

**THE PERFORMANCE OF CLONE  
R R II 105 IN KUTTANAD TALUK  
OF ALLEPPEY DISTRICT**

By

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**DISSERTATION**

Submitted in partial fulfilment of requirement for the  
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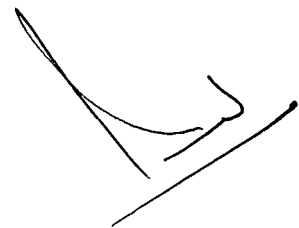
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### DECLARATION

I hereby declare that this dissertation entitled **The performance of clone RR11 105 in Kuttanad taluk of Alleppey district** is a bonafide record of research work done by me during the course of placement/training and that the dissertation has not previously formed the basis for the award to me on any degree, diploma, association or other similar title of any other University or Society.

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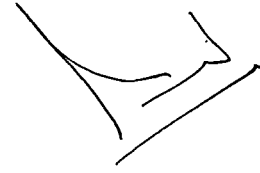
Words seem to be inadequate to express my sincere thanks to **Dr.S.Narayanan Potty**, Joint Director (Germplasm), Rubber Research Institute of India, Kottayam for his valuable suggestion and encouragement in carrying out the study.

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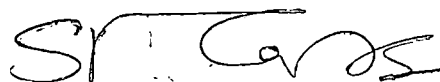
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## CERTIFICATE

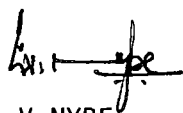
Certified that the dissertation entitled "**The performance of clone RRII 105 in Kuttanad taluk of Alleppey district**" is a record of research work done independently by **Sri.Mathew John** under our guidance and supervision and that it has not previously formed the basis for the award of any degree or diploma to him.

We the undersigned members of the Advisory Committee of **Sri.Mathew John**, a candidate for the Post-Graduate Diploma in Natural Rubber Production agree that the dissertation entitled "**The performance of clone RRII 105 in Kuttanad taluk of Alleppey district**" may be submitted by him in partial fulfilment of the requirement for the Diploma.

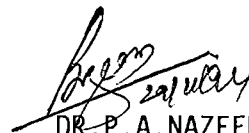


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# *Introduction*

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## INTRODUCTION

*Hevea brasiliensis* (Wild ex. Abr. de. Juss.) Muell. Arg. is perhaps the youngest of the major domesticated crops in the world. It accounts for 98 per cent of world's natural rubber production. Natural rubber has various uses and there is hardly any segment of life which does not make use of rubber based materials. Though the tree and its products have been known for long in the Amazonian Valley, its introduction as a plantation crop to the East during the last quarter of the 19th century paved the way for systematic studies on improvement, its exploitation and processing of the crop.

The first commercial planting of rubber in India was done in 1902 at Thattakad near Alwaye on the banks of river Periyar. Rubber now covers an area of about five lakh hectares, of which 85 per cent is in Kerala State.

India enjoys a unique position in the field of natural rubber. The country has been consuming the entire production of natural rubber which in fact runs short of demand. The shortage is overcome by imports depending upon demand. The production of natural rubber during 1992 in the country was 3.83 lakh tonnes (Rubber Board, 1994). It is estimated that the national requirement by 2000 would be 6.80 lakhs and in 2010 it is likely to be 12.8 lakh tonnes (Menon, 1993). This goal of production can be achieved both through long term and short term measures. Bringing more area under rubber as well as replanting of old plantings with high yielding clones are the long

term strategies taken up by the Rubber Board. Rubber Board envisages extending the area under rubber to the extent of 30,000 ha consisting of 23,000 ha in Kerala and Tamil Nadu, 5,000 ha in Tripura and 2,000 ha in other States/Union Territories (Rubber Board, 1994).

Kuttanad taluk in Alapuzha district is considered as an area with specific problems due to its peculiar land scape and soil conditions (Jacob, 1967). The total area of the taluk is 1,20,000 ha of which 52,000 ha is occupied by wet land. Garden land available is 32,000 ha and the rest is occupied by water waste (Gopalakrishnan et al., 1983).

Paddy is the main crop of the wet land. The garden land in the taluk is generally utilized for the cultivation of coconut, cocoa and vegetables. By the introduction of Rubber Plantation Development Scheme since 1980, growers started rubber cultivation in Kuttanad in garden lands. So far, rubber cultivation has been taken up by 25 small holders with a total area of 12.31 ha. A feasibility study was conducted in the area on the use of wet land for rubber cultivation (Gopalakrishnan et al., 1983). The study did not take into account the garden land which can be utilized for growing rubber. Though, Rubber Board recommends cultivation of rubber in garden lands of the taluk, no systematic study has since been conducted to find out the performance of rubber in this problem zone.

The short term approaches to increase production and productivity include adoption of scientific methods of cultivation and

exploitation of the tree. In order to formulate policies for increasing productivity, region wise studies are to be conducted on the conditions of the holding and adoption of management practices. Since Kuttanad is described as a lake-bed region situated 1 M above MSL, a study on the above aspect would be helpful in formulating recommendations for this area.

The present study was therefore undertaken in Kuttanad taluk with the objectives evaluating the performance of rubber with respect to yield and secondary characters, and studying the different management practices for rubber adopted by the growers.

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## *Review of Literature*

## REVIEW OF LITERATURE

Rubber cultivation in India is confined to the west coast region of the country extending from Kanyakumari in Tamil Nadu to Coorg district in Karnataka. The climatic conditions and physio-chemical properties of the soil differ from region to region. Based on the variation in climatic and soil conditions, the rubber growing tract is classified into eight regions (Jacob, 1967). Kuttanad is classified as an "area with specific problems" due to its peculiarity in climate and soil.

The studies conducted so far on the performance of rubber in problem areas are much less. However, the available literature on this aspect are reviewed.

### 2.1. Weather parameters

#### 2.1.1. Rainfall

Rubber is traditionally a rainfed crop. According to Montieth (1977), the potential evapotranspiration rate was around 4 mm day<sup>-1</sup>. In his study, it was found that a rainfall of 125 mm month<sup>-1</sup> with equal distribution was essential to maintain optimum gaseous exchange for rubber.

Cretin (1978) recorded positive correlation between rainfall deficit and cumulative production loss.

Pushpadas and Karthikakutty Amma (1980) found that for

optimum growth and yield, rubber required an evenly distributed rainfall of 2000-3000 mm in a year. In area where rainfall was much less it was found that the tree became stunted with crooked stem and lower number of branches. The growth of tree was retarded in regions with pronounced drought season.

In Malaysia, the daily E.T. rate of the clone RRIM 600 grown under glass varied from 2.1 to 6.9 mm day<sup>-1</sup> and under field conditions, it was found to be 4.4 mm day<sup>-1</sup> (Haridas, 1980).

The average annual rainfall in Kuttanad was reported as 3250 mm (Gopalakrishnan *et al.*, 1983).

#### 2.1.2. Temperature

Temperature is one of the key environmental factors influencing plant growth. Mean monthly temperature of 21°C to 35°C without wide variations is found suitable for the growth of rubber (Pushpadas and Karthikakutty Amma, 1980). According to Gopalakrishnan *et al.* (1983) the temperature in Kuttanad region varied from 21°C to 36°C and their report indicated that temperature was ideal for cultivation of rubber in this area.

In tropical low elevation areas, a mean monthly temperature of 26°C to 28°C with adequate soil moisture and sun shine were associated with high production (Rao and Vijaya Kumar, 1992).

#### 2.1.3. Relative humidity

Transpiration rate is influenced by temperature and relative

humidity of the surrounding atmosphere. A humid atmosphere throughout the year without much variations is found to be ideal for successful cultivation of rubber. According to Pushpadas and Karthikakutty Amma (1980), the relative humidity varies from about 70 per cent during January to 95 per cent during August in many rubber growing regions of India. When relative humidity is higher, evapotranspiration is lower. High rate of evapotranspiration results in lower soil moisture regimes, and lower turgor pressure of cells. Since the turgor pressure of the laticiferous system influences the yield of latex, relative humidity indirectly influenced the yield. The decrease in yield during the course of the day is related to increased loss of water due to transpiration and the resultant drop in pressure potential in the latex vessels (Deva Kumar *et al.*, 1988). Kuttanad enjoys a very humid climate which is suitable for rubber cultivation (Gopalakrishnan *et al.*, 1983).

