80 kg P_2O_5 per hectare for all the varieties. Similar results were obtained for K application also.

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Influence of N Levels on N Fractions and Nitrate Reductase Activity in Rice

by

T. RAMANUJAM[1] and J. SAKHARAM RAO[2]

Introduction: In rice cultivation, the general trend appears to be the application of more fertilizers, particularly nitrogenous, with the object of obtaining higher yields. Dastur and Malkani (1933) recorded that in certain rice varieties ammoniacal N decreased and nitrate N increased with the aging of crop and the *indica* varieties absorb more N than the *japonica* types. Ishizuka and Tanaka (1950) using N levels ranging from 0 to 200 ppm, observed increasing concentration of total N up to 60 ppm in the grains beyond which there was no change in the content of total N. In *indica* varieties, due to accumulation of more soluble N, the N metabolism itself gets disturbed at higher levels of N. A remarkable increase in total N content was noticed in rice by increasing N supply (Tanaka *et al.* 1964 and Murayama, 1965).

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1. Senior Research Assistant, I. A. R. I. Regional Centre, Coimbatore and 2. Reader in Plant Physiology, Agrl. College and Research Institute, Coimbatore.

Materials and Methods: ADT 27 strain of rice was selected for the study. Six levels of N *viz*. 30, 60, 90, 120, 150 and 180 kg N/ha with a control were tested under field conditions. The N was applied in three equal split doses namely at transplanting, after 30 and 40 days subsequent to transplanting. Basal dressings of 5000 kg green leaf manures, 45 kg P_2O_5 and 30 kg K_2O per ha were applied. The samples were analysed for total N including nitrate N (Humphris, 1956), protein N and non-protein N (Pregl, 1945), nitrite N (Humphris, *loc. cit.*), ammoniacal N (Pregl, *loc. cit.*), amide N (Shewan, 1938) and nitrate reductase activity (Eckerson, 1931).

Results: (i) *N fractions*: At *tillering stage* except nitrite N, ammonical N and amide N, rest of the fractions showed significant increase atleast in the highest three levels of N supplied to the crop (Table 1). Nitrate N content was 0.10% in the control as compared to 0.33% in the highest level of

TABLE 1. *Nitrogen fractions at Tillering Stage in relation to the Treatments*

Tt. no.	Nitrate nitrogen %	Nitrite nitrogen ppm	Ammoniacal nitrogen %	Amide nitrogen %	Non-protein nitrogen %	Protein nitrogen %	Total nitrogen %
C	0.10	74	0 06	0.09	0.28	1.58	1 86
T_1	0.09	75	0.10	0.09	0.32	1.72	2 04
T_2	0.23	74	0.08	0.08	0.42	1.82	2 24
T_3	0.29	67	0.09	0.10	0.45	1.98	2.43
T_4	0.33	67	0.10	0.11	0.48	2.24	2.72
T_5	0.32	65	0.11	0.11	0.58	2.42	3 00
T_6	0.33	74	0.10	0.12	0.60	2.50	3.10

C=Control; T_1=30; T_2=60; T_3=90; T_4=120; T_5=150 and T_6=180 kg N/ha

180 kg N/ha. Non-protein N showed 0.60% in T_6 (180 kg N/ha) and the control showed 0.28% As regards protein N and total N also a similar trend was seen with increasing levels of N application. The general trend at the *flowering stage* (Table 2) was that increasing values were obtained in all

TABLE 2. *Nitrogen fractions at Flowering Stage in relation to Treatments*

Tt. no.	Nitrate nitrogen %	Nitrite nitrogen ppm	Ammoniacal nitrogen %	Amide nitrogen %	Non-protein nitrogen %	Protein nitrogen %	Total nitrogen %
C	0.22	77	0.09	0.08	0.43	1.53	1 96
T_1	0.25	76	0.08	0.09	0.46	1.78	2.24
T_2	0.26	77	0.09	0.08	0.47	1.77	2.24
T_3	0 25	78	0.10	0 09	0.48	2.14	2 62
T_4	0.31	76	0.11	0.09	0.55	2.25	2.80
T_5	0.34	76	0.13	0.09	0.60	2.48	3.08
T_6	0.38	74	0.12	0.14	0.68	2.66	3.34

fractions of N as compared to the tillering stage. A maximum of 0.68% non-protein N, 2.66% protein N and 3.34% of total N 2.66% protein N and 3.34% of total N was recorded in T_6 (180 kg N/ha) as against 0.43%, 1.53% and 1.96% recorded in the control. At the *harvesting stage* (Table 3) there was a

