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RESPONSE OF WINTER RICE TO DIFFERENT WATER REGIMES AND NITROGEN LEVELS

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Abstract: A sutudy was conducted at the Agrnomic Research Station, Chalakudy for three consecutive winter (second crop) seasons from 1983-84 to 1985-86 to study the effect of different water regimes and nitrogen levels on the growhth and yield of short duration rice variety Triveni. Four water regimes (continuous submergence of 5±2 cm and 7 cm irrigation after one, three and five days of the disappearance of ponded water) and four levels of nitrogen (0, 35, 70 and 105 kg N/ha) in factorial combinations constituted the treatments.

The study indicated that irrigation for rice during the second crop season is to be scheduled five days after the disappearance of ponded water at a depth of 7 cm especially when the ground water table is shallow and the evaporative demand of the atmosphere is low. This schedule saved approximately 70 per cent of the irrigation water used to maintain continuous submergence without any appreciable reduction in grain and straw yields. Application of 70 kg N/ha recorded the maximum grain yield among the nitrogen levels. The response equation was quadratic in nature. The physical optimum dose of nitrogen was found to be 88.2 kg/ha. The response to nitrogen application was not influenced by the variation in irrigation management.

INTRODUCTION

The winter or second crop rice in Kerala is often subjected to moisture stress particularly during the later growth stages leading to heavy yield reduction. Though the productivity of the winter rice could be stabilisd to a large extent in the irrigation commands, adoption of faulty irrigation practices in the upper reaches of the command areas has been causing water shortage in the tail ends. The present ivestigation was undertaken to formulate an optimum water regime for winter rice so as to judiciously utilize the scarce water resources. It was also intended to study the response to nitrogen application under different water management practices.

MATERIALS AND METHODS

The experiment was conducted at the Agronomic Research Station, Chalakudy for three consecutive second crop seasons (October to January) from 1983-84 to 1985-86. The soil type was riverine alluvium belonging to sandy loam textural class. The bulk density and pH of the soil were 1.41 g/cc and 5.4, respectively. The soil contained 0.55 per cent organic carbon and 6.5 and 37.4 kg/ha of available P and K, respectively. The data on precipitation, pan evaporation and the fluctuations in ground water table during the cropping season are furnished in Table 1. The crop received 355 mm, 70 mm and 208 mm of rainfall in 28, 8 and 10 rainy days during the first, second and third years of study, respectively. The evaporation rate exceeded 4 mm/day only in two weeks during the entire experimental period. The ground water table was within 38 cm, 24 cm and 33 cm during the first, second and third year, respectively.

The treatments consisted of four water regimes (continuous submergence of 5 ± 2 cm and 7 cm irrigation after one, three and five days of the disappearance of ponded water) and four nitrogen levels (0, 35, 70 and 105 kg N/ha). The treatments were laid out as a factorial experiment in randomised block design with three replications. The test variety was Triveni, three-week-old seedlings of which were transplanted at a spacing of 15 cm x 10 cm. The details of irrigation given to

Table 1. Weather conditions and groundwater fluctuations in the experimental area

Standard week	1983-84				1984-85				1985-86			
	Rain fall (mm)	Rainy days	PE (mm/ day)	CWT (cm)	Rain fall (mm)	Rainy days	PE (mm/ day)	CWT (cm)	Rain fall (mm)	Rainy days	PE (mm/ day)	CWT (cm)
39	70.1	7	3.48	29.8								
40	72.7	5	2.94	31.2								
41	-	-	3.31	29.7								
42	3.5	1	3.16	30.2								
43	42.8	4	2.76	35.6								
44	87.7	6	2.87	33.4	2.2	-	3.60	11.0	10.2	1	3.12	10.2
45	70.7	3	3.25	34.9	14.2	2	4.29	13.8	110.8	3	1.99	9.0
46	-	-	2.07	33.6	-	-	3.86	16.5	4.0	1	2.38	12.7
47	2.6	1	2.80	33.6	12.2	2	4.04	18.2	-	-	1.95	9.6
48	-	-	3.41	35.3	13.0	1	3.52	19.3	-	-	3.43	10.2
49	4 4	1	3.16	38.0	10.2	1	3.98	19.8	8.6	2	2.93	16.6
50					-	-	3.11	17.8	12.4	?	2.39	23.2
51					-	-	3.32	19.0	37.0	1	3.36	18.3
52					-	-	3.39	20.0	-	-	3.39	25.0
1					3.6	1	2.92	22.0	-	-	3.02	29.4
2					14.1	1	3.44	24.0	0.6	-	3.36	33.0

