STUDIES ON FERTILITY STATUS OF RUBBER GROWING SOILS IN KOTTAYAM TALUK

By

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Dissertation

Submitted in partial fulfilment of the requirements for the postgraduate diploma in Natural Rubber production of the Kerala Agricultural University.

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1991.

DECLARATION

I hereby declare that this dissertation entitled fertility status of rubber growing soils of Kottayam Taluk is a bonafide record of research work done by me and that this dissertation has not formed the basis for award to me of any degree diploma, associateship, fellowship or other similar title of any University or society.

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CERTIFICATE

Certified that this dissertation entitled fertility status of rubber growing soils of Kottayam Taluk is a record of research work done independently by Sri. K. Parameswaran Nair under our guidance and supervision and that it has not previously formed basis for any degree or diploma to him.

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ACKNOWLEDGEMENT

The author wishes to place on record his deep sense of gratitude and indebtedness to Dr. G. Srikantan Nair, Professor, Plantation Crops & Spices, College of Horticulture, Vellanikara for his valuable guidance and critical evaluation at every stage of the study. Valuable guidance given by Dr. S.N. Potty, Joint Director (Germ Plasm) R.R.I.I. Dr. E. Tajudeen, Professor Agronomy, College of Horticulture, Vellanikara, and Smt. P.A. Nazeem, Associate Professor, Plantation crops & Spices are gratefully acknowledged.

Thanks are also due to Dr. M.R. Sethuraj, Director of R.R.I.I. for the facilities provided in carrying out the present study.

The staff of the department of ~~Department of~~ plantation crops and spices KAU for the invaluable help extended and division of Agronomy/soils R.R.I.I. for providing the soil analytical data and case history data utilised in this study.

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INTRODUCTION

INTRODUCTION

Fertility status of the soil denotes the reserves in the soil which get depleted by continous cultivation and hence nutrients will have to be replenished to ensure proper growth and productivity of the crops.

The experiments conducted so far confirm that the response of rubber to fertiliser application is intimately related to soil and the plant nutrient status. (Ananth et al) 1965 & Potty et al 1969)

Based on the above observation, discriminatory approach is needed for the most efficient and economic method of fertiliser usage in rubber. However, it may not be possible for all the rubber growers, especially in the small holders sector, to adopt this method. Therefore blanket recommendations have been formulated by the RRII based on the soil and leaf nutrient survey, which is only an approximation.

A detailed knowledge of the fertility status of a particular region would help in evolving more appropriate recommendation to that region for the benefit of those growers who can not adopt discriminatary fertiliser application. An Indepth study on this aspect for a particular region under different cropping situations, though was initiated has not been extended to all the regions. Hence a study to assess the fertility status of rubber growing soils in Kottayam Taluk especially small holdings is attempted in the present investigation.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

The response to fertiliser application has been reported to be varying with age, cultural practices and soil fertility status (Ananth et al 1965 & Sherocks 1964, Potty 69 & 78, Punnose et al 1975)

The experiments conducted by the RRII from 1956 to 1990 revealed that rubber responds mainly to nitrogen and phosphorus during the early immaturity period and there is no response to potassium (Ananth et al 1965) on the other hand, after the fading of cover crops response to nitrogen and phosphorus was almost absent but potassium often benefited crop growth and yield. (Ananth et al 1965 & Potty 1978.

At mature phase of rubber the effect of fertilisers is very much related to the fertility status of the soil (Potty 1969 & 1978). It is also reported that response to nitrogen was maximum when all other nutrients are at the optimum level. Application of Phosphorus as rock phosphate did not increase yield in areas where the soil is high in available phosphorus.

Based on the results of twelve fertiliser experiments with nitrogen, phosphorus, potassium and magnesium on five soil groups of Malaysia, Guha and Pushparajh (1966) reported that the presence or absence of fertiliser reponse is closely related to the nutrient contents of the soil.

The results indicated that response to manuring is more pronounced in the early immaturity period and response was marginal when nutrients locked up by ground covers were released. During the initial years of tapping also response was either little, erratic or inconsistent.

