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Growth, Yield attributes and Yield of Rice (*Oryza sativa* L.) as affected by Application of Organic Sources of Nitrogen

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A field experiment was conducted at the Agricultural College Farm, Bapatla, Andra Pradesh during *kharif 2012* to study the effect of organic sources of nutrients *viz.,* poultry manure, FYM, neemcake, vermicompost and recommended NPK fertilisers on growth, yield attributes and yield of rice. Application of recommended dose of fertilizer (120:60:40 kg N, P_2O_5, K_2O ha^{-1}) was found to be superior in giving maximum growth, yield attributes and yield of rice, which was on a par with 50% RDN as basal+50% at 10 days before PI stage through poultry manure.

Key words: Organic manures, Rice, Yield attributes, Yield

Indiscriminate use of chemical fertilizers leads to development of several problems like decline in soil organic matter, increase in soil salinity, soil pollution and severe attack of pest and diseases (Chakraborthi and Singh, 2004). Due to these problems, organic farming is gaining popularity in recent years. In view of escalating prices of non-renewable resources of nitrogen and the concern about environmental degradation and pollution, the need for cheaper sources of nitrogen is recognized. Balanced use of nutrients through organic sources like farm yard manure, vermicompost, green manuring, crop residues, neem cake and poultry manure are the pre requisites to sustain soil fertility and to produce the maximum crop yield with optimum input level (Dahiphale *et al.,* 2003). Nitrogen is pivotal in realization of rice yields. Basal application of organic manures has low nitrogen use efficiency and higher losses due to volatilization, leaching and denitrification. Hence, application of appropriate quantity of nitrogen as split doses will meet the crop demand and enhance the nutrient uptake at critical stages (10 days before panicle initiation) without causing much loss. Hence, use of organic sources like FYM, poultry manure, vermicompost and neemcake deserves priority for sustained production and better utilization in organic rice production. Therefore, an attempt has been made to study the response of rice to organic nitrogen sources on growth and yield in order to achieve the maximum production.

Materials and Methods

A field experiment was conducted on clay loam soil of Agricultural College Farm, Bapatla, Andra Pradesh during *kharif* season of 2012. The experiment was laid out in a randomized blocks 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 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, 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 were used as organic sources for nitrogen. Based on the equal N basis, and 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, respectively in the form of urea (46% N), single super phosphate (16% P_20_5) and murate of potash (60% K_20) 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 the remaining half applied at maximum tillering stage. The consumer preferred rice variety, BPT-5204 (Samba Mahsuri) was raised. 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.

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Results and Discussion

Growth

Plant height, number of tillers and drymatter accumulation at maturity were significantly influenced by organic manures and recommended NPK through fertilizers (Table 1). Application of recommended dose of chemical fertilisers (T_1) recorded significantly taller plants which were on par with 50% RDN as basal+ 50% at 10 days before PI stage through poultry manure (T_6). The rapid rate of mineralization in fertilizer treated plots might have led to more availability of nitrogen in initial stages of crop growth. Whereas, increased plant height in poultry manure treated plots might be due to its higher content of N, which was readily available to crops. These results are in agreement with the findings of Suvarna Latha and Sankara Rao (2001).

Table 1. Influence of organic manures on growth characteristics of rice

	Treatment	Plant height (cm)	Total number of tillers m^{-2}	Dry matter accumulation (kg ha^{-1})
T_1	100% RDN through inorganic sources (120:60:40 kg N, P_2O_5, K_20 ha^{-1})	100	488	13358
T_2	100% RDN through poultry manure (10 days before puddling)	92	416	11902
T_3	100% RDN through FYM (10 days before puddling)	65	255	7348
T_4	100% RDN through neem cake(10 days before puddling)	73	327	8946
T_5	100% RDN through vermicompost (10 days before puddling)	83	337	10432
T_6	50% RDN as basal + 50% at 10 days before PI stage through poultry manure	95	420	12963
T_7	50% RDN as basal + 50% at 10 days before PI stage through FYM	63	243	7204
T_8	50% RDN as basal + 50% at 10 days before PI stage through neem cake	75	333	8978
T_9	50% RDN as basal + 50% at 10 days before PI stage through vermicompost	84	342	10448
	SEm (±)	2	23	482
	CD (P=0.05)	7	69	1446

Significantly higher number of tillers were observed with the application of recommended dose of chemical fertilisers, which was on a par with 50% RDN as basal+50% at 10 days before PI stage through poultry manure (T_6). The chemical fertilizers offer nutrients which are readily soluble in soil solution and there by instantaneously available to plants. Better performance of poultry manure treated plots might be due to the involvement of certain growth promoting substances, which might have accelerated the number of tillers. This is in consonance with the findings of Helen Belefant-Miller (2007).

