EFFECT OF CONTINUOUS APPLICATION OF NITROGENOUS FERTILIZERS ON SULPHUR STATUS OF SOIL

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ABSTRACT

A nursery trial was carried out to evaluate the relative efficiency of Urea, Ammophos and Ammonium Sulphate on the Sulphur status of soil. The need for the study steamed from the depletion of sulphur possible by the continuous use of urea as a source of nitrogen in rubber. Nitrogen was applied @ 500 kg/ha and the experiment was repeated for 3 years in the same site to study the build up or depletion in Sulphur content in soil. Soil samples were analysed for total and available Sulphur, pH and available nutrients. In urea treated plots total and available Sulphur content were 166 ppm and 112 ppm while in Ammophos, it is 263 ppm and 194 ppm and for Ammonium Sulphate treated plots the values obtained were 346 ppm and 256 ppm respectively. The date on the total Sulphur as well as sulphate content shows that the use of Ammonium Sulphate and Ammophos has helped in the enrichment of sulphur status of the soil. While use of urea has resulted in a depletion of Sulphur to a certain extent. Of the treatments Ammonium Sulphate has influenced the in increasing the Sulphur status of the soil. As regards soil pH, the data at the end of third year reveals that the Ammonium Sulphate has lowered the soil pH and the plots under treatment with Urea increased the soil pH, but the changes were not statistically significant.

INTRODUCTION

Sulphur is one of the essential macronutrient element and resembles nitrogen in its role in biosynthesis activity of plant growth. It is a constituent of proteins, being a component of amino acids like Cysline and methionine and vitamins like biolin and thiamine. Plants and micro organisms absorb this element in sulphate form and due to continuous utilisation and storing result in sulphur reserves in soil organic matter. From this reserve it is freed for reabsorption as sulphate ion by a mineralisation process conducted by micro organisms. Since sulphate is easily leached and last from soil and also the chances for replenishment of sulphur due to rainfall is unlikely in rubber growing areas due to the absence of industrial fumes containing sulphur dioxide, the the chance for sulphur deficiency in rubber growing soils is an ever present possibility. Added to this, switching over to urea, a high analysis fertilizer as nitrogen source in place of ammonium sulphate may also enhance the occurence of sulphur deficiency in rubber growing soils. In India systematic studies on sulphur has

been taken up only during the past ten or fifteen years. From these studies a number of alluvial, red and laterite soils are reported to be deficient in sulphur (Naik and Das, 1964) and more than thirty crops are found to respond to sulphur application. Tandon (1986) has reported that soils containing less than 10 ppm available sulphur may cause its deficiency. In this context, the present study was taken up in a rubber seedling nursery to evaluate the effect of continous application of urea as compared to Ammonium sulphate and Ammophos in soil sulphur status and in growth of rubber seedlings.

Nurseries are required to raise stock seedlings for the purpose of budgrafting. Here the seedlings are well maintained for a period of 10 months and transplanted in the field after budding. The seedlings are budgrafted when a girth of 7 cms is attained at the collar region.

Materials and Methods

A nursery trial was laid out at Central Nursery of Rubber Board, Karikattoor, Kottayam District from 1985-'86 to 1987-'88. The nutrient status of soil selected for the study is given in Table 1.

Table -1. Initial Nutrient Status of the Experimental Field

Organic Carbon (%)	pH	Av.Sulphur (ppm)	Total Sulphur (ppm)	Av.nutrients in mgm/100 gm soil			
				P	K	Ca	Mg
1.62	4.5	40.91	264.00	5.28	3.38	18.40	8.39

The treatments included Ammonium sulphate, Urea and Ammophos applied @ 500 kg Nha^{-1} in two split doses. A Randomised Block Design with 6 replication was tried. The first dose was applied 6 - 8 weeks after planting and the second dose 12 weeks after planting. Phosphorus, Potassium and Magnesium were applied @ 250, 100 and 37.5 kgs ha^{-1} respectively. Soil samples were collected before the start and at the end of the experiment and analysed for total and available sulphur, total Nitrogen, Organic carbon, pH and available phosphorus, potassium, calcium and magnesium. Available sulphur was estimated as described in plant and soil analysis.

Results and Discussion

Data on available sulphur and total sulphur status of soil at the end of third season is furnished in Table 2.

The results indicated that the total as well as available sulphur was significantly higher in ammonium sulphate treated plots, as compared to urea treated plots.

