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NITROGEN UPTAKE, PER CENT RECOVERY AND RESPONSE TO NITROGEN OF RICE VARIETIES WITH DIFFERENT WATER MANAGEMENT PRACTICES

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ABSTRACT

Field experiments were conducted at Tamil Nadu Agricultural University, Coimbatore during the South West Monsoon and Summer seasons of 1985-86 to evaluate the nutrient uptake and the response of rice varieties to applied nitrogen and its percentage recovery with different water management practices. The results indicated that the N uptake increased with increment of N levels with continuous field submergence. The response to N application and per cent recovery revealed that application of N beyond 150 kg ha^{-1} could result in decrease in these parameters. Water stress resulted in lower uptake and hence lower response. The variety CO 37 showed more N uptake, response to applied N and per cent recovery of N than IR 50.

It is well known that nitrogen is the most limiting nutrient in rice soils of India and at the same time conditions of climate favouring rice growth are also congenial for the loss of N from the soil.

Peterson and Patric (1968) recommended flooding of rice fields immediately after fertilizer application and maintaining shallow submergence for achieving stability of added N and its effective utilisation. Kakade and Sonar (1983) also noticed the uptake of fertilizer N to be the highest in plants grown under submerged soil conditions.

This investigation was undertaken to study the nutrient uptake pattern of two high yielding dwarf indica varieties of rice as influenced by graded levels of N under different systems of water management.

MATERIALS AND METHODS

In the present investigation, field experiments were conducted at the wet lands of Tamil Nadu Agricultural University, Coimbatore during the South West Monsoon 1985 and Summer season 1986 in moderately drained, deep clay loam soil. The field had an available N, P_2O_5 and K_2O at 257, 12.4 and 523 kg ha^{-1}, respectively with a p^H of 8.0 and CEC 37.9 m.e./100 g soil. The experiment was laid out in a strip plot design with three replications accommodating combinations of irrigation levels (I_1 : 5cm continuous submergence throughout, I_2:

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Recouping 5 cm submergence one day after disappearance of water, I3: Recouping 5 cm submergence three days after disappearance of water (only during summer) and varieties (V_1 : IR 50, V_2: CO 37) in one strip and N levels 0, 75, 150 and 225 kg ha^{-1} (only during summer season) in another strip.

A uniform does of P and K to supply 50kg each of P_2O_5 and K_2O ha^{-1} was applied as basal through super phosphate and muriate of potash. N as urea was applied in three equal splits at transplanting, tillering (25 DAT), and at panicle initiation (45 DAT) stage. Twenty three day old seedlings were transplanted @ 3 seedlings per hill a spacing of 15 x 10 cm in both the seasons. After allowing one week for the seedlings to establish the differential irrigation treatments were imposed and the quantity of water applied was measured by using a 7.5 cm portable parshall flume. The irrigation was stopped 15 days before harvest of the crop.

N content of the plant was estimated at flowering and harvest stages using the microkjeldahl method as suggested by Jackson (1973) and the uptake worked out and expressed as kg ha^{-1}. The per cent recovery of applied N and N response were worked as follows.

$$\text{Per cent recovery} = \frac{\text{N uptake fromfertilized plot} - \text{N uptake from control} \times 100}{\text{N applied}}$$

This was worked out as suggested by Bartholomew and Clark (1965).

N response = (Yt - Yo/At) = Y/At, where Yt = yield of treatment, Yo = yield of control and At = N applied in treatment. This was worked out as suggested by Patnaik et al (1971).

RESULTS AND DISCUSSION

N uptake : The uptake of N (Table 1) during flowering and harvest stages increased with increment in levels of N. The higher uptake of N noticed might be due to the higher DMP and also more root growth which might have increased the absorption.

