A COMPARATIVE STUDY OF YIELD PERFORMANCE OF TWO IMPORTANT CLONES OF RUBBER - RRII 105 AND RRIM 600 IN MOOPLY VALLEY OF THRISSUR DISTRICT

BY

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VELLANIKKARA THRISSUR

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DISSERTATION

SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE 'POST GRADUATE DIPLOMA IN NATURAL RUBBER PRODUCTION' OF THE FACULTY OF AGRICULTURE KERALA AGRICULTURAL UNIVERSITY

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1992

DECLARATION

I hereby declare that this dissertation entitled '**A comparative study of yield performance of two important clones of rubber - RRII 105 and RRIM 600 - in Mooply Valley of Thrissur district'** is a bonafied 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 of any degree, diploma, associateship or other similar title of any other University or Society.

Vellanikkara,

20--7--1992.

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C E R T I F I C A T E

Certified that this dissertation entitled "A comparative study of yield performance of two important clones of rubber - RRII 105 and RRIM 600 - in Mooply Valley of Thrissur district' is a record of research work done independently by Sri. S. Perumal Pillai, 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. S. Perumal Pillai, a candidate for the Post Graduate Diploma in Natural Rubber Production agree that the dissertation entitled 'A comparative study of yield performance of two important clones of rubber - RRII 105 and RRIM 600 - in Mooply Valley of Thrissur distrct' may be submitted by Sri. S. Perumal Pillai in partial fulfilment of the requirement of the diploma.

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Introduction

1. INTRODUCTION

Rubber plantation industry occupies a unique position in the economic and social life of people not only in India but also of several other countries. Natural rubber is a versatile vegetable product and provides the principal raw material for the manufacture of a variety of products which are indispensable in modern life. World over, rubber is used for manufacturing a wide range of products numbering to about 50,000, while in India only 35,000 different items are now manufactured. Its multifarious uses made natural rubber a strategic industrial raw material and its demand is increasing tremendously. The industry provides direct employment to over 2.5 lakhs people and indirect employment to another 8 to 10 lakhs persons. Over 30 million people in the world depend on natural rubber for their livelyhood (Saraswathyamma *et al*., 1988).

Eventhough rubber is obtained from the latex of various plants numbering more than 2500 species belonging to 900 genera, distributed over 25 families, *Hevea brasiliensis* (Wild ex. A. de Juss.) Muell. Arg. commonly known as the para rubber tree is the most important source of natural rubber.

Rubber cultivation commenced in India in 1902. Before independence the area under rubber was less than 50,000 ha. Remarkable progress in the development of rubber cultivation had been made since 1955 and now reached an enviable position consequent to the formation of Rubber Board and establishment of Rubber Research Institute of India. The area has increased from 74,915 ha in 1950-51 to 4,51,252 ha in 1990-91; and the production from 15,830 tonnes to 3,29,615 tonnes and the productivity from 243 kg/ha to 1076 kg/ha during the same period (Rubber Board, 1992). The progress had been enviable when compared to that of any other crop. The use of high yielding planting materials developed through the process of crop improvement had played an important role in the spectacular performance of natural rubber industry.

Hevea brasiliensis has an economic life span of over thirty years. The productivity of a rubber plantation largely depend upon the planting material used. This warrants maximum care and caution in the selection of suitable variety for the particular region. The performance of each clone is correlated by its genetic constitution and its interaction with the environmental conditions of the particular region. A thorough study about the performance of different planting materials for a particular agroclimatic situation, therefore assumes very great importance as the performance of clones show variation in different locations. Therefore it is always necessary to select the appropriate material suited for each locality by evaluating the performance of materials available in the region. All relevant factors like yield, disease resistance, tolerance to wind etc should be taken into consideration. The selected material should have all the desirable characters such as high initial and subsequent yield, increasing yield trend, high growth vigour, good branching habit, resistance to stress conditions and tolerance to diseases, response to low intensity tapping etc. The environmental factors that influence the performance are soil type and terrain, pattern of rainfall, severity and duration of drought etc. So due consideration of the characteristics of planting material and the environmental constraints is very crucial and imperative when the selection of planting material is made. Choice of clones is aimed to maximise productivity of an area subject to the constraint prevalent. The probable adverse interaction between secondary clonal effects and the inhibitary environmental factors if any is intended to be overcome by the selection of appropriate clones. The ideal conditions would be the choice of specific clones possessing high yield potential and other characters best suited to each locality.

