GAU Res. J. 1993, 18 (2) : 49-55

# Yield and Nutrient Uptake by Rice as Influenced by Nitrogen Management

K. B. Monapara, B. B. Kunjadia* and P. M. Mehta

Department of Agricultural Chemistry and Soil Science, Gujarat Agricultural University, Navsari-396 450

## ABSTRACT

Field experiment was conducted in split plot design with three replications at Model Agronomy Farm, Navsari (South Gujarat). There were 18 treatment combinations comprising 5 different N managements with 3 levels of N(40, 80 and 120 kg/ha) alongwith 3 controls using rice Cv. Ratna as test crop. From the results it was observed that the $T_5$ treatment i.e. urea briquettes application at the time of transplanting produced significantly higher grain (47.78 q/ha) and straw (63.48 q/ha) yields as compared to other treatments. The level $N_3$ (120 kg N/ha) also recorded higher yields of grain (46.41 q/ha) and straw (63.51 q/ha) than those observed with $N_1$ and $N_2$. The nutrient uptake also followed the similar trend as was observed with dry matter production, except P uptake wherein treatment $T_3$ i.e. urea coated with rock phosphate recorded higher uptake (17.82 kg/ha). The combination of $T_5$ $N_3$ found to increase grain production to the tune of 25 per cent over control. The positive interaction effect was noticed in the case of dry matter production, while it was not so with nutrient uptake.

*(Received on 22nd July, 1991)*

## INTRODUCTION

Nitrogen is a single dicisive factor monitoring the rice production. When rice grown in lowland condition, certain nitrogen loss mechanisms viz., volatilization and denitrification becomes more operative. In order to increase the nitrogen fertilizer use efficiency number of ways have been tried. But by all means, the efficiency seldomly exceeds 40 to 60 per cent (Azam *et al.*, 1985, Sarkar and Uppal, 1988). Some ways of increasing efficiency, comprises split application, coating of urea with some indigenous materials and by increasing particle size of urea i.e. urea briquettes. In view of the paucity of date for the rice growing tract of South Gujarat (Chromustert of Eru soil series), present investigation was planned and the results are reported here.

## MATERIALS AND METHODS

A field experiment was conducted in split plot design with three replication, at Model Agronomy Farm, Navsari (South Gujarat).

The treatments were :

$T_1$ : Full dose of N applied at the time of transplanting (T.P.)

$T_2$ : N applied in two equal splits through urea (II split after 50 days of trasplanting).

$T_3$ : Rock phosphate coated urea applied at the time of transplanting.

$T_4$ : Urea gypsum (30% N) applied at the time of transplanting.

$T_5$ : Urea briquettes (46% N) applied by making hole near hill below 6 cm at the time of transplanting.

$T_6$ : Control ($N_0$ nitrogen)

*Present address : Agricultural Officer, Department of Agril. Chemistry and Soil Science, College of Agriculture, Sardar Krushinagar-385 506.

These treatments were tried with three levels of N viz., $N_1$ = 40, $N_2$ = 80 and $N_3$ = 120 kg N/ha. In all there were 18 treatment combinations i.e. treatments ($T_1$ to $T_5$) with 3 levels of N (3 x 5=15) and three control.

An experimental soil was clayey in texture (62.3% clay), alkaline in reaction (pH=7.6), normal with respect to salinity (EC = 0.38 $dSm^{-1}$), low in N, medium in available P and high in available K content. The grain and straw samples (Cv : Ratna) were collected at harvesting and subjected to chemical analysis for N, P and K content by using standard procedures.

## RESULTS AND DISCUSSION

**Dry matter production** : The data reported in Table-1 show that the grain and straw yields of rice were significantly affected by the N management (T) and its levels (N) along with the interaction effect. The dry matter production was found to increase with the levels of N application and $N_3$ level recorded significantly higher drymatter than those obtained with $N_1$ and $N_2$. Among the different treatments, application of urea vriquettes ($T_5$) produced significantly higher yields of grain (47.78 q/ha) and straw (63.48 q/ha). The combination $T_5$ $N_3$ produced higher drymatter as compared to other combinations.

The higher yields of rice grain and straw could be due to the fertilizer responsive property of the rice crop in general and high yielding variety Ratna in particular. Similar beneficial effects of N application to rice were also reported by George (1980). The higher drymatter production under $T_5$ i.e. urea briquettes application at a depth of 6 cm might presumably due to the better availability of N through-out the growing period of rice. The results of present investigation are in close agreement with those reported earlier by Craswell and De Datta (1980) and Chen and Zhu (1982).

