

Effect of split application of nitrogen on growth yield and N uptake in wetland rice (*Oryza sativa*)

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ABSTRACT

Nitrogen-use efficiency in wetland rice (*Oryza sativa* L.) was studied in a field experiment conducted during 1986 and 1987 at Pusa. The highest yield was obtained with 100 kg N/ha (40 kg N basal + 30 kg N at maximum tillering + 30 kg N/ha at panicle-initiation stage). However, it was similar to 80 kg N/ha when a fraction of it was applied basal. The N uptake, apparent recovery and its efficiency were also highest under 100 kg N/ha. Similar trend was recorded for the other ancillary characters and yield attributes.

The timing of nitrogen application is an important aspect of overall nitrogen management in rice (*Oryza sativa* L.) for efficient utilization of this nutrient. Proper time of N application minimizes its loss in rice fields, which depends on the amount of nutrient supply and also environmental conditions under which the crop is grown. Therefore, a field experiment was conducted to examine the fractional N application on lowland rice for obtaining more N-use efficiency.

MATERIALS AND METHODS

A field experiment was conducted at Pusa (Bihar) during 2 rainy (*kharif*) seasons of 1986 and 1987, using 'Pankaj' rice. The soil was calcareous silt loam, having pH 8.3, electrical conductivity 0.45 dS/m, organic carbon 0.7%, available P_2O_5 37 kg/ha and available K_2O 142 kg/ha. The rainfall received during the cropping period (June–November) was 780 and 1,561 mm in 1986 and 1987 respectively. All the

treatments (Table 1) were replicated 4 times in randomized block design. The recommended dose of 80 kg N, 40 kg P_2O_5 and 20 kg K_2O /ha was applied through urea, single superphosphate and muriate of potash respectively except the control. Besides this, a treatment (T_0) was also kept where N was applied @ 100 kg/ha in place of 80 kg/ha to increase more basal dose of N. The entire quantity of P and K were applied basal. Nitrogen was applied in splits (Table 1) to maintain different fractions. Seedlings of 30 days were transplanted at 20 cm × 15 cm spacing @ 2 seedlings/hill on 21 July 1986 and 11 July 1987. The crop was harvested at physiological maturity and grain yield was reported on 14% moisture basis.

RESULTS AND DISCUSSION

Growth and yield attributes

Application of fertilizers (NPK) showed a positive effect on vegetative growth and yield attributes (Table 1). Increased N application as basal with P and K increased

Table 1. Effect of N treatments on growth, yield and yield attributes of rice

Treatment	Final plant height (cm)		Panicles/m ²		Panicle length (cm)		Total spikelets/panicle		1,000-grain weight (g)		Grain yield (q/ha)		Straw yield (q/ha)	
	1986	1987	1986	1987	1986	1987	1986	1987	1986	1987	1986	1987	1986	1987
T ₁	89.8	92.3	208.6	202.8	20.7	20.5	94.2	93.7	20.5	20.8	18.8	24.9	26.2	31.2
T ₂	101.5	102.2	279.5	332.7	25.5	25.5	104.4	104.5	21.6	21.8	30.7	35.1	40.6	44.2
T ₃	103.3	104.5	298.1	342.3	25.2	26.6	105.6	104.3	22.1	22.3	33.4	43.8	41.4	53.3
T ₄	104.5	105.7	302.1	347.6	25.8	25.5	107.2	105.6	22.2	22.4	36.9	43.9	45.8	54.4
T ₅	105.0	106.2	303.1	353.4	25.4	25.6	106.8	106.2	22.1	22.4	37.3	42.4	46.0	54.6
T ₆	107.2	112.0	328.2	357.2	25.6	25.6	109.2	108.3	22.3	22.4	40.9	44.6	53.3	56.9
CD (P = 0.05)	5.0	9.2	18.2	33.6	3.2	3.5	10.2	7.3	1.3	1.9	8.9	4.9	6.3	5.1

T₁, Control (N₀P₀K₀); T₂, N₀ (B) + 30 (MT) + 50 (PI); T₃, N₁₆ (B) + 40 (MT) + 24 (PI); T₄, N₂₀ (B) + 30 (MT) + 30 (PI); T₅, N₃₀ (B) + 25 (MT) + 25 (PI); T₆, N₄₀ (B) + 30 (MT) + 30 (PI)

B, Basal; MT, maximum tillering; PI, panicle initiation

the magnitude of the characters, although they failed to differ significantly among themselves but were superior to no N as basal and the control. This might be due to more requirement of N at early stages of growth. The results confirm the findings of Sharma and Prasad (1984) and Sharma and Agarwal (1989).

Grain and straw yields

The cumulative effect of favourable growth and developmental characters resulted in higher grain yield under high N dose where more N was applied basal in both the years. However, all the treatments containing N splits as basal application were statistically similar. Most of the yield-contributory characters, particularly panicles/m² and spikelets/panicle, followed the trend of grain yield, which very well explains the effect of time of N application on the grain yield.

The straw yield was 26.2 – 53.3 q/ha in 1986 and 31.2 – 56.9 q/ha in 1987. T₆ treatment also recorded the highest straw yield in both the years and it was statistically

the same where N splits having basal dose even in lower amount was applied. This indicates that early application of N would have contributed more towards greater availability of N for root development, resulting in vigorous plant growth and higher straw yield. Patel (1982) also reported similar observations.

N uptake, utilization and its efficiency

Nitrogen uptake was maximum under T₆ treatment in both the years (Table 2). In the first year T₆ treatment showed superiority to the other treatments, whereas in the second year it was closely followed by all the other treatments, where N splits having the basal dose were applied. This might be due to more uptake at early stage of growth. Similar trend was obtained for apparent recovery by N also.

The efficiency of N applied to rice was judged by kg grain/kg applied N (Table 2). The efficiency of N was 14.9 – 27.6 kg grain/kg N in the first year and 12.8 – 24.6 kg grain/kg N in the second year. The lower efficiency of 14.9 kg grain/kg N (1986) and

Table 2. Nitrogen uptake, apparent recovery and its efficiency as affected by different N treatments in rice

Treatment	N uptake (kg) at harvest (grain + straw)		Apparent N recovery (%)		N-use efficiency (as grain yield kg/kg applied N)	
	1986	1987	1986	1987	1986	1987
T ₁	32.1	40.5				
T ₂	62.6	72.3	38.2	39.8	14.9	12.8
T ₃	72.1	91.7	49.9	64.1	19.2	23.6
T ₄	77.9	92.1	57.3	64.8	22.6	23.7
T ₅	79.0	90.3	58.8	62.3	23.1	21.9
T ₆	86.6	93.1	68.1	65.8	27.6	24.6
CD (P = 0.05)	5.3	7.6				

Details of treatments are given under Table 1

12.8 kg grain/kg N (1987) was observed in T_2 treatment, which might be due to lower early availability of N. The highest efficiency of N (27.6 kg grain/kg N in 1986 and 24.6 kg grain/kg N in 1987) was observed in T_6 treatment (Table 2). This maximum efficiency of N might be due to more absorption and utilization of added N under T_6 treatment.

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