Madras Agric. J., 101 (10-12): 336-339, December 2014
https://doi.org/10.29321/MAJ.10.001210

Effect of Time of Application and Organic Sources of Nitrogen On Drymatter Accumulation and Nutrient Uptake at Different Stages of Rice (*Oryza Sativa* L.)

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A field experiment was conducted at the Agricultural College Farm, Bapatla during *kharif* 2012 to study the effect of organic sources of nutrients (poultry manure, FYM, neemcake and vermicompost) and recommended NPK fertilisers on drymatter accumulation and nutrient uptake of rice. The results of the investigation showed that higher drymatter accumulation N, P and K uptake were recorded with 100 % RDN through chemical fertilisers which was significantly followed by 100% RDN through poultry manure. At 90 DAT and at maturity, significantly higher drymatter accumulation, yield and nutrient uptake were observed with fertiliser treated plots, which was on a par with 50% RDN as basal+ 50% at 10 days before PI stage through poultry manure and it is on a par with 100% RDN through poultry manure and significantly superior to all other treatments.

Key words: Organic manures, Rice, Drymatter Accumulation, Yield, Nutrient uptake

Modernized agricultural practices using high rate of fertilizer and agrochemicals destroy the soil ecosystem, which in turn decrease nutrient availability and degrade soil properties (Ladha *et al*., 2000). Among the various yield determining factors, soil fertility is of prime importance. Our soils are low in nutrients due to continuous cropping and inadequate use of organic manures and excessive use of inorganic fertilizers. Nitrogen is a crucial nutrient for rice growth, and its deficiency is a major constraint to stable rice production worldwide. Suzuki (1997) reported increased rice yield with increasing uptake of N until reaching a peak. Soil N supply plays a dominant role in the N nutrition of wetland rice as one-half to two-thirds of the total N taken up by rice crops even in N-fertilized paddy fields comes from the soil N pool (Sahrawat, 1983b). However, soil fertility has progressively declined due to plant nutrient depletion in most of the fields with only the application of chemical fertilizers (Ladha *et al*., 2000).

In order to ensure better crop production, efforts are needed to maintain soil fertility through the use of organic manures. Organic manures play an important role in maintaining soil fertility and productivity and they act as a reservoir of plant nutrients. Indiscriminate use of chemical fertilisers cause ill effects to both the environment and human beings. It is convenient to provide organic manure to replace the inorganic material partly or completely. It is, therefore, important to promote economically viable and environmental friendly interventions for sustainable agriculture. Application of animal waste manures, which contain both mineral and organic N, is useful for maintaining and improving soil fertility and rice production (Takahashi *et al*., 2004). Basal application of organic manures has low nitrogen use efficiency and higher losses due to leaching and denitrification. 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 deserve priority for sustained production and better utilization in organic rice production. Organic manure has been proven to enhance efficiency and reduce the need for chemical fertilizers (Sahrawat, 2006). Hence, this experiment was undertaken to find out the effect of organic sources of nitrogen on drymatter accumulation and nutrient uptake of rice.

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Materials and Methods

A field experiment was conducted at Agricultural College Farm, Bapatla, during *kharif* 2012. The experiment was laid out in a randomized blocks design and replicated thrice. 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. 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, the 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_2O_5) and muriate of potash(60% K_2O) 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 panicle initiation stage. The consumer preferred rice variety, BPT-5204 (Samba Mahsuri) was raised. Thirty day old seedlings were transplanted using two seedlings $hill^{-1}$ with a spacing of 20 ×15 cm. Recommended agronomic practices and plant protection measures were followed.

Results and Discussion

Drymatter accumulation

Drymatter accumulation at different growth stages was significantly influenced by organic manures and recommended NPK through fertilizers (Table1). The results of the investigation revealed that higher drymatter accumulation was obtained with application of recommended dose of chemical fertilisers which was significantly superior to 100% RDN through poultry manure (T_2) at 30 DAT but on par at 60 DAT and both the treatments recorded markedly higher dry matter accumulating than the other treatments. At 90 DAT and at maturity, significantly higher drymatter accumulation was observed with T_1, which was 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. The treatment T_6 remained on par with 100% RDN through poultry manure (T_2).

Significantly higher drymatter accumulation in fertilized treated plots might be due to greater solubility and accelerated release of nitrogen and by providing an opportunity time for rice to utilize higher quantum of nutrients. Increased drymatter accumulation in poultry manure and vermicompost

Table 1. Influence of organic manures on drymatter accumulation, yield and nitrogen uptake at different stages of rice