Breeding programme in Hevea brasiliensis was conducted with the main objective of evolving materials with high production potential and adoptability to regional agroclimatic conditions. However, detailed studies on the performance of these materials have not been attempted in each of the agroclimatic regions.

And so the present study was undertaken to evaluate the performance of two important high yielding clones viz. RRII 105 and RRIM 600 in the agroclimatic conditions of Mooply Valley region which is a potential rubber growing area of Thrissur district. This type of information is necessary to make any change in the choice of planting material for future plantings in the area.

Review of Literature

2. REVIEW OF LITERATURE

The world natural rubber production during 1991 is reported as 53.90 lakh tonnes and consumption as 51.60 tonnes (International Rubber Study Group, 1992). The total area under rubber cultivation in the world is over 89.32 lakh ha. The rubber tree is cultivated in over twenty countries. The main rubber growing countries are Indonesia (31.11 lakh ha), Malaysia (18.57 lakh ha), Thailand (17.47 lakh ha), Peoples Republic of China (5.87 lakh ha) and Sri Lanka (2 lakh ha), in addition to India. Nigeria, Liberia, Vietnam, Zaire, Union of Myanmar, Philippines, Ivory Coast, Combodia, Brazil, Bangladesh etc. are also growing rubber.

In India rubber is grown over an area of 4.51 lakh ha (Rubber Board, 1992), the main rubber growing States being Kerala (3,80,000 ha) and Tamil Nadu (17,150 ha). The tree is also grown in Karantaka (13,500 ha), Andamans & Nicobar Islands (962 ha), Goa (970 ha), Maharashtra (145 ha), Orissa (250 ha), Andra Pradesh (142 ha) and North Eastern States (34,000 ha). The production during 1990-91 was 3,29,615 tonnes, the average national productivity being 1076 kg/ha/year.

The most effective and popular method for increased productivity is by plant improvement through breeding and selection and making available improved cultivars to the farmers. The genetic constitution of planting materials, their adaptability to improved agrotechniques and response to environmental conditions are the major factors governing productivity. Perusal of the early history of the rubber plantation industry revealed that a limited number of genotype had paved the way for the industry in the South East Asian Countries (Haridasan and Nair, 1980). These materials however have good potentialities and could lead to the development of highly promising planting materials for commercial use. Establishment of primary clones directly from high yielding seedling genotypes, development of seedling families by hand pollination between high yielding clones and evaluation of their performance formed the principal subject of investigation (Nair and Panicker, 1966). Evolution of planting material in Hevea brasiliensis has been thus achieved following these two methods viz. hybridisation and clonal selection, and ortet or mother tree selection. Eventhough other techniques such as mutation and polyploidy breeding etc. were tried, the success was only very limited (Panicker et al., 1980). The first two methods have resulted in the development of a large number of hybrid clones and primary clones (Marattukalam et al., 1980). Panicker et al. (1980) reported that collection and conservtion of diversity of genotypes available in the centre of origin of the genus are essential for further tree improvement as the genetic diversity available in the breeders stock has been limited.

It is well established that clones as planting materials have many advantages such as uniformity among members of each clone which enables the growers to carry out annual maintenance operations in an easy, systematic and economic way (Marattukalam, 1980). Since the plants are uniform in growth thinning out is hardly needed. So initial stand need be less than that required for seedlings, and as a result cost of cultivation can be reduced to a certain extent. Uniformity in the quality of latex from clones make it more useful for specific purposes wherever it is necessary.

Hevea brasiliensis is propagated both by seeds and by vegetative means. During the initial stage of development of rubber cultivation propagation method by seed was popular which was gradually replaced by vegetative method of propagation through bud grafting and now it has become the most popular method.