#### 2.1.4. Wind

Wind is another important climatic factor having tremendous influence on the performance of rubber plantations. Morphological and anatomical deformations are reported to be usually associated with high wind velocities. One of the notable features of trees in windy areas is the deformation of their canopies to produce an asymmetric structure in which the branches appear to be swept to the leeward side (Grace, 1977).

Young plantations with heavy canopy may show stem bending and require corrective pruning and roping. Susceptibility to wind



damage is the greatest at the time of maximum girdling and canopy development. Trees with narrow crotches are more prone to wind damage. Tracts with strong wind should be avoided for cultivation of rubber (Rao and Vijaya Kumar, 1992).

#### 2.1.5. Flood

Clones may differ in their susceptibility to flood damage. One of the nine year-old plantings of Tjir 1 clonal seedling on coastal alluvium in Malaysia suffered severe tree damage following inundation under 0.7 to 1 m of flood water for 25 days. Stem bleeding and some defoliation were observed but after wound dressing and resting, recovery seemed possible (Rubber Research Institute of Malaya, 1964). In 1967, following rainfall of 2800 mm over a few months, certain plantings were under 4.6 m of water for 6 to 7 days. Clones RRIM 601 and RRIM 615 were defoliated while RRIM 600 and RRIM 605 retained their leaves (Newale, 1967).

### 2.2. Effect of agro-techniques on growth and yield of rubber

Adoption of appropriate agro-techniques has long been recognised as the surest means of sustaining high levels of productivity in rubber.

#### 2.2.1. Advantage of clonal material

Joseph *et al.* (1980) reported the superiority of using clones as planting materials. The clones were uniform in respect of growth, vigour, bark thickness, yield, properties of latex, wintering, refoliation, nutritional requirements and tolerance to diseases.

### 2.2.2. Use of polybag plants

Ramachandran (1992) reported that polybag plants produced better growth when compared to other methods.

Joseph and Nair (1984) found that by adopting polybag plants of advanced growth, the trees could be brought into tapping one year earlier.

### 2.2.3. Use of optimum population density

Increased density of planting resulted in lower tree girth, biomass and crown; higher crotch height and lighter branching (Ng *et al.*, 1979; Satheesan *et al.*, 1982; Webster and Baulkwill, 1989; Napitupula, 1977). Virgin bark and renewed bark also became thinner with high stand per hectare. The reduction in thickness was more pronounced in the renewed bark (Ng *et al.*, 1979). Because of these effects, yield per tree tended to be lower with increased number of trees per unit area. In addition to this, percentage tappability in a field during the initial year of tapping also decreased with increasing density, thus affecting yield per unit area.

Ng *et al.* (1979) studying the economic aspects of high density planting concluded that under Malaysian conditions; the cumulative yield increased as the planting density was increased from 211 to 741 trees ha<sup>-1</sup>, but declined with further increase in density. However, as the density increased from 211 to 741 trees ha<sup>-1</sup> the production cost was more than the revenue. The highest cumulative profit was released with a planting density of 399 trees ha<sup>-1</sup>. The

highest yield per tapper was also obtained with a density of 399 trees ha<sup>-1</sup>.

In India, Rubber Board (1994) recommends an optimum population density of 420-445 plants per hectare.

#### 2.2.4. Establishment of cover crops

The beneficial effects of establishing cover crops in immature rubber plantations were reduction in weeding cost, maintenance of moisture, control of soil erosion, fixation of nitrogen by leguminous cover crops, addition of organic manure and reduction in soil temperature (Potty *et al.*, 1980).

#### 2.2.5. Manuring

Judicious nutrient management is the surest way of increasing yield in rubber. Manurial trials on rubber in different rubber growing countries confirmed good response of the tree to the application of fertilizers. The effect of various nutrient elements on growth of *Hevea* was also established from the studies conducted in Malayasia (Bollejones, 1954). The mineral composition of *Hevea* was reported to be influenced by soil fertility status (Dijkman, 1951).

The nutrient requirement of *Hevea* varies with stages of growth. In India, Nair (1956) suggested a blanket recommendation based on soil fertility status and the observations from fertilizer trials on rubber conducted elsewhere. The experiments indicated that the response of rubber is directly related to soil available nutrients and leaf nutrient status (Ananth *et al.*, 1966; Potty *et al.*,

1976). A discriminatory approach was therefore proposed as the most efficient and economic method for optimum fertilizer use (Pushpadas and Ahamed, 1980).

#### 2.2.6. Drought management measures

The effectiveness of mulching and lime washing in young rubber to protect the plants from drought during summer were reported by Potty *et al.* (1980).

#### 2.2.7. Plant protection measures

Rubber tree is susceptible to several diseases but their economic importance and severity vary with climatic conditions, clones and cultural practices adopted.

Abnormal leaf fall caused by *Phytophthora* is an annually recurring disease of rubber in India causing severe yield losses ranging from 38-56 per cent. Pillai, (1977) George *et al.*, (1980) and Abraham, (1991) found that RR11 105 was tolerant to these diseases.

Powdery mildew caused by the fungus *Oidium hevea* attacks the immature leaflets when trees re-leaf after the annual wintering, causing secondary leaf fall. Saraswathy Amma *et al.* (1987) reported that RR11 105 and RRIM 600 were showing low disease intensity while PB 235 was highly susceptible.

Pink disease caused by *Corticium salmonicolor* is the only important stem disease of rubber. The fungus attacks the bark of the main stem and branches of 3-7 years old immature trees. Pink disease

also occurs in mature trees. The severity of attack varies from one locality to another according to rainfall pattern. A few clones are known to be of above average susceptibility, but most cultivars are prone to the disease (Liyanage and Jacob, 1992).

#### 2.2.8. Tapping systems and tapping panel dryness

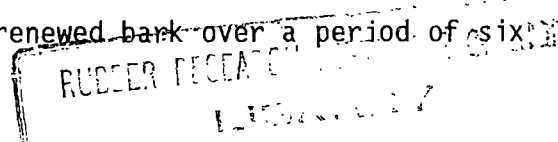
Abraham and Hashim (1983) recommended the tapping systems for different cultivars. The schedule covered conventional tapping from opening to felling recommended separately for clones and seedlings over a period of 25 to 28 years.

High intensity of exploitation is known to promote incidence of tapping panel dryness in rubber. The proportion of dry trees increased with tapping intensity and particularly with tapping frequency (Bealing and Chua, 1972; Paranjothy *et al.*, 1976). Clonal sensitivity to tapping panel dryness was observed Dijkman (1951).

#### 2.3. Performance of clones

As a result of extensive breeding studies conducted by Rubber Research Institute of India since 1954, the improved clone RRII 105 was released for cultivation in the State. This clone is recommended under category I of planting materials by the Rubber Board.

George *et al.* (1980) described the general characteristics of RRII 105. The growth rate of RRII 105 stood next to GT I and superior to RRIM 600. Average thickness of virgin bark of mature clone was about 9.89 mm and that of renewed bark over a period of six



years was 8.2 mm. It showed satisfactory tolerance to abnormal leaf fall but susceptible to pink disease. It was also reported that in the first year of tapping, an average yield of 1990 kg/ha/year was obtained. Average yield over six year in panel 'A' was estimated as over 2700 kg/ha/year. Yield depression during drought was only 23 per cent compared to Tjir 1 (Control) which recorded 31 per cent.

Krishnankutty *et al.* (1982) reported that the performance of planting materials varied according to different agroclimatic zones. It is also reported that the yield performance of clones in Malaysia and India differed. In India, rubber yields were generally less than that under Malaysian conditions in respect of all clones generally.

