STUDIES ON FERTILITY STATUS OF RUBBER GROWING SOILS OF PALAKKAD DISTRICT

By

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DISSERTATION

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D E C L A R A T I O N

I hereby declare that this dissertation entitled "A study on Fertility status of rubber growing soils of Palakkad District", is a bonafied record of research work done by me and that this dissertation has not formed the basis for award to me, of any degree, diploma, associate-ship fellowship or other similar title of any other University or Society.

Vellanikkara
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C E R T I F I C A T E

We, the undersigned members of the Advisory Committee of Shri.V.Mohanan, a candidate for the post Graduate Diploma in Natural Rubber Production, certify that this dissertation entitled "A study on Fertility status of rubber growing soils of Palakkad District", is a record of research work done independently by Shri.V.Mohanan under our guidance and supervision and that it has not previously formed the basis for award of any degree, diploma, associateship or fellowship to him.

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A C K N O W L E D G E M E N T

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C O N T E N T S

LIST OF TABLES

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INTRODUCTION

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1. INTRODUCTION

Fertilizer usage based on soil and leaf analysis is commonly referred as discriminatory fertilizer recommendation. It had been established as the most efficient and economic method (Pushpadas, et.al, 1978) for rubber growth and this practice not only reduce the cost of cultivation but also allieviate specific problems such as panel coagulation, brown bast and wind damages. The investigations conducted in India and elsewhere reveal that the response of rubber to fertilizer application is closely related to nutrient supplying capacity of the soil and the plant nutrient status (Potty, et.al. (1976), Guha and Pushparajan(1966).

Elaborate facilities are provided by the Rubber Board to extend the analytical and advisory facilities for the small and large growers through the central, regional and mobile soil and leaf testing laboratories. However, it may not be possible for all the growers numbering over four lakhs to avail these facilities. Hence blanket recommendations based on the preliminary soil and leaf nutrient surveys have to be resorted to in most cases. Further refinement of the recommendations need region-wise data on soil and leaf nutrient status. The present investigation is a study pertaining to the fertility status of the rubber growing soils of Palakkad District.

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REVIEW OF LITERATURE

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2. REVIEW OF LITERATURE

Most of the earlier studies on fertilizer requirements have been confined to the immature phase. Influence of fertilizing immature rubber plantations gave best results in poor soils (Dijkman, 1951). He was reported that fertilized plants reached tappability in 4.5 to 5 years when compared to unfertilized plots which attained tapping girth only after 8th year in Indonesia. It was established that mineral nutrients do have a role on the growth of Hevea brasiliensis (Bolle jones, 1954). The influence of nitrogen on growth of trees, though was negligible during the initial phase, had been reported to be significant from 6th year as suggested by Owen, (1957).

Phosphorus has been reported to be beneficial on girth increment. Results of 17 trials conducted in Malaysia revealed that marked influence of phosphorus had been recorded at 5th, 6th and 7th year of commencement of manuring programme. This observation suggested that effect of manuring during early immature phase was particularly the application of phosphorus. However, no significant influence of potassium was recorded in some experiments. The effect of nitrogen on girth increment has been found to be independent on the presence of potassium.

Studies conducted on the laterite soils in the South West India, revealed that rubber plants responded positively in terms of girth to application of phosphatic fertilizers of lower levels. A positive benefit from nitrogen

manuring also has been reported. However, no significant girth increment has been shown by the application of potassium alone. Potassium application with nitrogen had been found to favour growth revealing a positive interaction(George, 1963). Results of Multilocational trials in immature phase carried out in India revealed that the response to applied fertilizers during the first four years of immaturity was dependent on the initial soil fertility status (Ananth, 1966). However lack of response to nutrients, particularly nitrogen and phosphorus was reported from 5th year onwards which is attributed to the large quantities of nutrient released by the leguminous cover. Potty, et. al. (1978) have also reported that the response of rubber to fertilizer application was closely related to the type of ground covers.

The results of manuring trials was found to be dependent on the types of soil. Bolten, (1960) has reported that on sandy soil in Malaysia, there was marked response of rubber to soluble phosphatic fertilizers; the response to nitrogen being of lesser magnitude. He was reported that no benefit from the addition of potassium. The role of nitrogen has been generally limited to the immaturity period. In the absence of phosphorus and potassium, nitrogen fertilizer had shown deleterious effect. While studying the clonal differences in growth, (Bolton, 1960) a differeential response to applied fertilizers between different clones was reported.

Constable, (1953) reported that the use of N.P.K. fertilizers during immature phase and in early tapping years could increase yeild to the tune of about 27 per cent. Working with high yeilding clones it was reported by him from Sri Lanka that more significant response could be obtained with applied fertilizers.

