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Effect of Different Levels of Nitrogen Intake on the Chemical Composition of Grain and Husk of Local and Hybrid Varieties of *Oryza sativa*

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Rice is a staple diet of Indian people especially in some of the thickly populated regions of the country. The agricultural scientists have been successful in producing high yielding hybrid varieties of rice and the producing of rice has been considerably increased. But little attention seems to have been paid to the nutritive values of these varieties. Nitrogen supply commonly limits grain yield in irrigated rice systems. The demand of the rice plant for other macronutrients mainly depends on the N supply. On the other hand, the average and receiving of fertilizer N is only about 30 %. Recently the use of sophisticated nitrifying inhibitors like isobutylidene urea, *etc*., have been recommended for supplying nitrogen. It is necessary to test the real worth of these costly new fertilizers in comparison to indigenously prepared cheap and slow nitrogen release fertilizers like urea treated with neem or other non-edible cakes, which hold considerable promise for increasing the efficiency of N-fertilization.

Key Words: Nitrogen, Grain, Husk, *Oryza sativa*.

INTRODUCTION

In most soils, nitrogen is most often deficient. As plants grow, they absorb nitrogen salts in the form of ammonium or nitrate ions from the soil. The harvesting of plant, results in the removal of nitrogen from the soils. After continued cultivation, the lack of nitrogen becomes evident through the characteristics symptoms which appear in plants subsequently grown in that soil. A reduced yield always results and the solution to the problem is merely to add nitrogen.

It has been shown in literature that the application of nitrogen, not only reduces the deficiency of nitrogen in the soil, but have an appreciable effect on the chemical composition of the plants which are grown on such soils[1-4]. If the quantity of nitrogen applied more than the requirement of the

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plant, it is likely that it will go a waste and may prove rather harmful. Therefore, in the present investigation an attempt is made to find an optimum dose of urea, which on its application to a rice crop, adequately enhance its nutritive value and make it a rich source of energy for the benefit of mankind.

EXPERIMENTAL

In the present experiment, the plots were uniformly treatment with phosphorus and potassium @ 60 and 40 Kg/ha respectively and the effect of the application of different doses of nitrogen *viz.*, 0, 40, 80 and 120 Kg/ha in the form of urea was studied on the chemical constituents of two varieties (one local ratna and the other hybrid IET-3262) of rice and husk such as total nitrogen, crude protein, albuminoidal nitrogen, non-protein nitrogen, total free amino acid, ether extract, total carbohydrate, total ash, insoluble ash, calcium, phosphorus, copper, iron, manganese and zinc.

Blocks of land was divided into 16 plots and to all of them were given phosphorus and potassium uniformly as described earlier. Nitrogen was applied in the form of urea at a rate of 0, 40, 80 and 120 Kg/ha to a set of two plots each. The seedlings of two varieties of rice were transplanted according to the farm practices. When the crop was ready the grain was dehusked carefully and the chemical analysis of both of them was performed for various constituents.

RESULTS AND DISCUSSION

The soil samples of each experimental plot were collected and analyzed for its major constituents and the results are given below in Table-1.

TABLE-1

Available nitrogen	182 Kg/ha
Available phosphorus	48 Kg/ha
Available potassium	210 Kg/ha
pH	7.4

The application of nitrogenous fertilizers to the soils is one of the important methods by which crop yield can be increased. If the plant fulfil its requirement of nitrogen from basal soil for optimum growth then the supplementation of nitrogen as fertilizer will go a waste and may rather prove to be harmful.

The optimum quantities of plant nutrients to be applied to rice depend upon the fertility level of the sol and the requirements of the variety planted. Tables 2 and 3 show that total N and crude protein content of both ratna

TABLE-2
TOTAL NITROGEN CONTENT OF RICE GRAINS AS AFFECTED BY THE DIFFERENT LEVELS OF FERTILIZER ON DIFFERENT VARIETIES (PER CENT ON DRY MATTER BASIS)

Levels	Varieties			
	IET-3262	Ratna	Total	Mean
0 Kg/ha	1.300	1.280	2.58	1.290
40 Kg/ha	1.360	1.330	2.69	1.345
80 Kg/ha	1.360	1.340	2.70	1.350
120 Kg/ha	1.390	1.340	2.73	1.365
Total	5.410	5.290	10.70	–
Mean	1.352	1.322	–	–