Saraswathy Amma *et al.* (1988) studied the performance of a few RR II clones. The results showed that planting materials had region-wise response relating to yield and other secondary characters. It was also suggested that planting materials should be selected based on regional performance.

## *Materials and Methods*

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## MATERIALS AND METHODS

Paddy is the major crop in the wet land of Kuttanad. Garden land occupies 26.6 per cent of the total area. Due to the urgent need for increasing production of rubber, Rubber Board recommends cultivation of rubber in the garden land of Kuttanad. The cultivation of rubber has been started recently in some areas. So far, no study has been conducted on the performance of rubber in this area. The present study was therefore conducted in Kuttanad to find out the performance of rubber in the taluk. It was also intended to study the management practises adopted by the growers.

So far, 25 small holdings with a total area of 12.31 ha are planted with rubber which are localised at Kidanagara, Pulinkunnu, Ramankary and Muttar of Kuttanad taluk (Appendix I). All the 25 units were included for the study. The details of the holdings surveyed are outlined in Appendix II.

The total number of units were broadly classified into two groups.

1. Holding with immature area, comprising 14 units
2. Holding with mature area, comprising 11 units

Each group was further sub divided into three viz., good, average and poor based on the management practices adopted by planters (Appendix III and IV).

Details of height and girth increments recorded earlier were



collected from the available records kept in the Rubber Board Regional Office, Changanacherry. The weather parameters for the area were collected from the Rice Research Station, Moncompu.

Details regarding planting materials, planting distance, weeding, manuring, intercropping, interplanting, lime washing, establishment of leguminous cover etc were collected during the field visit. Attempts were also made to study the secondary characters like panel dryness, wind damage, flood condition, pink disease etc. Information on the girth of the plants, year of opening for tapping, system of tapping, yield per day etc. were collected. The field data pertaining to the above parameters were collected personally using pre-tested interview schedule (Appendix V). The data regarding planting distance, girth etc. were actually measured and expressed in centimetres.

The units selected for survey were broadly classified into immature and mature plantations. Each group was further grouped as good, average and poor based on management practices. Thus, the different categories included

- R - Immature plantations under good management
- R1 - Immature plantations under average management
- R2 - Immature plantations under poor management
- RM - Mature plantations under good management
- RM1 - Mature plantations under average management
- RM2 - Mature plantations under poor management

The data thus collected were appropriately tabulated, summarised, presented and discussed.

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## *Results and Discussion*

## RESULTS AND DISCUSSION

Kuttanad taluk has a garden land of 32,000 ha. Twenty five growers planted rubber in the garden land. The units are located in Kidangara (24%), Pulinkunnu (28%), Ramankary (32%) and in Muttar (16%) as shown in Table 1. The results obtained are discussed in the following pages.

### 4.1. Weather parameters

#### 4.1.1. Temperature

The data collected on the mean monthly temperature recorded during the period from 1990 to 1993 are given in Table 2. It could be seen that Kuttanad enjoyed a maximum temperature of about 34.5°C and a minimum of 19.3°C. The annual variation in temperature was only negligible. The data also indicated that the monthly variation in temperature was insignificant. From the study it was observed that the temperature in the region was ideal for rubber cultivation. The observation made by Pushpadas and Karthikakuttyamma (1980), Gopalakrishnan *et al.* (1983) and Rao and Vijayakumar (1992) are in agreement with that of the present study.

#### 4.1.2. Rainfall

The data on monthly rainfall and number of rainy days in Kuttanad for four years from 1990 to 1993 is furnished in Table 3.

Table 1. Village wise details of rubber holdings in Kuttanad taluk

Sl. No.	Name of village	No. of immature rubber units		No. of mature rubber units		Percentage
		No.	Area (ha)	No.	Area (ha)	
1	Muttar	1	0.63	3	0.80	16
2	Kidangara	3	0.70	3	1.62	24
3	Pulinkunnu	6	3.47	1	0.43	28
4	Ramankary	4	1.79	4	2.87	32
Total		14	6.59	11	5.72	100

Table 2. Mean maximum and minimum temperature ( $^{\circ}\text{C}$ ) for the period from 1990 to 1993 in Kuttanad taluk

Month	1990		1991		1992		1993		Mean	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Jan	30.50	20.60	32.60	21.60	32.60	19.30	31.20	19.54	31.73	20.26
Feb	33.00	22.00	33.50	21.80	32.50	22.60	32.45	21.42	32.86	21.96
March	33.90	24.10	34.40	24.50	34.00	23.90	33.44	24.42	33.92	24.23
April	34.00	25.40	34.50	24.90	34.50	25.70	33.80	25.38	34.20	25.34
May	31.50	24.10	34.00	25.93	33.00	25.00	33.25	25.53	32.94	25.14
June	30.50	23.40	30.10	23.70	30.70	23.80	29.40	23.80	30.18	23.67
July	29.80	22.50	30.60	23.00	30.00	22.60	29.40	23.40	29.95	22.88
Aug	30.20	23.70	29.80	23.01	30.00	23.00	30.40	24.50	30.10	23.57
Sept	31.20	23.80	31.85	24.41	30.64	24.71	31.30	24.40	31.25	24.33
Oct	32.00	23.60	31.30	24.20	30.68	24.03	31.00	24.00	31.25	23.95
Nov	31.60	23.30	32.50	22.80	32.24	24.97	32.20	24.10	32.14	23.79
Dec	34.00	22.00	32.80	21.20	32.84	22.39	32.40	23.60	33.02	22.29

Table 3. Mean monthly rainfall and number of rainy days during the period from 1990 to 1993 in Kuttanad taluk

Month	1990		1991		1992		1993		Mean	
	Rain-fall (mm)	No. of days	Rain-fall (mm)	No. of days	Rain-fall (mm)	No. of days	Rain-fall (mm)	No. of days	Rain-fall (mm)	No. of days
Jan	22.40	2	0.60	-	-	-	-	-	5.75	0.50
Feb	25.00	1	-	-	4.50	1	2.00	-	7.88	0.50
March	83.70	4	23.60	4	-	-	7.00	1	28.58	2.25
April	37.50	3	150.80	9	12.80	2	69.19	8	67.57	5.50
May	624.30	22	144.50	14	276.40	13	202.20	19	311.85	17.00
June	516.60	23	993.70	26	654.80	24	911.50	27	769.15	25.00
July	568.80	24	485.70	23	586.80	26	780.80	26	605.53	24.75
Aug	177.70	16	457.40	18	461.00	22	177.00	14	318.28	17.50
Sept	154.10	9	51.50	6	324.20	12	161.20	10	172.75	9.25
Oct	336.20	17	205.60	19	383.00	17	604.10	18	382.22	17.75
Nov	254.40	7	82.60	5	322.60	12	203.30	12	215.77	9.00
Dec	47.80	1	22.00	1	6.20	1	35.60	2	27.90	1.25
Total	2845.50	129	2623.00	125	3032.30	130	3154.09	137		

The results indicated that the rainfall received during the four years ranged from 2623 mm during 1991 to 3159.09 mm during 1993. The number of rainy days ranged between 125 during 1991 and 137 during 1993. The data also revealed that the South West monsoon extended from June to August and North East monsoon from October to November. January and February were the driest months with practically no rain. Occasional summer showers were obtained during March and April.

According to Pushpadas and Karthikakuttyamma (1980) rubber growing regions in Kottayam, Idukki, Alleppey, Ernakulam and Trichur receive an annual rainfall of 2000-4500 mm. Thus the results indicated that Kuttanad taluk received sufficient rainfall for rubber cultivation.