PE = Pan evaporation; GWT = Ground water table

the various treatmemts are furnished in Table 2.

All the plots received 35 kg/ha each of P_2O_5 and K_2O and nitrogen as per treatments. Full dose of phosphorus was applied as basal. Potash was applied in two euqual splits at planting and panicle initiation. Half the dose of nitrogen was applied as basal and the remaining half in two euqual splits at active tillering and panicle initiation stages. Other cultural and management practices were carried out as per the package of practices recommendations of the Kerala Agricultural University (Anon., 1983).

RESULTS AND DISCUSSION

Grain yield

The data revealed that the effect due to the nitrogen levels on the grain yield was significant while those due to water regimes and interaction were non-significant during all the three years of the study. The grain yield increased progressively with increase in the level of nitrogen up to 70 kg/ha whereupon the yield declined. Application of 70 kg N/ha outyielded 35 kg N/ha in two out of the three years and in the pooled mean. All the treatments receiving nitrogen recorded significnant yield increase over no nitrogen control. The mean increases were 33, 64 and 57 per cent at 35, 70 and 105 kg N/ha, respectively. Response function to nitrogen application was found to be quadratic in nature. The response equation was

$Y = 14.71 + 31.35 X - 12.10 X^2$,

where Y is predicted yield in q/ha and X is dose of nitrogen in q/ha.

The physical optimum dose of nitrogen was found to be 88.2 kg/ha.

Table 2. Details of irrigation given and rainfall received (mean of three years)

Water regime	Number of irrigations given	Irrigation water applied (mm)	Rainfall received (mm)	Total water (mm)
Continuous submergence of 5±2 cm	Daily	1384	211	1595
7 cm irrigation 1 DADPW	13	910	211	1121
7 cm irrigation 3 DADPW	8	560	211	771
7 cm irrigation 5 DADPW	6	420	211	631

* DADPW - Days after disappearance of ponded water

Table 3. Grain yield of rice (kg/ha) as influenced by water regimes and nitrogen levels

Treatments	1983-84	1984-85	1985-86	Mean
Water regimes				
Continuous submergence of 5±2 cm	2236	2140	2284	2220
7 cm irrigation 1 DADPW	2055	2024	2160	2079
7 cm irrigation 3 DADPW	1984	1991	2072	2015
7 cm irrigation 5 DADPW	1972	1918	2032	1974
CD (0.05)	NS	NS	NS	NS
Nitrogen levels (kg/ha)				
0	1587	1270	1634	1497
35	2112	1746	2113	1990
70	2348	2566	2438	2451
105	2199	2490	2365	2351
CD (0.05)	255	298	218	183
Interaction	NS	NS	NS	NS

DADPW = Days after disappearance of ponded water

The economic optimum dose was worked out to 79.6 kg/ha at the price level of Rs 5.20 per kg nitrogen and Rs 2.50 per kg grain. Though not significant, a decreasing trend in grain yield was observed when the water regimes were changed from continuous submergence to irrigations after one, three and five days of the disappearance of ponded water. The corresponding yield reductions were 6.4, 9.2 and 11.1 per cent, respectively. However, irrigation water to the tune of 474, 824 and 964 mm were saved by scheduling irrigation after one, three and five days of the disappearance of ponded water. The savings were worked out to 34, 60 and 70 per cent of the water used to

