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Research Articles

EFFECT OF COIR DUST ON MINERALISATION OF UREA NITROGEN IN COCONUT GROWING RED SANDY LOAM SOILS (Arenuc Paleustults)*

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ABSTRACT

Laboratory incubation studies revealed that blending urea with retted and unretted coir dust resulted in inhibition/immobilization of urea nitrogen. Blending of urea with unretted coir dust in 1 : 1 proportions resulted in accumulation of NH_4^+–N and retted coir dust in the same proportion led to lowest production of NH_4^+–N. During the incubation period NO_3^-–N appeared to be withdrawn from the system in urea blended with unretted coir dust (1 : 1) treatment, whereas its production was lower in the case of other combinations of urea with retted (1 : 1 and 9 : 1) and unretted coir dust (9 : 1) compared to urea. Production of total mineralised nitrogen was consistently lowest when urea was blended with retted coir dust (1 : 1). Unretted coir dust (1 : 1) produced lower mineralised nitrogen than urea alone and the other blendings with lower proportions of retted and unretted coir dust (9 : 1) showed intermediate behaviour. The results indicated the usefulness of blending urea with coir dust for controlled and gradual release of urea nitrogen. It has a bearing in the fertilizer programmes for perennial plantation crops largely grown in soils prone to heavy leaching losses.

INTRODUCTION

Heavy leaching loss of nutrients, particularly nitrogen, consequent to high precipitation is common with laterite and lateritic soils in the humid tropical regions of India. Simulated leaching studies revealed this loss to be as high as 70 per cent for the applied nitrogen (Anonymous, 1985). Perennial plantation crops like coconut are cultivated to a larger extent on these soils. Regulated supply and controlled release of nutrients, and attempts to retain the applied nitrogen in the effective root zone of perennial crops call for the use of agencies to immobilise and/or retard nitrification of the applied source to reduce the lossses. Chemical and by - products of plant origin like non- edible oil seed cakes *viz.*, neem *(Azadiracta indica)* and karanja *(Pongamia glabra)* are known to retard nitrification (Sahrawat and Mukherjee, 1977). Effect of coir dust on improved

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performance of coconut seedlings in coastal sand (Nambiar, Wahid and Pillai, 1978) and on the efficient use of fertilizers (Nambiar et al., 1983) have been documented. In the present investigation, coir dust, a waste product of coconut fibre industry, was tested for its immobilising/inhibiting properties on nitrogen.

MATERIALS AND METHODS

Coir dust obtained both from retted and unretted coconut husk, the former from coir industry (0.40% N) and the latter after mechanical removal of fibre (0.27% N), was utilized for the study. The coir dust has been reported to contain 25.2 to 33.3 per cent lignin and 35 per cent cellulose (Pillai and Warrier, 1952; Prabhu, 1958).

Two hundred ppm of N each as urea, urea blended with retted coir dust in the ratio of 1:1 and 9:1, urea blended with unretted coir dust in the ratio of 1:1 and 9:1 was mixed with 250 g of soil and incubated for 110 days. The incubation study had three replications with moisture maintained at 80 per cent of field capacity (10.5% by weight) and temperature 25±2°C during the course of study.

The soil samples (10 g) were drawn at 10 day intervals from the start of incubation and analysed for ammoniacal nitrogen (NH_4^+-N) and nitrate nitrogen (NO_3^--N) as described by Black (1965). Soil alone was also incubated and the analytical values obtained were deducted from the treatment values as blanks.

The results corrected for soil nitrogen transformation were calculated as percentage of soluble nitrogen applied. The results were statistically analysed. The absolute values after deducting blanks were fitted in the following empirical equation (Cooke, 1966): $P=R\sqrt{t}+b$; where P is the applied soluble N released as NO_3^--N or disappearing as NH_4^+-N in time 't' and R and b being constants.