#### 4.1.3. Flood

The data on the level of water table in Kuttanad taluk is furnished in Table 4. The results indicated that the fields were under submerged condition for a period from 7-15 days during 1993-94. The water level rose above 60 cm for 2-3 months. The results reported by Rubber Research Institute of Malaysia (1964) showed that Tjir-1 clonal seedlings recovered from a severe flood. Newall (1967) reported that clones differed significantly in respect of susceptibility to flood. He found that RRIM 600 and RRIM 605 were least affected by flood. According to Pushpadas and Karthikakuttyamma (1980) the water table should be well below 100 cm for successful rubber cultivation. In the present study, the growth of rubber was least affected



Table 4. Water table in rubber growing areas in Kuttanad taluk during 1993-94

Sl. No.	Ref. No.	Location	No. of days submerged	*Months during which	
				Water level rises above 60 cm	Water level rises below 60 cm
1	R1	Kidangara	12	3	9
2	R2	Do	8	3	9
3	R3	Do	10	3	9
4	RM2	Do	12	3	9
5	RM1-3	Do	14	3	9
6	RM1-4	Do	14	3	9
7	R1-5	Ramankary	11	2	10
8	R2-3	Do	10	2	10
9	R2-4	Do	10	2	10
10	R2-5	Do	10	3	9
11	RM3	Do	7	2	10
12	RM1-1	Do	12	2	10
13	RM1-2	Do	12	3	9
14	RM2-2	Do	10	2	10
15	R1-2	Muttar	10	2	10
16	RM2-3	Do	12	2	10
17	RM-4	Do	7	2	10
18	RM2-1	Do	10	2	10
19	R4	Pulinkunnu	15	3	9
20	R1-1	Do	12	3	9
21	R1-3	Do	14	3	9
22	R1-4	Do	14	3	9
23	R2-1	Do	13	3	9
24	R2-2	Do	15	3	9
25	RM1	Do	14	3	9

by high water table. This might be due to the flood resistant/tolerant nature of RRIM 105. Eventhough there are no reports on the flood resistance/tolerance of RRIM 105, GI-1 which is one of the parents of RRIM 105, is tolerant to high water table (Joseph *et al.*, 1980).

#### 4.1.4. Relative humidity

The data on relative humidity during the four years from 1990 to 1993 in Kuttanadu taluk is furnished in Table 5. The results revealed that the mean relative humidity during the four years ranged between 75.20 per cent and 95.03 per cent. Among the different months, December 1992 had the minimum relative humidity of 75.20 per cent while the maximum of 95.03 per cent was recorded during July 1990.

The data indicated that the relative humidity is high in Kuttanad taluk which ensures better growth and productivity of rubber (Gopalakrishnan *et al.*, 1983).

### 4.2. Management practices adopted by the rubber growers in Kuttanad taluk

Studies were conducted on the adoption of different practices viz. type of planting material used, spacing, weeding, manuring, intercropping, cover cropping and plant protection in mature and immature plantations.

#### 4.2.1. Immature plantations

The data gathered on different management practices are furnished in Table 6.

Table 5. Relative humidity for the period from 1990 to 1993 in Kuttanad taluk

Month	Relative humidity (%)				
	1990	1991	1992	1993	Mean
January	89.26	89.20	92.20	77.25	86.98
February	91.64	89.50	91.00	77.32	87.37
March	90.58	91.00	93.00	79.64	88.55
April	84.48	86.00	87.00	80.43	84.48
May	92.90	87.00	87.00	81.35	87.06
June	92.10	95.00	92.00	85.23	91.08
July	95.03	92.00	91.00	92.20	92.56
August	90.60	90.50	93.20	90.90	91.30
September	91.10	90.93	85.20	81.10	87.08
October	92.29	94.00	86.20	86.70	89.79
November	91.63	92.00	85.00	87.20	88.95
December	89.00	90.80	75.20	82.60	84.40
Mean	90.88	90.66	88.16	83.49	

Table 6. Management practices adopted by the rubber growers for immature rubber in Kuttanad taluk

Sl. No.	Category/Ref. No.	Year of planting	Area (ha)	Planting material	Population density/ha	No. of plants now in the unit	Weeding	Manuring details			Type of intercrop	Type of cover crop	Plant protection measures adopted	Protective against drought	
								Type of fertilizer	Quantity applied/plant (g)	Time of application					
1	Good R1	1990	0.33	Poly bagged	530	175	Once	20:20:20	500	Once	Pocket	Plantain 1st & 2nd year	Peuraria	Bor. paste	Lim 200g
2	" R2	1990	0.30	"	533	160	Twice	10:10:4	500	Twice	"	Tapioca 1st year	Nil	"	"
3	" R3	1990	0.02 0.05	"	1400 1000	28 } 50 }	Once	20:20:20	250	Once	Broadcasting	Nil	Nil	"	"
4	" R4	1989	0.91	Poly bagged	483	440	Twice	15:10:6	450	Twice	"	Plantain 1st year	Nil	"	"
5	Average R1-1	1989 1992	0.41 0.40	" "	1097 625	450 250	Once Once	10:10:4 -	500 -	Twice -	" -	Cocoa Plantain 1st & 2nd year	Nil -	Bor. Paste	-
6	" R1-2	1989	0.63	"	555	350	Nil	20:20:20	1000	Once	Round	"	-	-	-
7	" R1-3	1987 1988	0.20 0.52	" "	475 490	95 } 255 }	Nil	10:10:4	500	Once	Broadcasting	Cocoa	Nil	-	-
8	" R1-4	1987	0.46	"	478	220	Nil	10:10:4	500	Once	"	Cocoa	Nil	-	-
9	" R1-5	1986	0.30	Budded stumps	833	250	Nil	15:10:6	500	Once	Pocket	Nil	Nil	-	-
10	Poor R2-1	1988	0.16	Poly bagged	150	24	Nil	Nil	-	-	-	Nil	Nil	-	-
11	" R2-2	1992	0.41	"	730	300	Thrice	10:10:4	500	Once	Round	Nil	Nil	-	-
12	" R2-3	1993	0.91	"	560	504	Once	P <sub>2</sub> O <sub>4</sub> 175	Basal			Plantain	Nil	-	-
13	" R2-4	1993	0.37	"	543	201	Once	P <sub>2</sub> O <sub>4</sub> 175	"			Nil	Nil	-	-
14	" R2-5	1993	0.21	"	523	110	Once	P <sub>2</sub> O <sub>4</sub> 175	"			Banana	Nil	-	-

The results showed that 13 growers used polybag plants as planting material and one used the brown budded stumps for planting. The advantages of using polybag plants are stressed by Joseph and Nair (1984).

The population density in the 14 holdings ranged from 150 to 1400. The stand per hectare was found to be high. In one unit (Serial number 10), the population density is only 150, which is mainly due to cattle grazing. Rubber Board (1994) recommends an optimum plant population density of 420-445 plants ha<sup>-1</sup>. As a whole, the planting density observed in the surveyed area showed a higher trend and this is mainly because of the small holding size and some sort of hedge planting adopted on sides of canals and on bunds amidst the paddy fields.

Weeding was not a problem in this area as the weeds were damaged during short periods of flooding during July. Out of 14 growers, six growers practiced weeding once in an year. Two growers weeded the field twice and one grower thrice. Five growers did not attend weeding.

The data on manuring (Table 6) showed that the growers were not strictly adopting the recommendations of Rubber Board. Many scientists reported the advantages of judicious fertilizer application in rubber (Bellejones, 1954; Dijkman, 1951; Nair, 1956; Ananth *et al.*, 1966; Potty *et al.*, 1976).

The data furnished in Table 6 also indicated that intercropping was followed in 9 holdings out of 14. In five holdings, banana was used as intercrop during the first and second year. In three holdings, cocoa was interplanted along with rubber. Tapioca was planted during the first year in one holding. The beneficial effect of intercropping using banana is reported by Rubber Research Institute of Malaysia (1972). Dijkman (1951) reported that the practice of interplanting with cocoa would give early crops from the third year from cocoa. Thereafter the rubber trees suppress the growth of cocoa. Tapioca was thought to compete strongly with rubber and it might promote the spread of root disease. But later studies by Pushparajah and Tan (1970) indicated that if cassava is planted 1.5-2.0 m away from the rubber, the adverse effect could be reduced.