Bolton, (1960) reported that yeild closely followed the trend of growth and high correlation with girth and yeild was also reported. Increase in nutrient content with higher dose of fertilizer also was noticed. Studies conducted by Kumar, K and Potty, (1989) in North East revealed that marked increase in girth was observed at higher levels of nitrogen, phosphorus and potassium.

During the early immature phase, the nutritional requirement of Hevea has been found to vary with the type of planting material. Wherever Poly bag plants had been used as the planting materials providing higher nutrients during the early immature phase had resulted in better girth. This is attributed to the fact that in North East India soils are highly depleted due to the practice of shifting cultivating (Kumar, K and Potty, 1990).

Tapping involves drain of latex which indirectly results in the drainage of nutrients such as nitrogen, phosphorus potassium and magnesium (Sivanadhyan, 1972). Major nutrients, N.P.K and Mg have been shown to improve growth of bark,

yeild, bark renewal (Samsedar, 1975). Potty, et. al. (1976) studied the response of Hevea to fertilizers application and reported the effect of applied nitrogen on yeild of rubber was very much related to nitrate content of soil. It was reported that nitrogen was not having a significant influence on the yeild during the first four years. However, there was evidence of an earlier effect of due to the application of phosphorus, phosphorus has been found to be influencing the yeild significantly and positively during the first four years (Owen, 1957).

Study of the direct and residual effect of nitrogen, phosphorus and potassium on the growth and yeild of rubber in the red loam soils of South India, Punnoose, et.al, (1978) has reported that lack of any specific response to the major nutrients after an analysis of data from 5th year of planting upto the commencement of tapping. However, a marginal increase was recorded by increasing potassium from 50 to 100 kg./ha But towards the later stage of tapping, i.2., from the 4th year to 7th year residual effect of potassium was noticed which could be attributed to the minerology of soil permitting fixation of potassium due to large amount of illite component and subsequent release with progress of time. Results of experiments on manuring of mature rubber conducted by George, (1963) suggested that fertilizer application with nitrogen, phosphorus and potassium could substantially

increase yeild. Application of fertilizers resulted in increase of soil fertility and also the response of Heyea to growth has been directly related to soil available nutrient status as reported by Potty, et. al. (1976) in the soils under Heyea in India.

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MATERIALS AND METHODS

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3. MATERIALS AND METHODS

With a view to assess the fertility status of rubber growing soils in Palakkad District, data of 200 soil samples analysed in the mobile soil and tissue testing laboratory of the Rubber Research Institute of India was subjected to indepth study. The soil samples were mainly laterite in nature and were collected from the existing rubber plantations in Alathur, Mannarkkad, Ottapalam and Palakkad Taluks of Palakkad District.

In the mobile soil testing laboratory analysis was done following the standard procedures. Soil organic carbon was determined by the colorimetric method (Dutta, 1962). The organic matter was oxidised by dichromate and acid mixture and the intensity of the green colour of the chromium sulphate formed was measured to give the amount of carbondioxide. Available phosphorus was extracted with Bray II reagent using a soil extractent ratio of 1:10 and shaking time of 5 minutes in a receprocating shaker (Jackson, 1958).

Phosphorus was estimated by the Molybdenum blue method using a Bosch and Lomb spectrometer. Potassium, magnesium and calcium were extracted by Morgans reagent using a soil extractant ratio of 1:15 and a shaking time of five minutes in a receprocating shaker. Potassium was estimated by the cobaltinitrate method and turbidity was read in a photoelectric-colorimeter using red filter. Magnesium was estimated by Titan yellow method. Soil reaction was determined using

a glass electrode in a soil water ratio of 1:2.5 (Jackson, 1958).

The analytical values for organic carbon, available phosphorus, available potassium and available magnesium were rated as low, medium and high based the fertility standards fixed for rubber growing soils by the Rubber Research Institute of India (Table - I).

From the case history sheets provided by the growers, information on the age of the plants in the holding, cultivation practices followed, type of the planting materials used etc. were collected and the fertility status was evaluted to find out the influence of each of the factors on the soil nutrient levels.

RESULTS AND DISCUSSION

4. RESULTS AND DISCUSSION

The results of the investigation on the fertility status of rubber growing soils of Palakkad District are presented and discussed in this chapter.