As 1400 Kgs. dry rubber, normal annual produce from one hectar removes only 19 Kgs. of nitrogen 5 Kgs of P_2O_5 and 10 Kgs. of K_2O (George et al 1960) the crop removal, can be considered marginal. More over recycling of nutrients by the leaf fall & decay of leguminous covers add a lot of biomass to sustain growth and yield.

Response to fertilisers is largely dependent on cultural practices. Influence of nitrogen was significant only in areas where natural cover was present and is very little in areas where cover crops have been established well (Potty et al 1978)

High doses of phosphorus under leguminous cover has been found to suppress the growth of rubber. On the other hand potassium had a positive influence on rubber grown with leguminous covers probably due to the need for higher levels of potassium to ensure proper nitrogen potassium balance. The need for higher doses of nitrogen for natural ground cover areas was also reported from Malaysia (Punnose et al 1978)

Analytical data of rubber soils in South India reveals that the soils are deficient in available phosphorus and variable with regard to available potassium end soil reaction. Organic matter varies from 1.19 to 3.95 percent. The organic matter and available phosphorus were found to decrease with elevation. The exchangeable Magnesium status was high and varied from 46 to 240 ppm.

It was reported that total potassium varied from 0.11 to 0.50 percent, the water soluble potassium from 0.25 to 7.50 mg/100gms and exchangeable potassium from 4.0 to 45.3mg/100mg. A Major portion of potassium was found to be in fixed form.

An increased fertiliser dose can enhance the rate of girthing during the initial phase of immaturity besides improving soil available nutrient status. The water soluble phosphorus has shown superiority over the water insoluble form as evidenced by higher percentage of girth increment (Krishnakumar et al 1989)

Rubber cultivation has influenced favourably in moderating the deleterious effect of shifting cultivation by improving the soil physical property, enrichment of organic matter, favourable bulk density, increased porosity and resultant increased aeration, higher moisture retention high rate of infiltration and a highly favourable moisture desorption pattern point to the extreme beneficial factors in recuperating the depredated ecology (Krishna kumar et al 1989)

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MATERIALS AND METHOD

MATERIALS AND METHOD

The study was to asess the fertility status of rubber small holdings in Kottayam Taluk. Five locations Amayannoor, Thiruvanchiyoor, Koorapada, Kattachira & Meenadam) were selected for the study. The analytical data of the samples from 200 small holdings, collected earlier for offering fertiliser recommendations, were taken for the study.

Kottayam Taluk located in the western part of Kottayam District receives an annual rainfall of 3000mm distributed in the South West and North East monsoons. Soil is typical laterite. The elevation of the locations selected for the study is 50 to 100 metres above mean sea level.

The soil samples were analysed in the Mobile Soil Testing Laboratory of the Rubber Research Institute of India. The analytical procedures followed for various determinations are given below.

Soil Organic Carbon was determined by Colourimetric method (Datta 1962). The organic matter was oxidised by dichromate sulphuric acid mixture and the intensity of the green colour of the Chromium sulphate formed was measured to give the amount of carbon oxidised. Available phosphorus was extracted with Bray 11 ($0.03Nh_4F$ in 0.1 N HCL) reagent using a soil extractant ratio of 1:10 and a shaking time of five minutes in a reciprocating shaker (Jackson 1958) Phosphorus was estimated by the Molybdenum blue method using a Bosch and Lomb spectrometer.

Potassium, magnesium & Calcium were extracted by morgan's reagent using a soil extractant ratio of 1:5 and a shaking time of five minutes in a reciprocating shaker. Potassium was estimated by the Cobaltinitrate method and the turbidity was read in a photoelectric colorimeter using red filter. Magnesium was estimated by titen yellow method. Soil reaction was determined by 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 on the fertility standards (Table 1) fixed for rubber growing soils by the Rubber Research Institute of India.