The data furnished in Table 6 also showed that the plantations under the category good alone adopted lime washing against drought. The effectiveness of mulching and lime washing in young plants to protect from drought during summer were reported by Potty *et al.* (1980).

The data also indicated that a total of 26 plants were affected by pink which were properly treated with Boardeaux mixture. It is reported that the fungus attacks the bark of the main stem and branches of 3 to 7 year old immature trees. The severity of attack varies from one locality to another according to rainfall pattern and cultivars (Liyanage and Jacob, 1992).

#### 4.2.2. Mature plantations

The different management practices adopted by the growers in mature rubber plantations are furnished in Table 7.

The result showed that, 7 growers out of 11 used poly bagged plants for planting and three growers used brown budded stumps/clonal seedlings for planting and another grower (Serial number 9) attempted field budding. Use of advanced planting material was popularised by Rubber Board during 1979, and the growers in Kuttanad adopted that techniques from 1982 onwards. Joseph and Nair (1984) and Ramachandran (1992) reported the advantages of using poly-bagged plants.

The stand per hectare in the 11 units ranged from 365 to 800 and the population density was within the Board's recommendation in 3 units. Watson (1989) reported that wind damage will be less in high density planting.

Paardekooper and Newall (1977) reported that gross profit per hectare was almost constant when the population density ranged from 200 to 600 tappable trees per hectare.

Weeding was not a problem in Kuttanad as the weeds were damaged during the short period of flooding.

Table 7 also indicated that 72 per cent of the growers

Table 7. Management practices adopted by rubber growers for mature rubber in Kuttanad taluk

Sl. Category/ No. Ref. No.	Year of plant- ing	Area (ha)	Planting material	Populat- ion den- sity/ha	No. of plants now in the unit	Weeding	Manuring			Type of intercrop	Type of cover crop	Plant protection measures adopted		
							Type of manure	Quantity applied/ plant unit (g)	No. of appli- cation				Method of applicat- ion	
1	Good RM1	1984	0.43	Poly bagged	523	225	Nil	20:20:20	250	2	Pocket	Plantain 1st year	Peuraria	Rubber No 1-
2	"	1982 1984	0.71 } 0.34 }	"	576	605	Once	Bone meal MOP+Urea	500 + 500	2	-	-	-	DC
3	"	1986	0.61	Budded stumps	614	375	Nil	10:10:10	1000	1	-	-	-	DC
4	"	1988	0.20	Poly bagged	435	89	Nil	10:10:10	500+ 500	2	Banana 1st & 2nd year	Peuraria	-	DC
5	Average RM1-1	1986	1.03	"	624	643	Nil	15:10:6	500	1	-	-	"	DC
6	"	1979 1986	0.46 0.26	Budded stumps	365 438	168 } 114 }	Once	20:20:20	1000	1	-	-	-	DC
7	"	1984	0.30	Poly bagged	733	220	-	20:20:20	250	1	-	-	-	DC
8	"	1984	0.27	"	666	180	-	Urea+Rock phosphate	500+ 500	1	-	-	-	DC
9	Poor RM2-1 F/B 1982	1980	0.30	Field budding	966	290	-	-	-	-	-	Banana 1st & 2nd year	-	-
10	"	1984 1986	0.41 0.10	Poly bagged	488 500	200 } 20 }	-	-	-	-	-	"	-	-
11	"	1974 1982	0.10 0.20	Budded stumps	800 550	80 } 110 }	-	-	-	-	-	-	-	-



applied fertilizers, but were not strictly adopting the recommendations of Rubber Board. Adoption of discriminatory fertilizer usage is the most efficient and economic method of improving productivity (Pushpadas and Ahamed, 1980).

The Table 7 also indicated that 36 per cent growers planted plantain as intercrop during the first and second year. The beneficial effect of intercropping using banana is reported by Rubber Research Institute of Malaysia (1972).

The study also showed that only 3 growers established leguminous cover crops in their plantation i.e. 27 per cent. The beneficial effects of leguminous ground cover were reported by Potty *et al.* (1980).

Sethuraj and George (1980) reported that the portion of bark tapped off during a year should be treated with a wound dressing compound during the period of wintering every year. The data indicated that 72 per cent growers adopted panel protection measures in their plantation.

#### **4.3. Girth of plants**

Out of the eight plantations under the category 'Good', four were under tapping. Of these, data on girth during the immaturity period were obtained only for two estates. In the case of other two, data were not available in the Regional Office as they did not avail subsidy. There were four estates under immature rubber.

The data on mean girth of the plants are furnished in Table

8. The results showed that irrespective of population density, the plants attained the required girth by the seventh year (Sl. No.5 to 8). The population density of these estates were high and it ranged from 523 to 614. The results obtained in the present study didnot agree with findings reported by Buttery and Westgarth (1965). In their long term trial of 28 years in Malaysia, it was observed that 90 per cent of the trees planted at  $119 \text{ ha}^{-1}$  were tappable in the third year ~~at 119 ha<sup>-1</sup>~~ but at  $1074 \text{ ha}^{-1}$ , 31 per cent remained too small when the trees were 19 years old. This might be due to the fact that in most of the cases in the surveyed area, rubber was planted in isolated patches of two rows and also along the banks of small canals so that sufficient land and air space was available. The population density in such areas was worked out without considering the actual area occupied by the canals in between the rows of rubber.

The data also indicated that the plants under Serial number 8 attained tappable girth by the end of sixth year. In this case the population density was 435. Higher growth rates of rubber under optimum spacing using advanced planting materials, additional quantities and frequencies of application of fertilizer, mulching and corrective pruning was reported by Sivanadyan *et al.* (1973). All the above factors along with the optimum soil moisture conditions during the entire growth period might have led to the shortening of immaturity period to six years in unit No.8.

The data on immature rubber furnished in Table 8 as Serial number 1 to 4 also indicated better growth rate. The plants under Serial number 3 recorded a girth of 43 cm after three years which

Table 8. Girth of RRII 105 under category "good" during immaturity period and during May 1994

Sl. No.	Ref.No.	Year of planting	Extent (ha)	Stand per ha	Girth of plants in cm					May 1994
					Year					
					3rd	4th	5th	6th	7th	
1	R1	1990	0.33	530	15	20				26
2	R2	1990	0.30	533	20	28				33
3	R3	1990	0.02	1400	23	33				43
			0.05	1000	20	28				33
4	R4	1989	0.91	440	Data not available					40
5	RM-1	1984	0.43	523	23	30	40	48	55	60
6	RM-2	1982	0.71	576	20	28	40	48	55	60
		1984	0.34	576	20	28	35	43	50	55
7	RM-3	1986	0.61	614	Data not available					53
8	RM-4	1988	0.20	435	do					55

were planted at the highest density of 1400 ha<sup>-1</sup>. Favourable growing conditions, along with cultivation in two rows along the bank of canal might have contributed towards the better growth in this case also.

The observation on girth of plants categorised under 'Average' are furnished in Table 9. Among the nine units under this category, four units were under mature rubber and the rest under immature rubber. Observation on girth of plants in four units were not available in the Regional Office as they did not avail the subsidy.

The result showed that plants did not attain the tappable girth by the end of seventh year. Poor management conditions and the high population density might be the reason for the poor performance of rubber as reported by ~~201~~ Buttery and Westgarth (1965) and Sivandyan *et al.* (1973).

The data on girth of plants in units categorised under 'Poor' are furnished in Table 10. It was found that the performance of plants were very poor. The plants under Serial number 34 took almost 13 years to attain tappable girth. Even in the units with 100 plants per hectare, the rate of growth was very poor. The studies conclusively proved that management practices play a major role in enhancing rate of growth of rubber.

