grain and straw yields, lower cost of cultivation and higher net returns. Similar views were expressed by Mondal *et al*. (2003) [9].

The lowest net return of Rs. 3901 ha^{-1} and benefit cost ratio (0.1) was recorded with 100% RDN equivalent through vermicompost. This is due to higher cost of cultivation. This is in conformity with the findings of Godhawale *et al*. (2007) [5].

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 (T_6) or 100% RDN through poultry manure (T_2) is one of the cheap and efficient source of nitrogen in organic farming which can be an efficient substitute for chemical fertilizer in order to get hisgher yield and profitability of rice. Use of different organic manures (vermicompost and poultry manure, FYM) which are being produced in the farm itself and reduces the cost of cultivation and thereby increases the benefit cost ratio and availability of nutrients in long run.

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