Treatment		Drymatter accumulation (kg ha^{-1})				Grain yield	Straw yield	N UPTAKE (Kg ha^{-1})			Harvest	
		30 DAT	60 DAT	90 DAT	Harvest	(kg ha^{-1})	(kg ha^{-1})	30 DAT	60 DAT	90 DAT	Grain	Straw
T_1	100% RDN through inorganic sources (120:60:40 kg N,P_2O_5,K_2O)	1552	6785	10460	13358	5856	6902	34.0	58.5	96.5	63.8	42.4
T_2	100% RDN through poultry manure (10 days before puddling)	1380	6572	9308	11902	5102	6136	29.6	55.3	89.4	58.4	38.4
T_3	100% RDN through FYM (10 days before puddling)	826	3830	5718	7348	2796	3661	12.8	27.3	61.4	39.2	24.2
T_4	100% RDN through Neem cake (10 days before puddling)	1198	5662	6878	8946	3548	4534	23.4	47.2	68.4	44.4	28.4
T_5	100% RDN through vermicompost (10 days before puddling)	1208	5670	8143	10432	4338	5234	24.6	48.6	78.3	52.6	33.2
T_6	50% RDN as basal + 50% at 10 days before PI stage through poultry manure	1026	4761	9856	12963	5665	6704	19.5	40.2	94.2	60.2	40.2
T_7	50% RDN as basal + 50% at 10 days before PI stage through FYM	784	3796	5654	7204	2685	3530	12.2	25.4	59.2	38.6	22.6
T_8	50% RDN as basal + 50% at 10 days before PI stage through neem cake	997	4732	6991	8978	3580	4538	17.8	35.8	70.3	47.3	29.6
T_9	50% RDN as basal + 50% at 10 days before PI stage through vermicompost	1015	4753	8156	10448	4340	5360	18.4	38.4	82.1	53.1	34.6
	SEm (±)	55	266	383	482	249	255	0.6	1.2	1.6	1.3	0.8
	CD (P=0.05)	164	799	1149	1446	748	765	1.9	3.5	4.8	3.7	2.5
	CV (%)	8.5	8.9	8.4	8.2	10.3	9.0	5.2	4.8	3.6	4.3	4.5

treated plots might be attributed due to the continuous slow release of nutrients which 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 drymatter. Similar results were reported by Amanullah *et al.* (2006), Suvarna Latha and Sankara Rao (2001) and Altaf Hussain *et al*. (2012).

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 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 1).

Higher yield with recommended dose of chemical fertilizer was due to better growth of plants and better yield attributes (Manivannan and Srirama chandrasekharan, 2009) . Superior performance of poultry manure might be due to the fact that it can

Table 2. Influence of organic manures on phosphorus and potassium uptake at different stages of rice

	Treatment	P UPTAKE (Kg ha-1)			Harvest		K UPTAKE (Kg ha-1)			Harvest	
		30 DAT	60 DAT	90 DAT	Grain	Straw	30 DAT	60 DAT	90 DAT	Grain	Straw
T_1	100% RDN through inorganic sources (120:60:40 kg N, P_2O_5, K_20)	14.6	46.1	59.3	55.2	29.2	30.4	60.4	94.6	32.6	118.4
T_2	100% RDN through poultry manure (10 days before puddling)	12.2	44.2	54.7	51.2	25.8	27.8	58.6	88.3	28.6	110.5
T_3	100% RDN through FYM (10 days before puddling)	4.4	24.2	37.8	33.6	14.4	16.5	36.6	63.5	14.8	83.8
T_4	100% RDN through Neem cake (10 days before puddling)	9.6	38.1	42.8	38.4	17.5	23.6	50.6	73.2	18.4	92.2
T_5	100% RDN through vermicompost (10 days before puddling)	9.8	40.3	48.6	45.4	21.8	24.8	53.2	81.2	23.5	101.6
T_6	50% RDN as basal + 50% at 10 days before PI stage through poultry manure	7.2	32.1	56.4	53.6	27.3	20.8	46.2	91.5	30.4	113.3
T_7	50% RDN as basal + 50% at 10 days before PI stage through FYM	4.1	20.1	36.5	32.1	13.6	15.6	32.2	61.3	13.6	82.3
T_8	50% RDN as basal + 50% at 10 days before PI stage through neem cake	6.6	28.1	43.6	39.6	18.6	18.9	40.7	75.4	19.7	93.4
T_9	50% RDN as basal + 50% at 10 days before PI stage through vermicompost	6.8	30.1	50.2	46.8	22.4	19.6	44.3	82.7	24.8	102.3
	SEm (±)	0.3	1.1	1.3	1.1	0.6	0.6	1.2	1.7	0.7	2.3
	CD (P=0.05)	0.9	3.2	3.7	3.4	1.9	1.8	3.5	5.0	2.2	6.9
	CV (%)	6.0	5.5	4.5	4.5	5.2	4.8	4.3	3.7	5.5	4.0

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 Datta *et al*. (1994) and Channabasavanna (2002).

Nutrient uptake

There existed significant differences in nitrogen uptake by plant at 30, 60, 90 DAT and at maturity due to different treatments of organic manures (Table 1 and 2). The higher N,P and K uptake by rice crop was obtained with the application of recommended dose of chemical fertilisers which was significantly superior to 100% RDN through poultry manure (T_2) at 30 DAT but on par at 60 DAT and both the treatments recorded marked higher uptake than the other treatments. At 90 DAT and at maturity, significantly higher N, P and K uptake by rice crop were observed with T_1, which was on par with 50% RDN as basal+ 50% at 10 days before PI stage through poultry manure (T_6) and T_6 was on a par with 100% RDN through poultry manure (T_2) and significantly superior to all other treatments.