The climatic conditions prevailing in the rubber tract vary from region to region and from year to year especially in the case of annual rainfall. Kanyakumari district of Tamil Nadu and the southern districts of Kerala enjoy more distributed rainfall through both south west and north east monsoons, compared to that of northern districts where the north east monsoon is either weak or rare. Rubber cultivation in India has been traditionally confined to a narrow belt extending from Kanyakumari district and lying in general west of western ghats and parallel to it for approximately 400 km. But expansion of rubber cultivation to non-traditional areas such as North Eastern States, Orissa, Maharashtra etc have already been started as it was found that suitable areas with suitable agroclimatic conditions are available. It was also proved to be successful (Menon and Unni, 1990).

Growth of rubber has been proved to be successful up to 450 m above mean sea level. At high elevation temperature becomes unfavourable and the rate of biochemical and physiological processes generally decreases. Very low temperature may cause death of tissues from freeze injury. Considerable retardation of growth takes place at higher elevations (Pushpadas and Karthikakuttyamma, 1980). In North Eastern States, during winter which occur from November to January, the buds remain dormant or even destroyed. Retardation of growth occur which leads to delay in attainment of tappable girth when compared to regions of low elevation. Experiments indicated that immaturity period was increased by over six months for every 100 m rise in altitude. High yielding clones at low elevations were not found to be high yielders when planted at high elevations. High incidence of oidium, retarded growth and poor bark renewal were also observed in Sri Lanka (Chandrasekhara, 1971, 1972). Similar observations have also been made in India (Rubber Research Institute of India, 1989, 1990). But here in spite of such constraints several cases of successful establishment of economic units can be noticed in some of the rubber growing areas, wherever conditions are congenial (Pushpadas and Karthikakuttyamma, 1980). A gently undulating topography or a slope in the range from 5^0 to 15^0 is reported to be ideal. The important physical properties of soil which affect growth of rubber are reported to be soil depth, drainage, texture and structure. Shallow soil and high water table results in uprooting.

Wind also adversely affect rubber and the extent of damage depends on age of the tree and speed of wind. Young trees exposed to strong seasonal winds for prolonged periods become stunted in growth. The leaves become lacerated, crinkled and get dried up particularly along the margins and along the lacerations. The dried up portions are subsequently blown of resulting in a sparse foliage and ultimately results in decrease in yield. Trunk snap and branch break and even uprooting are the major wind effects on old trees. Trunk snap and branch break are the consequences of unduly heavy development of canopy. Rate of girthing on tapping and configuration of branches, both clonal characters, influence susceptibility to trunk snaps and branch breaks. Incorrect and unbalanced nutrition is another pre-disposing factor causing wind damage (Pillai, 1980). Marattukalam and Premakumari (1987) studied the performance of a few Sri Lankan clones and reported that eventhough they are prone to wind damage, some possess good secondary characters like vigour in growth, tolerance to certain diseases and good yield during the initial years of tapping.

Saraswathyamma et al. (1988) mentioned the work done for crop improvement in rubber by the Rubber Research Institute of India from 1954 onwards. It was reported that selective hybridisation between superior clones, vegetative multiplication and evaluation of most promising selections have resulted in evolving clones with high production potential.

