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EFFICACY OF COATING MATERIALS ON UREA APPLIED UNDER SALINE WATER IRRIGATION. I. MINERALIZATION OF UREA-N

G.S MAGO AND K.L. TOTAWAT*

Rajasthan College of Agriculture, Udaipur-313001

ABSTRACT

Efficacy of indigenous coating materials for urea under saline water irrigation was assessed by incubation for 21 days. Different coating materials definitely affected mineralization of applied urea. The formation of urea-N and NH_4-N decreased and the formation of NO_3-N increased as the period of incubation advanced beyond three days. However, higher values of urea-N and NH_4-N and lower values of NO_3-N were recorded in the soil receiving urea coated with neem *(Azadirachta indica)* and mahua *(Bassia latifolia)* cakes (300 g cake kg^{-1} urea) in conjunction with coaltar, Under these treatments the nitrification rate remained low and the per cent inhibitiod in nitrification of applied urea remained high when examined beyond one day of incubation period. Efficiency of inhibition of nitrification was in the order 'neem' cake> 'mahua cak: > sulphur > gypsum > coaltar.

INTRODUCTION

Most of the applied nitrogen is either lost through leaching or volatilization, which is further enhanced when subjected to saline environment. Low recovery and poor efficiency of applied nitrogen have thrown a challenge to research workers to develop proper techniques. Various chemicals have been used effectively either by mixing with fertilizer, or coating the fertilizer granules to lower down the nitrification of the applied nitrogen but their commercial use is not feasible because of very high costs. Nitrification inhibitors for field use have to be cheap and easily available under Indian conditions.

Non edible oilseed cakes like 'neem' (*Azadirachta indica* L.), 'mahua' (*Bassia latifolia* Roxb.) and 'karanja' (*Pongamia glabra* Vent) act as inhibitors of nitrification due to the presence of acrid alkaloids nimbidin, saponin and karanjin, respectively (Sahrawat, 1978). Those low cost indigenous material have good scope of their being used in agriculture to minimize nitrogen losses and increase the efficiency of fertilizer nitrogen. Keeping this in view an incubation study was undertaken using different indigenous coating materials.

* Soil Physicist, Agriculture Research Station, ARJIA—Bhilwara - 311 001 (Rajasthan)

MATERIAL AND METHODS

Two kg sandy loam soil (sand 58%, silt 21 5%. clay 17.8%) low in nitrogen (189.7 kg available N/ha) and potash (125 kg available K/ha) and medium in phosphorus (11.3 kg available P/ha). having field capacity and 15 bar moisture retention value of 37.5 and 15 cm, respectively, was incubated in plastic wares at room temperature (30° to 32°C) after being incorporated with plain urea and urea coated with different coating materials (coaltar alone and in conjunction with gypsum, 'mahua' cake, 'neem' cake and sulphur at 150 and 300 kg^{-1} urea) for a period of 21 days replicating each treatment twice. Organic emulsion of coaltar (asphalt) and kerosene (1:2) was prepared and urea granules were coated using emulsion and urea in the proportion of 1.5:100. Desired quantity of finely ground (100 mesh) coating materials was super imposed on fresh emulsion-coated urea granules. Nitrogen was applied at 40 mg kg^{-1} soil and the soil in the pots was maintained at a moisture level 19 6 cm through the period of incubation with the water of high salinity (EC 7.6 dSm^{-1}) and medium sodicity (SAR 10.9) class C_4S_2. A basal dose of 8.8mg P pnd 16.6 mg Kg^{-1} soil was also given alongwith urea treatment.

A 10 -g composite soil sample was drawn from each pot just after treatment and at an interval of 1, 3, 7, 14 and 21 days after incubation and analaysed for urea, ammoniacal, and nitrate nitrogen (Prasad, 1983). Data obtained were computed on oven-dry basis using per cent moisture determined at each sampling and were analysed statist: cally to assess the effect of different treatments. For evaluating the effect of mineralization of applied urea, nitrification rate and per cent inhibition in nitrification was computed from the data on NH_4-N and NO_3-N from the soil under different treatments as described by Sahrawat (1978).

RESULTS AND DISCUSSION

Urea nitrogen : A progressive decrease in Urea-N with an increase in the period of incubation was recorded under all the treatments examined (Table 1). However, when compared with pots receiving plain urea, coating of urea with neem cake at both the levels and mahua cake at 300 g kg^{-1} urea recorded a significantly higher level of urea-N when examined one day after incubation. Further, under these treatments urea-N maintained a higher level over other treatments at 1, 3, 7, 14 and 21 days period of incubation.

