

Effect of Nitrification Inhibitors on the Mineralization of Urea in Soil

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An experiment was conducted with six indigenous nitrification inhibitors namely neem oil, neem cake extract, mahua cake extract, coal tar extract, sulphathiazol and direct application of neem cake. The inhibitors were tried at two concentrations. The fertilizer urea was applied at 50 and 100 kg/ha. The results showed that the efficacy of the inhibitors was in the following order viz. coal tar extract > sulphathiazol > mahua cake extract, neem cake extract, neem oil > neem cake applied directly. The study revealed that there was mineralization of urea only between 20 to 30 days from the date of application i. e upto 20 days the effect of inhibitor was there in the soil. The inhibitors applied at higher concentration gave better results.

Fertilizer urea when applied to soil undergoes several transformations and is converted mainly into ammonia and nitrate and to a lesser extent nitrite forms of nitrogen. These forms of N are subjected to loss through leaching, denitrification or as gaseous ammonia and these losses assume serious proportions particularly where manuring is done for high-yielding varieties which require large quantities of fertilizers under intensive cultivation. These losses can be minimised to a certain extent by the controlled release of fertilizer N by using nitrogen inhibitors. Much information is available for the synthetic inhibitors like 'N-serve', 'AM' and 2-chloro-6-pyridine (Lakhdive and Prasad, 1970; Prasad *et al.* 1971 and Rajale and Prasad, 1973). Moreover these synthetic products are not available in large quantities and also they are costly. Hence with a view to explore the possibilities of using the indigenous N inhibitors, the present trial was conducted.

MATERIALS AND METHODS

The experiment was conducted in a clay loam textured soil. The inhibitors tried were (1) neem oil (2) neem cake extract (3) mahua cake extract (4) coal tar extract (5) sulphathiazol and (6) neem cake direct application. The oil cakes were extracted with acetone (1:10 ratio). Inhibitors 1 to 4 were applied at 10 (D₁) and 20% (D₂) of fertilizer while sulphathiazol was added directly to the soil at 5 (D₁) and 10 (D₂) ppm. Neem cake was mixed with the fertilizer at 15 (D₁) and 30% (D₂) rate and added to the soil. Two rates of fertilizer at 50 and 100 kg/ha were tried. The pot culture experiment was conducted with Co.10 *ragi* under garden-land condition. The control treatment consisted of addition of urea without any inhibitor. The soil samples were drawn at 10 days' interval from the date of planting up to 60th day and analysed for ammoniacal and nitrate nitrogen content according

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to the method of Keeney and Bremner (1966).

RESULTS AND DISCUSSION

The results of soil and statistical analysis are presented in Table 1. The results revealed that the treatments recorded significantly more of NH_4 -N than the control. This was due to the fact that the inhibitors in the treatment prevented mineralization of NH_4 to NO_3 -N while in control there was complete mineralization of NH_4 -N to NO_3 -N as indicated by the

higher amount of NO_3 -N in the control. Among the two fertilizer levels compared both NH_4 -N and NO_3 -N were higher in 100 kgN/ha. Among the two concentrations of inhibitors, the NH_4 -N was not affected significantly, while NO_3 -N was the lowest at the higher concentration indicating the fact that the inhibitors were effective at the higher concentration used.

The different inhibitors showed a significant influence on both the NH_4 -N and NO_3 -N content of the soil.

TABLE I. Results of soil analysis (ppm on moisture free basis)

Name of Inhibitor	Mean values for inhibitors		Number of days	Mean values for interval of soil analysis	
	Ammoniacal nitrogen	Nitrate nitrogen		Ammoniacal nitrogen	Nitrate nitrogen
Control	7.05	115.1	—	—	—
Neem oil	73.5	81.7	10	54.9	48.9
Neem cake extract	75.1	80.4	20	62.2	52.6
Mahua cake extract	98.9	78.9	30	113.9	98.9
Coal tar extract	94.7	70.4	40	114.4	100.1
Sulphathiazol	117.5	70.5	50	112.2	100.7
Neem cake direct application	111.3	115.1	60	113.2	95.8

Results of statistical analysis			S. E. D	C.D. at 5% level
1. Ammoniacal nitrogen (ppm)				
a)	Inhibitors and interval of analysis		3.4	6.7
b)	Control vs Rest		3.5	7.0
	Mean	70.5 95.1		
c)	Fertilizer levels :	50 — 100 kg/ha		
	Mean	87.2 102.9	2.0	3.9
2. Nitrate nitrogen (ppm)				
a)	Inhibitor and interval of analysis		4.5	8.8
b)	Control vs Rest		4.7	9.2
	Mean	115.1 82.8		
c)	Fertilizer levels ;	50 - 100kg/ha		
	Mean	79.1 86.6	2.6	5.1
d)	Concentration of inhibitors :	D1 D2		
	Mean	86.0 78.8	2.6	5.1

Neem cake when applied to the soil directly was found to be least effective on the inhibition of nitrification of urea to nitrate as revealed by the highest amount of NH_4 and NO_3 -N in the soil. Coal tar extract and sulphathiazol recorded higher amounts of NH_4 -N, but at the same time lower NO_3 -N was present. Thus these two inhibitors prevented the mineralization of NH_4 -N to NO_3 -N, but not amide to NH_4 -N. Neem oil and neem cake extract had similar effect but less effective than sulphathiazol and coal tar extract. The efficacies of the different inhibitors were found to be in the following order: coal tar extract, sulphathiazol > mahua cake extract, neem cake extract, neem oil > neem cake direct application. The higher efficiency of sulphathiazol was due to its bactericidal effect unlike that of oil seed cakes whose effects were due to their alkaloid content like nimbidin (neem cake) and saponin (mahua cake) as reported by Bains *et al* (1971). The coal tar contained the alkaloid leucol. Of the three forms of neem seed products viz., neem oil, neem cake extract and neem cake itself, the neem oil and neem cake extract were similar and superior to direct application of neem cake itself. This significant effect of neem oil might be due to its total bitterness and odourous compounds present in it (Patil, 1972). However, these inhibitors failed to produce a significant yield difference.

The analysis of the soil for its NH_4 -N and NO_3 -N indicated that the inhibitive effect of these inhibitors lasted only for 20 days from the date of application. On 30th day higher amount of

NH_4 and NO_3 -N were recorded indicating that mineralization had taken place between 20 to 30th day.

When nitrogenous fertilizers are added to the soil, they are converted into a more readily absorbable form for the plant viz. nitrate form, but unfortunately the anionic form of nitrogen viz. NO_3 suffers great loss by way of leaching. Moreover the ammoniacal nitrogen is also subjected to gaseous loss by volatilization and denitrification. So by treating the fertilizers with indigenous nitrogen inhibitors, these losses can be reduced. From this study it could be suggested that the above loss of nitrogen could be controlled by treating urea with inhibitors like coal tar extract, sulphathiazol.

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