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Research Notes

Nutrient availability vis-a-vis uptake in CORH2 rice as influenced by split application of N

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Nitrogen is a major plant nutrient element essential for growth and development of a crop and for maximizing and sustaining higher yield. The indigenous nitrogen supply is inadequate in case of rice which is a heavy feeder of nitrogen. Addition of sufficient level of nitrogenous fertilizer synchronizing to the demand of the crop at well defined physiological stages is the prerequisite for maintaining the nitrogen supply in the soil and sustaining higher yield of rice. The information for calibrating the optimum doses of N by relating the doses of N added with yields is lacking with special reference to CORH2 hybrid rice. In view of the above, an attempt was made to study N availability vis-a-vis uptake in CORH2 hybrid rice in Periyar Vaigai command area as influenced by split applications of graded levels of N.

A field experiment was conducted in the central farm of AC & RI, Madurai during early *rabi* season of 2001-02 with five levels of nitrogen *viz*., 0, 75, 100, 125 and 150 kg N ha^{-1} applied as three and four splits in a RBD design with three replications. Fertilizer N was applied in three splits i.e. 1/2 at basal, 1/4 at active tillering (30 DAT) and remainingl/4 at flowering (60 DAT) stage and in four splits i.e. 1/2 at basal, 1/4 at active tillering (30 DAT), 1/8 at maximum tillering (45 DAT) and remaining 1/8 at flowering (60 DAT) stage. A common application of 50 kg K_2O ha^{-1} was applied as MOP in three splits i.e. 1/2 at basal, 1/4 at 30 DAT and 1/4 at 60 DAT and 50 kg P_2O_5 ha^{-1} in the form of single superphosphate as a common basal dose to all treatments.

Pre-planting surface soil samples (0-15 cm depth) collected from the experimental plots, dried in shade, powdered and sieved through a 2 mm sieve were analyzed for soil properties and fertility status. The experimental soil was sandy loam in texture with a sand content of 65.8 per cent. It was neutral (pH 7.8), non-saline (EC 0.3 d S m^{-1}) with a CEC of 24.0 cmol (p+) kg^{-1}. The available N status (195 kg ha^{-1}) was low but that of P (11.5 kg ha^{-1}) and K (120 kg ha^{-1}) was found to be medium. All cultural operations were carried out as per the crop production guide. On maturity, the crop was harvested and grain and straw yields were recorded.

The soil samples were collected at active tillering (30 DAT), flowering (60 DAT) and post-harvest stages and analyzed for available N, P and K. The plant samples drawn at corresponding stages of crop growth including grain and straw were analyzed for N, P and K. The uptake of these nutrients was also calculated.

The results (Table 1) revealed that the availability of N significantly increased from

Table 1. Influence of split application of graded levels of N on available N, P, K status (kg ha^{-1}) of soil at different growth stages of hybrid rice

(Mean of three replications)

Stage	Available nitrogen				Available phosphorus				Available potassium			
	Active tillering (S_1)	Flowering (S_2)	Post harvest (S_3)	Mean	Active tillering (S_1)	Flowering (S_2)	Post harvest (S_3)	Mean	Active tillering (S_1)	Flowering (S_2)	Post harvest (S_3)	Mean
N_0	204	213	200	205	11.0	10.3	9.2	10.2	119	139	127	128
$N_{75(3)}$	233	243	230	235	12.4	11.1	10.1	11.2	139	161	152	151
$N_{100(3)}$	245	252	241	247	13.8	12.2	11.1	12.4	151	172	161	161
$N_{125(3)}$	259	266	257	261	14.2	12.7	12.1	13.0	161	181	172	171
$N_{150(3)}$	265	277	259	267	15.8	14.3	13.4	14.5	172	191	179	181
$N_{75(4)}$	233	253	228	238	12.4	11.4	10.4	11.4	142	166	157	155
$N_{100(4)}$	245	264	242	250	13.8	12.4	11.3	12.5	151	176	166	164
$N_{125(4)}$	259	276	257	264	14.1	13.2	12.4	13.2	160	187	177	174
$N_{150(4)}$	266	289	259	271	15.8	14.7	13.6	14.7	171	196	185	184
Mean	245	259	241	249	13.7	12.5	11.5	12.6	152	174	164	163

	SEd	CD(P=0.05)		SEd	CD(P=0.05)		SEd	CD (P=0.05)
N	0.7	1.4	N	0.1	0.2	N	0.5	1.0
S	0.4	0.8	S	0.1	0.1	S	0.3	0.6
NxS	1.2	2.3	NxS	0.2	0.3	NxS	0.81	1.7

(3) - 3 split application

(4) - 4 split application.

early stage up to the flowering stage, followed by a decline at post-harvest stage. The per cent increase in N was 25.8 and 32.8, respectively at active tillering and flowering stage compared to initial availability but the per cent decrease after flowering stage to post-harvest was only 7.0. The increase of available N at flowering stage was through the direct enrichment of N as these treatmental inputs are nothing but N contributors. They also enhance the decomposition of organic nitrogenous materials. This is in close agreement with the findings of Das *et al.* (1998). The decrease in the availability at post-harvest stage might be related to plant growth.

Application of increasing levels of N to 150 kg N ha^{-1} led to conspicuous build up of available N in soil from 205 kg ha^{-1} (No) to 267 kg ha^{-1} ($N_{150(3)}$)in case of three split doses and from 205 kg ha^{-1} (N_0) to 271 kg ha^{-1} $N_{150(4)}$) in case of four split doses. It is evident that increased addition of N doses through four splits is advantageous compared to three splits in upgrading the N availability in rice soils. Among all the treatments, 150 kg N ha^{-1} applied through four splits led to the highest availability of N (271 kg ha^{-1}) than the rest. The increase in available N due to split application could be due to reduction in transformation process, such as ammonium fixation and immobilization that lead to temporary losses of nitrogen from the soil - water system.

