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Effect of Forms and Levels of Fertilizer Nitrogen on the Quality of certain High Yielding Paddy Varieties*

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ABSTRACT

A pot culture experiment was conducted with three forms and five levels of N, to study their effects on the quality of high yielding paddy varieties. The results revealed that Karuna recorded higher crude protein content, followed by Kaveri and Kanchi but on the basis of crude protein production per pot, Kanchi excelled the other two varieties. Forms and levels of N had no effect on the crude protein content of grain. Ten amino acids were identified and the treatments had no influence on the total carbohydrate content.

INTRODUCTION

High yielding varieties are introduced with the main objectives of reducing duration, obtaining better response to fertilizer and increasing yield. But from the health point of view of the consumer of rice the quality by way of the nutrient content also needs to be considered. Deosthale and Pant (1970) indicated that coloured and coarse rice varieties were often richer in protein and total mineral content as compared to white and long-grained fine rice. Srinivasa Rao and Ramasastri (1969) showed that the protein content of high yielding rice varieties had negative correlation with the lysine content of the protein. The present study was undertaken to study the effect of forms and levels of fertilizer N on the quality of rice.

MATERIALS AND METHODS

A pot culture experiment with the high yielding paddy varieties Karuna (CO.33) (V_1), Kaveri (CO.35) (V_2) and Kanchi (CO.34) (V_3) and N levels at 0 (L_0), 40 (L_1), 80 (L_2), 120 (L_3) and 160 (L_4) kg/ha with half the quantities of P_2O_5 and K_2O at each level of N was laid out. N was applied in the form of ammonium sulphate (A), Urea (U) and sodium nitrate (S). Full dose of P_2O_5 and K_2O and half of N was applied at planting. The other half of N was applied at panicle initiation stage. Paddy grain was analysed for its nutritive value. Crude protein was arrived at by multiplying the total N (Humphries, 1956) content by a factor 6.25. Protein-bound amino acids in rice were estimated by unidimensional paper chromatography (Block *et al.* 1958) in the ethanol solution of HCl hydrolysate. The total carbohydrate was estimated by the calorimetric method of Somogyi (1952).

RESULTS AND DISCUSSION

Crude protein and total carbohydrate content and production in

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grain are presented in Table-I, amino acid content in Table 2 and summary of results in Table 3.

Crude Protein:

Karuna recorded higher crude protein content in grain followed by Kaveri and Kanchi. However, on the basis of crude protein production per pot, Kanchi excelled the other two varieties. Similar varietal influence on the protein content of cereals was reported by Garcha and Chopra (1968). Neither the forms of N nor the levels had produced any significant effect on the crude protein content of grain. Balanarasaiah and Rao (1967) reported similar result that increase in N application did not show any marked effect on the protein content of rice. Ammonium sulphate and urea were on a par and superior to sodium nitrate in crude protein production. The levels 120 and 160 kg N/ha recorded similar values and superior to 80 and 40 kg levels which were on a par and superior to control.

Total Carbohydrates:

The total carbohydrate content in grain was not influenced by any of the treatment whereas its accumulation in grain (gm/pot)was significantly higher in Kanchi followed by Kaveri and Karuna. Ammonium sulphate and urea were superior to sodium nitrate in this respect. Increased application of fertilizer increased the total carbohydrate accumulation in grain per pot.

Protein-Bound Amino Acids:

Ten amino acids were identified of which only six amino acids namely glutamic acid, aspartic acid, Leucine, glutamine, alanine and glycine were present in appreciable quantities. The other amino acids were asparagine, lysine, histidine and proline. Lysine, an important constituent of protein was present in limited quantities (Deosthale and Pant, 1970). Varietal influence was found to be present in the total amino acid content of rice with the highest value being recorded in Karuna, followed by Kaveri and Kanchi. Neither the forms of N nor the fertilizer levels appeared to have any effect on the total amino acid content. There was a significant positive correlation ($r=0.41$) between the amount of crude protein in rice and the total amino acid content. This was in accordance with Kik and Hall (1961).