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Table 1

SOIL FERTILITY STANDARDS

Nutrient	Low	~~Standard~~ Medium	High
Organic Carbon (%) used as a measure of availability of nitrogen	< 0.75	0.75 - 1.50	> 1.50
Available Phosphorus (P)mg/100gms of soil	< 1.00	1.00 - 2.50	> 2.50
Available potassium (K)mg in 100 gms of soil	< 5.00	5.00 -12.50	> 12.50
Available magnisium (Mg) in mg/100 gms of soil	< 1.00	1.00 - 2.50	> 2.50

Table 2

pH rating

Class	pH range
1	4 - 4.5
2	4.6-4.9
3	5. -5.5
4	5.6-6.00
5	6.1-6.5

The percentage frequency in each of the ranges were worked out after rating, in order to facilitate easy comparison.

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

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RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

FERTILITY STATUS:

The general fertility status of the soil rated as low, medium and high is given in Table 3. The organic matter status of the soil ranges from medium to high (59% being in the medium range & 36% rated as high and only five percent is rated as low). Inspite of the fact that the tropical climate experienced in rubber growing belts is favourable for quick oxidation of soil organic matter medium to high values of organic matter is because soil disturbance is much less in rubber estates and consequently oxidation loss is comparatively less. Annual leaf fall and presence of natural as well as leguminous ground cover contribute to maintain a high level of organic matter content. It is estimated that the ground cover accumulates 10 tonnes of organic matter and 7 to 8 tonnes by annual leaf fall. The data on the organic matter in holdings of different ages groups (Table 4) show that there is slight depletion in organic matter as indicated by the decrease in percentages of soil that could be rated as high. 40 percent of samples were rated as high in early immaturity period which reduced to 27 percent in plantations of more than 14 years of age even though minimum tillage is followed.

Table 3

GENERAL FERTILITY STATUS

Nutrients	Percentage frequencies		
	Low	Medium	High
Organic Carbon	5	59	36
Available 'P'	51	31	18
Available 'K'	65	25	10
Available magnesium	24	38	38

Table 4

ORGANIC CARBON STATUS IN PLANTATIONS

OF DIFFERENT AGES

Age	Percentage frequency		
	Low	Medium	High
up to 4 years	1	60	39
5 to 7 years	0	69	31
8 to 14 years	1	70	29
Above 14 years	1	72	27

Table 5

AVAILABLE PHOSPHORUS STATUS

Ages	Percentage frequencies		
	Low	Medium	High
up to 4 years	80	15	5
5 to 7 years	90	2	8
8 to 14 years	85	8	7
Above 14 years	80	13	7

Table 6

AVAILABLE POTASSIUM STATUS

Ages	Percentage frequencies		
	Low	Medium	High
up to 4 years	60	30	10
5 to 7 years	58	34	8
8 to 14 years	55	38	7
Above 14 years	65	22	13

The available phosphorus and potassium present a different picture out of the soil samples tested 51% of samples are low, 31% medium and 18% high in available phosphorus status (Table 5). The soils in the area selected for the study are mostly laterite with high aluminium and iron content. The fixation of "p" is very high in such soils and hence the available phosphorus status observed in the study is low. The available phosphorus status is found to be improved as the years pass on (Table 5) The higher organic matter content even after gradual depletion in older plantations might have influenced the availability of phosphorus due to its protective action of organic matter in available forms of phosphorus.

The available potassium also ranged from low to medium only 10% of holdings had high available potassium (Table-6) Leaching of potassium under high rainfall conditions resulted in the lower potassium status pointing o out the need for a judicious management of this nutrient. Potassium status is not influenced by the age of plants (Table 6)

Table 7

AVAILABLE MAGNESIUM STATUS

Age	Percentage frequencies Low	Medium	High
up to 4 years	25	35	40
5-7 years	25	40	35
8-14 years	25	30	45
above 14 years	24	38	38

Table 8

SOIL REACTION

pH range	Percentage frequencies
4 - 45	34
4.6 - 4.9	34
5. - 5.5	30
5.6 - 6.0	2
6.1 - 6.5	Nil

Of the soils tested 38% contained high, 38% contained 38% medium and 24% low magnisium (Table 7)

In a study on the available magnesium status of rubber growing soils (Potty et al 1973) it was found that soils in Central Travancore are having comparatively lower status of available magnesium in relation to Southern Travancore and Malabar regions. In the present study only 24% showed lower magnesium.

