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Influence of delayed basal dressing and split application of nitrogen in wet-seeded rice (*Oryza sativa*)

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ABSTRACT

A field experiment was conducted during *samba* (September–January) 1998–99 and 1999–2000 to study the effect of skipping basal dressing and split application of nitrogen in wet-seeded rice (*Oryza sativa* L.). Skipping basal N and applying it 21 days after sowing increased the plant height, leaf-area index (LAI) and dry-matter production (DMP). Split application of N in 5 splits promoted these parameters significantly. These treatments increased the yield parameters and yield of wet-seeded rice. Delayed basal application of N at 21 days after sowing (DAS) and fractional application N in 5 splits increased the soil available nutrients and N uptake. Fertilizer-use efficiency, viz. N-use efficiency and recovery fraction, also increased by adopting this method of N application.

Key words : N splits, Wet-seeded rice, N-use efficiency, Recovery fraction

Direct-seeded rice accounts for 35% of the total cultivated area in India. Nitrogen is the key nutrient, which plays a dominant role in promoting the plant growth and yield of rice. Under direct-seeding in the puddled soil (wet seedling), alternate wetting and drying is practised in the early-establishment stage causing loss of basally applied N (Sahoo *et al.,* 1990). Hence it is important to assess the effect of delayed application of N to improve its use efficiency. Keeping this in view, a field experiment was conducted to find out the feasibility of delaying the basal N application and appropriate method of split application of N in the wet-seeded rice.

MATERIALS AND METHODS

A field experiment was conducted at the Central farm, Agricultural College and Research Institute, Madurai, Tamil Nadu, during *samba* seasons (September–January) of 1998–99 and 1999–2000. The soil was sandy loam classified as Udic Haplustalf. It was low in available N (238 and 224 kg/ha), medium in available P_2O_5 (14.5 and 14.3 kg/ha) and K_2O (230 and 215 kg/ha), with pH 7.6 and 7.4 respectively, during both the years. The experiment was laid out in a factorial randomized block design replicated 3 times. The plot size was 32 m^2. Pre-germinated seeds of the rice 'IR 20' was sown using a drum seeder. The factors such as time of basal N and splits of N application were tested. Basal N application treatments included : at sowing, 7, 14.21 days after sowing (DAS). The split application of N consisted of 2 splits (equal splits at basal and panicle initiation), 3 splits (50% N at basal, 25% N at maximum tillering, 25% at panicle initiation), 4 splits (16.5% N at basal, 33.5% N at maximum tillering, 33.5% N at panicle initiation and 16.5% N at heading stages) and 5 splits (equally at basal, early tillering, active tillering, panicle initiation and heading). General fertilizer recommendation of 150, 50 and 50 kg N, P_2O_5 and K_2O/ha was followed. Phosphorus as single superphosphate was applied basal. Nitrogen as urea was split applied as per the treatment schedule along with potash as muriate of potash. Growth parameters such as plant height and leaf-area-index (LAI) were assessed at flowering stage. Dry-matter production (DMP), yield parameters and grain yield were recorded at harvest. Post-harvest soil was analysed for available N, P and K. Nitrogen uptake at different growth stages was worked out. Fertilizer response such as nitrogen-use efficiency (NUE) as the ratio of grain yield: quantity of fertilizer N applied and recovery fraction (RF) as the ratio of nutrient uptake: nutrient added was worked out. Pooled analysis of the data for 2 years was done.

RESULTS AND DISCUSSION

Growth parameters

The growth parameters like plant height, leaf-area index (LAI) and dry-matter production (DMP) were significantly influenced by skipping the basal dressing and fractional application of N. Delayed basal dressing of N at 21 days after sowing (DAS) produced taller plants than basal N applied at sowing. Fractional application of N at 5 critical stages showed significantly higher plant height than the other method of split application. Skipping basal application of N and 21 DAS increased the foraging capacity of plants and resulted in larger leaves contributing higher LAI, as was also reported by Choubey *et al.* (1985). Among the N splits, 5-split application produced more LAI. Significantly higher dry-matter production was recorded with dalayed basal dressing of N at 21 DAS and 5 splits due to increased plant height and LAI.

Yield attributes and grain yield

Basal dressing of N at 21 DAS produced more number of panicles, panicle weight and filled grain percentage. Among the N splits, 5 split application had greater impact on enhancing the yield parameters compared to 4 or 3 splits. This might be attributed due to better tiller production, sustenance of number of panicles and their development under continuous supply of nutrients (Karuna Sagar and Rama Subba Reddy, 1992).

The highest grain yield (43.6 q/ha) was obtained under delayed basal dressing of N at 21 DAS. The yield increase due to this treatment was 17.3% over basal N application. The results are also in accordance with those of Kandasamy (1997). Five-split application of N recorded comparatively higher grain yield (42.4 q/ha) than other methods of N application. Effective utilization of N at critical stages of crop growth ultimately led to higher grain yield (Kandasamy and Palaniappan, 1990) (Table 1).