Marattukalam et al. (1990) studied the early performance of a few RRII clones from 46 new clones evolved through ortet selection by the Rubber Research Institute of India. Saraswathyamma et al. (1987) evaluated the performance of certain selected RRII clones and reported the mean yield for the first six years of tapping of clones RRII 105, RRII 203, RRII 208, RRIM 600 and GT 1 as 1576 kg/ha, 1212 kg/ha, 1297 kg/ha, 907 kg/ha and 662 kg/ha respectively. Important secondary characters like vigour at opening, girth increment on tapping, percentage of yield depression during summer, virgin bark thickness etc. were also studied. It was observed that the clones show region wise response with regard to yield and secondary characters. It was suggested that evolution of planting material at different environments is necessary to facilitiate planting of the appropriate variety suited to each locality. Krishnankutty et al. (1982) also reported that performance of planting materials differs according to agroclimatic variations in different zones. Further it is reported that on a comparison of yield performance of planting materials in Malaysia and India except PB 86, all the others (PB 28/59, PBIG, PB 5/51, LCB 1320, RRIM 600 and RRIM 623) yielded much higher in Malaysia than in India. Krishnankutty and Sreenivasan (1985) studied the yield performance of 22 clones in important rubber growing regions which also revealed that the average yield of clones in Malaysia is more than that of India in respect of all materials except PB 86 on a comparative analysis of the Indian and Malaysian figures. Joseph and Haridasan (1990) reported the consistency figures of yield and also attempted a region wise analysis of yield of selected planting materials in India. They also compared the commercial yield reported in India and Malaysia. It is reported that the average yield of RRIM 600 as 1031 and 1252 kg/ha/annum in Thrissur district during the first five years and ten years respectively under commercial planting. Their study also revealed that in the first five year period RRII 105 tops the list with 1412 kg/ha. They also expressed the view that RRII 105 is relatively more consistant.

George *et al.* (1988) reported the performance of selected clones with regard to the planting policy of the sample estates, over three time periods of 15 years covering 32 clones. It was observed that planting materials had very great influence on productivity. Stability of yield of different planting material was also analysed. Saraswathyamma *et al.* (1988a) studied different planting materials, planting material recommendations, clone identification and details of evolving primary, secondary and tertiary clones and their classification. Remarks were also made on the approval of planting materials and the restrictions on the use of old and experimental materials which are included under the second and third categories in the list of approved materials. It was mentioned that clones suited for different regions may be selected on the basis of available informations on their genetic potentialities and response to environmental conditions.

Cherian (1987) has reported commercial yield of over 2000 kg in estates. Yield figures of estates having production of above 2000 kg/ha was also mentioned. He included RRII 105 and RRIM 600 as high yielding clones.

The Sub-Group on Plantation Crops Agricultural Experts (1987) has appreciated on the remarkable growth in natural rubber production and productivity. The highest growth rate in productivity was more responsible than the increase in area for the enhancement in India's natural rubber production. It was stated that the average Indian yield at present is 80 per cent of the average yield obtained in Malaysia, the difference being attributed to more favourable agroclimatic factors prevailing there. The remarkable growth rate of productivity in India was achieved through increase in area under high yielding clones and by adoption of scientific cultural practices.

The two clones selected for the study were recommended for planting by the Rubber Board under Category I up to 1990 in both traditional and non-traditional areas. But from 1991 onwards RRIM 600 has been included under Category II for traditional areas and under Category I for non-traditional areas. The Rubber Board issues planting material recommendations for every year, based on the informations available on the performance of the different materials. Material under Category I are proven ones and can be planted on a large scale with a strong recommendation that this may be used to cover only 50 per cent of the total area of any estate or small holding. Category II consists of RRIM 600 and other clones which still show good performance in certain localities and promising new clones which are yet to be fully tested. Category III includes clones for experimental planting based on the encouraging performance in the small scale trials. Polyclonal seeds, from approved sources are included under Category III(b). The cultivars under each category are listed under Table 1.

Table 1. Rubber planting materials approved for 1992.

Category		Materials recommended	Remarks
I		Buddings of clone RRII 105 (Also RRIM 600 and GT 1 for non-traditional areas)	Should not exceed 50% of the total area of the estate/holding.
II		Buddings of clones RRIM 600, GT 1, PB 28/59, PB 217, PB 235, RRIM 703.	Combination of three or more clones for planting upto 50% of the area.
III	(a)	Buddings of clones RRII 5, PCK 1, PCK 2, PB 260 PB 280, PB 311.	Should not exceed 15% of the total area ie., for very small scale planting.
	(b)	Buddings of clones Tjir 1, PB 86, Gl 1, PR 107, RRIM 605, RRIM 623, RRIM 628, RRIM 701, PB 6/9, PB 5/51, RRII 118, RRII 203 and RRII 208 and polyclonal seeds of approved source.	
	(c)	Other promising clones approved by Chairman, Rubber Board.	