**Nutrient uptake**

The results pertaining to N, P and K uptake through grain and straw, are presented in tables 2, 3 and 4, respectively. The data clearly indicated that, the treatment as well as N levels individually significantly affected the nutrient removals. Whereas, the interaction effect was found to be non-significant in most of the cases. The N and K uptake by rice grain and straw followed an identical pattern as was observed for dry matter production. On the other hand the P uptake was higher in $T_3$ treatment i.e. rock phosphate coated urea. This might be due to addition of P and S through rock phosphate. Total uptake (grain + straw) of N by rice was of the order of 139.02 kg N/ha under $T_5$ treatment. Similarly, the combination $T_5N_3$ could derive 154.73 kg N/ha. The results are in accordance with the results of Prasad and Prasad (1980). In case of P and K uptake, the beneficial effect of coating of urea with rock phosphate were also reported by Singh and Modgal (1978).

From the results of present study, it is quite clear that N application to rice is a must. It is also evident from the increase in grain yield to the tune of 27% in case of $T_5$ treatment over control. Further, an application of N @ 120 kg/ha as urea briquette found superior to split application or coating of urea with rock phosphate or gypsum under lowland condition.

*TABLE 1*

**Grain and straw yield of rice (q/ha) as affected by nitrogen management.**

| Treatment | Grain | | | | Straw | | | |
|---|---|---|---|---|---|---|---|---|
| | Levels of Nitrogen | | | | Levels of Nitrogen | | | |
| | $N_1$ | $N_2$ | $N_3$ | Mean | $N_1$ | $N_2$ | $N_3$ | Mean |
| $T_1$ | 35.98 | 38.75 | 47.17 | 38.96 | 48.66 | 53.02 | 60.64 | 54.10 |
| $T_2$ | 39.20 | 43.06 | 45.83 | 42.69 | 53.56 | 55.91 | 63.91 | 57.80 |
| $T_3$ | 40.16 | 42.74 | 45.54 | 42.82 | 55.01 | 58.82 | 64.45 | 59.43 |
| $T_4$ | 39.69 | 44.13 | 45.11 | 43.24 | 54.47 | 58.70 | 61.91 | 58.16 |
| $T_5$ | 46.19 | 48.75 | 48.40 | 47.78 | 57.19 | 66.63 | 66.63 | .63.48 |
| $T_6$ | --- | --- | --- | 34.79 | --- | --- | --- | 46.30 |
| Mean | 40.24 | 43.49 | 46.41 | --- | 53.78 | 58.62 | 63.51 | --- |
| | Treat | N Levels | T x N | | Treat | N Levels | T x N | |
| C.D. at 5% | 3.1 | 0.63 | 1.53 | | 3.0 | 0.28 | 4.72 | |

TABLE 2

**Nitrogen uptake (kg/ha) by grain and straw as affected by nitrogen management.**

| Treatment | Grain | | | | Straw | | | |
|---|---|---|---|---|---|---|---|---|
| | Levels of Nitrogen | | | | Levels of Nitrogen | | | |
| | $N_1$ | $N_2$ | $N_3$ | Mean | $N_1$ | $N_2$ | $N_3$ | Mean |
| $T_1$ | 49.73 | 54.58 | 64.59 | 56.31 | 42.35 | 51.58 | 62.32 | 52.04 |
| $T_2$ | 58.57 | 68.31 | 74.00 | 66.99 | 52.06 | 57.45 | 69.16 | 59.56 |
| $T_3$ | 59.22 | 66.19 | 73.90 | 66.44 | 52.37 | 57.58 | 68.00 | 59.32 |
| $T_4$ | 57.25 | 66.46 | 73.49 | 65.73 | 58.81 | 59.65 | 66.34 | 59.60 |
| $T_5$ | 68.57 | 77.27 | 79.91 | 72.25 | 57.07 | 68.41 | 74.83 | 66.77 |
| $T_6$ | --- | --- | --- | 46.63 | --- | --- | --- | 39.46 |
| Mean | 58.67 | 66.56 | 73.18 | --- | 52.53 | 58.91 | 68.13 | --- |
| | Treat | N Levels | T x N | | Treat | N Levels | T x N | |
| C.D. at 5% | 7.34 | 2.74 | NS | | 4.74 | 5.10 | NS | |

