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Coating of prilled urea with neem (*Azadirachta indica*) for efficient nitrogen use in lowland transplanted rice (*Oryza sativa*)

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ABSTRACT

A field experiment was conducted during 1995–96 at New Delhi, to study the efficiency of modified forms of urea materials, viz. prilled urea (PU), neem cake-coated urea (NCU), 0.5% of 10% neem oil emulsion-coated urea and 0.5% of 20% neem oil emulsion-coated urea at varying N rates (0, 60 and 120 kg/ha) on the productivity of lowland transplanted rice (*Oryza sativa* L.). Each incremental N level recorded significantly higher growth parameters, yield attributes, grain and straw yields and also N uptake over its preceding level. However, apparent N recovery decreased with increasing N levels. Neem cake-coated urea and neem oil emulsion-coated urea irrespective of the concentration improved rice growth, yield attributes and resulted in more grain and straw yields, N uptake and also higher apparent N recovery than did commercial prilled urea.

Key words : Nitrogen, Coated urea, Yield attributes, Yield, N uptake, Apparent N recovery, Rice

Dwarf high-yielding varieties of rice (*Oryza sativa* L.) are highly nitrogen-responsive and have increased fertilizer N demands. The current trend in fertilization of N research is to develop more efficient modified urea fertilizers for minizing nitrogen losses. Nitrification-inhibitors for blending urea has shown some promise (Prasad and Power, 1995). Neem has nitrification-inhibiting properties (Deva Kumar and Mukherjee, 1985; Santhi *et al.*1986) and neemcake-coated urea shows more effectiveness than prilled urea for rice and other crops (Prasad *et al.*, 1993). With the current thrust on sustainable agriculture and organic farming, the use of natural products like neem has achieved a great practical significance, especially in augmenting the N-use efficiency which abysmally low, around 20–40% under our predominantly sub-tropical agriculture. Therefore a field study was undertaken to study the effect of nitrogen levels and the modified urea materials on productivity and nitrogen-use efficiency of lowland transplanted rice.

MATERIALS AND METHODS

A field experiment was conducted during the rainy (*kharif*) season of 1995 and 1996 at the research farm of the Indian Agricultural Research Institute, New Delhi. The soil was a sandy clay loam, having 53.5% sand, 20.5% silt and 26% clay, pH 8.1 (1:2.5, soil : water), 0.55% organic carbon, 34 mg/kg soil alkaline potassium permanganate hydrolysable N, 11 mg/kg 0.5 n $NaHCO_3$-extractable P and 135 mg/kg ammonium acetate-extractable K. Nine treatment combinations, consisting of 2 levels of nitrogen (60 and 120 kg N/ha) and 4 sources of nitrogen (prilled urea; neemcake-coated urea; 0.5% of 10% neem oil emulsion-coated urea and 0.5% of 20% neem oil emulsion-coated urea) with an additional treatment of a control without nitrogen were laid out in randomized block design with 3 replications. The nitrogen treatments were imposed in 2 equal splits; half at 10 days after transplanting and half at 30 days after transplanting. All plots were given 20 kg P/ha as single superphosphate, 30 kg K/ha as muriate of potash and 4 kg Zn/ha as zinc sulphate heptahydrate respectively. Twenty five-days-old seedlings of rice variety 'Pusa 169' were transplanted in the second week of July at a spacing of 20 cm × 10 cm during both the crop seasons. Rice crop was harvested in last week of October in both the crop years.

RESULTS AND DISCUSSION

Growth and yield attributes

Successive increase in N level from 0 to 120 kg N/ha resulted in significant increase in growth parameters (plant height) and

Table 1. Influence of nitrogen and neem-coated urea on growth and yield attributes of lowland transplanted rice

Treatment	Plant height at maturity		Productive tillers/ hill		Panicle length (cm)		Filled grains/ panicle		Grain weight/ panicle (g)	
	1995	1996	1995	1996	1995	1996	1995	1996	1995	1996
N (kg/ha)										
0	77.1	75.1	7.5	6.8	18.2	18.6	64	65	1.3	1.5
60	84.9	82.9	10.1	9.1	23.2	22.2	75	73	1.8	1.7
120	90.9	88.9	11.8	10.7	24.7	23.7	79	77	2.1	2.0
CD (P=0.05)	2.7	2.7	0.8	0.8	1.3	1.2	3.5	3.6	0.17	0.21
Source of N										
Prilled urea	86.7	84.7	10.3	9.3	23.4	22.4	76	74	1.8	1.8
NCU	89.2	87.2	11.4	10.4	24.5	23.5	78	76	2.0	1.9
0.5% of 10% neem oil emulsion-coated urea	88.2	86.2	10.8	9.8	23.8	22.9	77	75	1.9	1.8
0.5% of 20% neem oil emulsion–coated urea	87.5	85.5	11.2	10.2	23.9	22.9	78	75	1.9	1.9
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 2. Influence of nitrogen and neem-coated urea on yields, N uptake and apparent N recovery of lowland transplanted rice

