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STUDIES ON THE NITROGEN RELEASE PATTERN BY UREAFORM AND COATED FERTILIZERS IN ACID SOILS*

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ABSTRACT

The results of investigation conducted on the coastal sand, red sandy loam and laterite soils with four slow release nitrogen sources for their nitrogen release pattern in the laboratory have been reported. Ureaform recorded low exchangeable ammonium and urease activity than all other slow release sources used. The ureaform released ammonical, nitrate and urea nitrogen for more than 105 days irrespective of the soils. In laterite, urea and neem cake coated urea registered significantly high nitrate nitrogen. In all the soils, nitrite nitrogen was recorded upto 45 days only. Neem cake blended urea and urea blended with neem cake and coal tar showed higher nitrate nitrogen.

INTRODUCTION

There is considerable scope for increasing the recovery of fertilizer nitrogen according to the agro-climatic conditions. The efficiency of nitrogen utilisation constitute a key factor concerned with high production. The hydrolysis of urea to ammonium, forms an important path way of conversion of organic nitrogen to inorganic form in the soils receiving urea fertilizers. During the course of bio-transformation of urea nitrogen, the losses of nitrogen occur at various stages to varying degree. Among other practices to check the nitrogen losses, the use of slow release nitrogen fertilizer and nitrification inhibitors such as neem cake (Biddappa and Sarkunan, 1981) and coir dust (Nambiar, Biddappa and Khan-Unpublished data) have been reported. The present study was primarily intended to determine the effect of urea formaldehyde and other slow release urea fertilizers on the nitrogen release pattern in three typical coconut growing soils.

MATERIALS AND METHODS

A laboratory investigation was conducted by using three typical coconut growing soils *viz.*, coastal sand, red sandy loam and laterite soils on the nitrogen release pattern with progress of time. Five hundred grams of the soil was taken in the plastic containers and following treatments were imposed to supply 250 ppm nitrogen in each case:

(1) Urea mixed with the soil; (2) Ureaformaldehyde powder mixed with soil; (3) Neem cake powder (4.0% N) mixed with urea at the rate of 30% by weight (Joshi et al., 1985)., (4) Neem cake and coal tar mixed with urea in the presence of kerosene (1%) (Biddappa and Sarkunan, 1981) (5) Coir dust (0.4% N) coated with urea (9 : 1 ratio)

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(Joshi et al., 1985). The soil moisture was maintained at 50% of the water holding capacity at room temperature (29.0 ± 2°C). The basic characters of soils are as follows:

Coastal sand (Oxic quartzipsaments) —98% sand, 0.2% silt, 0.7% clay
41 kg/ha available N
19 kg/ha available P, 8.2 Kg/ha available K.
0.1% O.C., 6.5 pH and 20.4% W.H.C.

Red sandy loam (Arenic Paleustults) —76% sand, 2.0% silt, 22% clay, 0.60% O.C.
5.1 pH and 31.5 W.H.C.

Laterite (Arenic Paleustults) —45% sand, 10.0% silt, 45.0% clay, 1.49% O.C.
4.7 pH and 33% W.H.C.

Soil samples were drawn from all the treatments at 0, 10, 20, 30, 45, 75 and 105 days interval for nitrogen fractionation and urease activity. The urease activity was determined by the method described by Hoffmann and Teicher (1961) and nitrogen fractionation was done by extracting the soil with 1 N sodium sulphate solution (1:5 ratio). The urea N, ammonical N and nitrate N were determined as per the procedure described by Onkan and Sundarman (1977). The nitrate nitrogen in the extract was estimated by chromotropic acid method (Sims and Jackson, 1971). Data are reported on oven dry (105°C) weight basis.

RESULTS AND DISCUSSION

Urease activity

The data in Table I depicts the urease activities in different soil types treated with various slow release nitrogen fertilizers. It is seen that the urease activity was significantly higher in all three types of soils treated with urea followed by coated urea and ureaform. In laterite, urea blended with neem cake and coal tar recorded significantly higher urease activity than other treatments. The urease activity was very low in soils treated with ureaform indicating the suppression of this enzyme in the soil by formaldehyde present in the ureaform. In general the maximum urease activity was registered at 10th day of sampling in all the three soils which was significantly decreased upto 75th day in coastal sand and sandy loam soils and 45th day in laterite soils. The urease activity was about 80% less in soils treated with ureaform as compared to urea alone. Among different soils, sandy loam and laterite registered higher urease activity compared to coastal sand. This may be due to low organic matter content in this soil. Tomar and Mac Kenzie (1984) recorded positive relationship between organic matter content of the soil and the urease activity.