Soil available nutrients

The nutrient availability was the maximum in the plots receiving basal N at 21 DAS, followed by N application at 14 DAS. Application of basal N at 7 DAS or at the time of sowing did not increase the available nutrient content. Available nutrient status was also improved due to N application in 5 splits. Higher available N status in the post-harvest soil with delayed basal N application and 5 splits might be due to reduction in N losses and continuous availability (Humphrey *et al.,* 1987).

Nitrogen uptake

There was a steady increase in N uptake by the crop at different growth phases from seedling to harvest (130 DAS) and it was higher at harvest. Nitrogen uptake was significantly higher due to delayed application of basal N at 21 DAS. The N uptake due to basal N application at 14 DAS did not vary significantly with 21 DAS at the stages of 30 DAS and at harvest. Nitrogen uptake did not increase significantly due to basal N application at 7 DAS as compared to N application at sowing. Nitrogen uptake was lower because of basal N application at sowing. With respect to N scheduling, split application of N at 5 stages significantly increased the N uptake. A significant increase in N uptake due to split application was also reported (Diekmann *et al.,* 1993).

Fertilizer-use efficiency

Nitrogen-use efficiency of the applied N was improved by delayed basal dressing of N at 21 DAS and N splits at 5 critical growth phases. This might be due to higher grain yield obtained with these treatments. The results are in agreement with the findings of Prasad and Rao (1989). Recovery fraction of applied N was higher when for initial N application at 21 DAS. This was in accordance with Kandasamy (1997). Application of N in 5 splits increased the recovery fraction (Table 2).

Thus, delayed basal dressing of N at 21 days after sowing along with the application of N in 5 equal splits (equally

Table 1. Effect of delayed basal dressing and split application of N on plant growth, yield parameters and yield of rice (mean data of 2 years)

Treatment	Plant height (cm)	Leaf-area index	Dry matter (kg/ha)	Panicles (No./m^2)	Panicles weight (g)	Filled grains (No.)	Grain yield (kg/ha)
Basal N							
At sowing	90.8	4.52	8,558	311	2.08	70.0	3,719
7 DAS	92.6	5.24	9,040	320	2.24	74.2	3,933
14 DAS	95.3	5.47	9,664	365	2.34	78.9	4,093
21 DAS	101.1	5.50	10,110	372	2.38	81.2	4,362
CD (P=0.05)	2.67	0.059	267	10.4	0.043	3.8	147
N split							
2 splits	92.3	4.73	8,657	324	2.15	73.2	3,774
3 splits	94.9	5.18	9,218	333	2.24	74.7	3,942
4 splits	95.4	5.27	9,540	350	2.31	76.6	4,090
5 splits	97.4	5.29	9,943	360	2.41	78.0	4,242
CD (P=0.05)	2.67	0.060	267	10.4	0.093	3.8	147

DAS, Days after sowing

Table 2. Effect of delayed basal dressing and split application of nitrogen on soil available nutrient, N uptake and fertilizer-use efficiency (mean data of 2 years)

Treatment	Soil available nutrient (kg/ha)			N uptake (kg/ha) at days after sowing					NUE	RF
	N	P	K	30	55	80	105	130		
Basal N										
At sowing	246	11.8	208	12.5	38.9	62.8	80.4	92.9	24.8	0.62
7 DAS	254	12.6	213	13.4	40.9	69.4	81.3	99.0	26.3	0.67
14 DAS	262	12.9	221	14.4	50.6	73.5	84.3	106.5	27.4	0.71
21 DAS	280	14.2	231	15.4	53.6	80.5	92.3	109.7	28.4	0.73
CD (P=0.05)	5.15	0.18	5.5	1.00	2.80	4.70	3.20	4.20	0.86	0.014
N splits										
2 splits	258	12.6	214	13.2	43.6	67.5	80.1	95.4	25.3	0.64
3 splits	261	12.8	217	13.7	45.0	69.8	82.1	99.5	26.3	0.67
4 splits	263	13.0	220	14.1	46.8	72.8	85.2	104.7	27.3	0.70
5 splits	267	13.3	223	14.5	48.6	76.0	86.5	108.9	27.9	0.73
CD (P=0.05)	5.15	0.18	5.45	1.00	2.80	4.70	3.20	4.20	0.86	0.014

NUE, Nitrogen-use efficiency (kg grain/kg N); RF, recovery fraction (kg N uptake/kg N)

at basal, early tillering, active tillering, panicle initiation and heading stages) could be an appropriate N management technique to improve growth and yield of wet-seeded rice and to improve the fertilizer use.

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