The uptake of N was highest with continuous submergence and it was very much reduced when intervals between irrigations were increased. Draining and reflooding the field caused a marked decreased in N uptake by rice plants. The decrease was apparently due to the lower N supply available to the crop as a result of denitrification broughtout by draining and reflooding. NO_3 formed where the soil was aerated probably lost through denitrification as well as leaching when the soil was reflooded. Such decreased N uptake is reported by several workers (Erickson et al, 1985). The decrease in uptake with increase in stress could also be attributed to decreased transpiration and possibly more on the physiological impairment of the nutrient absorption and transport mechanism in

Table 1 : Season-wise N uptake (kg ha^{-1}) of rice varieties under different N levels and water management practices

A. FLOWERING STAGE

	SOUTH WEST MONSOON										SUMMER											
	I_1					I_2					I_1				I_2				I_3			
	N0	N1	N2	N3	Mean	N0	N1	N2	N3	Mean	N0	N1	N2	Mean	N0	N1	N2	Mean	N0	N1	N2	Mean
V_1	50.87	64.33	78.53	87.53	70.32	52.83	61.27	67.27	77.43	64.70	69.43	82.00	97.77	83.07	68.47	72.40	82.77	74.55	58.03	67.67	73.57	66.42
V_2	58.67	66.83	80.90	94.47	75.72	54.60	65.00	77.40	80.60	69.40	70.73	80.70	96.40	82.61	62.03	78.53	91.63	77.40	54.63	58.43	63.60	58.89
Mean	54.77	66.58	79.72	91.00	73.02	53.72	63.13	72.33	79.02	67.05	70.08	81.35	97.08	82.84	65.25	75.47	87.20	75.98	56.33	63.05	68.59	62.66

	N0	N1	N2	N3	Mean		N0	N1	N2	Mean
Ix(V_1)	51.85	62.80	72.90	82.40	67.51	Ix(V_1)	65.31	74.02	84.70	74.68
(V_2)	58.63	66.92	79.15	87.53	72.56	(V_2)	62.47	72.56	83.88	72.97,
Mean	54.24	64.86	76.03	85.01		Mean	63.89	73.29	84.29	

	N	I	V	I x V	N at I	I at N	N at V	V at N
SED (SWM)	1.61	0.59	0.59	0.84	1.90	1.39	1.90	1.39
CD (P=0.05)	3.93	1.45	1.45	N.S.	4.47	2.99	N.S.	N.S.,
SED (SUMMER)	1.04	1.64	1.34	2.31	1.66	1.08	1.39	1.70,
CD (P=0.05)	2.90	3.65	N.S.	5.16	3.92	4.53	N.S.	N.S.,

B. HARVEST STAGE

	SOUTH WEST MONSOON										SUMMER											
	I_1					I_2					I_1				I_2				I_3			
	N0	N1	N2	N3	Mean	N0	N1	N2	N3	Mean	N0	N1	N2	Mean	N0	N1	N2	Mean	N0	N1	N2	Mean
V_1	68.63	82.70	99.10	116.53	91.74	62.87	81.13	98.13	108.17	87.58	78.63	95.60	127.13	100.46	66.60	85.63	116.70	89.64	74.90	87.17	112.17	91.41
V_2	71.77	88.47	102.17	126.83	97.31	66.00	83.33	97.13	114.53	90.25	81.37	108.00	136.70	108.69	76.33	93.37	118.37	96.02	71.20	89.30	113.40	91.30
Mean	70.20	85.56	100.63	121.66	94.53	64.43	82.23	97.63	111.35	88.91	80.00	101.80	131.92	104.57	71.47	89.50	117.53	92.83	73.05	88.23	112.78	91.36

	N0	N1	N2	N3	Mean		N0	N1	N2	Mean
Ix(V_1)	65.75	81.92	98.62	112.35	89.66	Ix(V_1)	73.38	89.47	118.67	93.84
(V_2)	68.88	85.90	99.65	120.68	93.78	(V_2)	76.30	96.89	122.82	98.67,
Mean	67.32	83.91	99.13	116.52		Mean	74.84	93.18	120.74	

	N	I	V	I x V	N at I	I at N	N at V	V at N
SED (SWM)	1.04	0.88	0.88	1.25	1.33	1.34	1.33	1.34
CD (P=0.05)	2.56	2.16	2.16	N.S.	3.09	3.02	3.09	3.46
SED (SUMMER)	1.22	1.52	1.24	2.15	1.73	1.96	1.96	1.60
CD (P=0.05)	3.38	3.59	2.77	4.79	4.42	4.25	3.80	4.43

N.S. = NOT SIGNIFICANT

Table 2 : Season-wise response to applied N (kg grain/Kg N) and precentage recovery of applied N.