Higher NPK uptake with recommended dose of chemical fertiliser compared to other levels of nitrogen in organic form at all crop growth stages could be ascribed to the increase in the available nitrogen due to readily soluble nature of nutrients which might have increased the absorption (Khanda and Dixit, 1996; Biswas and Narayanasamy, 1998).

Increased rice yield could also be attributed to significant increase in nutrient uptake of rice in respective treatment involving organic manure *viz.,* poultry manure and vermicompost. Increase in nutrient availability in poultry manure treated plots was due to higher N content and its gradual mineralisation process. This process ensures increased N availability throughout crop growth, besides improving crop yield. The added organic manure (poultry manure and vermicompost) might have enhanced the activity of beneficial soil microflora increasing the availability and uptake of nutrients by the crop. Further, it has a favorable effect on uptake of N, P and K by rice with poultry manure application as reported by Dravid and Biswas (1996), Hossan *et al*. (2010) and Meena *et al*. (2010).

From the present study, it can be concluded that drymatter accumulation and N, P and K uptake at 30, 60, 90 DAT and maturity were significantly influenced by time of application and sources of organic nitrogen. Significantly higher drymatter accumulation and NPK uptake were 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 (T_6).

References

Altaf Hussain, S., Sheraz Mahdi, R.A., Bhat Faisul-ur-Rasool and Raihana Habib Kanth. 2012. Integrated nutrient management of rice (*Oryza sativa* L.) under temperature conditions of kasmir. *Agric. Sci. Digest*., **32**(1): 18-22.

Amanullah, M.M., Alagesan, A.,Vaiyapuri, K., Pazhanivelan, S. and Sathyamoorthi, K. 2006. Intercropping and organic manures on the growth and yield of cassava (*Manihotesculenta crantz*.). *Res.J.Agric.Biol.Sci*., **2**: 183-189.

Biswas, T.D. and Narayanasamy, G. 1998. Soil organic matter and organic residue management for sustainable productivity. *ISSS Bull. No.9 Society of Soil Sciences*. New Delhi.

Channabasavanna, A.S. 2002. Efficient utilization of poultry manure with inorganic fertilizers in wet land rice*. J. Maharashtra Agri. Univ.,* **27**(3): 237-238.

Datta, M. and Banik, S. 1994. Effect of poultry manure and phosphate dissolving bacteria on rice (*Oryza sativa*) in arid soil. *Indian J. Agric. Sci.,* **64**(11): 791-793.

Dravid, M.S. and Biswas, D.R. 1996. Effect of phosphorus, poultry manure, biogas slurry and farm yard manure on dry matter yield and utilization of applied P by wheat. *J. Nuc. Agric. Bio*., **25**: 89-95.

Hossan, A.T.M.S., Rahman, F., Saha, P.K. and Solaiman, A.R.M. 2010. Effects of different aged poultry litter on the yield and nutrient balance in boro rice cultivation. *Bangladesh J. Agrl.Res*., **35**(3): 497-505.

Khanda, C.N. and Dixit, L.1996. Effect of zinc and nitrogen fertilization on yield and nutrient uptake of summer rice (*Oryza sativa*). *of irrigation. Indian J. Agron.,* **41**(3): 368-372.

Ladha, J.K., Dawe, D., Ventura, T.S., Singh, U., Ventura, W. and Watanabe, I. 2000. Long-term effects of urea and green manure on rice yields and nitrogen balance*. Soil Sci. Soc. Am. J.,* **64**(6): 1993"2001.

Manivannan, R. and Sriramachandrasekharan, M.V. 2009. Response of lowland rice to addition of organics and mineral N grown on Typic Haplusterts soil. *J. Appl. Sci. Res.,* **7**: 1988-1991.

Meena, R.N., Singh, S. P. and Kalyan Singh. 2010. Effect of organic nitrogen nutrition on yield, quality, nutrient uptake and economics of rice (*Oryza sativa*) - table pea (*Pisum sativum* var. *Hortense*) – onion (*Allium cepa*) cropping sequence*. Indian J. Agric. Sci.,* **80**(1): 1003-6.

Sahrawat, K.L. 1983. Nitrogen availability indexes for submerged rice soils. *Adv. Argon.*, **36**: 415-451.

Sahrawat, K.L. 2006. Organic matter and mineralizable nitrogen relationships in wetland rice soils. *Comm. Soil Sci. Plant Anal.,* **37**(5-6): 787-796.

Suvarna Latha, A.J. and Sankara Rao,V. 2001. Integrated use of fertilizers and poultry manure on nutrient availability and yield of rice. *J. Indian Soc. Coastal Agric. Res.,* **19** (2):153-157.

Suzuki, A. 1997. Fertilization of rice in Japan. FAO Association, Tokyo, Japan.

Takahashi, S., Uenosono, S. and Nagatomo, M. 2004. Rice uptake of nitrogen form aerobically and an aerobically composted poultry manure. *J. Plant Nutr.,* **27**(4): 731"741.

Received: June 21, 2013; Revised: August 19, 2014; Accepted: October 27, 2014