Analysis of variance of total nitrogen content

Source of variation	Degree of freedom	Sum of squares	Mean square	Variance ratio 'F'
Levels	3	0.00645	0.00215	21.5*
Varieties	1	0.00180	0.00180	18.0*
Error	3	0.00030	0.00010	–
Total	7	0.00855	–	–

Difference of means and critical difference

Between levels	Difference of means	Between levels	Difference of means
I and II	0.055*	II and III	0.005
I and III	0.060*	II and IV	0.020
I and IV	0.075*	III and IV	0.015
Critical difference at 5 % level			0.031

*Significant at 5 % level.

and IET-3262 varieties of rice have continuously increased with increasing N-fertilization up to a level of 120 kg/ha. The basal nitrogen content of the soil was 182 Kg/ha. This concluded that if the total N-output from the soil and the fertilizer is 302 Kg/ha, the two varieties of rice tried in present experiment would get their optimum N-requirement to ensure the highest level of total N or crude protein content in the rice grain. The further addition of any amount of N-fertilizer will not be fruitful. This has been supported by previous authors[1,2,5-8] who have recorded a continuous increase in the total N/crude protein content of rice. Khan and Pathak[9] recorded, unlike the above scientists, an increase in N-content of rice grain upto 75 ppm N and a decrease at 150 ppm N. Similarly an increase in crude protein content was recorded by Hongyo[10], up to N-fertilization level of 0.75 Kg N/acre which did not increase or decrease by further N-fertilization as observed

TABLE-2A
TOTAL NITROGEN CONTENT OF RICE HUSK AS AFFECTED BY THE DIFFERENT LEVELS OF FERTILIZER ON DIFFERENT VARIETIES (PER CENT ON DRY MATTER BASIS)

Levels	Varieties			
	IET-3262	Ratna	Total	Mean
0 Kg/ha	0.41	0.37	0.78	0.390
40 Kg/ha	0.42	0.39	0.81	0.405
80 Kg/ha	0.44	0.40	0.84	0.420
120 Kg/ha	0.45	0.40	0.85	0.425
Total	1.72	1.56	3.28	–
Mean	0.430	0.390	–	–

Analysis of variance of total nitrogen content

Source of variation	Degree of freedom	Sum of squares	Mean square	Variance ratio 'F'
Levels	3	0.0015	0.0005000	15.01*
Varieties	1	0.0032	0.0032000	96.09**
Error	3	0.0001	0.0000333	–
Total	7	0.0048	–	–

Difference of means and critical difference

Between levels	Difference of means	Between levels	Difference of means
I and II	0.015	II and III	0.015
I and III	0.030*	II and IV	0.020*
I and IV	0.035*	III and IV	0.005
Critical difference at 5 % level			0.018

*Significant at 5 % level; **Significant at 1 % level.

by previous workers[9,11]. They studied the effect of 0, 80, 120 lb.N/acre in the form of $(NH_4)_2SO_4$ on the protein content of three varieties of rice *viz.*, saturn, dawn and blue-belle extended over two years. In first year they recorded a slight increase in the protein content of saturn (6.06 to 6.31 %) and no change in dawn variety upto 120 lbs.N/acre. In the next year, however, Patrick and Hoskins[11] recorded an increase of 10-11 % in the protein content of all the three varieties with increase in N-fertilization. Thus variety of the rice also proved to be an important factor, besides the soil condition.

Tables 2 and 3 show that in the present experiment the total N/protein contents of hybrid as well as of local variety *viz.*, IET-3262 and ratna, both have recorded a continuous increase upto a level of 120 Kg N/ha as compared to the basal treatment. In the hybrid variety *viz.*, IET-3262, the increase in protein content was found from 8.15 to 8.70 % while in local variety *viz.*,

TABLE-3
CRUDE PROTEIN CONTENT OF RICE GRAINS AS AFFECTED BY THE DIFFERENT LEVELS OF FERTILIZER ON DIFFERENT VARIETIES (PER CENT ON DRY MATTER BASIS)