RRII 105 is a secondary clone. Trees of this clone are tall with straight trunk, branching good, canopy dense, crown restricted to the top; foliage dark green with glossy leaves. Vigour before and after tapping is average. Virgin and renewed bark thickness are above average. This clone has fair degree of tolerance to abnormal leaf fall disease under normal prophylactic measures, susceptible to pink, fairly tolerant to yield depression during drought, S/2 d/3 system of tapping is preferable as susceptible to brown bast reported from many holdings. Latex colour white and d.r.c. high. Mean yield in large scale trial over first five and ten years is 65.57 and 66.71 g/tree/tap respectively. Commercial yield over five and ten years is 1450 and 1555 kg/ha/year.

RRIM 600 is also a secondary clone. Average commercial yield over first five, ten and fourteen years in India is 1129, 1327 and 1387 kg/ha/year respectively. Experimental yield in large scale trial over first five, ten and fifteen years is 48.0, 52.3 and 52.6 g/tree/tap respectively. Experimental yield in large scale trial in Malaysia over first five, ten and fifteen years is 1540, 1990 and 2199 kg/ha/year. Summer yield is high. Young plants show spindly growth and late branching. Trunk is tall and straight, canopy broom shaped and narrow with moderate heavy branches, foliage sparse and small yellowish green leaves. Though girth at opening is low, girth increment on tapping is high. Similarly virgin bark thickness is low and thickness of renewed bark over five years is high. The clone is highly susceptible to Phytophthora leaf fall, incidence of pink medium; Oidium mild. Latex colour white and d.r.c. medium. Latex unsuitable for concentration (Annamma et al., 1990).

According to Abraham (1991) RRII 105 was the highest yielder (1528 kg/ha) followed by RRIM 600 (1194 kg/ha) in Pathanamthitta district. He attributed this higher yield to the interaction between the clones and the agroclimatic situations of that area coupled with the high intensity of tapping. He revealed that the incidence of brown bast in RRII 105 and RRIM 600 is 5 per cent and 6 per cent respectively. Though RRII 105 was highly tolerant to Phytophthora, RRIM 600 had severe incidence (40 per cent). The incidence of pink disease in RRIM 105 was 15 per cent whereas it is little low in RRIM 600 (10 per cent). He also reported that Oidium attack was comparatively low for both the clones in that area. Wind damage in RRII 105 was to the tune of 7 per cent followed by RRIM 600 with 5 per cent.

Muralidharan (1991) when studied the yield performance of high yielding clones in Kozhikode and Malappuram districts indicated the superiority of RRII 105 with an yield of 1742 kg/ha followed by RRIM 600 with 890 kg/ha and GT 1 with 900 kg/ha. He also reported that wind damage was more in RRIM 600 (12.77 per cent) and less in RRII 105 (8.02 per cent). The brown bast incidence was to the tune of 12.34 per cent in RRIM 600 while there was no incidence at all in RRII 105.

Materials and Methods

3. MATERIALS AND METHODS

The study covered the performance of two popular clones of Hevea brasiliensis (Willd. ex. Adr. de Juss.) Muell. Arg. in Thrissur district of Kerala. The two materials were hybrid clones, one evolved by the Rubber Research Institute of India and the other by the Rubber Research Institute of Malaysia. The former was RRII 105 whose parents are Tjir 1 and Gl 1. The latter was RRIM 600 developed through hybridisation between Tjir 1 and PB 86.

Two estates were covered. They were Pudukad estate and Chemoni estate, both located at Mooply Valley area in Varandarapilly village of Mukundapuram taluk, Thrissur district. Observations were recorded on:

(1) Location of the estates and details regarding the area under rubber.

(2) Area under different planting materials.

(3) Area under RRII 105 and RRIM 600 with details on year of planting and hectarage under each year.

(4) Respective year of opening and immaturity periods.

(5) Cultural practices and estate maintenance.

(6) Tapping system.