Further classification of the data on the basis of year of planting showed that 40% of the immature area had high magnesium status 35% medium and 25% low. In oldest area magnesium status remained slightly reduced (Table 7)

During the first four years the recommended fertiliser mixture contains magnesium oxides. (For Central Travancore only) In the analysis only 24% showed low magnesium content perhaps becuase of addition of MgO along with the fertiliser.

In mature areas Mg is applied if pronounced deficiency is noticed in soil and leaf analysis.

The samples rated as high becomes medium as rubber becomes older and even low in certain cases.

The pH of the soil varied from 4 to 6. The percentage of samples in the pH range of 4-4.5, 4.6 - 4.9, 5-5.5, 5.6-6.00 are 34%, 34%, 30% and 2% respectively. (Table 8)

The soil can be rated as highly acidic. The optimum pH range for rubber is 5 to 6 but it tolerates the range 4 to 6.5. Hence the cheapest available rock phosphate can be used in rubber estate instead of water soluble phosphorus which could be easily fixed and may not be available to the plants.

The results of the present study indicated that the soils in the five locations of Kottayam Taluk are generally low in available Phosphorus and potassium. Pronounced variations in rating was also noticed in different locations confirming soil and leaf analysis and discriminatory fertiliser applications.

The field experiments conducted in India (Anath et al 1965 & Potty et al 1978) and abroad (Boltan 1969) showed the response to fertiliser is definitely dependent on fertility status of the soil.

Therefore it could be concluded that most of the small holding will be benefited by the application of Phosphatic & Potasic fertilisers while getting response to Magnesium and nitrogen cannot be belittled. Hence discriminatory fertiliser application is most beneficial in small holdings (Sherrocks 1969 & Punnose, 1975)

Table 9

ORGANIC MATTER OF SOILS AS INFLUENCED BY

PREVIOUS HISTORY OF SAMPLED AREA

Age	Percentage frequencies					
	New Planting			Replanting		
	Low	Medium	High	Low	Medium	High
up to 4 years	5	60	35	0	60	40
5 to 7 years	0	65	35	0	70	30
8 to 14 years	0	70	30	0	75	25
Above 14 years	1	64	35	0	70	30

Table 10

ORGANIC MATTER STATUS AS INFLUENCED BY

GROUND COVERS

Age	Percentage frequencies					
	With leguminous cover			With natural cover		
	Low	Medium	High	Low	Medium	High
up to 4 years	5	55	40	2	65	33
5 to 7 years	3	50	47	0	80	20
8 - 14 years	2	58	40	5	65	30
Above 14 years	4	60	36	4	70	26

The comparison of nitrogen status (Table 9) does not appreciably differ in new plantings and replantings confirming the recommendation of the same grade fertilisers to cover new plantings and replantings.

GROUND COVERS:

Nitrogen status was high in the legume covered areas even in older areas where cover crops have been faded. The same trend was noticed for available potassium and phosphorus (Table 11&12). The results of field experiments conducted (Abdul Kalam & Potty 1978) reveal that there is no response to fertiliser applications from 5th year onwards due to the release of N.P.K. locked up by legume cover.

Table 11

AVAILABLE PHOSPHORUS STATUS AS INFLUENCED BY LEGUME COVER

Age	Percentage frequencies					
	With legume cover			With natural cover		
	Low	Medium	High	Low	Medium	High
up to 4 years	85	8	7	88	5	7
5 to 7 years	74	18	8	80	7	13
8 to 14 years	74	18	8	40	45	15
Above 14 years	84	5	11	75	20	5

Table 12

AVAILABLE POTASSIUM STATUS AS INFLUENCED BY LEGUME COVER

	Percentage frequencies					
	With legume cover			With natural cover		
Age	Low	Medium	High	Low	Medium	High
up to 4 years	60	30	10	63	24	13
5 to 7 years	42	45	13	70	20	10
8 to 14 years	58	35	7	64	30	6
Above 14 years	75	15	10	66	25	9