Ammonification : Formation of NH_4-N in soil fertilized with urea (Table 2) recorded a sharp increase upto first three days of incubation and, thereafter, a linear decrease upto fourteen days of incubation. However, the decrease in the level of NH_4-N was gradual beyond fourteen days of incubation. Like urea-N the level of NH-N in the pots receiving urea coated with 'mahua' and 'neem' cake at both the levels maintained

Table 1. Effect of coating materials on levels of urea-N in soil fertilized with urea (ppm, oven-dry basis)

Treatments	Days after incubation					
	0	1	3	7	14	21
Control No urea)	10.10	10.10	10.10	9.50	10.50	8.25
Plain urea	69.80	48.95	36.50	31.95	26.60	22.00
			COATED UREA			
Coaltar	69.05	52.05	38.25	33.30	28.50	24.05
Gypsum (L_1)	67.50	53.90	38.95	34.35	28.49	23.35
Gypsum (L_2)	67.95	56.90	43.00	37.10	32.50	26.05
'Mahua' cake (L_1)	66.70	60.00	45.85	40.90	36.65	31.85
'Mahua' cake (L_2)	69.30	61.60	47.80	43.00	38.05	32.25
'Neem' cake (L_1)	67.80	61.10	47 25	42.00	36.35	30.70
'Neem' cake (L_2)	67.15	63.40	48.85	44.30	39.85	35.30
Sulphur (L_1)	67.70	58.10	42.45	37.80	32.65	27.00
Sulphur (L_2)	68 85	58.95	45.50	40.35	35.10	29 90
SEm ±				4.85		
CD 5%				13.44		

L_1 = 150 g kg^{-1} urea L_2 = 300 g kg^{-1} urea

Table 2. Effect of coating matterials on NH_4 - N formation in soil fertilized with urea (oven-dry basis)

Treatments		NH_4-N ppm) days after incubation					
		0	1	3	7	14	21
Control (No urea)		15.30	14.40	14.80	10.80	10.65	8.30
Plain urea		19.95	38.05	61.25	35.90	11.00	9.00
		COATED UREA					
Coaltar		21.00	36.35	63.30	37.95	11.50	9.03
Gypsum	(L_1)	20.50	35.50	68.10	40.80	11.80	9.60
Gypsum	(L_2)	21.10	34.10	69.30	44.15	12.20	10.00
'Mahua' cake	(L_1)	20.50	30.00	73.05	50.65	14.00	11.50
'Mahua' cake	(L_2)	20.70	28.90	77.10	52.85	14.40	12.10
'Neem' cake	(L_1)	19.85	30.50	74.65	51.35	15.00	12.20
'Neem' cake	(L_2)	19.95	27.50	78.05	55.95	15.60	12.80
Sulphur	(L_1)	19.15	33.90	70.05	44.65	12.50	10.20
Sulphur	(L_2)	20.05	32.10	71.50	47.80	13.10	10.80
SEm±					7.63		
CD 5%					21.16		

L_1 = 150 g kg^{-1} urea L_2 = 300 g kg^{-1} urea

a higher level over all other treatments at and beyond three days of incubation, indicating an accumulation NH_4-N as a result of retardation in the nitrification rate. Data when compared with absolute control (no treatment), treatment with plain urea and urea coated with different coating materials recorded a significantly higher NH_4-N at three and seven days of incubation. Different levels of coating materials used did not influence the NH_4-N formation significantly, although the level of NH_4-N remained higher in posts receiving urea coated wiih 300 g kg^{-1} urea of coating materials at and beyond three days of incubation.

Nitrlfication : NO_3-N formation in soil fertilized with urea showed a linear increase upto seven days of incubation, followed by a gradual decrease in its level with the advancement of the period of incubation (Table 3). When compared with the treatment receiving plain urea, application of urea coated with coaltar alone or in conjunction with different coating materials recorded a lower value of NO_3-N throughout the period of incubation, shaving inhibition in the nitrification of fertilized N, Further, a definitely lower value of NO_3-N was recorded under the treatments receiving urea coated with 'neem' cake at 300 g kg^{-1} urea which was followed by the treatment wherein urea was coated with 'mahua' cake at the same level of coating.

Nitrification rate : The nitrification rate in the pots treated with plain urea and urea coated with coaltar alone and in conjunction with gypsum remained constant upto first three days of incubation (Fig. 1). However, a decrease in nitrification rate was recorded under the pots receiving urea coated with 'mahua' cake, neem cake and sulphur during 1 to 3 days of incubation. With the advancement of the period of incubation beyond three days a sharp increase in nitrification rate occurred upto fourteen days of incubation as a result of increased enzymic oxidation of NH_4-N formed through ammonification under all the treatments examined. Beyond fourteen days of incubation the rate of nitrification remained almost contsant under respective treatments. However, it is quite evident from the data that nitrification rate under the pots receiving urea coated with 'neem' and 'mahua' cake remained low as compared to all other treatments.

Inhibition in nitrification : Inhibition in nitrification rate beyond three days of incubation was highest under the pots receiving urea coated with 'neem' cake followed by the pots receiving urea coated with 'mahua' cake (Fig. 2). Inhibition in nitrification due to coating urea granules with coaltar alone was quite insignificant. Different coating materials examined can be placed in order : 'neem' cake > 'mahua' cake > sulphur > gypsum > coaltar their relative efficiency in inhibiting the nitrification rate.

