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Efficacy of slow release nitrogen-fertilizers to rice (*Oryza sativa*) and their residual effect on wheat (*Triticum aestivum*)

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ABSTRACT

A field experiment was conducted during 1989–91 on sandy clay loam soil at Ranchi to study the efficiency of forms of urea, viz. prilled (PU), lac-coated (LCU), rock phosphate-coated (RCU), *karanj* cake-coated (KCU) and neem cake-coated (NCU) at varying N rates (0, 40, 80, 120 kg/ha) on the productivity of rice (*Oryza sativa* L.) and their residual effect on succeeding wheat (*Triticum aestivum* L. emend. Fiori & Paol.). The LCU, NCU, and KCU gave 24, 14.2 and 12.7% more grain yield of rice respectively than PU. Each incremental N levels recorded higher grain yield over its preceeding levels. However, nitrogen-use efficiency decreased with increasing N level. Application of LCU, NCU and KCU favourably affected soil-available N after rice which consequently exhibited more residual effect on the productivity of succeeding wheat. Rice fertilized with 120 kg N/ha also recorded maximum grain yield of succeeding wheat (23.1 q/ha).

Key words : Slow-release N fertilizers, Rice, Wheat, Residual effect

The recovery of fertilizer N in rice does not exceed 50% as considerable amounts are lost through leaching, volatilization, run-off and denitrification. These losses can be minimized by nitrification inhibitors, viz. AM and N-serve (Prasad and Power, 1995) and coating of urea with nitrification retarders, viz. neem-cake, *karanj* cake and lac (Chakravarty, 1979). Since nitrification inhibitors are costly and limited in availability the coating of urea with indigenous materials is of paramount importance, as they release nitrogen slowly to meet the demand of rice crop throughout the growing period and also leave significant residual effect on the succeeding crop in sequence. This study was undertaken to determine the efficacy of urea coated with various indigenous materials at varying N rate on the productivity of rice and their residual effect on succeeding wheat.

MATERIALS AND METHODS

Field experiments were conducted at Birsa Agricultural University Farm, Ranchi in 1989–90 and 1990–91 on a sandy clay loam soil (26.5% silt and 35.9% clay) with pH 6.5 containing low available N (240 kg/ha), P (10 kg/ha, Ammonium acetate method) and K (140 kg/ha, Bray P_1 method) (Jackson, 1973). Sixteen treatments consisting of five forms of urea viz. prilled (PU), lac coated (LCU), rock phosoate coated (RCU), *karanj* cake

Table 1. Effect of sources and levels of nitrogen on grain yield and nitrogen use efficiency of rice and their residual effect on succeeding wheat

Treatment	Grain yield (q/ha)						Mean NUE (kg grain/ kg N)		Soil available N (kg/ha) after rice	
	Rice			Wheat						
	1989	1990	Pooled	1989-90	1990-91	Pooled	Rice	Wheat	1989	1990
Sources										
PU	26.2	28.1	27.2	16.5	15.4	15.9	11.9	4.1	238	230
LCU	30.9	36.6	33.7	22.6	21.8	22.2	20.1	12.0	285	274
RCU	26.7	28.5	27.6	17.1	16.1	16.6	12.4	4.9	247	235
KCU	29.0	32.3	30.6	21.0	20.6	20.8	16.2	10.2	265	260
NCU	29.2	32.8	31.0	21.9	21.2	21.5	16.7	11.1	280	271
CD (P = 0.05)	1.6	3.3	2.2	1.2	1.1	1.2			13	10
N (kg/ha)										
40	24.9	27.2	26.0	16.2	14.9	15.6	20.8	7.3	235	226
80	28.7	32.0	30.3	19.9	19.3	19.6	15.8	8.6	268	256
120	31.7	35.8	33.8	23.4	22.8	23.1	13.4	8.7	286	280
CD (P = 0.05)	1.8	2.6	2.4	2.0	1.9	2.2			16	12
Control vs. rest										
Control	16.5	18.8	17.7	12.8	12.5	12.7			220	212
Rest	28.4	31.7	30.0	19.8	19.0	19.4			263	254
CD (P = 0.05)	3.6	5.4	5.0	4.2	3.9	4.4			35	27

coated (KCU) and neem cake coated (NCU) with three levels of N (40, 80 and 120 kg/ha) including one control were tested in split-plot design keeping N sources and control in main plot and their rates in sub-plot with three replications. Full dose of N was applied at transplanting as per treatment except the PU which was applied in three splits (50% at transplanting, 25% at active tillering and 25% at panicle initiation). A basal dose of 60 kg P_2O_5 and 40 kg K_2O/ha was also applied. The rice variety Sita was transplanted on 8 and 17 July and harvested on 25 October and 2 November in 1989 and 1990, respectively. The succeeding wheat Sonalika was sown on 15 and 22 November in 1989 and 1990, respectively with 50% recommended fertilizer (50 : 25 : 12.5 kg N : P_2O_5 : K_2O ha) and harvested on 25 and 29 March 1990 and 1991 respectively.

RESULTS AND DISCUSSION

Yield of rice

Sources of N significantly affected the grain yield of rice during both the years (Table 1). Lac coated urea produced 24% more mean grain than PU (27.2 q/ha) and exhibited its superiority over rest of the N sources tested. Further, NCU and KCU were at par and recorded 14.2 and 12.7% more grain yield than PU respectively. In terms of N use efficiency, LCU was most efficient followed by NCU and KCU as their magnitude of increase was 69, 40 and 36% compared with PU respectively.

Similarly levels of N positively affected the grain yield of rice as each incremental level produced higher grain yield over its preceding level. Mean grain yield (33.8 q/ha) was maximum at 120 kg N/ha. However, nitrogen use efficiency decreased with N rates as it was 20.8, 15.8 and 13.4 kg grain/kg N at 40, 80 and 120 kg applied N/ha, respectively. This confirms the findings of Panigrahi and Dixit (1991).

Residual effect on wheat

Sources and levels of N applied to rice

exhibited significant residual effect on the productivity of succeeding wheat crop. Application of LCU and NCU in rice produced more grain yield of succeeding wheat than the application of PU in preceding rice crop because of greater availability of N after rice harvest (Table 1). Further NCU and KCU had similar carry over effect on the productivity of wheat.

Increasing levels of N to rice exhibited increased carryover effect and productivity of succeeding wheat was maximum (23.1 q/ha^{-1}) after rice fertilized with 120 kg N/ha^{-1}. Residual nitrogen utilization efficiency by wheat crop followed the trend of rice crop for different sources, however, the trend was reverse for N rate applied to rice indicating that residual nitrogen utilization efficiency by wheat increases with increasing rate of N applied to rice crop.

Soil available N after rice

Sources and levels of N applied to rice significantly affected the soil available N after crop harvest (Table 1). Lac and neem coated urea treated plots had significant higher soil available N after rice crop than the plots receiving PU and RCU. The plots receiving KCU had intermediate value of soil available N.

Increasing N levels to rice crop increased the soil available N after rice but the magnitude of increase decreased with increasing N. Soil available N in control plot after rice was reduced by 10% from its initial value (240 kg/ha) indicating the significance of nitrogen application for sustaining soil fertility and productivity of the crop.

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