There was a significant gradual decline in P availability with crop growth from 13.7 kg ha^{-1s} at active tillering to 11.5 kg ha^{-1} at post-harvest stage (Table 1). With the increase in level of N, there was 9.8 to 44.1 per cent accrual in the soil available P. The per cent enhancement in the availability of P due to increase in the number of splits varied from 0.8 to 1.8. The gradual decline in P availability with crop growth might be due to the continuous absorption and assimilation of P, throughout the growth period of crop and also due to the transformation of P in soil to various sparingly / insoluble fractions resulting in less available P in soil at harvest stage.

The results indicate that there was an improved K availability from pre-planting stage (120 kg ha^{-1}) to flowering stage (174 kg ha^{-1}). There was a decrease of 5.6 per cent in K availability from flowering to post-harvest stage, however, it remained higher than initial K status. The K content was more at flowering stage, which could be attributed to addition of K fertilizer in all the treatments except control at active tillering stage, besides the K reversal from plant to soil due to leaching action of rain also could not be ruled out. Earlier, Roy and Wright (1974) reported this leaching action even at 6 mm rainfall. The enrichment in K availability due to increased number of splits ranged from 2.7 to 3.9 kg ha^{-1}. Addition of 150 kg N ha^{-1} in four splits registered the highest K availability (184 kg ha^{-1}) than the rest. The increased K availability with increasing N levels was evident. The possibility of mutual release between K^+ and NH_4^+ ions in the interlattice positions of clay minerals depending upon their concentration in soil solution might be operating in soil (Durairaj Muthiah, 1986).

The uptake of N by straw and grain increased with increasing levels of N. Sharp increase in N uptake by straw and grain was observed with increase in levels of N applied in three as well as four splits. With increasing splits from three to four, the percentage increase in the uptake of N by grain was 24.5, 22.9, 3.9 and 6.5 at the levels of 75, 100, 125

Table 2. Influence of split application of graded levels of N on N, P and K uptake in straw and grain (kg ha^{-1})

(Mean of three replications)

Nutrient	N		P		K	
N kg ha^{-1}	Straw	Grain	Straw	Grain	Straw	Grain
N_0	11.0	44.6	5.3	11.5	36.4	12.9
$N_{75(3)}$	38.9	68.5	12.5	16.2	62.0	19.5
$N_{100(3)}$	51.8	77.6	14.9	18.0	70.4	24.5
$N_{125(3)}$	63.5	99.5	17.4	23.2	76.5	28.5
$N_{150(3)}$	71.6	108.4	20.6	24.6	84.0	30.7
$N_{75(4)}$	51.3	85.3	17.0	20.2	81.1	25.4
$N_{100(4)}$	59.0	95.4	19.9	22.0	89.7	27.4
$N_{125(4)}$	71.6	103.4	22.3	24.0	98.0	30.0
$N_{150(4)}$	85.9	115.5	25.2	26.4	106.5	32.4
Mean	56.1	88.8	17.2	20.7	78.3	25.5
SEd	0.64	0.81	0.29	0.41	0.50	0.72
CD(P=0.05)	1.35	1.71	0.62	0.86	1.06	1.53

(3) - 3 split application
(4) - 4 split application

and 150 kg N ha^{-1}. Increase in the uptake of N by straw and grain of rice due to application of N has also been reported by Sharma *et al*. (1994). The per cent increase in P uptake was found to be about 129 by application of 150 kg N ha^{-1} in four splits. However, the per cent increase in uptake of P by straw was more pronounced when the N was applied in three splits as compared with four splits of N application. It is evident from the results that the uptake of P by grain increased more at lower levels of N application when the number of splits was increased from three to four. The favourable effect of N application in graded levels and increased splits was also reported by Karuna Sagar and Ramasubba Reddy (1995).

The uptake of K by straw and grain was found to increase with application of N in three as well as four splits. The percentage increase in the uptake of K by straw and grain was more pronounced at lower levels of N applied in four splits as compared with three splits. Raju and Varma (1983) have also reported that favourable effect of N on the uptake of K by rice.

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Productivity of rice as influenced by innovative management practices of modified SRI approach

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In order to sustain present food sufficiency and to meet future food requirements, we have to realize a minimum annual growth rate of 3% in rice productivity. (Thiyagarajan *et al*., 2002). New and innovative methods of rice cultivation must be identified to increase the productivity. Under the system of rice intensification (SRI) planting young seedlings with single seedling per hill, wider spacing, inter cultivation with conoweeder, intermittent irrigation provide better growing condition for the rice crop. (Uphoff, 2002).

Most rice farmers plant aged seedlings (30-40 days old) in clumps, at closer spacing with too much of standing water. Such practices are being followed to reduce the risk of crop failure. There is a wide spread feeling among the farmers that more mature plants would survive better when planted in clumps and ensure good crop yields even few seedlings might fail and others survive and result in more yield. Hence present study on the effect of age of seedlings, number of seedlings/hill and row spacing on productivity of rice was taken up.

Field experiments were conducted at TRRI, Aduthurai during 2003-2004 & 2004-2005 in the factorial randomized block design with three replications. Two seedling ages (14 days old and existing 30 days old), three levels of number of seedlings/hill (one, two and three seedlings/hill), three plant spacing (20 x 20