Exchangeable ammonia

It can be seen from the Table II that the ureaform recorded significantly low exchangeable ammonium when

Table I. *Effect of coated urea fertilizers on urease activity (mg/NH_4/100g)*

	Coastal sand				Sandy loam				Laterite			
Intervals (days)	0	10	20	105	0	10	20	105	0	10	20	105
Treatments												
Urea	10.7	13.4	10.0	5.8	11.6	18.1	6.5	7.1	14.7	14.9	11.2	11.2
Ureaform	2.1	1.1	1.0	1.1	4.4	3.4	2.6	2.5	3.8	3.2	2.7	4.3
Urea + coir dust	4.8	15.2	9.4	7.7	9.2	7.4	2.6	3.9	8.6	12.8	7.1	7.0
Neem cake + urea	8.2	17.9	10.1	8.1	19.5	17.6	4.2	3.9	12.1	13.5	11.0	4.9
Urea blended with tar + neem cake	3.4	17.2	11.3	6.0	9.6	16.7	6.5	4.7	12.9	15.9	11.2	10.2
Control	3.2	1.3	1.3	1.7	3.8	1.5	1.9	1.7	2.7	1.8	1.5	1.1
C.D. 5% for treatments		1.06				1.38				1.23		
C.D. 5% for intervals		1.15				1.49				1.33		

compared to urea and other coated fertilizers in all the three types of soils. This may be due to slow hydrolysis of urea to ammonia in the ureaform because of very low activity of urease enzyme. In the case of urea treated soils, high exchangeable ammonia was registered in sandy loam followed by coastal sand. While in laterite, urea blended with neem cake and coal tar gave higher ammonium content at different invervals of time. Though it was reported (Biddappa and Sarkunan, 1981) that neem cake and coal tar serve as nitrification inhibitors, it was not evident from the present study with respect of coastal sand and sandy loam soils. In general, lowering of ammonical nitrogen was noticed on the 75th day reaching lowest by 105 days.

Table II. *Effect of coated urea fertilizers on exchangeable ammonium N contents in soils (ppm)*

	Coastal sand				Sandy loam				Laterite			
Intervals (days)	0	10	20	105	0	10	20	105	0	10	20	105
Treatments												
Urea	84.1	139.5	135.2	45.4	139.4	172.8	141.6	87.2	112.1	139.7	151.9	86.0
Ureaform	9.2	22.7	27.7	57.9	49.1	31.9	48.6	60.9	25.2	45.1	36.7	10.7
Urea + coir dust	64.9	147.0	130.6	118.2	99.9	102.4	92.5	92.5	93·2	122.4	120.3	65.7
Neem cake+urea	113.7	169.5	158.8	12.7	162.4	158.2	120.4	5.1	118.1	134.3	155.2	25.2
Urea blended with tar + neem cake	48.3	132.6	167.9	37.9	76.3	151.4	168.6	25.9	123.1	148.3	159.1	99.2
Control	11.2	6.4	4.4	1.0	16.4	4.1	4.8	0.9	21.4	10.6	7.5	0.5
C.D. between treatments		11.57				12.54						11.75
C.D. between intervals		12.50				13.54						12.69

Nitrate

Coastal sand in general showed low nitrate nitrogen compared to sandy loam soils (Table III). The highest nitrate nitrogen was produced after 45th day of incubation. However, in red sandy loam and laterite soils the maximum production of nitrate nitrogen was observed upto 105 days. The high recovery of nitrate may be due to either non utilisation in the absence of crop plant or faster nitrification process with the progress of time. In sandy loam soils, all the treatments except control recorded significantly high nitrate nitrogen whereas in laterite, urea and neem cake blended urea registered high nitrate nitrogen. Ureaform however showed low nitrate-N in all three soils irrespective of time of sampling.

Urea nitrogen

The data presented in Table IV indicated that the urea nitrogen persisted over a period of 105 days in the case of ureaform compared to other slow release nitrogen sources. In the case of other slow release fertilizers used, the urea nitrogen was practically absent beyond 10th day. In the case of laterite soils, the urea nitrogen was in trace even at zero day in the treatments urea, coir dust blended urea, and neem cake blended urea. The extended availability of nitrogen from ureaform over a long period of time has been reported by Brown and Volk (1966). The present study was also in conformity with the above report. It is seen from the table that a constant amount of urea nitrogen is present in all the three soils even upto 105 days when nitrogen was supplied through urea formaldehyde.

