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Influence of Nitrogen Management Practices with *Glyricidia* Leaf Manure on Yield and Nutrient uptake of Rice (*Oryza sativa* L.)

N Venkata Lakshmi, R Veeraraghavaiah, G Subbaiah, Y Ashoka Rani and P Ravindra Babu
Department of Agronomy, Agricultural College, Bapatla 522 101, Andhra Pradesh

ABSTRACT

Field experiments were conducted during *kharif* seasons of 2007-08 and 2008-09 on sandy clay loam soils of Agricultural College Farm, Bapatla to study the economics and productivity of rice with different levels of nitrogen (120, 180, 240 kg N ha^{-1}) and in combination with *Glyricidia* leaf manure @ 10 t ha^{-1}. The study revealed that application of 240 kg N ha^{-1} + *Glyricidia* leaf manure (GLM) @ 10 t ha^{-1} recorded significantly higher yield components and yield of rice and found on a par with that of application of 240 kg N ha^{-1} alone and 180 kg N ha^{-1}+ GLM @ 10 t ha^{-1}, showing the benefit of GLM to a tune of 60 kg N ha^{-1} in enhancing the yield of rice during both the years of the study. Across the treatments, application of 240 kg N ha^{-1} with GLM resulted in significantly higher NPK uptake (162.2, 22.7, 201.7 kg N, P_2O_5, K_2O ha^{-1}), during *kharif*, 2007 and during *kharif*, 2008 145.2, 15.3, 157.2 kg N, P_2O_5, K_2O ha^{-1}, compared to that of 120 kg N ha^{-1} with or without GLM and180 kg N ha^{-1} application alone. The status of available NPK in the soil was significantly higher in the plots, which received N levels along with GLM @ 10 t ha^{-1} than that of fertilizer N alone during both the years of the study.

Key words : *Glyricidia* leaf manure, Nitrogen levels, Rice.

Rice (*Oryza sativa* L.) occupies a pivotal place in Indian agriculture and it is the staple food for more than 60% of Indian population and it accounts for 43% of total food grain production and 46% of total cereal production. In India, rice is grown in an area of 44.0 m.ha. with annual production of 99 m.t. and productivity of 20.93 q ha^{-1} (Anonymous, 2009). At the current rate of population growth in India, it is estimated that the demand for food grains by 2020 will be around 340 million tonnes (Abdul Kalam, 2010). The scope for meeting such demand is possible only through increasing productivity of food grain crops. Among several management practices that affect crop productivity, fertilizer application especially nitrogen, is of paramount importance for its role in growth and development of the crop. Continuous use of inorganic sources of N leads to decline or stagnation in productivity due to limitation of one or more nutrients. On the other hand, use of organic nutrient sources alone, though improved soil health, seldom found to meet the crop nutrient requirement completely. In this context, combined use of cost effective inorganic fertilizers and organic manures is essential for economic viability and environmental safety. Keeping this in view, the present investigation was undertaken to study the response of rice to different nitrogen levels alone and in conjunction with *glyricidia* leaf manure.

MATERIALS AND METHODS

Field experiments were conducted at Agricultural College Farm, Bapatla, during *kharif* seasons of 2007-08 and 2008-09. The experimental soil was sandy clay loam in texture, having soil pH of 7.8 and EC of 0.3 d Sm^{-1}, low in organic carbon content (0.3%) and available soil nitrogen and medium in phosphorus and high in potassium content. The experiment was laidout in a randomized block design with six treatments *viz*., M_1:120 kg N ha^{-1}, M_2:180 kg N ha^{-1}, M_3: 240 kg N ha^{-1}, M_4: 120 kg N ha^{-1} + GLM@ 10 t ha^{-1}, M_5: 180 kg N ha^{-1} + GLM @ 10 t ha^{-1} and M_6: 240 kg N ha^{-1} + GLM @ 10 t ha^{-1} and replicated for four times during *kharif* seasons of 2007-08 and 2008-09. *Glyricidia* leaf manure was incorporated seven days before rice transplanting as per the treatments, during both the years of study. A popular super fine rice cultivar BPT 5204 (Samba Mashuri) was selected for the study. The weekly mean maximum temperature ranged from 29.2 ^{0}C to 33.7 ^{0}C and 27.5 ^{0}C to 34.9 ^{0}C during 2007 and 2008, respectively. The mean minimum temperature for the corresponding period ranged from 18.1 ^{0}C to