#### 4.4. Productivity

The data on system of tapping, number of tapping days obtained per year, yield per day, total yield from the unit and yield

Table 9. Girth of RR11 105 under category average during immaturity period and during May 1994

Sl. No.	Ref.No.	Year of planting	Extent (ha)	Stand per ha	Girth in cm					May 1994
					Year					
					3rd	4th	5th	6th	7th	
1	R1-1	1989	0.41	1097						38
		1992	0.40	625	13					13
2	R1-2	1989	0.63	555	15	20	28			33
3	R1-3	1987	0.20	475						43
		1988	0.52	490						35
4	R1-4	1987	0.46	478						43
5	R1-5	1986	0.30	833						50
6	RM1-1	1986	0.45	643	15	20	28	36	43	53
7	RM1-2	1979	0.46	365						88
		1986	0.26	438	15	20	28	35	43	55
8	RM1-3	1984	0.30	733	15	20	28	35	43	60
9	RM1-4	1984	0.27	666	15	20	28	35	43	58

Table 10. Girth of RR II 105 under category poor during May 1994

Sl. No.	Ref.No.	Year of planting	Extent (ha)	Stand per ha	Girth during May 1994 (cm)
1	R2-1	1988	0.16	100	30
2	R2-2	1992	0.41	731	6
3	RM2-1	1982	0.11	966	50
4	RM2-2	1986	0.10	490	45
5	RM2-3	1982	0.20	613	50

per hectare are furnished in Table 11. It was observed that all the growers under the category 'Good' adopted S/2 d/2 system of tapping while the growers under the category 'Average' adopted S/2 d/1. The average yield per ha ranged from 1677 kg to 3190.697 kg under 'Good'. It ranged between 1952 kg and 2475 kg under the category 'Average'.

The study also showed that tapping rest was not usually given except during flood period for 7 to 15 days during July-August. More than 140 tapping days were obtained in all cases except Serial number 3 and 4 units. Because of labour problem Serial number 3 was tapped for 93 days and Serial number 4 for 30 days.

The average yield of rubber in India during 1992-93 was 1154 kg ha<sup>-1</sup> (Rubber Board, 1994). The data furnished in Table 11 showed that even in area under average management conditions, the yield was above the national average. The reason for this might be due to the favourable climatic conditions and better management practices adopted in the case of units under category 'Good'. In units under the category 'Average' daily tapping was followed and this might have led to the higher yield. These findings agree with the reports of George *et al.* (1980), Joseph and Haridasan (1991) and Abraham (1991).

#### **4.5. Bark thickness (virgin and renewed)**

The data collected on bark thickness (virgin and renewed) in the three categories are furnished in Table 12. From the study it was found that the rate of growth of renewed bark was good in all the units under the category 'Good' except in Serial number 4, where the

Table 11. Tapping system and yield in units categorised under good and average

Sl. Ref.No. No.	Area	No. of plants under tapping	Year of opening	System of tapping	Days tapped per year	Yield per day		Total yield (kg)	Yield per ha (kg)	Category
						Sheet (kg)	Scrap (kg)			
1 RM1	0.43	225	1991	S/2 d/2	140	9.0	0.8	1372	3190.697	Good
2 RM2	1.05	605	1988 1991	,,	148	8.5	2.5	3256	3100.925	,,
3 RM3	0.61	300	1992	,,	93	10.0	1.0	1023	1677.000	,,
4 RM4	0.20	87	1994	,,	30	2.5	0.1	78	Shallow tapping	
5 RM1-3	0.30	220	1990	S/2 d/1	165	4.5	0.5	742.5	2475.000	Average
6 RM1-4	0.29	180	1990	,,	155	3.0	0.4	527	1952.000	,,

NOTE: Unit Nos.RM1-1 and RM1-2 under category average and units under RM2-1, RM2-2 and RM2-3 under category poor are planted with other cultivars like RR11 118, PB 217, PB 311. Ettumanoor clone and unselected seedlings along with RR11 105. No separate yield data was available and hence not included in the survey.



Table 12. Bark thickness (virgin and renewed) of plants in the three categories during May 1994

Sl. No.	Ref.No.	Year of planting	Year of opening	Thickness of virgin bark (mm)	Thickness of renewed bark (mm)	Category
1	RM-1	1984	1991	7.0	7.0	Good
2	RM2	1982 1984	1988 1991	9.2 7.0	9.2 7.0	,, ,,
3	RM3	1986	1992	6.2	6.2	,,
4	RM4	1988	1994	6.2	5.5	,,
5	RM1-1	1986	1992	6.5	6.0	Average
6	RM1-2	1979 1986	1985 1992	11.0 9.1	9.7 7.1	,, ,,
7	RM1-3	1984	1990	8.0	6.5	,,
8	RM1-4	1984	1990	8.0	6.5	,,
9	RM2-1	1980	1987	11.0	8.0	Poor
10	RM2-2	1986	1992	6.5	6.0	,,
11	RM2-3	1982	1989	8.0	8.0	,,

growth was excellent. It attained 5.5 mm thickness within 5 months. In this unit, tapping was started in January and was tapped only for 30 days. Further, the tapping was shallow. This might be the reason for the higher rate of growth of renewed bark. In the other two categories the rate was less. This proved that the management practices influence the rate of growth of renewed bark. The results obtained tally with the findings of George *et al.* (1980).

#### **4.6. Secondary characters**

##### **4.6.1. Tapping panel dryness**

This is a physiological disorder in most of the high yielding clones. Tapping panel dryness in each category of plantation is furnished in Table 13. Under category 'Good' 4.64 per cent trees were affected under S/2 d/2 system and in 'Average' 7.82 per cent trees were affected under S/2 d/1 and in 'Poor' category 19.33 per cent trees were affected by panel dryness. In Serial number 10, the plants were tapped from 1993 onwards and hence tapping panel dryness was not noticed eventhough the system adopted was S/2 d/1. From the study it is evident that high tapping panel dryness was associated with high intensity of tapping as reported by Sethuraj (1976) and Paardekooper (1989).

##### **4.7. Abnormal leaf fall**

The data furnished in Table 14 showed that abnormal leaf fall was not recorded in any of the holdings. This might be due to the fact that conditions prevailing in this area were not favourable

Table 13. Relation between tapping system and tapping panel dryness

Sl. No.	Category	Ref.No.	Year of opening	System of tapping	No.of trees tapped	No.of days tapped	No.of plants affected by panel dryness	Percent
1	Good	RM1	1991	S/2 d/2	225	140	10	4.44
2	,,	RM2	1988 1991	,,	605	148	45	7.43
3	,,	RM3	1992	,,	300	93	--	-
4	,,	RM4	1994	,,	87	30	--	-
Total					1207		55	4.64
5	Average	RM1-1	1992 1985	S/2 d/2	643	63	--	-
6	,,	RM1-2	1992	S/2 d/1	274	142	45	16.42
7	,,	RM1-3	1990	,,	220	165	30	13.60
8	,,	RM1-4	1990	,,	180	155	28	15.50
Total					1317		103	7.82
9	Poor	RM2-1	1987	Slaughter	90	130	80	27.58
10	,,	RM2-2	1993	S/2 d/1	50	120	--	-
11	,,	RM2-3	1989	Upward	104	116	60	32.60
Total					724		140	19.33

Table 14. Disease incidence (percentage) in the three categories of holding

Category	Ref.No.	Year of planting	Extent (ha)	Total No. of plants	No. affected by abnormal leaf fall	Disease incidence				
						Shoot rot	Pink	Powdery mildew		
						No. (%) affected	No. (%) affected			
Good	RM1	1984	0.43	256	-	16	6.25	10	3.9	Mild
"	RM2	1982 1984	1.05	620	-	--	-	10	1.6	"
"	RM3	1986	0.61	400	-	25	6.25	--	-	"
"	RM4	1988	0.20	100	-	13	13.00	--	-	--
Average	RM1-1	1986	0.45	300	-	56	16.60	20	6.6	Mild
"	RM1-2	1986	0.26	113	-	14	12.30	6	5.3	"
"	RM1-3	1984	0.30	250	-	--	-	28	11.0	--
"	RM1-4	1984	0.27	202	-	18	8.90	4	1.9	Partial
Poor	RM2-1	1982	0.10	90	-	--	-	--	-	Mild
"	RM2-2	1986	0.10	50	-	--	-	--	-	--
"	RM2-3	1982	0.20	104	-	--	-	--	-	--
Total				2485	-	136	5.47	78	3.13	

for the disease outbreak. It was also found that most of the planters used RRII 105 as planting material, which is reported to have fair tolerance to the disease (George *et al.*, 1980).