4. 1. Fertility status:

4. 1. 1. Organic Carbon Level:

The general fertility status of the soil in Palakkad District rated as low, medium and high is given in Table 2. The organic matter status of the soil was rated in the order - 17 per cent as low 65 per cent medium and 18 per cent as high. The tropical climate prevailing in the rubber growing areas in the South India is condusive for quick oxidation of soil organic matter. However, cultivation practices followed in the rubber holdings are such that there is minimum soil distrubance and hence the loss in most of the cases. So, most of the soils are rated as medium high (83%). In certain areas organic matter oxidation is comparitively high with consequent low status of organic matter. One of the major reasons for this condition could be the intercropping with tapioca which could reduce the organic matter status to a great extent. From the case history it was evident that 63.5 per cent of the growers did not establish leguminous ground covers. The data on the organic matter in holdings

of different age group (Table 3) show that the organic carbon status is maintained throughout the growth phase which again may be due to the minimum tillage adopted in rubber plantations and the organic matter added up due to the deciduous nature of the rubber trees.

4. 1. 2. Available Phosphorus Level.

Available phosphorus is generally low as in the case of other rubber growing areas of Kerala, 78 per cent of soils tested are low, 15 per cent medium and only 7 per cent could be rated as high (Table 2). This may be due to the high rate of phosphorus fixation in the laterite soils in most of the holdings selected for the study. The available phosphorus status is found to be increased as the years pass on (Table 4) indicating substantial residual effect of water insoluble phosphates (Rock phosphate) applied during early years. The higher organic matter status of the older plantation might have increased the available phosphorus status due to the protective action of the soil organic matter.

4. 1. 3. Available Potassium Level.

In the case of available potassium the majority of the soils are in low range 57.5 per cent (Table 2). High available potassium status could be evidenced in 13.5 per cent of holdings. This may be due to the low rainfall in certain

Table I

SOIL FERTILITY STANDARDS

FIXED FOR RUBBER BY THE RUBBER RESEARCH INSTITUTE OF INDIA

Nutrient status	Standards		
	Low	Medium	High
1. Organic carbon % used as a measure of availability of nitrogen	<.75	0.75 - 1.50	>1.50
2. Available phosphorus (P) mg/100g of soil	<1.00	1.00 - 2.50	>2.50
3. Available potassium (K) mg/100g soil	<5.00	5.00 -12.50	>12.50
4. Available magnesium (mg) mg/100 soil	<1.00	1.00 - 2.50	>2.50

TABLE 2

GENERAL FERTILITY STATUS OF RUBBER GROWING SOILS OF PALAKKAD DISTRICT

Nutrients	Percentage frequencies		
	Low	Medium	High
Organic carbon	17.0	65	18.0
Available phosphorus	78.0	15	7.0
Available potassium	57.5	29	13.5
Available magnesium	1.5	10	88.5

Table 3

ORGANIC CARBON STATUS OF RUBBER GROWING SOILS OF PALAKKAD DISTRICT

Age	Percentage frequencies		
	Low	Medium	High
Upto 4 years	22.0	64	14.0
5th - 7th year	15.0	60	25.0
8th - 14th year	8.0	76	16.0
Above 14 years	3.5	71	25.5

Table 4

AVAILABLE PHOSPHORUS STATUS OF RUBBER GROWING SOILS OF PALAKKAD DISTRICT

Age	Percentage frequencies		
	Low	Medium	High
Upto 4th years	84.0	6.0	10.0
5th - 7th years	95.0	5.0	0.0
8th - 14th years	84.0	16.0	0.0
Above 14th years	81.5	13.5	5.0

Table 5

AVAILABLE POTASSIUM STATUS OF RUBBER GROWING SOILS OF PALAKKAD DISTRICT

Age	Percentage frequencies		
	Low	Medium	High
Upto 4th years	57.0	27.5	15.5
4th - 7th years	60.0	25.0	15.0
8th - 14th years	61.5	23.0	15.5
Above 14th years	37.0	42.0	22.0

Table 6

AVAILABLE MAGNESIUM STATUS OF RUBBER GROWING SOILS OF PALAKKAD DISTRICT

Age	Percentage frequencies		
	Low	Medium	High
Upto 4th years	3.2	10.8	86.0
5th - 7th years	0.0	10.0	90.0
8th - 14th years	0.0	7.7	92.3
Above 14 years	0.0	11.8	88.2

rubber growing areas of the district. Low rainfall results in reduction of leaching loss of potassium. Grouping of potassium according to the age of the plants did not reveal remarkable difference in different years of planting (Table 5).

4. 1. 4. Available Magnesium:

Unlike in the case of rubber growing areas of central Travancore, available magnesium content of the soil is found to be very high i.e. 88.5 per cent, 10 per cent medium and only 1.5 percent of the soils studied is found to be low in magnesium content (Table 2).