A. Response to applied N (kg grain/kg N)

	SOUTH WEST MONSOON								SUMMER								
	I_1				I_2				I_1			I_2			I_3		
	N1	N2	N3	Mean	N1	N2	N3	Mean	N1	N2	Mean	N1	N2	Mean	N1	N2	Mean
V_1	30.77	20.03	12.13	20.98	30.44	19.85	12.09	20.79	24.92	17.05	20.99	23.56	17.20	20.38	17.53	18.11	17.82
V_2	30.09	19.66	11.56	20.44	30.01	19.79	11.55	20.45	31.15	20.14	25.65	27.07	19.71	23.39	19.31	18.71	19.01
Mean	30.43	19.85	11.85	20.71	30.23	19.82	11.82		28.04	18.60	23.32	25.32	18.46	21.89	18.42	18.41	18.42
Ix(V_1) (V_2)	30.61 30.05	19.94 19.73	12.11 11.56	20.89 20.45				Ix(V_1) (V_2)	22.00 25.84	17.45 19.52	19.73 22.68						
Mean	30.33	19.83	11.83					Mean	23.92	18.49							

	N	I	V	I x V	N at I	I at N	N at V	V at N
SED (SWM)	0.22	0.39	0.39	0.55	0.46	0.60	0.46	0.60
CD (P=0.05)	0.62	0.96	N.S	N.S.	1.06	1.38	1.06	2.06
SED (SUMMER)	0.14	0.22	0.18	0.31	0.64	0.56	0.62	0.67
CD (P=0.05)	0.60	0.50	0.40	0.70	0.64	0.56	0.62	0.67

B. Percentage recovery of applied N

	SOUTH WEST MONSOON							SUMMER									
	I_1				I_2			I_1			I_2			I_3			
	NI1 N2	N3	Mean	N1	N2	N3	Mean	N1	N2	Mean	N1	N2	Mean	N1	N2	Mean	
V_1	18.80	20.30	21.30	20.13	24.37	20.53	20.17	21.69	22.63	32.33	27.48	25.37	33.40	29.38	19.47	26.40	22.93
V_2	22.30	20.27	24.50	22.36	23.13	20.30	21.57	21.67	31.07	36.90	33.98	19.07	28.03	23.55	20.80	28.13	24.47
Mean	20.55	20.88	22.90	21.24	23.75	21.92	20.87	22.18	26.85	34.62	30.73	22.22	30.72	26.47	20.13	27.27	23.70
Ix(V1 (V2	21.58 22.72	20.42 20.28	20.73 23.03	20.91 22.01				Ix(V1 (V2	22.49 23.04	30.71 31.02	26.60 27.33						
Mean	22.15	21.10	21.88					Mean	23.07	30.87							

	N	I	V	I x V	N at I	I at N	N at V	V at N
SED (SWM)	0.64	0.72	0.72	1.01	0.83	0.93	0.83	0.93
CD (P=0.05)	N.S	N.S	N.S	N.S	2.10	2.10	2.10	2.19
SED (SUMMER)	1.95	1.10	0.89	1.55	2.06	1.23	2.01	1.01
CD (P=0.05)	N.S	2.44	N.S	1.99	N.S	N.S	N.S	N.S

N.S. = NOT SIGNIFICANT

the roots (Tanguiling *et al* 1985). The N uptake at flowering was higher with CO 37 during SWM whereas it was non-significant between varieties in Summer. The N uptake with Co37 was higher than IR50 during both the seasons though the DMP was higher with IR50 at flowering in SWM, evidently the increase in uptake was due to its nutrient content.

Interactions of irrigation with variety and N as well as N with variety were found to be present in one or the other stages in SWM or Summer season. For both irrigation and N levels, higher uptake was noticed when they were applied at their respective higher doses.