Levels	Varieties			
	IET-3262	Ratna	Total	Mean
0 Kg/ha	8.15	8.00	16.15	8.075
40 Kg/ha	8.50	8.32	16.82	8.410
80 Kg/ha	8.51	8.38	16.89	8.445
120 Kg/ha	8.70	8.39	17.09	8.545
Total	33.86	33.09	66.95	–
Mean	8.465	8.272	–	–

Analysis of variance of crude protein content

Source of variation	Degree of freedom	Sum of squares	Mean square	Variance ratio 'F'
Levels	3	0.24974	0.0832466	25.38*
Varieties	1	0.07411	0.0741100	22.59*
Error	3	0.00984	0.0032800	–
Total	7	0.33369	–	–

Difference of means and critical difference

Between levels	Difference of means	Between levels	Difference of means
I and II	0.335*	II and III	0.035
I and III	0.370*	II and IV	0.135
I and IV	0.470*	III and IV	0.100
Critical difference at 5 % level			0.182

*Significant at 5 % level.

ratna from 8.00 to 8.39 %. Thus it can be concluded that under such agro climatic and soil conditions, as were available during this experiment, hybrid variety of rice can undoubtedly, be considered better in respect of its response to N-fertilization which is in agreement with the results of Dutta and Barua[5] who fertilized nine varieties of rice at the level of 40 and 80 Kg N/ha and observed more increase in protein content in the grains of high yielding varieties than in those of local varieties. Ghosh *et al.*[6] conducted a series of experiments with different levels of N-fertilizers as 0, 50, 100, 150, 200 Kg N/ha on five varieties of rice *viz.*, IR-8, jaya, sabarmati, jamuna & taichung native-1 and reported increasing trends in the protein content up to the highest level except in one, the taichung native-1. The values of protein content differed from variety to variety. The minimum 9 % increase was observed in IR-8 and maximum 24 % increase in sabarmati.

TABLE-3A
CRUDE PROTEIN CONTENT OF RICE HUSK AS AFFECTED BY THE DIFFERENT LEVELS OF FERTILIZER ON DIFFERENT VARIETIES (PER CENT ON DRY MATTER BASIS)

Levels	Varieties			
	IET-3262	Ratna	Total	Mean
0 Kg/ha	2.57	2.28	4.85	2.425
40 Kg/ha	2.65	2.44	5.09	2.545
80 Kg/ha	2.78	2.48	5.26	2.630
120 Kg/ha	2.82	2.51	5.33	2.665
Total	10.82	9.71	20.53	–
Mean	2.705	2.427	–	–

Analysis of variance of crude protein content

Source of variation	Degree of freedom	Sum of squares	Mean square	Variance ratio 'F'
Levels	3	0.068438	0.0228126	21.81*
Varieties	1	0.154013	0.1540130	147.29**
Error	3	0.003137	0.0010456	–
Total	7	0.225588	–	–

Difference of means and critical difference

Between levels	Difference of means	Between levels	Difference of means
I and II	0.120*	II and III	0.085
I and III	0.205*	II and IV	0.120*
I and IV	0.240*	III and IV	0.035
Critical difference at 5 % level			0.102

*Significant at 5 % level; **Significant at 1 % level.

From the present experiment it can be concluded that, beside the similar conditions of soil and N-level, a variety has its own genetic behaviour and nature of protein synthesis. Kaul and Raghavish[8] have tried four levels 0, 60, 120, 180 Kg N/ha on three varieties *viz.*, basmati-370, sabarmati & IR-8 and observed a continuous increase in protein content. Singh and Modgal[1] applied four different levels 30, 60, 90 and 120 Kg N/ha on two dwarf indica varieties padma and bala in two consecutive years *i.e.*, 1972 and 1973 and reported an increase in protein percentage with the increasing dose of nitrogen. It is an interesting observation, as the dose of fertilizer changes from 30 to 120 Kg N/ha the value of protein in grain increase by 6 % in the year 1972 (*i.e.* from 6.99 to 7.42) and 10.2 % in year 1973 (*i.e.* from 7.13 to 8.0), showing that in addition to the level of N-supplied other factors such as different basal status of soil in different years also affected the

percentage of crude protein. To explain such behaviour, it is necessary to know the value of nitrogen in the soil and hence should be analyzed for its basic major constituents such as N, P and K every year.