TABLE 3

**Phosphorus uptake (kg/ha) by grain and straw as affected by nitrogen management.**

| Treatment | Grain | | | | Straw | | | |
|---|---|---|---|---|---|---|---|---|
| | Levels of Nitrogen | | | | Levels of Nitrogen | | | |
| | $N_1$ | $N_2$ | $N_3$ | Mean | $N_1$ | $N_2$ | $N_3$ | Mean |
| $T_1$ | 27.80 | 31.41 | 35.50 | 31.57 | 13.08 | 14.93 | 17.72 | 15.25 |
| $T_2$ | 31.00 | 35.42 | 39.86 | 35.50 | 14.39 | 16.12 | 18.67 | 16.40 |
| $T_3$ | 31.64 | 35.97 | 37.58 | 35.07 | 15.21 | 19.02 | 19.21 | 17.82 |
| $T_4$ | 30.98 | 35.16 | 38.19 | 34.78 | 14.58 | 16.55 | 18.12 | 16.42 |
| $T_5$ | 35.65 | 39.54 | 41.90 | 39.03 | 15.38 | 18.18 | 19.21 | 17.59 |
| $T_6$ | --- | --- | --- | 26.50 | --- | --- | --- | 12.76 |
| Mean | 31.41 | 35.50 | 38.61 | --- | 14.53 | 16.96 | 18.59 | --- |
| | Treat | N Levels | T x N | | Treat | N Levels | T x N | |
| C.D. at 5% | 3.37 | 1.21 | 2.98 | | 1.29 | 1.08 | NS | |

*TABLE 4*

**Potassium uptake (kg/ha) by grain and straw as affected by nitrogen management.**

| Treatment | Grain | | | | Straw | | | |
|---|---|---|---|---|---|---|---|---|
| | Levels of Nitrogen | | | | Levels of Nitrogen | | | |
| | $N_1$ | $N_2$ | $N_3$ | Mean | $N_1$ | $N_2$ | $N_3$ | Mean |
| $T_1$ | 17.94 | 19.30 | 21.55 | 19.60 | 98.88 | 111.78 | 128.99 | 113.21 |
| $T_2$ | 18.57 | 21.97 | 22.83 | 21.12 | 107.57 | 117.94 | 136.90 | 120.80 |
| $T_3$ | 20.49 | 21.80 | 22.75 | 21.61 | 110.59 | 132.41 | 135.82 | 126.32 |
| $T_4$ | 20.32 | 22.00 | 22.35 | 21.56 | 118.80 | 121.23 | 132.68 | 121.90 |
| $T_5$ | 22.40 | 24.28 | 22.95 | 23.21 | 115.53 | 138.26 | 141.24 | 131.67 |
| $T_6$ | --- | --- | --- | 17.74 | --- | --- | --- | 91.15 |
| Mean | 19.94 | 21.87 | 22.49 | --- | 110.27 | 124.32 | 135.13 | --- |
| | Treat | N Levels | T x N | | Treat | N Levels | T x N | |
| C.D. at 5% | 2.38 | 1.03 | NS | | 5.25 | 4.86 | 10.75 | |

## REFERENCES

Azam, F; K. A. Malik, M. I. Sajjad (1985). Transformation in soil and availability to plant of $N^{15}$ applied as inorganic fertilizer and legume residues. *Plant Soil*, **86** : 3-13.

Chen Rong-Ye and Zhu Zhao-Liang (1982). Characteristics of the fate and efficiency of nitrogen in super grains of urea. *Ferti. Res.* **3** (1) : 63-71.

Craswell, E. T. and S. K. De Datta (1980). Recent development in research on nitrogen fertilizers for rice. *Irri. Res. Series* **49** (5).

George I, Ghobrial (1980). Effect of levels, time and splitting of urea on the yield of irrigated direct seeded rice. *Plant Soil*, **56** : 209-15.

Prasad Mangal and Prasad Rajendra (1980). Yield and nitrogen uptake by rice as affected by variety, method of planting and new nitrogen fertilizers. *Ferti. Res.* **1** : 207-13.

Sarkar, M. C. and K. S. Uppal (1988). Nitrogen balance studies in wheat-maize cropping system using $N^{15}$ tracer measurement by mass spectrometry. Proc. IV National Symp. on 'mass spectrometry' Indian Institute of Sci. Bangalore. pp. Ac-1 : 1-4.

Singh, B. K. and S. C. Modgal (1978). Drymatter production, phosphorus and potassium uptake as influenced by levels and method of nitrogen application in rainfed upland rice. *Plant Soil* **50** : 691-701.