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Nitrogen management on crop growth and yield of puddled wet seeded lowland rice

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Abstract : Field experiments were conducted for two years (1998 - 2000) to study the effect of delayed basal dressing and split application of N in wet seeded rice (IR 20). The time of basal N application comprised of four treatments: basal N at the time of sowing, 7,14, and 21 DAS. The method of N scheduling comprised of two splits (basal and panicle initiation), three splits (50% basal, 25% maximum tillering and 25% panicle initiation), four splits (16.5% basal, 33.5% maximum tillering, 33.5% panicle initiation and 16.5% heading), and five equal splits (basal, early tillering, maximum tillering, panicle initiation and heading stages). The results of the study indicated that delayed basal dressing of N at 21 DAS and fractional application of N in five equal splits promoted LAI, LAD, CGR and RGR enabling higher grain and straw yield.

Keywords: Wet seeded rice, Basal N, Split application of N

Introduction

Among many systems office culture, direct seeded rice accounts for about 33 per cent in India. Since the age-old practice of transplanting is labour intensive, direct seeding with pre-germinated seeds (wet seeding) is an option in areas of labour scarcity. The results of several studies indicated that skipping basal application of fertilizer N is more beneficial to wet-seeded rice. This is due to the fact that alternate flooding and drainage of water being adopted in the early establishment stages of wet seeded rice cultivation also favour loss of basally applied N (Sahoo *et al.* 1990). If the basal N application is delayed until seedling establishment, there will be greater chances of N recovery and yield improvement. There is also risk of more N loss, if larger quantity of N is applied as a single dose. The effective N management maximize N uptake at the critical phases of crop growth to ensure that N absorbed by the plant is used for grain production (De Datta, 1981). Hence, the current experiment was undertaken to study the feasibility of delaying basal N with appropriate split application in wet seeded rice.

Materials and Methods

Field investigations were carried out at Agricultural College and Research Institute, Madurai, Tamil Nadu during *Samba* season (Sep - Feb), 1998 - 1999 and 1999 - 2000. Factors such as time of basal N and split application were tested in a Factorial Randomized Block Design with 3 replications. Timing of basal N application was: at sowing, 7, 15 and 21 days after sowing (DAS). N Splits were: two equal splits (50 % each) at basal (B) and panicle initiation (PI), 3 splits at 50% B, 25% active tillering (AT), 25% PI, 4 splits at 16.5% at B, 33.5% AT, 33.5% PI and 16.5% Heading (H) and five equal splits (20 % each) at B, early tillering, AT, PI and H. A high yielding medium duration

(130-135 days) rice cultivar, IR 20 was the test variety. Pre-germinated seeds (80 kg/ha) were sown in the puddled field using drum seeder maintaining a uniform spacing of 20 cm between the rows. Common fertilizer dose of 150-50-50 kg N, P_2O_5 and K_2O per hectare was adopted and no organic manure applied. Nitrogen (Urea) was split applied as per the treatment schedule .Potash as muriate of potash was split applied along with N at various stages. Phosphorus (single super phosphate) was basally applied during last puddling. Irrigation was regulated for 15 days to obtain uniform germination and establishment of seedlings. Subsequently the crop was irrigated one day after disappearence of previousoly ponded water. Pre-emergence herbicide, butachlor (1.25 Kg a. i. ha^{-1}) was applied on 8 DAS and a hand weeding on 35 DAS was adopted. Excess seedlings were removed gap-filled and a spacing of 10 cm between the hills in the row was maintained during weeding. Calculations were made for different growth indices such as Leaf Area Index (LAI), Leaf Area Duration (LAD), Crop Growth Rate (CGR) and Relative Growth Rate (RGR) at different growth stages. Grain yield was recorded at 14% moisture and the straw yield as sun-dried. Pooled data for two years (1998-1999 and 1999 - 2000) are presented.

Results and Discussion

Leaf area index and Leaf area duration

The parameters such as LAI and LAD gradually increased from 30 DAS (seedling stage) and attained its maximum at 105 DAS (grain filling stage). Application of basal N at 21 DAS recorded significantly higher LAI and LAD at all the phenophases. At 105 DAS, LAI recorded with this treatment was 5.50 with LAD 123. Application of basal N at 14 DAS was comparable with 21 DAS during grain filling stage. Application of basal N at the time of sowing and at 7 DAS reduced these parameters at all the stages. At 105 DAS, LAI and LAD recorded with basal N was 4.52 and 108 respectively. Five split application of N was found to increase the LAI and LAD (5.29 and 121 respectively at 105 DAS). This could be attributed due to continuous availability of N at different growth stages (Panda and Rao, 1991). Dhyani and Mishra (1994) also reported that split application of N maintained higher leaf area and leaf duration and increased the photosynthetic activity.