Treatment	Grain yield (q/ha)			Straw yield (q/ha)			Nitrogen uptake (kg/ha)						Apparent N recovery (%)	
							Grain		Straw		Total			
	1995	1996	Pooled	1995	1996	Pooled	1995	1996	1995	1996	1995	1996	1995	1996
N (kg/ha)														
0	27.5	26.8	27.1	32.6	32.2	33.0	30.2	29.2	18.5	18.1	48.7	47.3		
60	39.1	37.3	38.2	43.3	42.0	44.5	45.6	43.6	28.3	26.5	73.8	70.1	41.7	39.6
120	47.3	45.2	46.2	51.9	50.6	53.1	57.4	54.6	36.8	33.5	94.2	88.1	37.9	34.5
CD (P=0.05)	2.9	3.1	3.0	4.1	4.4	3.8	3.6	3.9	2.8	3.3	4.1	5.0	NS	NS
Source of N														
Prilled urea	40.6	38.8	39.7	44.9	43.7	46.1	47.3	44.3	28.1	26.8	75.4	71.1	30.4	26.9
NCU	45.0	43.0	44.0	49.9	48.6	51.2	54.9	52.7	32.5	33.2	87.4	85.9	47.2	43.8
0.5% of 10% neem oil emulsion coated urea	43.1	41.1	42.8	47.3	46.1	48.5	51.1	48.8	32.3	29.4	83.4	78.2	39.1	39.1
0.5% of 20% neem oil emulsion-coated urea	44.0	42.0	43.0	48.2	46.9	49.4	52.7	50.6	33.5	30.6	86.2	81.2	42.6	38.2
CD (P=0.05)	NS	NS	NS	NS	NS	NS	5.1	5.5	3.9	NS	5.8	7.1	10.0	8.7

yield-attributing characters of rice (productive tillers/hill, panicle length, filled grains/panicle and grain weight/panicle) (Table 1). Application of modified urea fertilizer, viz. neemcake-coated urea and neem oil emulsion-coated urea irrespective of the concentrations had beneficial effects on all the growth parameters and yield-attributing characters over prilled urea. Prasad *et al.* (1999) also reported superiority of neem oil-coated urea materials to prilled urea.

Grain and straw yields

There was a significant increase in the grain and straw yields of rice with an increase in level of N. The highest grain yield of rough rice was recorded with 120 kg N/ha and pooled over 2 years, it was 70.4% higher over the yield obtained with the control. The yield with 60 kg N/ha was only 40.8% higher over the control (Table 2). Application of coated urea materials, e.g. neemcake-coated urea and neem oil emulsion-coated urea, irrespective of the concentrations, had beneficial effects on grain and straw yields of rice. Based on the pooled data of 2 years, there was nearly 7.7 to 10.9% increase in grain yield and 5% to 11% increase in straw yields of rice owing to application of modified urea fertilizers over prilled urea. Singh and Singh (1991) and Panigrahi and Dixit (1991) also reported superiority of neem-coated urea materials to the prilled urea.

Uptake and apparent recovery of N

There was a significant increase in nitrogen uptake by grain and straw of rice with an increase in levels of nitrogen (Table 2). The highest total N uptake of grain and straw of rice during 1995 was recorded with 120 kg N/ha and it was 93.4 and 27.6% higher over the total N uptake recorded with control and 60 kg N/ha, respectively, whereas during 1996 the highest total N uptake (88.1 kg N/ha) was recorded with the highest level of N applied and it was 86.2 and 25.7% higher over the total N uptake recorded with the control and 60 kg N/ha respectively. Application of modified urea materials, viz. neemcake-coated urea and neem oil emulsion-coated urea irrespective of concent rations had significant effect on and neem oil total N uptake of rough rice grain and straw. Based on the total nitrogen uptake of rice grain and straw, there was nearly 10.6 to 15.9% increase during the first year and 9.9 to 20.8% increase in total N uptake of rice during second year, due to application of modified urea fertilizers over prilled urea. Apparent recovery of N also influenced significantly due to application of modified urea materials irrespective of concentrations (Table 2). The highest (47.2% and 43.8%) apparent N recovery was recorded with neemcake-coated urea, followed by neem oil emulsion-coated urea irrespective of concentrations.

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