TABLE 3. *Nitrogen fractions in Straw at Harvesting Stage in relation to Treatments*

Tt. no.	Nitrate nitrogen %	Nitrite nitrogen ppm	Ammoniacal nitrogen %	Amide nitrogen %	Non-protein nitrogen %	Protein nitrogen %	Total nitrogen %
C	0.09	75	0.01	0.03	0.16	0.56	0.72
T_1	0.10	67	0.01	0.02	0.19	0.59	0.78
T_2	0.10	65	0.02	0.03	0.19	0.69	0.88
T_3	0.11	68	0.01	0.04	0.20	0.72	0.92
T_4	0.12	67	0.02	0.02	0.20	0.72	0.92
T_5	0.13	60	0.03	0.03	0.22	0.80	1.02
T_6	0.12	68	0.03	0.03	0.21	0.80	1.01

marked decrease in all the fractions as compared to the earlier two stages. In grain (Table 4), the quantities of ammoniacal N and amide N were not only very low, but also indicated no relationship with the treatments. Non-protein N, protein N and total N showed gradual increase in grain in relation to the treatments.

TABLE 4. *Nitrogen fractions in Grain in relation to Treatments*

Tt. no.	Nitrate nitrogen %	Ammoniacal nitrogen %	Amide nitrogen %	Non-protein nitrogen %	Protein nitrogen %	Total nitrogen %
C	0.09	0.02	0.01	0.16	1.36	1.52
T_1	0.12	0.02	0.01	0.20	1.42	1.62
T_2	0.13	0.02	0.01	0.22	1.58	1.80
T_3	0.13	0.02	0.02	0.22	1.62	1.84
T_4	0.14	0.02	0.02	0.23	1.60	1.83
T_5	0.16	0.03	0.01	0.24	1.70	1.94
T_6	0.19	0.02	0.02	0.28	1.84	2.12

(ii) *Nitrate reductase activity*: The nitrate reductase activity (Table 5) at tillering stage was slightly lower than what was recorded in the control plot. At all the stages there was no particular indication of the influence of N levels on the activity of the enzyme. But the activity was more at flowering stage than at tillering stage in the case of lower levels of N.

TABLE 5. *Nitrate reductase activity in relation to Treatments expressed in mg of nitrite nitrogen per 100 g fresh tissue*

Tt. no.	Tillering stage		Flowering stage		Harvesting stage	
	Nitrate reductase activity	% on control	Nitrate reductase activity	% on control	Nitrate reductase activity	% on control
C	4.000	100.00	4.072	100.00	2.492	100.00
T_1	3.984	99.60	4.004	98.33	2.024	81.21
T_2	3.968	99.20	3.976	97.64	2.336	93.73
T_3	3.928	98.20	4.000	98.23	2.732	110.51
T_4	3.960	99.00	3.976	97.64	2.808	112.68
T_5	3.976	99.40	3.968	97.44	2.848	114.28
T_6	3.960	99.00	3.944	96.85	3.224	129.37

Discussion: A critical analysis of the different fractions of N in relation to levels of N indicated certain important trends. Nitrite N, ammoniacal N and amide N did not exhibit any significant differences in relation to N application, although there was some fluctuation. But nitrate N, non-protein N, protein N and total N showed increasing values corresponding to levels of N supplied. Many reports are available suggesting that in high fertility strains the above type of response has been common. Comparing several *indica* and *japonica* varieties, similar trend has been recorded in high fertility strains of *japonica* rices. Hence this appears to be a varietal character and ADT 27 being a high fertility strain, the observations made agreed with the findings of others (Tanaka *et al.*, 1958 and 1959; Murayama, 1965). The possible reason for the reduction in N fractions in the straw may be due to utilization of N fractions in the formation of grains by translocation from active straw at the time of grain formation.

The nitrate reductase activity showed clearly that a reduction was obvious with increase in levels of N. The reduction in the activity of this enzyme at earlier stages may be due to more accumulation of nitrate N in the treated samples. At harvesting stage the activity was somewhat increasing along with increased doses of N. This may be due to limited availability of nitrate N. The present view is in agreement with the work of Eckerson (1928) and Nightingale *et al.* (1931).

Summary: Application of graded levels of nitrogen to the high fertility strain of rice ADT 27 influenced the contents of nitrate nitrogen, non-protein nitrogen, protein nitrogen and total nitrogen. But contents of nitrite nitrogen, ammoniacal nitrogen and amide nitrogen were not affected to a reasonable degree by the treatments. There was a reduction in nitrate reductase activity with increasing levels of nitrogen.

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