MINERALISATION OF UREA COATED WITH NEEM CAKE AND TAR AND ITS EFFECTS ON GROWTH OF RUBBER

By

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INTRODUCTION

Out of the three major plant nutrients used as fertilizers, nitrogen ranks first and its efficient use has been the subject of study since the dawn of scientific agriculture. In India nitrogen constitutes about three-fourth of the total fertilizer consumption. However, its efficiency is only less than 50 per cent under the agro-climatic conditions prevailing in our country. Urea has become the most popular nitrogenous fertilizer because of its low unit cost, high nitrogen content and easy availability. When applied to soil, urea gets easily hydrolysed resulting in nitrification and leaching losses (Allison, 1966). The use of chemicals like N-serve (pyridine derivative) and AM (pyrimidine derivative) as nitrification inhibitors were reported by numerous workers (Gasser, 1965 ; Prasad, *et al*, 1971). But most of these chemicals are costly and have to be imported. This necessitated testing of cheaper and indigenously available materials as nitrification inhibitors and alcohol extract of neem seed, neem cake and tar were found to have this property (Bains *et al*, 1971 ; Muthuswamy *et al*, 1975 ; Patil, 1972 ; Yeoh and Soong, 1979). The present work was undertaken to study the effect of neem (*Azadirachta indica L*) cake coated and tar coated urea on the growth of budded stumps and to study the mineralisation pattern of these coated forms when applied to rubber growing soils.

EXPERIMENTAL

Pot culture experiment

A green house experiment in glazed pots was conducted with the soil collected from the RRII farm. The characteristics of the soil are pH 4·5, organic carbon 0·8%, Bray II extractable phosphorus 2·4 mg/100g ; morgan extractable potassium 3·5 mg/100 g and magnesium 0·80 mg/100 g. Three doses of urea (5·0 g, 7·5 g and 10·0 g) were tried in the experiment. There were ten treatments:

1. 5·0 g urea neem coated
2. 5·0 g urea tar coated
3. 5·0 g urea without coating
4. 7·5 g urea neem coated
5. 7·5 g urea tar coated
6. 7·5 g urea without coating
7. 10·0 g urea neem coated
8. 10·0 g urea tar coated

9. 10·0 g urea without coating
10. Control (no nitrogen)

All the treatments were replicated thrice.

Twenty g of coal tar was melted in a beaker and dissolved in 30 ml kerosene oil and 250 g of neem cake powder was added and mixed thoroughly. To this 1000 g urea were added and thorough mixing was done with a glass rod. For preparing tar coated urea, urea was directly added to the melted tar-kerosene mixture and mixed well.

The treatments were incorporated 75 days after planting the budded stumps. Regular watering and recycling of leachate were done. Soil samples were collected at 15, 45 and 75 days after incorporation of fertilizers. The samples were analysed for ammoniacal-N and nitrate-N (Black, 1965). Periodic height and girth measurements were also recorded. The plants were uprooted 12 months after planting and dry matter production determined.

Incubation study

500 gm of air dried soil passing through a 2 mm seive were taken for the study. Urea at the rate of 100g N/kg soil was thoroughly mixed with the soil. There were four treatments (neem cake coated, tar coated, uncoated and a control without nitrogen). The treatments were replicated seven times. The soil was kept at field capacity throughout the period of study by adding distilled water. The beakers were incubated at room temperature for 37 days. 10 g samples were drawn at periodic intervals and analysed for ammoniacal and nitrate-N (Black, 1965).

RESULTS AND DISCUSSION

Pot culture experiment

Mean height, diameter and dry matter production of the plants under various treatments are given in Table 1. Application of urea coated with neem cake and tar at 7·5 and 10·0 g per plant resulted in a significant increase in height and diameter. However, at the lowest level viz., 5·0 g, the effect was not significant. Favourable effect of coating on dry matter production was observed only for neem cake applied at 10·0 g. Increase in dose of uncoated urea from 5·0 to 10·0 g did not significantly increase the growth attributes. On the other hand, increase in height of 29·6 cm and 29·0 cm was observed due to increase in dose of neem and tar coated urea from 5·0 to 10·0 g. Corresponding figures for diameter increase were 2·84 and 2·66 mm, respectively. Neem cake and tar have been found to be equally efficient as far as their effect on growth is concerned. From these results it is clear that the efficiency of urea nitrogen on growth of rubber plants can be improved by coating urea with neem cake or tar. Favourable effect of rubber coated fertilizers on growth of rubber plants has been reported from Malaysia (Yeoh and Soong, 1979). Growth and yield of many crops have also been reported to be increased by the application of coated fertilizers and nitrification inhibitors (Bains *et al*, 1971 ; Muthuswamy *et al.*, 1975 ; Patil, 1972 ; Subbiah *et al*, 1979).