When the data is further grouped according to the year of planting, 86 per cent of the holdings in immaturity phase has high magnesium content which marginally increased with age. Reasons may be the excess magnesium originally present in the soil and additional application of magnesium containing fertilizers in subsequent years.

p^H of the soils ranged from 4.3 to 6.5. Majority of the samples studied come under the range 5-6. Only a very low percentage of samples were above the p^H 6 and below p^H 5. due to the laterite nature of the soils.

Results of the study reveal that rubber growing soils in the Palakkad district are generally low in available phosphorus and available potassium. But available magnesium status is very high and organic carbon is medium. Field experiments conducted in India (Potty, et.al, (1976) and

Punnoose, et.al.(1975)) and abroad (Bolton, 1964) and Guha and Pushparaja, (1966)) have already proved that the response to fertilizer is closely related to the nutrient status of the soil. So that it can be concluded that majority of the rubber growing soils of Palakkad district will respond well to the application of phosphatic and Potassic fertilizers. Chance for response to magnesium fertilizers is very little. Magnesium fertilizer should be applied only when it is absolutely essential as otherwise excess magnesium can lead to secondary complications especially with low rainfall. Based on these observations scope of discriminatory fertilizer application is fully justified as the most judicious approach for manuring of rubber plantation as reported by the earlier workers (Potty, et.al. (1976) and Punnoose,et.al. (1975)).

4. 2. Leguminous cover.

The nitrogen status is very closely related to the percentage of organic carbon present in the soil or organic carbon is an index of the soil nitrogen. The present study reveals that organic carbon content is higher under natural cover (non-leguminous) (Table 7). This may be due to the majority of the holdings selected for the study come under new planting (80%) in virgin land where the luxuriant growth of weeds especially chromoleana odorata was not controlled properly and consequently a good amount of biomass

Table 7

INFLUENCE OF LEGUMINOUS COVER CROP ON ORGANIC CARBON STATUS

Range	Percentage frequencies	
	Area with cover crop	Area without cover crop
Low	20.0	13.3
Medium	63.3	66.7
High	16.7	20.0

Table 8

INFLUENCE OF LEGUMINOUS COVER ON AVAILABLE PHOSPHORUS STATUS

Range	Percentage frequencies	
	Area with cover crop	Area without cover crop
Low	72.0	87.7
Medium	16. 6	6.7
High	11.4	5.6

Table 9

INFLUENCE OF LEGUMINOUS COVER ON AVAILABLE POTASSIUM STATUS

Range	Percentage frequencies	
	Area with cover crop	Area without cover crop
Low	56.5	62.8
Medium	31.6	19.2
High	11.9	18.0

Table 10

INFLUENCE OF LEGUMINOUS COVER ON AVAILABLE MAGNESIUM STATUS

Range	Percentage frequencies	
	Area with cover crop	Area without cover crop
Low	1.7	1.5
Medium	6.7	12.3
High	91.6	82.6

Table II

PERCENTAGE OF NEW PLANTING/REPLANTING

NP	RP
80	20

was added to the soil (Table 7). The available phosphorus ar potassium percentage was remarkably higher and areas where leg. cover was planted, indicating that growers can reduce the respective fertilizers if leguminous cover crop was properly established.

There is no considerable change in magnesium status irrespective of the nature of ground covers. However a slight increase in percentage of available magnesium could be found eventhough depletion of magnesium was reported by the earlier workers in the Central Travancore region. This may be due to high magnesium content of soils even prior to establishment of cover crop. Field experiments conducted (George, (1963), Potty, et. al. (1978) and Punnoose, et. al. (1975)) have indicated that response of rubber to fertilizers from fifth year of planting was little. This is due to availability of large quantities of nitrogen through minerilization of organic matter added through leguminous covers and release of locked up phosphorus and potassium by the leguminous covers (Potty, et. al. 1978).

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SUMMARY AND CONCLUSION

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5. SUMMARY AND CONCLUSION

To assess the fertility status of rubber growing soils of Palakkad district, Soil analytical data of 200 holdings comprising Mannarkkad, Ottapalam, Palakkad and Alathur Taluks were collected. The organic matter status of majority of the soils ranged from medium to high. In general soils were deficient in available phosphorus and potassium. High content of available magnesium was evident in 88.5 per cent of the samples studied. All the samples studied were acidic in reaction. There was no marked difference in organic carbon status irrespective of the soils under leguminous and non-leguminous ground covers.

Based on the observations of the study the following are the suggestions for improvement in soil management to increase the productivity of rubber plantations in Palakkad District:

1. Manuring should be done only on the basis of soil and leaf analysis.
2. Magnesium fertilizers should not be applied unless when it is absolutely essential to avoid secondary complication like panal coagulation.
3. Establishment of leguminous cover during the first year itself is essential.
4. Intercropping with Tapioca should be avoided to minimise the loss of fertile top soil especially in slopy area.

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