Growth rate of rice

The RGR was higher during the early growth phase (0-30 DAS) and declined during 80-105 DAS while the reverse trend was observed with CGR. Mac and Ohira (1981) reported a progressive increase in CGR which reached its peak around heading stage and then decreased gradually. Gilmour (1985) observed a relatively constant mean relative growth after late tillering in rice. Application of basal N at 21 DAS showed higher CGR and RGR during all the stages of crop growth. Increased CGR of 13.17 $g/m^2/day$ was recorded with this treatment at 80-105 DAS. Higher RGR observed due to delayed basal dressing of N was 246.8 mg/ g/day) at 30-55 DAS. This was followed by basal N at 14 DAS. Application of N at sowing reduced the growth rate of CGR and RGR (11.05 $g/m^2/day$ at 80-105 DAS and 244.8 mg/ g/ day at 0-30 DAS respectively). Nitrogen scheduling exhibited significant influence on the growth rate. Five split application of N increased the CGR and RGR (13.05 $g/m^2/day$ at 80-105 DAS and 247.6 mg/g/day at 0-30 DAS respectively) than other methods of N splits. This was due to increased drymatter accumulation recorded at all growth stages with more number of splits. The results are in line with Chandragiri and Iruthayaraj (1981). Growth rate was much reduced when N was applied in two splits (Table 2).

Table 1. Leaf Area Index and Leaf Area Duration as influenced by delayed basal N and N splits in wet seeded rice (Pooled for 2 years)

Treatments	LAI				LAD		
	30	55	80	105	30-55	55-80	80-105
Basal N							
At sowing	1.41	3.30	4.09	4.52	59	93	108
7 DAS	1.57	3.36	4.22	5.23	61	95	118
14 DAS	1.59	3.47	4.28	5.47	63	97	122
21 DAS	1.67	3.65	4.37	5.50	67	100	123
CD (P=0.05)	0.034	0.065	0.039	0.059	1.44	1.72	1.27
N Splits							
2 Splits	1.42	3.26	4.17	4.43	59	93	115
3 Splits	1.51	3.30	4.19	5.18	60	94	117
4 Splits	1.63	3.60	4.28	5.27	65	99	119
5 Splits	1.65	3.62	4.31	5.29	65	100	121
CD (P=0.05)	0.034	0.065	0.039	0.059	1.44	1.72	1.27

Table 2. Crop Growth Rate and Relative Growth Rate as influenced by delayed basal N and splits in wet seeded rice (Pooled for 2 years)

Treatments	CGR ($g/m^2/day$)				RGR (mg/g/day)			
	0-30	30-55	55-80	80-105	0-30	30-55	55-80	80-105
Basal N								
At sowing	6.19	7.37	8.19	11.05	244.8	27.2	19.5	16.7
7 DAS	6.42	7.75	8.75	11.76	245.9	30.6	20.0	17.1
14 DAS	6.65	8.05	9.05	12.99	247.2	32.2	20.4	17.9
21 DAS	7.14	8.91	9.30	13.17	246.8	33.4	20.7	18.1
CD (P=0.05)	0.64	0.61	0.33	0.65	1.2	1.0	0.8	0.8
N Splits								
2 Splits	6.48	6.87	8.63	11.45	246.2	28.4	19.9	16.7
3 Splits	6.55	7.49	8.77	12.23	246.5	30.5	20.4	17.4
4 Splits	6.67	7.96	8.91	12.48	247.2	31.5	20.6	17.5
5 Splits	6.74	9.05	9.93	13.05	247.6	34.1	20.9	17.6
CD (P=0.05)	0.63	0.61	0.332	0.65	1.2	1.0	0.7	0.8

Table 3. Yield of wet seeded rice (kg / ha) as influenced by delayed basal N and N splits (Pooled for 2 years)

Treatments	Grain yield	Straw Yield
Basal N		
At sowing	3720	4837
7 DAS	3935	5105
14 DAS	4093	5376
21 DAS	4263	5590
CD (P=0.05)	147	193
N Splits		
2 Splits	3774	4974
3 Splits	3940	5166
4 Splits	4090	5356
5 Splits	4200	5593
CD (P=0.05)	147	193

Grain and Straw Yield

Skipping basal N and applying at 21 DAS produced higher grain and straw yield (4.3 and 5.6 t/ha respectively) over basal N application at the time of sowing (3.7 and 4.8 t/ha respectively). Grain yield increased to the tune of 15 per cent with the delayed basal application of N on 21 DAS as compared to N application at sowing. Regarding scheduling of N, five split application recorded higher grain and straw yield (4.2 and 5.6 t/ha respectively). The yield of grain and straw was much reduced with the application of N in two splits (3.8 and 5.0 t/ha respectively). The marked increase in grain yield by the application of N in five splits might be due to the favourable influence on growth attributes, effective utilization of N at needy steges of crop growth from seedling to maturity . This was in accordance with the findings of Kandasamy and Palaniappan (1990), Chakravarti and Chalam (1992) and Sivasamy et. al. (1994).

It could be concluded from the results that basal of N can be delayed for 21 days than apply at sowing for wet seeded rice. Five split application of N at various critical phases (21 DAS, early tillering, maximum tillering, panicle initiation and heading stages) at 15 days interval promoted growth rate and yield of wet seeded rice.

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