In the present experiment where the levels tried were 0, 40, 80 and 120 Kg N/ha, the value of total N/crude protein increased till the highest level was obtained at 120 Kg N/ha. The present findings are in agreement with the workers[2,4,12], who have reported a continuously increasing trend in rice. Da Silva *et al.*[13] tried N-fertilizer in the range of 10 to 160 Kg N/ha over wheat IAS-59 and found highest protein at 160 Kg N/ha. Austin and Ahuja[14] tried three levels 0, 80 and 160 Kg.N/ha over two varieties of wheat *viz.*, kalyansona & heera and reported a marked increase in the protein content of the grain at 160 Kg N/ha whereas Jevtic and Malesevic have found a continuous increase in the protein content with increasing rates of N-fertilizer by using 20 to 200 Kg N/ha levels on wheat crops. Barszozak[15] tried 0, 75, 150, 300 Kg N/ha over grain of maize and reported an increase in protein content by 21 % at 300 Kg N/ha level. A continuous increase in the protein content have been reported by Andersen and Koeii[16] who tried 0, 1, 2, 3, 4, 5 and 6 g. N/pot levels over grain of barley; Kudzin[3] tried 60-90 Kg N/ha levels over wheat and barley. Yaroshenko[17] found four fold increase in crude protein at 120 Kg N/ha while studying grasses of parkswards on varying levels (0-120 Kg N/ha).

Hence, the above study makes it evident that the avoid undue wastage of N-fertilizer, it is always advisable to find out an optimum dose for the crop under experiment. In the other words, the cost of production of the grain with high nutritive value will be reduced by the optimum use of N-fertilizer.

Tables 2A and 3A give the total nitrogen and crude protein content in rice husk at different levels of nitrogen. Similar to rice grain, in husk also it was found that at the basal level where no N-fertilizer was used, the value of crude protein/total nitrogen was lowest and the contents were continuously increasing till the highest value was reached at 120 Kg N/ha as in rice grain. Since the pattern of variation in husk is similar as in rice grain, it can easily be concluded that the findings in grain will equally well apply to husk.

Table-2 clearly shows that the protein content of IET-3262 variety of rice is 8.465 % irrespective of level of N-fertilizer used, is significantly higher ($p < 0.05$) than the ratna variety tested in this experiment. These results indicate that nutritionally speaking IET-3262 variety is to be preferred over ratna variety, wherever the agro-climatic and soil conditions support the growth of IET-3262 variety. Singh & Modgal[1] studied two drawf indica varieties of rice on rain fed uplands and reported protein content was higher in bala than padma variety. Lai *et al.*[2] reported that the protein

content of TN-1 variety (7.0 %) was always higher than that of T-65 variety (6.3 %). A wide variation in protein contents (6.56 to 12.86 %) was observed by Baba[18] who had grown as many as 40 varieties of rice in Kashmir and recommended that the varieties rich in protein content may be utilized in rice-breeding programmes. Govindaswami *et al.*[12] studied the genetic coefficient of variability of protein contents of 32 indica varieties of rice and found genetic coefficient of variation was higher at higher N-rate under appropriate environment *viz.*, adequate nitrogen fertilization. This could be expected that the varieties which are genetically superior in protein content would readily respond and show out their potential. Efforts have been made by Ghosh *et al.*[6] to genetically improve the protein content of rice by providing not only the adequate supply of nitrogen to various varieties of rice but also by trying different locations providing a variation in soil cum-agro climatic conditions. They reported that the samples obtained from Mandya (Mysore) were superior over the samples obtained from Cuttack (Orissa) in their protein content. Similar considerations led many workers to study the protein content in different varieties of wheat[14,19-21], barley[16] and maize[15].

It has been established beyond doubt by the work of above scientists that the varietal and genetic difference in rice always exists and need proper investigation of different varieties for the selection. The results of the present experiment on the hybrid and local variety of rice grown in the Tarai region of Uttar Pradesh show that IET-3262 variety is better over the ratna variety tested.

Tables 2A and 3A show the total N and crude protein content of the rice husk in local and hybrid variety. Here IET-3262 gave a significantly higher value of crude protein (p 0.05) over ratna in both rice grain and husk.

Rice husk was being burnt or thrown away but recently it is being utilised as cattle feed and for this purpose husk of IET-3262 variety should be found nutritionally superior over ratna variety.

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