The highest drymatter accumulation was observed with the application of recommended dose of chemical fertilizers, which was on a par with 50% RDN as basal+50% at 10 days before PI stage through poultry manure (T_6). Significantly higher drymatter accumulation in fertilizer treated plots might be due to greater solubility and accelerated release of nitrogen, thereby providing an opportunity time for rice to utilize higher quantum of nutrients. Increased drymatter accumulation in poultry manure treated plots might be attributed to the continuous slow release of nutrients, which might have enabled the leaf area duration to extend, thereby, providing an opportunity time for plants to increase the photosynthetic rate which in turn, could have led to higher accumulation of dry matter. Similar results were also obtained by Amanullah *et al.* (2006).

Table 2. Influence of organic manures on yield attributes and yield of rice

	Treatment	Productive tillers m^{-2}	No. of grains $panicle^{-1}$	No. of filled grains $panicle^{-1}$	Test weight (g)	Grain yield (kg ha^{-1})
T_1	100% RDN through inorganic sources (120:60:40 kg N, P_2O_5, K_20 ha^{-1})	306	196	176	15.8	5856
T_2	100% RDN through poultry manure (10 days before puddling)	280	178	161	15.7	5102
T_3	100% RDN through FYM (10 days before puddling)	178	120	112	15.1	2796
T_4	100% RDN through neem cake(10 days before puddling)	224	138	127	15.2	3548
T_5	100% RDN through vermicompost (10 days before puddling)	252	158	144	15.3	4338
T_6	50% RDN as basal + 50% at 10 days before PI stage through poultry manure	294	191	168	15.7	5665
T_7	50% RDN as basal + 50% at 10 days before PI stage through FYM	176	117	110	15.0	2685
T_8	50% RDN as basal + 50% at 10 days before PI stage through neem cake	226	140	129	15.3	3580
T_9	50% RDN as basal + 50% at 10 days before PI stage through vermicompost	254	160	146	15.4	4340
	SEm (±)	8	5	4	0.6	249
	CD (P=0.05)	25	17	13	NS	748

Yield attributes

Yield attributes *viz*., productive tillers m^{-2}, total number of grains $panicle^{-1}$ and filled grains $panicle^{-1}$ were significantly influenced by time and application of organic sources of nitrogen. Application of recommended dose of chemical fertilizers recorded significantly higher productive tillers m^{-2}, total number of grains $panicle^{-1}$, filled grains $panicle^{-1}$, which was on a par with 50% RDN

as basal+50% at 10 days before PI stage through poultry manure (T_6), but proved significantly superior to the rest of the treatments. Test weight was not significantly influenced by application of organic sources.

Better yield attributes recorded with the application of chemical fertilizers might be due to better nutrition especially, quick nitrogen availability to the crop (Table 2). Among the organic manures, better performance of T_6 might be due to the continued supply of N until the reproductive stage of the crop growth, due to faster decomposition by making the nutrients more available and also better supply of macro and micro nutrients which might have helped for more enzymatic activity and physiological processes of plant, which resulted into better translocation of the photosyntates and portioning of drymatter to the sink (grain). This might have helped in increasing the yield attributes. These results are in conformity with the findings of Begum *et al*. (2001).

Yield

The highest grain yield of 5856 kg ha^{-1} was obtained with the application of 100% RDN through fertilizer (T_1), which was however, on par with 50% RDN as basal+50% at 10 days before PI stage through poultry manure (T_6), but proved significantly superior to the rest of the treatments (Table 2).

The grain yield was the highest when recommended dose of chemical fertilizer was applied. It is due to better growth and yield attributes in these treatments, which might have resulted in increased rice yields compared to added levels of N in organic form (Manivannan and Sriramachandra sekharan, 2009). Poultry manure contains about 60 per cent of its nitrogen as uric acid, 30 per cent as more stable organic form of N and less than 10 per cent as mineral N (Srivastava, 1998). The uric acid N changes rapidly to ammonical form of nitrogen. Similar results were also reported by Datta *et al*. (1994) and Channabasavanna (2002).

Conclusion

From the present study, 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 in order to get higher growth and yield of rice.

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