#### 4.8. Shoot rot

The data on incidence of shoot rot in the three categories are furnished in Table 14. A total of 136 plants were lost in the first year of planting in six units due to shoot rot and the loss was worked out to be 5.47 per cent.

#### 4.9. Pink disease

The data showed that pink disease was also negligible and its percentage was only  $3.93^{13}$ .

#### 4.10. Powdery mildew

The incidence of *Oidium* was very mild. The growers were not adopting any control measures against the *Oidium*.

#### 4.11. Wind damage

The data on extent of wind damage are furnished in Table 15. Wind damage was noted only in the mature area. Out of 2696 mature trees, 74 plants were damaged by wind and this worked out to 2.74 per cent. So the wind damage was very negligible and no remedial measures were required.

Table 15. Extent of wind damage in three categories of holdings

Category	Ref.No.	Year of planting	Extent (ha)	Total No. of plants	Extent of wind damage	
					No. of plants affected	(%)
Good	RM1	1984	0.43	256	14	5.46
,,	RM2	1982 1984	1.05	620	14	2.25
,,	RM3	1986	0.61	400	1	0.25
,,	RM4	1988	0.20	100	--	-
Average	RM1-1	1986	0.45	300	14	4.66
,,	RM1-2	1986	0.26	113	8	7.00
,,	RM1-3	1984	0.30	250	2	0.80
,,	RM4	1984	0.27	202	4	1.90
Poor	RM2-1	1982	0.10	90	4	4.40
,,	RM2-2	1986	0.10	50	--	-
,,	RM2-3	1982	0.20	104	13	12.50

## *Summary and Conclusion*

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## **SUMMARY AND CONCLUSION**

An attempt was made to assess the performance of clone RRII 105 in Kuttanad taluk. Data were collected through personal contacts and interview with the help of a pretested interview schedule.

For the study, all the units in Kuttanad were selected. The results revealed that garden lands were suitable for rubber cultivation because of the high fertility of the soil and conducive climatic features. The growers adopted a high population density per unit area. All the growers used clone RRII 105 for planting and majority used polybagged plants. The study also revealed that growth of plants were satisfactory even if the stand per hectare was high.

Another interesting factor noted was that the fungal diseases were very negligible. Weed growth was found to be little due to prolonged floods (7 to 15 days) during July-August. The average yield obtained was high when compared to the national average. As the growers preferred high intensity tapping, tapping panel dryness showed an increasing trend. The study showed that the growers in this area are not strictly following the management practices recommended by the Rubber Board.

The studies, thus indicated that rubber cultivation is economic and viable in garden lands of Kuttanad taluk. Field studies are to be initiated to find out the optimum population density per hectare and manurial practices for enhancing productivity in the taluk.



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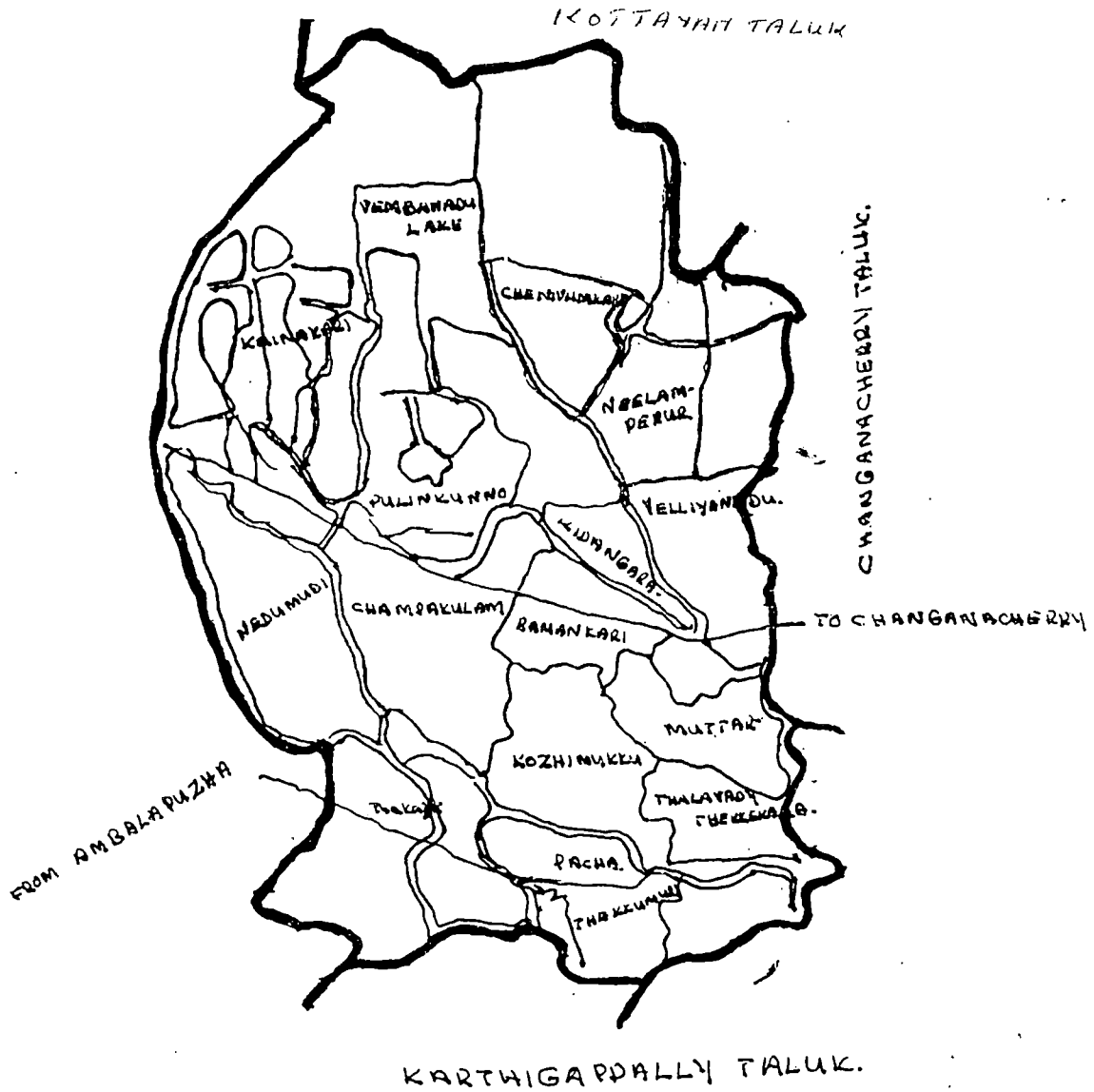
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## *Appendices*

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# APPENDIX-I

Map showing the Villages in Kuttanad taluk





APPENDIX-II  
List of units selected for study

Sl. No.	Regn/Appln. No.	Name and address of owner	Area (ha)
1	2	3	4
1	PD3/CH/A/90/362	Sri.Ouseph Chacko Thundiyil Kidangara	0.33
2	PD3/CH/A/90/321	Sri.Eapen Joseph Vadakara Kidangara	0.30
3	PDA/CH/A/721/92	Sri.Varky Varky Kochupurackal Kuttissery Kidangara	0.07
4	Unregistered	Sri.K.Josekutty Kulanthara Near S.H.School Changanacherry	0.91
5	PD3/CH/A/92/308	Sri.K.Sasikumar Kunnumpurath Vallamkulam	0.81
6	PD2/CH/A/89/585	Sri.Eapen Aprem Mapprathusseril Mithrakkary, P.O.	0.63
7	Kutanadu 7	Thomas Joseph Edayadil Kannady, P.O. Pulinkunnu	0.72
8	Kuttanadu 13	Sri.Alex Joseph Edayadiyil Kannady, P.O. Pulinkunnu	0.46
9	Unregistered	Sri.K.A.Joseph Karuvethara Nalukalathil Mithrakkary, P.O.	0.30

Contd.

