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EFFICACY OF SLOW RELEASE FERTILISERS FOR YOUNG RUBBER

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ABSTRACT

The effect of different slow release fertilisers on early performance of rubber and their mineralisation pattern were studied in comparison to those of conventional fertiliser (prilled urea) in a field experiment. The different controlled release fertilisers evaluated were NPKMg tablets, nimin coated urea and neem cake mixed urea. Application of N at 75 per cent of the recommended dose through any of the controlled release fertilisers was found to be equally effective as conventional fertilisers applied at 100 per cent of the recommended dose with respect to plant growth. Among the different controlled release fertilisers, NPK Mg tablets recorded the highest values of diameter and diameter increment.The use of controlled release fertilisers at the reduced rate did not adversely affect the soil and leaf mineral nutrient status .The study on mineralisation pattern revealed that NPK Mg tablets underwent mineralisation more gradually maintaining a higher concentration of $NO_2 + NO_3$-N up to three months as against one month in the case of nimin coated and neem cake mixed urea and two weeks in the case of prilled urea. A possibility for reducing the leaching losses and subsequent environmental hazards through ground water pollution with the use of controlled release fertilisers was indicated.

Key words : Controlled release fertilizers, *Hevea,*Growth, Mineralisation

INTRODUCTION

The efficiency of most of the conventional fertilisers are affected by their solubility in water and the loss of nutrients through leaching. Under the tropical conditions existing in India, a considerable amount of nitrogen applied to the soil is lost through leaching and volatilisation (Sharma and Ghosh, 1976). In rubber also considerable leaching losses of N and K fertilisers have been reported (Pushparajah *et.al.*, 1973 ; In this context, controlled release fertilisers offer a promising new tool to regulate the availability of mineral nutrients and ensure adequate nutrition for a prolonged period. The use of these fertilisers will reduce the nutrient loss through leaching and run off and facilitate fertiliser application practices (Zekri and Koo, 1991). Information is scarce regarding the growth response of immature rubber to application of controlled release fertilisers under the tropical situation of Kerala. The objective of this paper is to evaluate the effect of different controlled release fertilisers on early growth of rubber and to study the mineralisation pattern of different controlled release fertilisers in comparison with those of conventional fertilisers under field conditions.

MATERIALS AND METHODS

A field experiment was laid out in the 1993 replanted RRII 105 area at Central Experiment Station, Chethackal of Rubber Research Institute of India to evaluate the efficacy of different controlled release fertilisers for rubber. The soil of the experimental site was sandy loam in texture and was high in organic carbon (2.4%), low in available P (0.38 mg/100g) and medium in available K (6. 08 mg /100g). The soil was acidic with a pH of 5.6. The treatments consisted of a no fertiliser control (NFC), nitrogen applied at 100% of the recommended dose as prilled urea (conventional fertiliser, CF - 100), nitrogen at 100% and 75% of the recommended dose as NPK Mg tablets (TAB - 100 and TAB - 75) and nimin coated urea (NCU -100 and NCU -75) and nitrogen at 75% of recommended dose as neem cake mixed urea (NCMU-75). The details of the N - fertilisers are given in Table 1. P,K and Mg were applied uniformly according to the standard recommendation (Pushpadas and Ahammed, 1980) in all the treatments except in TAB 75, where the above nutrients also were added at 75% of the recommended dose. The fertilisers were applied in September during 1993. From 1994 onwards, the fertilzers were applied in two equal splits during June -July and September-October. The fertilisers except NPK Mg tablets were applied in circular bands around each plant and slightly forked in. NPK Mg tablets were placed at a depth of 10 cm at 15 cm radius around the base of the plant during the first year and 30 cm radius during the second year. The design of the experiment was RBD with three replications with 7 plants per plot at a spacing of 22' x 11'.