Table 3. Effeet of coating materials on NO_3 - N formation in soil fertilized with urea (ppm, oven-dry basis)

Treatments	Days after incubation					
	0	1	3	7	14	21
Control (no urea)	15.95	15.95	15.85	15.15	14.95	15.00
Plain urea	17.85	34.65	59.40	78.00	69.10	59.20
			COATED UREA			
Coaltar	17.55	32.20	56.10	75.10	65 15	56.00
Gypsum (L_1)	16.85	29.05	56,10	73.00	63.00	56.00
Gypsum (L_2)	16.70	28.05	52.10	72,15	62.05	52.10
'Mahua' cake (L_1)	17.65	27.05	51.10	70.15	60 15	51.10
'Mahua' cake (L_2)	16.90	24.70	49.10	67.55	57 50	49.05
'Neem' cake (L_1)	16,95	27.55	50.30	69,05	60.10	50.60
'Neem' cake (L_2)	17.80	24 35	48.10	66.10	55.00	47 00
Sulphur (L_1)	16.85	30.00	55.45	73.95	64.15	55.50
Sulphnr (L_2)	17.35	28.85	54.15	72.25	62 85	53.85
SEm±				6.57		
CD 5%				18.23		

L_1 = 150 g kg^{-1} urea L_2 = 300 g kg^{-1} urea

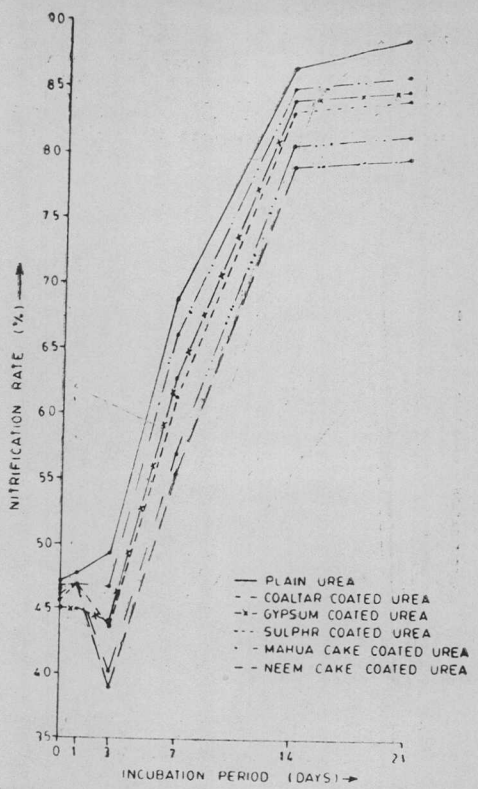

Fig. 1. Effect of coating materials on nitrification rate in soil fertilized with urea

A sharp decrease in the formation of NH_4-N and a sharp increase in the formation of NO_3-N during the period of three to seven days of incubation in the present investigation indicated an increased activity of nitrifying bacteria within this period. However, high values of urea-N and NH_4-N and low values of NO_3-N under the pots receiving urea coated with 'neem' and 'mahua' cake indicate an inhibiting action on the nitrification of fertilized urea. The presence of nimbidin in 'neem' cake and saponin in 'mahua' cake inhibit the nitrfication as they are toxic to the bacteria involved in the first step of enzymic oxidation, converting NH_4-N to NO_2-N (Cleave and Goring, 1962), thereby preventing the nitrification of NH-N_4. This inhibition of nitrification under these treatments releases only small quantities of NO_3-N at a time, which can be utilized by growing plants and thereby minimises the chances of loss or, in other words, increases the efficiency of applied fertilizer nitrogen. The results of present investigation are in corroboration with the findings of Patil (1972), Muthuswamy et al. (1975, 1977), Reddy and Prasad, (1975), Sahrawat and Parmar (1975), Mishra and Chhonkrha (1978), Sahrawat (1980, 1982), Subbaiah and Kothandaraman (1980).

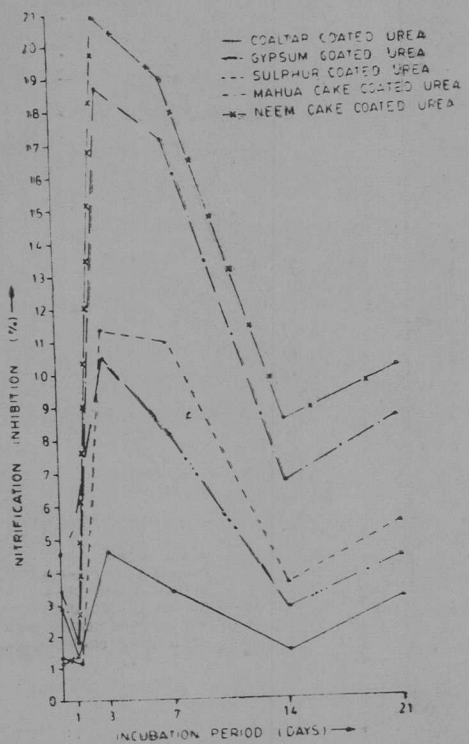

Fig. 2. Relative efficacy of cooting materiols on inhibition fo initrificaton of urea in soil

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