Table 1. *Effect of coating on growth of budded stumps*

Treatments	Height (cm) April '82	Diameter (mm) July '82	Dry matter g/plant July '82
5·0 g urea-neem	97·00	15·40	477·8
5·0 g urea-tar coated	93·3	15·11	440·8
5·0 g urea	94·00	14·83	411·7
7·5 g urea-neem	116·7	17·90	568·8
Urea-tar	115·7	17·54	532·6
Urea	95·7	14·97	488·5
10·0 g urea-neem	126·7	18·24	608·6
Urea-tar	122·3	17·77	579·2
Urea	100·3	15·15	504·4
Control	63·3	11·81	240·1
SE	6·37	0·70	28·5
CD	18·86	2·07	84·3

Soil samples drawn from pot culture experiments at 15, 45, 70 days showed that ammonium-N was higher in the first sampling and decreased as the crop growth advanced (Table 2). Reduction in ammonium-N after 15 days might be due to its nitrification and plant uptake. Significantly higher ammonium-N values were observed for uncoated urea over coated forms in the first sampling. At 5 g level, soil treated with uncoated urea registered 195·33 ppm of ammoniacal-N, while soil treated with neem cake and tar coated urea had only 72·66 ppm and 149·33 ppm, respectively. At a subsequent sampling coated forms retained higher ammonium-N than uncoated urea. On the fifteenth day, release of ammonium-N from neem cake coated urea was lower than tar coated urea. On the other hand, ammonium-N was higher in neem coated urea treated pots on the 45th day. This brings out that neem cake and tar when used for coating urea are effective in slowing the process of ammonification, neem cake being superior. Similar results have been reported by several workers on the effect of neem cake (Muthuswamy *et al*, 1975; Patil, 1972 ; Subbiah *et al*, 1979) and coal tar (Bains, *et al*, 1971) in other crops.

Table 2. *NH_4 - N (ppm) in soil at various stages of growth*

Treatments	NH_4 - N 15 days	45 days	75 days
5·0 g urea-neem	72·66	35·00	18·66
5·0 g urea-tar	149·33	28·33	15·00
5·0 g urea	195·33	12·66	11·00
7·5 g urea-neem	150·00	41·33	21·00
7·5 g urea-tar	165·66	36·00	19·33
Urea	199·66	21·33	14·33
10·0 g urea-neem	189·33	46·33	35·33
Urea-tar	230·66	42·66	36·33
Urea	269·33	26·33	20·66
Control	·0	2·66	6·66
SE	10·78	0·84	1·83
CD	32·00	2·48	5·44

Incubation study

In the incubation study ammoniacal-N and nitrate-N were estimated at close intervals (Table 3). Ammonification was evident from the first day and attained a peak in 7 days in all the treatments and gradually decreased as the period of incubation advanced. Between the coated forms and uncoated forms of urea, a significant difference was noticed in all the observations. Till the 21st day of incubation, uncoated urea treated soil registered higher values of ammoniacal-N than neem and tar coated urea treated soil. Thereafter the soils treated with coated urea retained more of ammoniacal-N. From the second week onwards ammoniacal-N was more in neem coated urea, which indicates the beneficial effect of this material on controlled release of nitrogen from applied urea. These results confirm the observation on ammoniacal-N reported in pot culture experiment (Table 2).

Table 3. *NH_4 - N (ppm) at various periods of incubation*

Treatment	Days of incubation						
	1	4	7	14	21	28	37
Control	1·4	2·3	2·6	2·3	2·1	2·1	1·3
Urea	34·9	101·0	105·3	100 6	88·0	73·5	48·2
Urea-neem	19·6	60·6	98·6	92·6	78·7	77·8	70·5
Urea-tar	19·2	57·5	99·6	91·7	78·6	72·7	64·3
SE	0·23	0·72	0·78	0·85	1·53	1·40	0·73
CD	0·68	2·13	2·31	2·52	4·53	4·14	2·16

Nitrate-N at different periods of incubation are presented in Table 4. Indication of release of nitrate-N from applied urea could be detected only in the case of uncoated urea from the 14th day of incubation. Even though nitrification started by the 14th day appreciable nitrification was noticed only by the 28th day. In Munching series soil in Malaysia, nitrate-N was detected only after 28 days (Tan Keh Huat, 1982). Till the close of the incubation study, no appreciable release of nitrate-N was noticed in both the coated forms of urea. The absence of nitrification of applied urea in the coated forms could be attributed to the inhibitory effect of the coating materials on ammonification and nitrification.

Table 4. *NO_3-N (ppm) after various periods of incubation*

Treatments	Days of incubation						
	1	4	7	14	21	28	37
Control	1·4	1·8	1·8	2·2	2·4	2·2	3·3
Urea	1·6	1·8	2·5	10·7	18·1	37·9	41·0
Urea-neem	1·7	1·7	1·7	1·7	2·1	2·2	1·8
Urea-tar	1·6	1·8	1·4	1·6	2·1	2·1	2·5
SE	0·05	0·11	0·14	0·23	1·36	0·77	0·14
CD	0·15		0·41	0·68	4·03	2·28	0·41

The results of the pot culture and incubation studies indicate that both neem cake and tar are efficient in increasing the growth of plants by retarding nitrification as well as ammonification, when used as coating materials on urea. Even though neem cake coating is only marginally superior to tar coating on the growth of plants, the rate of ammonification is reduced significantly with neem cake coating. This justifies the use of neem cake along with tar as coating material for enhancing the efficiency of urea. Further investigations are required to find out whether repeated applications of coal tar treated urea at higher levels will have any phytotoxic effects on growth of rubber under field conditions.

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