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EFFECT OF ORGANIC SOURCES ON NITROGEN AVAILABILITY IN FLOODED RICE SOILS

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Abstract: A study was conducted during the rabi season of 1982 to study the changes of N in the lateritic rice soil as well as in the rice plant as influenced by flooding in the presence of various organic and inorganic sources of nitrogen. The results revealed that daincha treated plots were able to liberate more nitrogen in the soil as well as in the solution than farm yard manure or azolla treated or urea alone treated plots. In general the NH_4-N content in the soil showed a progressive decrease from tillering to harvest (11.13 - 1.99 ppm). The chemical kinetics of NO_3-N, hydrolysable-N, non-hydrolysable N, organic carbon and total N were not influenced by the various treatments. Urea applied alone or in combination with daincha was found better for increased N uptake by the rice plant.

INTRODUCTION

Nitrogen is the most important nutrient for rice. Most of the nitrogen is in the organic form with only a small fraction (2-3%) being converted to inorganic forms. Flooding a soil brings about a series of reactions which affect the availability of nutrients in the soil and the uptake by the plants. Very little information is available about the changes brought in lateritic rice soils following submergence in the presence of organic, inorganic and biofertilizers. Hence this study was taken up with a special reference to changes of nitrogen in these soils during submergence as well as in the plant during the various periods of rice growth.

MATERIALS AND METHODS

A field experiment was conducted during rabi 1982 in the lateritic rice soil of the Regional Agricultural Research Station, Pattambi. The soil of the experimental area was sandy clay loam with a pH of 6.70; Eh +110 mV, EC 0.20 dS/m; organic carbon 1.94%; total N 0.185%; NH_4-N 14.75 ppm; NO_3-N 13.5 ppm; hydrolysable N 12.50 ppm and non-hydrolysable N 1019.00 ppm. The treatment details are given in Table 1. Phosphorus and potassium were applied at 40 kg/ha P_2O_5 and K_2O as superphosphate and muriate of potash respectively. Organic manures viz., azolla, daincha and farm yard manure were applied five days prior to transplanting and incorporated well. Urea, superphosphate and muriate of potash were applied to the plots fully as basal on the day of transplanting. The test variety was Bharathy (115-120 days duration). For the collection of soil solution, piezometers were installed at 20 *an* depth in each plot. Wet soil samples, soil solution and plant samples were collected periodically and analysed for NH_4-N, NO_3-N, hydrolysable N, non-hydrolysable N, organic carbon and N uptake by plants adopting standard procedures (Bremner, 1965; Sim and Jackson 1971; and Jackson, 1958).

RESULTS AND DISCUSSION

The changes in NH_4-N under flooded conditions under the influence of various treatments are presented in Table 2. On the 5th day of observation a rapid increase in NH_4-N was observed. Then showed a decrease on 7 DAT followed by an increase on 9 DAT and then a progressive decrease from 13 DAT onwards. No treatment differences could be noticed during the first week of transplanting but from 9 DAT onwards, the treatment differences became significant. Application of dif-

Table 1. Changes in NH_4^+ concentration in soil solution at different intervals (ppm)

	Treatments	Days after transplanting 15	30
T_1	No nitrogen	5.74	2.19
T_2	30 kg N/ha as FYM + 30 kg N/ha as urea	7.84	5.52
T_3	30 kg N/ha as green (daincha) leaf + 30 kg N/ha as urea	7.56	1.69
T_4	30 kg N/ha as azolla + 30 kg N/ha as urea	5.60	2.44
T_5	60 kg N/ha as urea	5.54	3.28
T_6	45 kg N/ha as FYM + 45 kg N/ha as urea	5.37	2.53
T_7	45 kg N/ha as green (daincha) leaf + 45 kg N/ha as urea	9.47	5.02
T_8	45 kg N/ha as azolla + 45 kg N/ha as urea	5.94	2.51
T_9	90 kg N/ha as urea	5.55	1.40
Mean		6.51	2.75
CD (0.05)		1.184	1.986

NH4 in soil solution at 45 days after planting was only in traces.

Table 2. NH_4^+ N in soil (ppm) on oven day basis

Treatments	Days after transplanting 3	7	11	15	30	45	78
T,	12.57	18.87	16.29	12.58	6.67	4.33	1.83
T_2	12.79	21.99	21.39	17.64	10.01	5.94	2.00
T_3	17.12	22.46	30.19	24.12	20.12	6.03	2.13
T_4	17.56	24.06	22.38	21.15	9.25	6.84	2.10
T_5	15.72	20.42	23.08	20.18	9.69	6.93	1.96
T_6	14.35	23.51	30.33	20.60	10.09	5.93	1.93
T_7	16.70	25.92	28.77	15.88	32.31	8.30	2.03
T_8	16.69	20.32	20.90	16.84	15.05	5.17	1.86
T_9	17.61	23.77	23.06	20.96	13.96	4.71	2.06
Mean	15.68	22.37	24.04	18.88	14.13	6.02	1.99
CD (0.05)	NS	NS	3.143	4.418	3.986	1.215	0.125