26.0 ^{0}C and 14.1 ^{0}C to 26.0 ^{0}C, respectively, while the average maximum and minimum temperatures during period were 31.3 ^{0}C and 22.0 ^{0}C during 2007, and 31.7 ^{0}C and 22.4 ^{0}C during 2008, respectively. A total rainfall of 484.5 mm and 358.6 mm was received during 2007 and 2008, respectively. A common dose of 60 kg P-$_2$O$_5$and 40 kg K$_2$O ha^{-1} was applied in the last puddle through single super phosphate and muriate of potash, respectively, by taking the plot size into consideration. Nitrogen was applied as per the treatments in three equal splits as 1/3 at planting, 1/3 at active tillering and 1/3 at panicle initiation stage. The seedlings of 28 day-old were transplanted in all the plots @ 2-3 seedlings hill-^{1} at a spacing of 20 cm x15 cm. To maintain uniform population across the treatments, gap-filling was done on the seventh day after planting by taking seedlings from the nursery left out for the purpose. All other recommended agronomic and plant protection measures were adopted to raise the crop. Observations on yield components, grain yield, and straw yield of rice were recorded. The plant samples collected for dry matter accumulation at maturity from different treatments were oven dried, ground into powder, and used for chemical analysis. Plant and kernel samples taken at maturity were analyzed for nitrogen (Piper, 1960); Phosphorus (Jackson, 1973), and Potassium (Jackson, 1973). Uptake was calculated by multiplying the nutrient content by the respective dry weights of kernel and stover and then summed up to represent total nutrient uptake at harvest. Soil samples from each plot were drawn after harvest of the crop to analyze for available N (Subbiah and Asija, 1956), available P (Olsen *et al.,* 1954) and available K (Jackson, 1973).

RESULTS AND DISCUSSION

Effect of different N management practices on yield components and yield

Number of productive tillers m^{-2} across different N levels alone or together with GLM ranged from 318.7 to 425.8 during the first year and from 308.8 to 417.8 during the second year of the study, the lowest was with 120 kg N ha^{-1} alone and the highest was with 240 kg N ha^{-1} together with GLM. The highest productive tiller number recorded with 240 kg N ha^{-1} plus GLM @ 10 t ha^{-1}, however, was on a par with that of 240 kg N ha^{-1} alone or 180 kg N ha^{-1} plus GLM. The differences in the filled grains panicle^{-1} recorded across different N treatments over the two years of the study were significant (Table 4.1). During both the years, number of filled grains panicle^{-1} increased significantly with increase in level of N application from 120 kg ha^{-1} to 240 kg ha^{-1} alone, but when these levels of N application were combined with GLM, the increase in number of filled grains was significant upto 180 kg N ha^{-1} only. The number of filled grains panicle^{-1} ranged from 122.9 to 165.4 in the first year and from 120.5 to 152.7 in the second year of the study.

As was noticed with productive tillers m^{-2}, number of filled grains panicle^{-1}, the test weight recorded was also the highest with 240 kg N ha^{-1} plus GLM, but it was on a par with that of application of 240 kg N ha^{-1} alone or 180 kg N ha^{-1} plus GLM during both the years of the study (Table-2). The test weight recorded with the application of 180 kg N ha^{-1} alone was found at par with that of 120 kg N ha^{-1} together with GLM, whereas the lowest was recorded with 120 kg N ha^{-1} alone (13.9 g and 13.5 g, respectively, during 2007 and 2008) .

There was a progressive increase in grain yield with each increment in N level from 120 to 240 kg ha^{-1} during both the years of study, however, when these levels of N application were combined with GLM, the increase in grain yield was significant upto 180 kg N ha^{-1} only. The highest grain yield was recorded with 240 kg N ha^{-1} plus GLM, however, it was on a par with that of 240 kg N ha^{-1} alone or 180 kg N ha^{-1} plus GLM. The grain yield ranged from 3285 kg ha^{-1} to 5672 kg ha^{-1} in the first year and from 3156 kg ha^{-1} to 5249 kg ha^{-1} in the second year of the study. As was noticed with grain yield, straw yield was also the highest with 240 kg N ha^{-1} applied with GLM, but it was on a par with that of application of 240 kg N ha^{-1} alone or 180 kg N ha^{-1} plus GLM, during both the years of study and differences in harvest index across different treatments were followed the similar trend of grain and straw yields. The increase in yield with increase in N application might be due to the fact that it is a substrate for the synthesis of organic nitrogen compounds which are constituents of protoplasm and chloroplasts. The increased grain yield with increasing level of N was attributed to significant improvement in yield components as was reported

Table 1. Yield components and yield of rice as influenced by different nitrogen management practices.