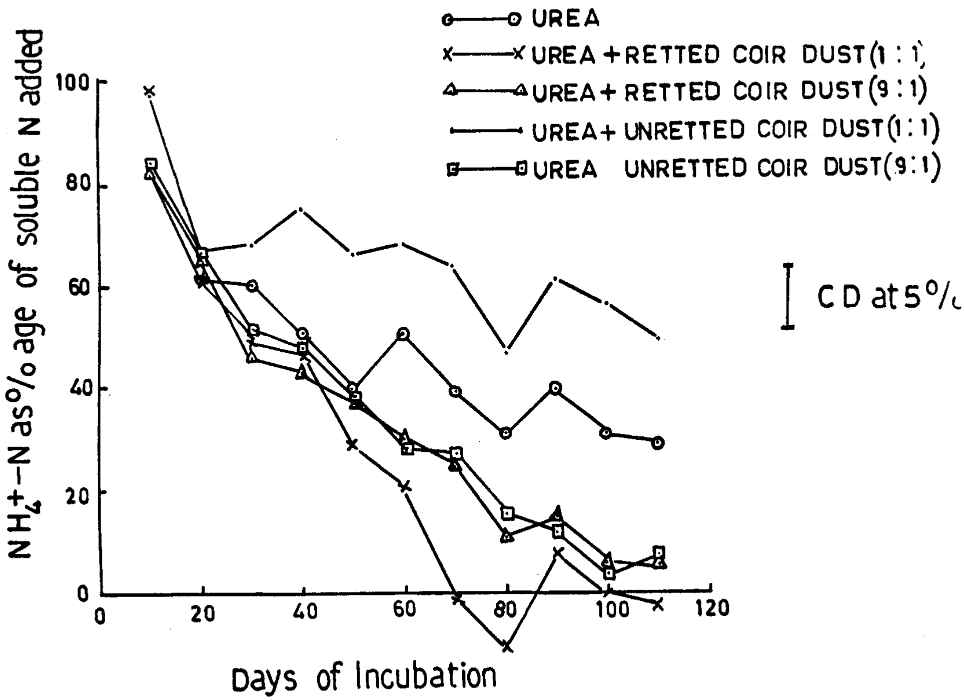
The experimental soil tested: pH 5.1, available nitrogen 95 ppm, available phosphorus 14.2 ppm and available potassium 23 ppm. Texturally, the soil was sandy clay loam with 76 per cent sand, 2 per cent silt and 22 per cent clay.

RESULTS AND DISCUSSION

Production of ammoniacal nitrogen (NH_4^+-N)

In general, production of NH_4^+-N (expressed as per cent of soluble applied N) was found to be decreasing with time of incubation, irrespective of the treatments (Fig. 1). At 10th day of incubation, urea blended with unretted coir dust (9:1), urea blended with retted coir dust (9:1) and urea alone produced almost same quantity of NH_4^+-N which was significantly lower in quantity than urea blended with unretted coir dust (1:1) and urea blended with retted coir dust (1:1). With the advancement of incubation period, urea blended with unretted coir dust (1:1) maintained higher quantum of NH_4^+-N over other treatments during the entire course of study, the differences were significant from 40 days onwards. On the contrary, the urea blended with retted coir dust (1:1) and urea blended with retted and also with unretted coir dust (9:1) did not differ much in production of NH_4^+-N during first 50 days, and

Fig. 1. Effect of blending coir dust with urea on production of NH_4^+-N



afterwards the blended treatments produced significantly lower NH_4^+-N than that of urea; the lowest being by urea blended with retted coir dust (1:1). When NH_4^+-N production was compared over period of incubation (Table I), the following trend was observed: urea blended with unretted coir dust 1:1 > urea alone > urea blended with unretted coir dust 9:1 > urea blended with retted coir dust 9:1 > urea blended with retted coir dust 1:1.

Production of nitrate nitrogen (No_3^-–N)

Production of NO_3^--N (Fig. 2) indicated that urea blended with unretted coir dust (1:1) produced consistently lower amounts except at the 10th day during which the difference was not significant with urea blended with retted coir dust (1:1). The blending of urea with lower proportions of unretted coir dust (9:1) also influenced significantly lesser production of NO_3^-–N than urea, except at 10, 30, and 90 days interval. Urea, in general released higher NO_3^-–N than other treatments. The treatment, urea blended with retted coir dust (9:1) favoured a sudden drop in NO_3^-–N fraction from 80 days onwards. The release of NO_3^-–N over incubation intervals (Table I) indicated the following trend: Urea alone > urea blended with retted coir dust 9:1 > urea

Table I. *Production of ammoniacal-N, nitrate-N and mineralised-N from blended sources*

Carrier / blended carrier	NH_4^+ - N	NO_3^- - N	$(NH_4^+ + NO_3^-)$ - N
	% of added soluble N		
Urea	46.48	26.72	73.20
Urea+coir dust (R) (1:1)	27.37	11.63	38.92
Urea+coir dust (R) (9:1)	33.39	19.68	53.08
Urea+coir dust (UR) (1:1)	65.34	-5.55	59.81
Urea+coir dust (UR) (9:1)	34.21	17.32	51.53
C. D. at 5%	3.60	4.07	4.68

blended with unretted coir dust 9:1 > urea blended with retted coir dust 1:1 > urea blended with unretted coir dust 1:1.

Production of total mineralised nitrogen

Total mineralised nitrogen (NH_4^+-N+NO_3^--N) signified a highest contribution from urea and lowest from urea blended with retted coir dust (1:1) (Fig 3). Urea blended with unretted coir dust (1:1) was next to urea in the production of NH_4^+-N+NO_3^--N consistantly, which differed significantly from urea blended with retted coir dust (1:1) from 40 day onwards. Urea blended with retted and unretted coir dust at lower proportions (9:1) exhibited a similar trend in production of mineralised N. The average production of mineralised N over the incubation period (Table I) showed the following trend: Urea alone>urea blended with unretted coir dust 1:1> Urea blended with retted coir dust 9:1> urea blended with unretted coir dust 9:1>urea blended with retted coir dust 1:1.