Response to N and per cent recovery of applied N (Table 2)

(i) **Response to N application :**

The response to N application was not increased substantially beyond 75-150 kg ha^{-1}. At higher rate of N application, expansion of leaf area may have a dominant role and the excessive vegetative growth and leaf area development might result in decreased grain yields due to problems of mutual shading or uptake of excessive ammonia disturbing the balance between carbohydrate and protein metabolism (Pillai and De, 1979) and as such further increase in N resulted in a decrease in grain production per kg of applied N.

Submerging the field three days after disappearance of water (I_3) resulted in very low response to N in summer season. Draining and reflooding the soil as in I_3 resulted in marked decrease in N uptake, apparently due to the lower N supply available to the crop as a result of possible denitrification losses of N and this might have been one of the major reasons for a lower growth rate, development of yield components and in a lower grain yield of rice. The variety CO 37 registered more response to applied N than IR50 in both the seasons.

Data on interaction effect between irrigation and N revealed that 75 kg N ha^{-1} with either of irrigation levels (I_1 or I_2) produced the highest grain yield per kg of applied N. This beneficial effect was not pronounced at the higher levels of N. With regard to the interaction of variety with irrigation or N observed during Summer, it was seen that CO37 was having higher response to applied N than IR50 with either of the irrigation levels or applied N.

(A comparison between seasons indicate that the response of rice to N was high in Summer. At the early stage of plant growth, high temperature, low sunshine hours per day and more cloudy day exist during SWM, whereas during Summer sometime the temperature is also wide.

The maximum temperature ranged from 29 to 37°C in summer, whereas, it was in the range of 27 to 31°C in) the SWM season.

REFERENCES

BARTHLOMEW, W.V. and CLARK, F.E. 1965. Soil Nitrogen, In : The Series of Agronomy, No. 10, p. 524, Wisconsin. Am Soc. Agron.

BRICKSEN, A.B., KJELDBY, M. and NILSEN, S. The effect of intermittent flooding on growth and yield of wetland rice and N losses mechanism with surface and deep application of urea. P. Soil 84 : 387-401

JACKSON, M.L. 1973. Soil chemical analysis. Pretice Hall of India (Pvt.) Ltd., New Delhi. p.498.

KAKADE, B.V. and SONAR, K.R. 1983. Nutrient uptake and yield of rice as influenced by moisture regimes. Int. Rice. comm. Newsl. 32 : 38-40.

MOHANKUMAR, B. and SINGH, K.N. 1984. Studies on water, nitrogen regimes and weed control in upland direct seeded rice. II Nitrogen - its recovery and productive efficiency. Indian J. Agron. 29 (4) : 453-456.

PATNAIK, S., RAO, M.V. and NANDA, B.B. 1971. Some consideration on the technique of evaluating nitrogen responsiveness of rice varieties independent of soil. Int. Sym. Soil fert. Eval. proc. 1 : 679-685. Published by Indian Soc. Soil Sci., New Delhi.

PETERSON, F.J. and JR. PATRIC W.H. 1968. Effect of draining and re-flooding rice field during the growing season on the yield of rice. Ann. Progr. Rep. Lousiana Rice Res. Stn. 57 : 98.

PILLAI, G.K. and DE, R. 1979. Mineral nitrogen status of soil, leaf nitrogen content and grain yield of rice variety 'Jaya' as affected by water and nitrogen fertilizer management. Fld. Crops Res. 2 : 125-133.

TANGUILING, V.C., YAMBO, E.B., TOOLE, J.C.O. and DE DATTA DE, S.K. 1985. Nutrient uptake of rice, maize and soybean during water stress. Paper presented at the 1st scientific meeting of the federation of crop societies of the philippines. May 8-10, 1985.

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INTEGRATED WEED MANAGEMENT IN UPLAND BUNDED RICE

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ABSTRACT

Field investigations were conducted in two locations at Coimbatore and Paramakudi during 1984-85 to find out an efficient weed management practice for rice (CV.TKM 9) under upland condition. The results revealed that both pendimethalin (1.25 kg/ha) and