Table 3. Uptake of nitrogen by plants, kg/ha

Treatments	15 DAT	30 DAT	45 DAT	Grain	Straw	Grain + Straw
T,	15.5	31.5	43.2	25.2	45.63	70.83
T_2	15.1	45.3	56.8	33.8	59.53	93.33
T_3	12.0	41.4	68.7	31.8	58.18	89.98
T_4	12.3	43.8	52.5	32.1	47.98	80.08
T_5	18.5	43.3	59.2	33.0	62.89	95.89
T_6	14.3	51.7	62.0	31.9	60.98	92.88
T_7	17.2	49.5	69.8	41.9	66.58	108.48
T_8	11.3	44.9	62.3	30.7	61.86	92.56
T_9	20.5	41.0	68.9	37.9	69.70	107.60
Mean	15.2	43.6	60.4	33.1	59.26	92.40
CD (0.05) •	NS	NS	NS	NS	13.585	16.09

DAT : Days after transplanting
NS : Not significant

Treatment details are given in Table 1.

ferent sources of N affected the kinetics of soil and solution NH_4-N. This can be attributed to the differential rates of docomposition of the various N sources. However, in general, the daincha treated plots were able to maintain high concentration of NH_4-N in the soil. NH_4^+ concentration reached peak values on the 5 DAT and at harvest the concentration was the minimum. When the soil solution content was observed on 15 and 30 DAT, there were significnant differences between treatments (Table 1). In general, it can be stated that there was marked reuduction in NH_4-N content from tillering to harvest. This may be due to the continued absorption of the mineralized NH_4^+ by the crop and also due to losses of N either by volatilization, leaching or denitrification (Velu *et al.*, 1986).

The changes in the contents of NO_3-N, hydrolysable N, non-hydrolysable N, organic carbon and total N were not influenced by the application of various treatments. The NO_3-N concentration was 2.17 ppm on 3 DAT which decreased rapidly to 1.09 ppm on 5 DAT and on 7 DAT the content further reduced to 0.86 ppm. From 7 DAT onwards little fluctuations in the concentration of NO_3-N were observed. At harvest (78th day) the mean concentration of NO_3-N was 0.82 ppm. In the soil solution, the NO_3-N content reduced continuously from 0.17 ppm at 15 DAT to traces at 45 DAT. This can be attributed to the leaching and denitrification losses of NO_3-N. The hydrolysable N content of the soil increased gradually from 975 ppm at 15 DAT to 1549 ppm at 45 DAT. At harvest the values decreased to 1189 ppm whereas the non-hydrolysable N increased from 1137 ppm at 15 DAT to 1271 ppm at 30 DAT, then it decreased to 1009 ppm at 45 DAT. At harvest the values slightly increased to 1045 ppm. Organic carbon content increased from the initial value of 1.94% to 2.39% and the total N content increased from 0.185% to 0.233% at harvest. The application of various organic N sources resulted in higher organic carbon and total N content in the soil after harvest.

Nitrogen uptake by the plant

The treatments had no influence in N uptake during the growth stages, but at harvest the effect of treatments became manifested when straw, and grain + straw were analysed. All the treatments except T_1 and T_4 were on par with regard to N uptake by the straw. For the uptake by the grain + straw T_9 and T_7 followed by T_5 showed the highest rates. The lowest rates of uptake were shown by T_1 and T_4 followed by T_3 Intermediate rates of uptake were shown by T_6, T_8 and T_2. In general, urea alone or in combination with daincha was found better for increased N uptake by the rice plant. The results also suggest that the N in daincha is easily mineralised and made available for the various functions of the rice plant. Farm yard manure and azolla were not as effective as daincha in influencing the content and uptake of N by the rice plant. The resistant fibrous plant materials in farm yard manure and high lignin content (18 - 24%) in azolla may be the reasons for their low performance when compared to daincha in influencing the N uptake by the rice plant (Alexander 1985).

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REFERENCES

Alexander, D. 1985. Ecophysiology of azolla and its management for rice production. Ph.D. thesis, Kerala Agricultural University, Vellanikkara, Kerala

Bremner, J.M. 1965. Organic and inorganic forms of nitrogen. *Method of Soil Analysis.* Black, C.A. (ed). Am. Soc. Agron. Madison, Wisconsin, USA, p. 1179 -1255

Jackson, M.L. 1958. *Soil Chemical Analysis.* Prentice Hall of India, Pvt. Ltd., New Delhi, p. 183-226

Sims, J.R. and Jackson, G.D. 1971. Rapid analysis of soil nitrate with chromotropic acid. *Proc. Soil Sci. Soc. Am. 35:* 603-606

Velu. V., Saravanan, A. and Ramanathan, K.M. 1986. Effect of NPK fertilizers on changes in the available nutrient content in a submerged rice soil. *Oryza* 23: 213-216

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