The nature of transformation of nitrogen was studied by employing the absolute values in the empirical equation. The negative 'R' value indicated that NH_4^+-N was disappearing from the system as a function of time (Table II). The smallest rate of disappearance of NH_4^+-N (4.31 mg/kg/day) associated with the longest period of 462.3 days for total removal was observed in urea blended with unretted coir dust (1:1). In urea blended with retted coir dust (1:1), the rate (13.45 mg/kg/day) of disappearance (210.3 days) of NH_4^+-N remains more or less the same as that of urea alone.Urea blended with retted and unretted coir dust 9:1 ratio revealed similar rates (−18.61 and −19.14 mg/kg/day) and shorter time (113.4 days) for disappearance of NH_4^+-N from the system. The fit for production of NO_3^--N showed faster rate for urea (11.64 mg/kg/day) followed by urea blended with unretted coir dust (6.24 mg/kg/day). The other two combinations of urea with retted and unretted coir dust (both at 1:1) did not follow the trend, probably on account of higher quantity of coir dust added and possible immobilisation.

Accumulation of NH_4^+-N in case of urea blended with unretted coir dust (1:1) was inferred based on consistency in higher production of NH_4^+-N (than urea), lower production of NO_3^--N and

Fig. 2. Effect of blending coir dust with urea on production of NO_3^-–N

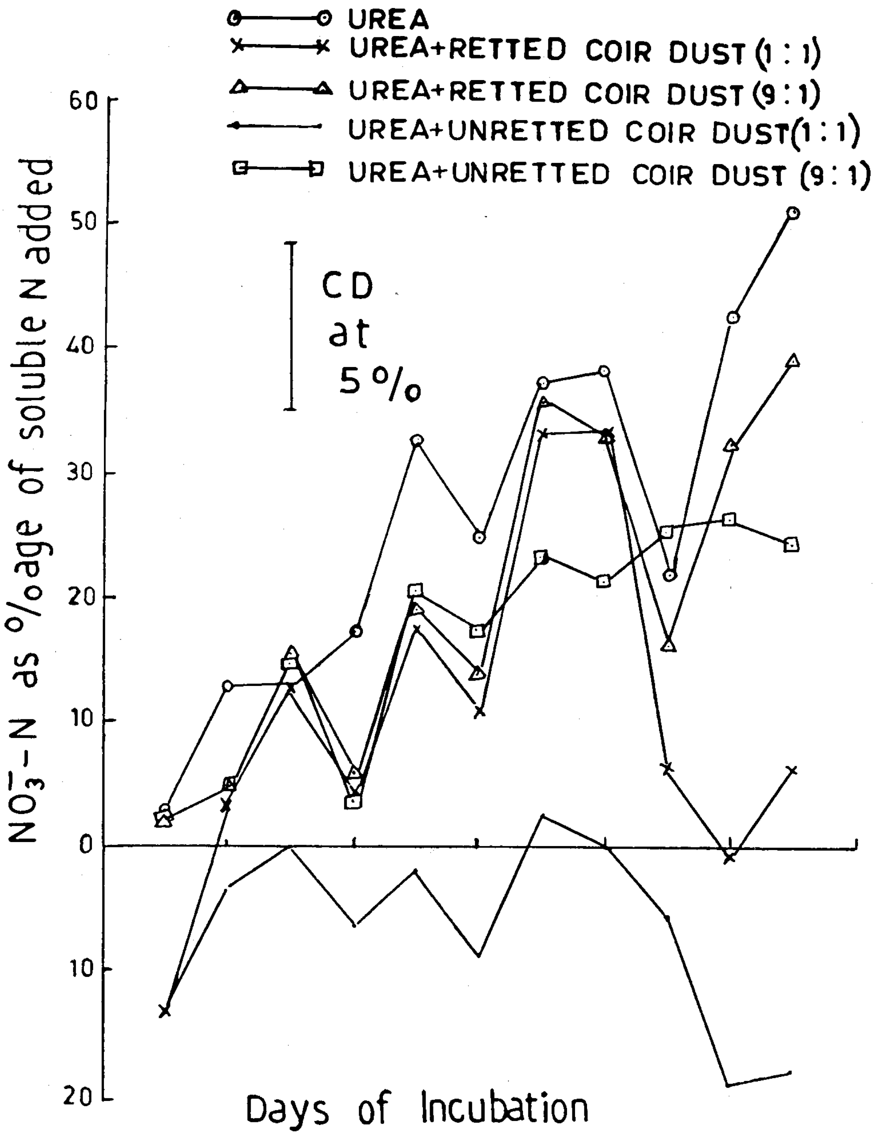


Fig. 3. Effect of blending coir dust with urea on production of ($NH_4^+ + NO_3^-$)-N