Nitrite

In general, the nitrite content was trace in laterite under all the treatments. However, the soils treated with neem cake coated urea recorded 72 to 95 ppm of nitrite nitrogen upto 45 days beyond which it was in traces. In the sandy soil, the highest nitrite production was

Table III. *Effect of coated urea fertilizers on nitrate nitrogen contents in soils (ppm)*

	Coastal sand				Sandy loam				Laterite			
Intervals (days)	0	10	20	105	0	10	20	105	0	10	20	105
Treatments												
Urea	0.17	2.9	3.8	24.5	1.37	22.3	41.1	64.8	2.5	11.5	30.3	144.1
Ureaform	1.4	3.3	14.1	29.7	2.0	12.3	27.7	62.9	2.7	14.9	30.5	115.4
Urea+coir dust	1.2	3.4	15.1	26.9	1.8	18.7	27.4	87.7	3.6	14.2	30.2	127.5
Neem cake+urea	6.1	9.9	15.7	27.6	5.6	3.4	43.6	66.5	6.3	3.9	13.7	166.7
Urea blended with tar+neem cake	8.3	8.2	11.4	30.4	7.5	4.9	24.1	71.4	7.3	5.6	4.5	155.5
Control	0.5	1.1	5.3	9.3	1.22	4.7	11.2	16.4	4.1	5.4	7.2	148.0
C.D. between treatments	1.51							11.93				4.40
C.D. between intervals	1.63							12.89				4.75

Table IV. *Effect of ureaform and coated fertilizers on urea N (mg/100g.)*

	Coastal sand				Sandy loam				Laterite			
Intervals (days)	0	10	20	105	0	10	20	105	0	10	20	105
Treatments												
Urea	40.31	0.68	T	T	1.17	T	T	T	T	T	T	T
Ureaform	3.71	3.81	3.71	3.14	3.55	3.02	3.41	3.36	3.9	3.7	3.1	2.02
Urea+coir dust	28.28	T	T	T	1.85	T	T	T	T	T	T	T
Neem cake+urea	5.05	1.14	T	T	0.97	T	T	T	T	T	T	T
Urea blended with tar+neem cake	45.82	1.18	T	T	1.60	T	T	T	2.01	T	T	T
Control	0.62	T	T	T	1.23	T	T	T	T	T	T	T

T–Trace

observed for coir dust treated soils (136 to 463 ppm) upto 45 days followed by neem cake treated (17 to 58 ppm) soils. In other treatments the presence of nitrogen was almost in trace.

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REFERENCES

BIDDAPPA, C. C. and SARKUNAN, V. 1981. Effect of urea blended with neem cake on nitrogen transformation in three typical rice soils of Orissa. *Mysore J. Agric. Sci.* **15**: 388–393.

BROWN, M. A. and WOLK, G. M. 1966. Evaluation of fertilizer using nitrogen–15 labelled materials in sandy loams. *Soil Sci. Soc. Am. Proc.* **30**: 278–281.

HOFFMAN, G. and TEICHER, K. 1961. Colorimetric determination of urease activity in soils. *Z. Pflanzenernahr. Diing Bodunk.* **95**: 55–63.

JOSHI, O. P., KHAN, H. H., BIDDAPPA, C. C. and MANIKANDAN, P. 1985. Effect of coir dust on the mineralisation of urea nitrogen in coconut growing red sandy loam soils. *J. Plant. Crops.* **13**: 88–95.

ONKAN, A. B. and SUNDERMAN, H. D. 1977 Colorimetric determination of exchangeable ammonium, urea, nitrate and nitrite in single soil extract. *Agronomy Journal.* **69**: 49–53.

SIMS, J. S. and JACKSON, G. D. 1971. Rapid analysis of soil nitrate with chromotropic acid. *Soil Sci. Amer. Proc.* **35**: 603–606.

TOMAR, T. S. and MAC KENZIE, A. F. 1984. Effect of catechol and P. Benzoquinone on the hydrolysis of urea and ene.rgy barriers of urease activity in soil. *Can. J. Soil Sci.* **64**: 51–60.