Table 13

AVAILABLE MAGNESIUM AS INFLUENCED BY LEGUME COVER

	Percentage frequencies					
	With legume cover			With natural cover		
Ages	Low	Medium	High	Low	Medium	High
up to 4 years	5	45	50	10	50	40
5 to 7 years	2	58	40	12	52	26
8 to 14 years	0	52	48	1	60	39
Above 14 years	5	55	40	2	62	36

Table 14

ORGANIC MATTER STATUS AS AFFECTED BY
INTER CROPPING

Percentage frequencies								
Tapioca			Banana			Tree crops		
Low	Medium	High	Low	Medium	High	Low	Medium	High
5	75	20	2	56	42	1	54	45

Table 15

AVAILABLE PHOSPHORUS STATUS AS EFFECTED BY
INTERCROPPING

Tapioca			Banana			Tree crops		
Low	Medium	High	Low	Medium	High	Low	Medium	High
75	5	20	80	10	10	76	14	10

Table 16

AVA ABLE POTASSIUM STATUS AS AFFECTED BY INTERCROPPING

Percentage frequencies								
Tapioca			Banana			Tree crops		
Low	Medium	High	Low	Medium	High	Low	Medium	High
60	15	25	55	15	30	48	32	20

(C) INTERCROPPING:

Intercropping with annual crops like tapioca and banana & interplanting with tree crops like coconut jack, mango and cocoa etc are quite common in small holdings - organic matter content was found to be low in areas intercropped with tapioca than that of Banana & interplanted with tree crops.

Table 17

AVAILABLE MAGNESIUM STATUS AS AFFECTED BY INTERCROPPING

Percentage frequencies								
Tapioca			Banana			Tree crops		
Low	Medium	High	Low	Medium	High	Low	Medium	High
5	50	45	3	60	40	10	60	40

Table 18

PLANTING MATERIALS USED

Type of planting materials	Percentage frequencies: up to 4 years	5-7 years	8-14 yrs.	Above 14 yrs.
Budgrafts	100	99	97	96
Clonal	-	1	3	4

Phosphorus and Magnesium status were not affected by intercropping. Potassium level was also not affected by intercropping with tapioca and banana perhaps due to heavy manuring with potassium fertilisers.

(d) Planting materials used and manurial practices followed by small growers.

From the case history data most of the small holdings up to the 7th year are planted with modern high yielding clones especially with RRII 105; A very few was planted with RRIM 600 also and no other clone has been tried. Mixed plantings with clones RRII 105, RRIM 600 & GT1 also was noticed. Polyclonal seedlings are planted very rarely. The small growers are quite conscious of selecting only high yielding planting materials for planting.

Table 19

MANURING PRACTICE ADOPTED

Dosages	Percentages up to 4 years	5-7 years	Above 8 years
Correct dosage	80	75	85
Wrong mixtures	25	15	5
Over dose	5	10	2
Under dose	2	4	5

Table 19 shows that most of the small growers apply correct dose of fertilisers. Wrong mixtures are used in a large number of cases since fertiliser mixtures intended for other crops in stock with them are used for rubber also. over dose and under dose manuring are quite less.

The data presented and discussed give a general fertility status of five locations of Kottayam Taluk.

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SUMMARY

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To assess the fertility status of the Rubber growing soils of Kottayam Taluk analytical data of five locations in Kottayam Taluk viz, Kooropada, Thiruvanchoor, Meenadam, Kottachira and Amayannur covering 200 small holdings including their case history were studied and the study revealed the following.

All the soils tested were lateritic and acidic. Generally organic matter status was medium to high. Phosphorus and Pottasium status were very low and Magnesium status medium to high. Tapioca intercropped areas showed depletion of nitrogen status. There was no depreciation of Phosphorus and Potassium status in intercropped areas. Areas with leguminus ground covers showed better nitrogen status. Response to fertiliser was pronounced in the first four years and response was poor from 5th year onwards. All the small holdings were planted with modern high yielding clones and the trend is to follow Boards recommendation for manuring.

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