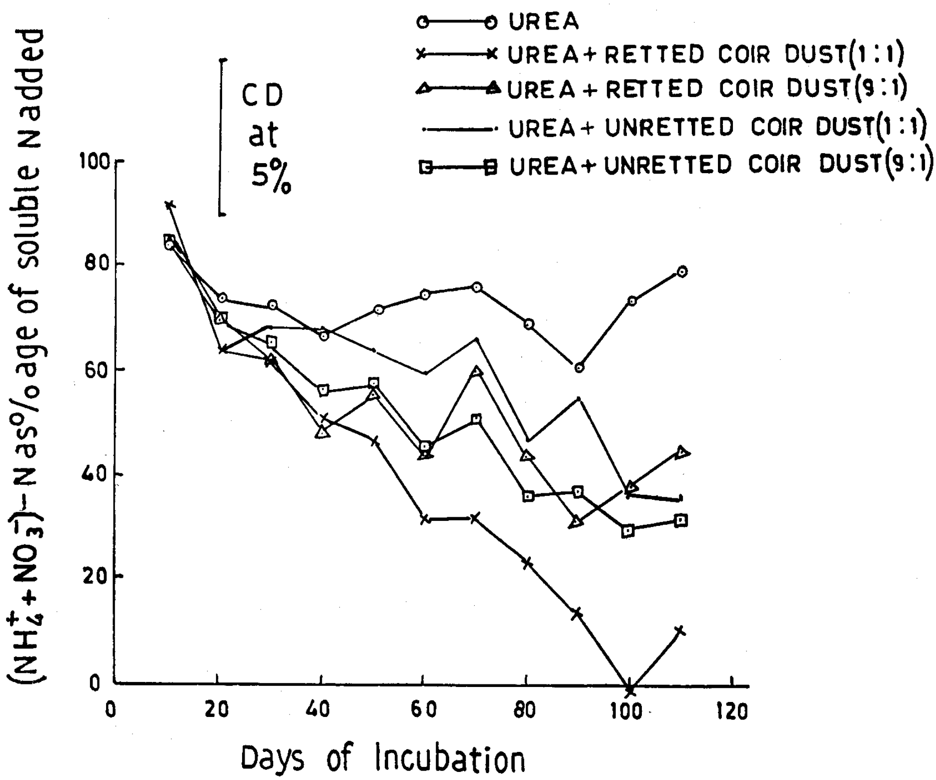


Table II. *Constants b (mg/kg), R (mg/kg/days) and t (days) of appearance of NO_3^--N and disappearance of NH_4^+-N*

Carrier / blended carrier	NO_3^--N			NH_4^+-N		
	R	b	t	R	b	t
Urea	11.64	-33.67	8.41	-12.95	188.74	213.2
Urea+coir dust (R) (1:1)		*		-13.45	126.97	210.3
Urea+coir dust (R) (9:1)	8.46	-27.36	10.24	-18.61	198.06	113.4
Urea+coir dust (UR) (1:1)		*		- 4.31	94.81	462.25
Urea+coir dust (UR) (9:1)	6.24	-15.11	6.76	-19.14	203.41	113.4

* Does not obey the equation

production of mineralised N close to urea. The lower rate of disappearance of NH_4^+-N (-4.31 mg/kg/day) and non-consistancy in NO_3^--N production also indicate partial immobilisation. On blending urea with retted coir dust (1:1), production of NH_4^+-N as well as mineralised N were minimum indicating the effect of retted coir dust on the transformation of urea nitrogen. The treatment also produced higher NO_3^--N up to 80th day followed by a sudden drop thereafter, indicating immobilisation of mineralised nitrogen at later stages. The intermediate behaviour of urea with retted and unretted coir dust blended at lower proportions (9:1) suggested that the properties of inhibition and/or immobilisation did not express to its full capacity. The release of phenolic compounds of varied nature from retted and unretted coir dust is expected to cause the differential behaviour in the mineralisation of nitrogen. Some of the vegetable tannins (Basarba, 1964), quinols and phenolic compounds (Mishra, Flaig and Soechtig, 1980) are known for their strong nitrification inhibiting properties in soil. The lower conversion of urea blended with retted coir dust to NH_4^+-N may be due to inhibition of urease activity in soil by dihydric phenols and quinones (Bremner and Douglas, 1971).

The results reported point out that blending of urea with coir dust lessens the pace of transformation and release of mineralised nitrogen. The information has utility value in blending urea with coir dust in the fertilization programme for soils prone to heavy leaching losses, where controlled release of nitrogen can be achieved in the root zone of perennial crops.

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