Plant growth measurements were made by recording the diameter of the plant at a height of 50 cm before the imposition of treatments and at an interval of four months after the first treatment imposition. Leaf samples were collected during August,1994 and analysed for the mineral nutrients according to the standard methods (Piper,1966). To study the mineralisation pattern of different controlled release fertilisers soil samples were drawn at 0 to 30 cm depth at intervals of 1,5,15,30,60 and 90 days after the application of fertilisers. Different forms of nitrogen were estimated in wet samples. The analysis was as per Muvery & Bremer, 1979) & Jackson, 1958. Inorder to study the leaching losses another field experiment was laid out adjacent to the field trial. An area consisting of fifty plants was divided in to five sub plots , each subplot having 10 plants in two rows of five each. Four plots were applied with equal quantities of N through different sources,viz., prilled urea, NPK Mg tablets, nimin coated urea and neem cake mixed urea. P and K were also applied uniformly to all the four plots.One plot was left as no fertiliser control. In each sub plot, in between two rows of rubber two trenches of size 1 m^3 were excavated and mini lysi meters (Santana and Cabala- Rosand, 1982) were inserted in to the wall of the trench for collection of leachate at a depth of 0.2m and 0.3m.The mini lysimeters were constructed of rigid PVC pipes 10 cm diameter and 30 cm long. Apertures were made along one side and covered with nylon net and the ends of the pipes were closed except for a drainage hole in one end, which emptied the leachates in to a 5 l plastic container. The leachates were collected weekly, their volumes measured and aliquots were taken for estimation of NO_3-N using standard procedure. Throughout the duration of the experiment, the rainfall data were collected daily.

RESULTS AND DISCUSSION

Growth of rubber: The pre-treatment diameter and diameter at four months after

Table 1. Effect of controlled release fertilizers on growth of rubber.

Treatment			Diameter (cm)			Cumulative Diameter increatment
Sept. 93	Jan. 94	May 94	Sept. 94	Jan. 95		(cm)
NFC	1.22	1.88	2.67	3.28	4.02	2.80
CF 100	1.37	2.11	2.89	3.75	4.54	3.17
TAB 100	1.28	1.28	3.1	3.98	4.85	3.57
TAB 75	1.37	2.23	3.25	4.15	5.00	3.63
NCU 100	1.25	2.12	2.92	3.75	4.65	3.40
NCU 75	1.19	2.02	3.03	3.91	4.71	3.52
NCMU 75	1.43	2.19	2.99	3.87	4.73	3.30
SE	0.08	0.11	0.10	0.11	0.14	0.12
CD(0.05)	NS	NS	0.31	0.34	0.48	0.36

Table2. Effect of controlled release fertilisers on the release pattern of urea N (ppm).

	Period after treatment imposition (days)				Mean		
Treatment	1	5	15	30	60		90
NFC	Tr	Tr	Tr	Tr	Tr	Tr	Tr
CF 100	57.66	24.00	6.0	2.33	Tr	Tr	14.99
TAB 100	13.66	2..00	16.0	13.33	7.33	4.67	12.83
TAB 75	13.00	18.00	14.67	11.33	6.33	6.00	10.55
NCU 100	55.38	30.66	21.33	10	Tr	Tr	19.56
NCU 75	52.60	28.67	17.33	12	Tr	Tr	18.38
NCMU 75	53.8	30.00	18.67	7.33	Tr	Tr	18.3
Mean	39.4	211.9	13.42	8.04	1.95	1.52	

	S.E.	CD (P=0.05)
Fertilizers	0.5	1.39
Intervals	0.46	1.27
F * 1	1.22	3.38

treatment imposition didn't exhibit any significant difference among the treatments (Table1.) However, from eight months onwards the effect of fertilisers on the diameter of the plants became evident.The conventional and controlled release fertilisers recorded significantly higher diameter than the unfertilised control. But there was no statistical difference in diameter responses between the different controlled release fertilisers and standard practice at any of the observation time and hence, the diameter response to different controlled release fertilisers at both the levels of applied nitrogen were comparable to that of conventional fertiliser.

Controlled release fertilisers can maintain a low concentration of nutrients in soil without imposing nutrients stress on crops and minimises the nutrient loss(Karnika de Silva *et al.*, 1996). It also avoids excessive consumption of fertilisers in earlier stages and helps to reduce the disruption of nutrient balance in the soil. This is again supported by the mineralisation pattern of different fertilisers tried. The plant available N (NO_3 N) increased progressively up to the 15th day for prilled urea 30th day for nimin coated and neem cake mixed urea and 90th day for NPK Mg tablets.

Leaf nutrient status: No significant difference was noticed in the content of N, P, K. Ca and Mg in the leaves of the plants from different treatments .But the unfertilised control maintained a low concentration of all the nutrients. It can be found that the use of controlled release fertilisers, that too at reduced rate did not adversely affect the leaf mineral status of the rubber plants. This is in general agreement with the results obtained by Zekri and Koo (1991) in orange trees and Mohd. Yousaf *et al.*,(1995) in rubber.