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Table 1. Crude protein and total carbohydrate in grain

Particulars		Ammonium sulphate				Sodium nitrate				Urea			
	L_0	L_1	L_2	L_3	L_4	L_1	L_2	L_3	L_4	L_1	L_2	L_3	L_4
a) Crude Protein content (Percentage)													
Karuna	12.38	11.63	10.44	10.81	10.44	9.69	10.44	10.81	11.63	11.63	11.63	10.06	9.69
Kaveri	9.31	9.69	8.88	10.06	9.31	10.81	9.69	8.88	10.06	9.69	10.44	10.44	10.44
Kanchi	9.31	9.69	8.50	8.13	9.31	10.81	9.31	10.06	9.31	8.50	9.31	9.69	9.31
b) Crude protein production (gm/pot)													
Karuna	0.78	1.09	1.35	1.67	1.67	0.83	0.81	0.86	0.93	0.95	1.01	1.68	1.60
Kaveri	0.59	1.12	1.12	1.52	1.60	1.06	0.93	0.80	1.04	1.05	1.29	1.63	1.72
Kanchi	1.02	1 45	1 64	1.77	1.70	0.87	0.81	1.27	1.12	1.24	1.48	1.73	1.58
c) Total carbohydrate content (Percentage)													
Karuna	68.0	76.0	90.7	74.0	86.2	74.8	71.0	80.1	76.4	78.5	78.8	85.1	86.4
Kaveri	81.6	80.5	74.0	80.1	81.6	78.4	86.0	79.4	79.8	85.0	85.3	80.2	79.8
Kanchi	72.2	79.5	91.3	81.8	82.1	77.2	78.6	79.1	68.0	78.6	92.1	86.4	73.0
d) Total carbohydrate accumulation (gm/pot)													
Karuna	4.27	7.10	11.74	11.43	13.79	6.37	5.52	6.39	6.11	6.44	6.82	13.42	14.27
Kaveri	9.45	9.32	9.37	12.12	14.02	7.71	8.22	7.17	8.22	9.25	10.51	12.55	13.13
Kanchi	7.88	11.91	17.63	17.80	14.98	6.22	6.82	9.97	8.17	11.43	14.67	15.44	12.41

Table 2.
Protein-bound amino acids
(Mean values in mgm/gm)

	V_1	V_2	V_3	Mean
Glycine	1.00	0.82	0.58	0.80
Alanine	1.02	0.89	0.76	0.89
Leucine	1.70	1.44	1.20	1.45
Aspartic acid	2.80	1.87	1.79	2.15
Glutamic acid	5.28	3.18	3.70	4.05
Glutamine	0.95	1.12	0.95	1.01
Total	12.75	9.32	8.98	—

Table 3. Summary of results (mean values)

Particulars	Mean values					Conclusion		S. E_d	C. D. (P=0.05)
a) Crude Protein content (Percentage)									
i) Varieties	V_1	V_2	V_3			V $\overline{V_2 \quad V_3}$		0. 35	0. 75
	10.87	9.82	9.33						
b) Crude Protein production (gm/pot)									
i) Varieties	V_1	V_2	V_3			V_3 $\overline{V_2 \quad V_1}$		0.053	0.115
	1.17	1.19	1.36						
ii) Forms of Nitrogen	A	S	U			$\overline{A \quad U}$ S		0.059	0.120
	1.48	0.94	1.41						
iii) Fertilizer levels:	L_0	L_1	L_2	L_3	L_4	$\overline{L_4 \quad L_3 \quad L_2 \quad L_1 \quad L_0}$	L_0 Vs Rest	0.089	0.194
	0.80	1.07	1.16	1.44	1.44		L_1 to L_4	0.063	0.137
c) Total Carbohydrate accumulation (gm/pot)									
i) Varieties	V_1	V_2	V_3			V_3 V_2 V_1		0. 63	1. 38
	8.74	10.08	11.95						
ii) Forms of Nitrogen	A	S	U			$\overline{A \quad U}$ S		0. 65	1. 41
	12.60	7.24	11.70						
iii) Fertilizer levels	L_0	L_1	L_2	L_3	L_4	$\overline{L_3 \quad L_4 \quad L_2 \quad L_1} \quad L_0$	L_0 Vs Rest	1. 06	2. 31
	7.20	8.42	10.14	11.81	11.68		L_1 to L_4	0. 75	1. 63
d) Total Protein-bound amino acids									
i) Varieties:	V_1	V_2	V_3			V_1 $\overline{V_2 \quad V_3}$		1. 02	2. 22
	12.75	9.32	8.98						