Table 4. Straw yield of rice (kg/ha) as influenced by different water regimes and nitrogen levels

Treatments	1983-84	1984-85	1985-86	Mean
Water regimes				
Continuous submergence of 5±2 cm	3059	2222	2493	2591
7 cm irrigation 1 DADPW	2856	2106	2263	2408
7 cm irrigation 3 DADPW	2753	2040	2241	2345
7 cm irrigation 5 DADPW	2728	1935	2215	2293
CD (0.05)	NS	NS	NS	--
Nitrogen levels (kg/ha)				
0	2356	1518	1619	1831
35	2790	2001	2178	2323
70	3030	2292	2698	2673
105	3220	2493	2716	2810
CD (0.05)	255	376	278	-
Interaction	513	NS	NS	

DADPW = Days after disappearance of ponded water

Table 5. Growth and yield attributes of rice as influenced by different water regimes and nitrogen levels

Treatments	Height of plant (cm)	Tillers per hill	Panicles per hill	Grains per panicle	1000 grain weight (g)	Percentage of chaff	Length of panicle (cm)
Water regimes							
Continuous submergence of 5± cm	57.7	5.7	4.7	49.1	23.8	38.9	20.2
7 cm irrigation 1 DADPW	55.8	5.6	4.6	46.6	23.4	39.6	19.9
7 cm irrigation 3 DADPW	53.8	5.6	4.6	45.3	22.1	40.0	19.6
7 cm irrigation 5 DADPW	53.2	5.3	4.5	45.2	22.0	40.8	19.4
CD (0.05)	2.5	NS	NS	NS	NS	NS	NS
Nitrogen levels (kg/ha)							
0	53.8	4.2	3.6	42.5	19.8	41.1	19.2
35	54.1	5 3	4.4 .	44.9	22.9	40.4	19.9
70	56.2	6.0	5.1	46.7	24.1	39.5	20.0
105	56.5	6.5	5.2	52.1	24.1	38.4	20.1
CD (0.05)	2.5	0.8	0.6	6.0	1.6	NS	NS
Interaction	NS	NS	NS	NS	NS	NS	NS

maintain continuous submergnence. Since the ground water table did not recede below 38 cm from ground level during the experimental period, it would have contributed partially to the crop water requirement. The evaporative demand of the atmosphere was also low (<4 mm/day) and the crop received intermittant rains. The study thus indicated that irrigation for winter rice is to be scheduled five days after the disappearance of ponded water under conditions of shallow ground water table to ensure optimum use of irrigation water without appreciable yield reduction.

Straw yield

The effect due to water regimes, nitrogen levels and their interaction on the straw yield of rice followed a similar trend as that of grain yield. The different water regimes recorded comparable yields indicating that the treatment receiving the lowest quantity of irrigation water viz., 7 cm irrigation after five days of the disappearance of ponded water is good enough for optimum straw yield in rice.

Significant increase in straw yield was obtained with incremental doses of nitrogen. Application of 35 kg N/ha appreciably increased the straw yield over control. The nitrogen dose of 105 kg/ha produced comparable straw yield with that of 70 kg N/ha but was significantly higher than 35 kg N/ha.

The growth and yield chracters (Table 5) were not significantly influenced by the water regimes except the height of plant. The continuous submergence treatment and the treatment receiving 7 cm irrigation one day after the disappearance of ponded water recorded maximum plant heights. The non-significant effect of water regimes on the grain and straw yields may thus be attributed to it's non-significant effect on the growth and yield characters.

Except the percentage of chaff and the length of panicles, all the growth and yield characters were significantly influenced by the levels of nitrogen which ultimately reflected in the increased grain and straw yield. Though not significant, the percentage of chaff showed a decreasing trend with increase in the level of nitrogen.

REFERENCE

Anonymous. 1983. *Package of Practices Recommendations.* Kerala Agricultural University, Trichur, p. 1-36

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