Mineralisation of urea-N:

Urea -Nitrogen: Urea N content was maximum during the first day of application in all treatments except where NPK Mg tablets were applied (Table 2) .In the NPK Mg tablets treated plots maximum urea N was recovered 5 days after application and the urea-N recovery was comparatively low and consistent throughout the experimental period. Here 30% of urea N is the form of urea formaldehyde. This along with the waxy coating might have contributed towards controlled release of urea N from fertiliser material. The superiority of urea formaldehyde as a slow release fertiliser was reported by other workers (Cox, 1993).

Table 3. Effect of controlled release fertilizerson the release pattern of NO_2 + NO_3 - N (ppm).

	Period after treatment imposition (days)						Mean
Treatment	1	5	15	30	60	90	
NFC	6.66	7.33	7.00	7.66	8.00	9.00	7.61
CF 100	20.00	32.67	58.66	33.00	12.33	10.33	27.83
TAB 100	7.33	11.33	20.33	28.33	41.33	49.33	26.33
TAB 75	6.83	13.33	16.33	25.00	40.66	43.33	24.25
NCU 100	11.66	27.66	44.66	51.66	8.66	9.00	25.55
NCU 75	13.33	18.33	41.66	48.66	13.33	10.33	24.27
NCMU 75	9.66	26.00	56.00	40.66	10.00.	14.00	26.05
Mean	10.78	19.52	34.95	33.57	19.19	20.76	

	S.E.	CD(P=0.05)
Fertilizers	1.38	3.82
Intervals	1.28	3.55
F * I	3.38	9.36

Ammonical Nitrogen: The concentration of NH_4 - N also decreased at faster rate in the prilled urea treatment indicating the absence of any inhibiting agents, allowing the natural process of mineralization to continue rapidly (Table 3). However, in the nimin coated urea treatment recovery of NH_4- N was significantly high compared to the prilled urea treatment, showing the influence of nitrification inhibitors in retarding the rate of mineralisation of NH_4 -N to NO_3-N. Sidhu, 1993 also reported the efficiency of blending urea with nitrification inhibitors. The level of NH_4-N recovered was proportional to the quantity of urea applied in all the treatments. In the case of NPK Mg tablets, the maximum recovery of ammoniacal N was obtained 5 days after application and it was significantly superior to all other treatments. Thereafter the ammonical N content decreased and at 60th and 90th days of sampling significant quantities of NH_4-N could be recovered only from these treatments as in the case of urea N. This indicates the mode of hydrolysis of NPK Mg tablets.

Nitrite + Nitrate Nitrogen: An increase in the concentration of NO_3 -N was observed with the passage of time in all the treatments. It could be seen from the table that NO_3-N concentration one day after the application of fertilisers ranged from 6-13 ppm in all treatments except in prilled urea, where it was 20 ppm. Like the other forms of inorganic nitrogen, the changes in the NO_3-N concentration was comparatively faster in the prilled urea applied treatment. The NO_3-N concentration increased progressively up to the 15th day in the case of prilled urea treatment, 30th day in the case of nimin coated urea and neem cake mixed urea treatments and upto 90 days in the case of NPK Mg tablets treated plots.

Leaching of N: The discharges in both the lysimeters were directly proportional to the quantity of rainfall received. Only lesser quantities of leachate were collected in lysimeter II (installed at 30cm depth) compared to lysimeter I (installed at 20 cm depth). The NO_3-N concentration in the leachates also followed almost a similar trend. The amounts of NO_3-N leached were proportional to the amounts of rainfall. The NO_3-N concentration was more in the leachate from lysimeter I than from lysimeter II. This is expected as most of the fertilisers were surface applied and the content of soil organic nitrogen is also more in top layers. The content of NO_3-N was comparatively higher for prilled urea where as the same was comparatively low and consistent for NPK Mg tablets during most of the sampling periods indicating the effectiveness of different modified forms in reducing the solubility of urea . A substantial difference in the NO_3-N concentration between different treatments was noticed only during the 1st week of August corresponding to the maximum rainfall period. Although the methods used to measure leaching do not allow extrapolations to unit areas, results suggest that nitrogen leaching losses can be reduced with the use of controlled release fertilisers.

The results of the present study indicated that controlled release fertilisers underwent mineralisation more gradually and hence application of low doses of N through controlled release fertilisers provided optimum N for the growth of rubber. A possibility for reducing the leaching losses and the subsequent environmental hazards through ground water pollution through the use of controlled release fertilisers was indicated.

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