Appendix-II. Continued

1	2	3	4
10	Kuttanadu 14	Sri.Jimmy Joseph Edayadiyil Kannady, P.O. Pulinkunnu	0.16
11	Unregistered	The Trustee St.Reetha's Church Kannady	0.41
12	Kuttanadu 8 PDA/CH/461/93	Sri.Peter Thomas Athikayam Veliyanadu	0.91
13	PDA/CH/459/93	Sri.Ninan Thomas Athikayam Veliyanadu	0.37
14	PDA/CH/460/93	Sri.N.K.George Ettuparayil Pullampalayil Kannady, P.O.	0.43
15	Kuttanadu 11	Sri.Thomas Thomas Athikayam Veliyanadu	0.21
16	Kuttanadu 10	Sri.Thomas Kuncheriya Thuruthimalyil Kidangara	1.07
17	Unregistered	Sri.Thomas Abraham Karuvelithara Keerickal Mampuzhakkary	0.61
18	Unregistered	Sri.Abraham Abraham Geemangalath Mampuzhakkary	0.20
19	PD2/CH/A/86/350	Sri.K.C.Joseph Karuvelithara Mithrakkary	1.03

Contd.

Appendix-II. Continued

1	2	3	4
20	PD2/CH/86/714	Sri.Thomas Joseph Thoppil Veliyanadu West, P.O.	0.72
21	PD/CH/A/84/813	Sri.Jacob Eapen Vadakara Kidangara	0.30
22	PD/CH/A/84/806	Sri.Eapen Kuncheria Vadakara Thattasserry Kidangara	0.27
23	Unregistered	Sri.Joseph Kurian Vachaparambil Mithrakkary	0.30
24	Unregistered	Sri.Alexander Antony Karuvelithara Mithrakkary	0.51
25	Kuttanadu 9	Sri.Joseph Antony Geemangalath Mithrakkary	0.30

### APPENDIX-III

#### Classification of immature units based on management practices

Sl. No.	Ref.No.	Name of owner	Year of planting	Area (ha)	Category
1	R1	Sri.Ouseph Chacko	1990	0.33	Good
2	R2	Sri.Eapen Joseph	1990	0.30	,,
3	R3	Sri.Varky Varky	1990	0.07	,,
4	R4	Sri.K.Josekutty	1989	0.91	,,
5	R1-1	Sri.K.Sasikumar	1989 1992	0.41 0.40	Average ,,
6	R1-2	Sri.Eapen Aprem	1989	0.63	,,
7	R1-3	Sri.Thomas Joseph	1987 1988	0.20 0.52	,, ,,
8	R1-4	Sri.Alex Joseph	1987	0.40	,,
9	R1-5	Sri.K.A.Joseph	1986	0.30	,,
10	R2-1	Sri.Jimmy Joseph	1988	0.16	Poor
11	R2-2	The Trustee	1992	0.41	,,
12	R2-3	Sri.Peter Thomas	1993	0.91	,,
13	R2-4	Sri.Ninan Thomas	1993	0.37	,,
14	R2-5	Sri.Thomas Thomas	1993	0.21	,,

APPENDIX-IV  
Classification of mature units based on management practices

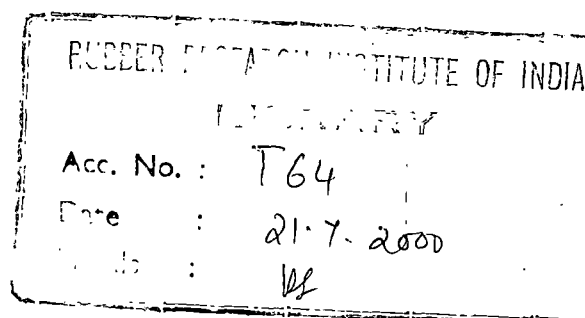
Sl. No.	Ref. No.	Name of owner	Year of planting	Area (ha)	Category
1	RM-1	Sri.N.K.George	1984	0.43	Good
2	RM-2	Sri.Thommi Kuncheria	1982 1984	0.71 0.34	,, ,,
3	RM-3	Sri.Thomas Abraham	1986	0.61	,,
4	RM-4	Sri.Abraham Abraham	1988	0.20	,,
5	RM1-1	Sri.K.C.Joseph	1986	1.03	Average
6	RM1-2	Sri.Thomas Joseph	1979 1986	0.46 0.26	,, ,,
7	RM1-3	Sri.Jacob Eapen	1984	0.30	,,
8	RM1-4	Sri.Eapen Kuncheria	1984	0.27	,,
9	RM2-1	Sri.Joseph Kurian	1980/ FB 1982	0.30	Poor
10	RM2-3	Sri.Alexander Antony	1984 1986	0.41 0.10	,, ,,
11	RM2-3	Sri.Joseph Antony	1979 1982	0.10 0.20	,, ,,

APPENDIX-V  
Performance of the clone RR11 105 in Kuttanad taluk  
of Alleppey District

Interview schedule

01. Name and address of the owner :
02. Name and Reg.No. of the estate:
03. Location of the estate :
04. Date of visit :
05. Area owned by the grower : (a) Mature ..... ha  
(b) Immature ..... ha
06. Year/years of planting with extent : 19 ...../.....ha  
19...../.....ha  
19...../.....ha
07. Variety of clone used for planting : RR11 105/RR11 600/GT1/  
Ettumanoor clone
08. Type of planting material used : Budded stumps/Polybagged plants
09. Planting distance adopted :
10. No.of pits taken/No. of plants planted :
11. No. of vacancies supplied with year :
12. No. of plants now existed :
13. Whether the area is exclusively planted/inter-planted :
14. Details of other trees present in the area : 1..... 2..... 3.....
15. Whether intercropping done : Yes/No  
If yes, state  
(a) Name of the intercrop :  
(b) Frequency of intercrop :
16. Whether leg. cover established. If yes, : Yes/No  
(a) Year of establishment :

- (b) Variety of Leg. cover :  
 established  
 (c) Still present :
17. Weeding : Yes/no
18. No. of times done :
19. Whether manuring done : Yes/No  
 regularly. If yes, Immature Mature  
 (a) Type of fertilizer :  
 applied  
 (b) Quantity applied per :  
 plant  
 (c) Method :  
 (d) Time of application :  
 (e) If not, reason for :  
 not manuring
20. Details of plant protection measures adopted
- (a) Spraying : Yes/No  
 (b) Dusting : Yes/No  
 (c) Lime wash : Yes/No  
 (d) Pannel protection : Yes/No  
 measures
21. Intensity of damage due to : Partial Medium Serious Lost  
 (a) Phytophthora :  
 (b) Oidium :  
 (c) Pink disease :  
 (d) Brown bast :  
 (e) Wind damage :  
 (f) Flood :  
 (g) Drought :
22. Wintering : Partial Complete
23. Whether the area is flooded : Yes/No  
 annually
24. No. of days the area in a :  
 submerged condition in an  
 year
25. Age at tapping :
26. Time of tapping :
27. System of tapping :



28. No. of tapping days obtained :  
in an year
29. Yield obtained per day : ..... kg
30. Quantity of scrap obtained : ..... kg  
per day
31. Rainguarding done : Yes/No
32. Tapping rest given and days :
33. No. of labourers employed : Men Women Children Self
1. Weeding
  2. Manuring
  3. Spraying
  4. Lime wash
  5. Dusting
  6. Tapping
  7. Pannel protection
  8. Processing of crop
  9. Transporting of material
  10. Any other item, specify

Place :

Date :

Signature of the student