Table-2. Available and Total Sulphur in Soil at the end of Third Season

Treatments	Available Sulphur (ppm)	Total Sulphur (ppm)
Ammonium Sulphate	256.44	346.67
Urea ..	112.69	166.67
50% Ammonium Sulphate + 50% Urea	172.99	306.67
50% Ammophos + 50% Urea	194.87	263.33
SE	24.66	34.66
CD (P=0.05)	74.28	104.38

An incidental addition of 600 kgs $ha^{-1}yr^{-1}$ was done in plots treated with ammonium sulphate alone. In plots applied with 50% each of ammonium sulphate and urea the quantity added was 300 kg where as no addition of sulphur was done in the case of urea treated plots. There was a reduction of about 56 and 52 percent in available and total sulphur respectively in soil in a period of three years in urea applied plots as compared to ammonium sulphate applied plots. A similar results of decrease in sulphate content in urea treated plots was reported for rubber growing soils of Ceylon (Yogaratnam and Perea, 1981). Data on sulphate content in leaves of the rubber seedlings are given in Table-3.

Table -3. Sulphur Content of Leaves of Rubber Seedlings

Treatment	%S
Ammonium Sulphate ..	0.29
Urea	0.21
50% Ammonium Sulphate +50% Urea	0.26
50% Ammophos + 50% Urea	0.24

Sulphur content of leaves was found to be high in ammonium sulphate treated plots as compared to urea treated plots as compared to urea treated plots, but the difference is not statistically significant.

Data on diameter of rubber seedlings for the three years of study are given Table-4.

Table-4. Diameter (mm) of Rubber Seedlings for the Three Years

Treatment	1985-86	1986-87	1987-88
Ammonium Sulphate	24.40	11.10	14.33
Urea ..	24.10	10.70	11.62
50% Ammonium Sulphate +50% Urea	24.00	10.80	12.85
50% Ammophos + 50% Urea	23.50	10.60	13.63
SE	..	..	0.59
CD	..	..	1.79

For the first and second season, no significant difference in diameter of rubber seedlings was observed between ammonium sulphate and urea treated plots. But at the end of third season, a significant reduction in diameter was noticed in urea treated plots which may be attributed to the decrease in available sulphur status in urea treated plots. It may be noted that the girth of the seedlings in the first year is substantially more than that of the subsequent years. Due to certain technical reason we could not do the mulching and summer irrigation during second and third season. These cultural operations are recommended as a usual practice for obtaining vigorous growth. One round of mulching with broad leaves has been reported to increase the girth (Potty etal, 1968)

The leaf nutrient status of rubber seedlings at the and of the third year of study is presented in Table-5.

Table-5. Leaf Nutrient Status (%) of Rubber Seedlings During 1987-88

Treatment	N	P	K	Ca	Mg
Ammonium Sulphate ..	3.52	0.21	0.92	0.50	0.26
Urea	3.30	0.20	0.92	0.50	0.22
50% Ammonium Sulphate + 50% Urea	3.36	0.20	0.90	0.55	0.24
50% Ammophos + 50% Urea	3.38	0.21	1.02	0.48	0.24

An increase in nitrogen was noticed in ammonium sulphate treated plots as compared to urea treated plots but the increase is not statistically significant.

Similar increase in leaf nitrogen content in ammonium sulphate treated plots for rubber seedlings was reported by Pushparajah, etal (1981). The pH of the soil at the end of the third year of study is presented in Table-6.

Table-6. pH of the Soil at the end of Third Year of Study

Treatments	pH
Ammonium Sulphate ..	4.1
Urea	4.3
50% Ammonium Sulphate + 50% Urea ..	4.2
50% Ammophos + 50% Urea	4.1

From the table, it can be observed that there is a reduction of pH in ammonium sulphate treated plots as compared to urea treated plots. Eventhough the difference is not statistically significant, by the continued use of ammonium sulphate, considerable reduction in pH may occur in rubber growing soils. It may also be noted that the pH of the soil before the start of the experiment was 4.5. But this may not cause any adverse effect on rubber plants as rubber is reported to be an acid loving crop (Dijkman, 1951).

From the present study, it can be inferred that in rubber nurseries continuous use of urea without addition of organic matter may result in depletion of sulphur reserve in soil which in turn may retard the growth of rubber seedlings.

Eventhough Tandon (1986) has reported the critical level of available sulphur in soil to cause deficiency of this element to be 10 ppm, a significant reduction in plant growth was noticed in our study. Hence the level of sulphur in soil suggested by Tandon may not hold good in rubber growing areas and thus need further study on this aspect.

Acknowledgement

The authors wish to express their sincere thanks to Dr.M R Sethuraj, Director Research, for the suggestions offered by his during the course of this study.

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