Treatments (kg N ha^{-1})	No. of productivetillers m^{-2}		No. of filled grains $panicle^{-1}$		Test weight (g)		Grain yield (kg ha^{-1})		Straw yield (kg ha^{-1})		Harvest Index (%)	
	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008
M_1-120	318.7	308.8	122.9	120.5	13.9	13.5	3285	3156	4176	3958	44.0	43.2
M_2-180	363.8	358.8	135.2	132.3	15.5	15.2	4268	4123	5243	4962	44.9	45.4
M_3-240	401.9	397.6	158.6	147.6	16.8	16.3	5253	4872	6215	5693	45.8	46.1
M_4-120 + GLM	352.4	347.8	131.4	127.9	15.4	15.1	3821	3657	4756	4625	44.5	44.2
M_5-180 + GLM	422.1	415.3	162.7	149.5	17.1	16.5	5437	5083	6423	5944	45.8	46.1
M_6-240 + GLM	425.8	417.8	165.4	152.7	17.3	16.6	5672	5249	6674	6032	45.9	46.5
SEm $\pm$	12.2	11.7	2.4	1.8	0.2	0.2	165	161	168	118	0.2	0.2
CD (0.05)	32.8	35.2	7.3	5.4	0.7	0.6	492	485	506	357	0.6	0.6
CV (%)	6.8	6.3	3.5	2.6	2.9	2.3	6.1	6.0	5.1	3.7	1.7	2.1

GLM – *Glyricidia* leaf manure @10 t ha^{-1}

Table 2. Nitrogen (kg ha^{-1}), phosphorus (kg ha^{-1}) and potassium uptake (kg ha^{-1}) by rice as influenced by nitrogen and g*lyricidia* leaf manure and their status in soil after harvest.

Treatments (kg N ha^{-1})	Nutrient uptake by rice						Nutrient status in soil after harvest					
	Nitrogen (kg ha^{-1})		Phosphorus (kg ha^{-1})		Potassium (kg ha^{-1})		Nitrogen (kg ha^{-1})		Phosphorus (kg ha^{-1})		Potassium (kg ha^{-1})	
	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008
M_1-120	97.2	81.4	9.2	8.1	125.5	100.2	174.9	188.0	26.4	17.9	221.9	211.6
M_2-180	129.2	121.7	12.7	10.7	157.2	135.9	200.4	207.9	35.2	20.9	238.2	216.6
M_3-240	153.2	137.7	14.9	14.3	182.5	146.8	210.6	209.8	37.6	24.1	240.4	220.4
M_4-120 + GLM	119.3	113.4	11.3	9.7	153.2	126.3	235.8	225.7	41.9	27.9	251.0	231.9
M_5-180 + GLM	157.4	143.5	17.8	15.1	191.6	152.2	240.0	239.1	43.5	28.4	253.5	236.4
M_6-240 + GLM	162.2	145.2	22.7	15.3	201.7	157.2	252.3	239.5	44.6	29.7	256.7	239.2
SEm $\pm$	3.8	3.1	1.0	0.4	7.8	3.8	6.6	4.9	0.9	1.2	2.2	2.7
CD (0.05)	11.6	9.2	3.0	1.1	23.4	11.6	19.9	14.8	2.8	3.7	6.5	8.2
CV (%)	5.4	4.7	14.0	5.9	8.9	5.5	6.0	4.4	4.9	10.5	1.8	2.4

GLM – *Glyricidia* leaf manure @10 t ha^{-1}

by several workers (Chaudhary and Sinha, 2007; Latheef and Reddy, 2007; Senthil Kumar *et al.*, 2008 and Alpna and Kumar, 2010).

Influence of nitrogen management practices on nutrient uptake of rice

Across the treatments, application of 240 kg N ha^{-1} with GLM resulted in significantly higher NPK uptake (162.2, 22.7, 201.7 kg N, P_2O_5, K_2O ha^{-1}, during *kharif*, 2007 and 145.2, 15.3, 157.2 kg N, P_2O_5, K_2O ha^{-1}, during *kharif*, 2008) compared to that of 120 kg N ha^{-1} with or without GLM and180 kg N ha^{-1} application alone but it was on a par with 240 kg N ha^{-1} applied alone or 180 kg N ha^{-1} applied together with GLM during both the years of study (Table-2). Irrespective of the year of the study, the lowest NPK uptake was noticed with 120 kg N ha^{-1} without GLM (97.2, 9.2, 125.5 kg ha^{-1} and 81.4, 8.1, 100.2 kg ha^{-1} during 2007 and 2008, respectively) than that of the rest of the treatments. The uptake being the product of nutrient content and dry matter accumulation, the increase in nutrient uptake by the crop at higher dose of N in addition to GLM incorporation might be due to increased availability of nutrients and higher grain and straw yields. Comparable findings were reported by

Bhattacharya *et al.* (1992); Devasenamma *et al.* (1999); Sudhakar *et al.* (2003); and Sujathamma and Reddy (2004).

The status of available NPK in the soil was significantly higher in the plots, which received N levels along with GLM @ 10 t ha^{-1} than that of fertilizer N alone during both the years of the study. Irrespective of the year of study, the lowest status of available NPK was recorded in those plots which received 120 kg N ha^{-1} alone. Similar increase in residual status of soil N P K due to application of organic manures was also reported by Dekamedhi and Medhi (2000), Swarup and Yaduvanshi (2000) and Premi (2003).

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