(7) Yield and productivity.

(8) Wind damage.

(9) Incidence of brown bast.

(10) Relative merits of each clone.

The data were gathered with the help of a preprepared proforma (Annexure I). Details were collected from the estate records and by frequent visits to the estates and discussions with the management personnel of the concerned estates. Additional information wherever found necessary were gathered from the Managers and Field Supervisors of the two estates by personal discussions.

The yield performance of the clones have been studied and recorded from the first year of tapping to the seventh year wherever available from both the estates. The performance of both clones were evaluated by working out the mean yield per hectare per year. Attempts were also made in this study for a general analysis of the secondary characters like panel dryness, wind damage, pink, oidium, abnormal leaf fall etc. Girth records of these clones were also obtained from the office records. The data collected were tabulated to draw conclusive results.

Results and Discussions

4. RESULTS AND DISCUSSION

4.1 Agroclimatic conditions of the project area

Depending on the available details regarding the agroclimatic conditions and soil profile the traditional rubber growing areas in India are classified into five regions. Thrissur district comes under two regions, viz. (1) Central region, which consists of whole of Ernakulam district and part of Thrissur district, and (2) Palghat, Malapuram and part of Thrissur district. The area selected for the study comes under the Central region. This region is characterised by moderate to high rainfall, laterite soil, poor soil nutrient status in general and high incidence of Phytophthora and pink disease. The other part of Thrissur district was characterised by low rainfall, moderate to severe drought, strong wind, generally fertile soil and high incidence of Phytophthora and pink diseases.

Thrissur is located more or less in the middle of Kerala State and consists of five taluks and 213 villages. It has seventeen Community Development Blocks, seven Municipalities/Townships, 25 towns and 98 panchayats. The area of the district is 3031 sq km and population (as per 1981 census) is 24.37 lakhs, of which rural population is 19.22 lakhs. Annual rainfall is 317.74 mm (Government of Kerala, 1982).

The agroclimatic conditions in both the estates are almost similar. This is a conventional rubber growing tract having an annual rainfall ranging from 246 cm to 307 cm and the major portion is received during June/July every year. The average annual rainfall during the last 10 years is 282.50 cm and the average number of rainy days during the same period is 132.25 (Table 2 and 3). The temperature ranges from 24° to 36° and humidity from 60 to 100 per cent. The pattern of rainfall is almost similar in both the sample estates. The terrain of the land is flat and undulating with gentle slopes. The soil is laterite and moderately fertile.

4.2 Rubber cultivation

Mooply Valley is a concentrated area for rubber having four large estates (above 20 ha) and a large number of small holdings (below 20 ha in area). Mooply Valley is nearly 16 km east of Amballur junction in the NH 47.

Chemoni estate consists of two divisions, Chemoni and Echipara located 8 km apart. The total extent of area under rubber is 622.33 ha of different years of planting with new and older clones (Table 4). Pudukad estate has a total area of 398.27 ha under rubber which is contiguous and a large number of clones are planted in different years (Table 5).

Planting and other cultural operations were strictly followed in both the sample estates as recommended by the Rubber Board.

Table 2. Monthwise rainfall distribution in Chemony estate (cm).

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	Average
January	-	-	0.84	7.25	-	-	-	-	0.16	-	0.827
February	-	-	0.86	-	1.46	-	0.74	-	-	-	0.306
March	0.27	-	3.33	4.70	0.12	1.50	3.04	0.50	-	0.10	1.356
April	11.03	2.57	15.03	2.33	8.58	1.27	12.46	11.88	2.20	8.84	7.619
May	18.00	4.31	11.19	24.17	15.18	11.72	8.63	21.56	39.17	4.36	15.829
June	70.03	46.64	82.14	101.80	74.92	80.10	61.09	76.93	63.80	114.86	77.231
July	50.41	70.31	86.95	52.57	30.37	39.31	84.14	75.90	68.95	104.64	66.355
August	52.16	70.15	28.86	46.58	41.34	51.23	58.38	30.34	40.76	48.01	46.781
September	7.51	46.78	11.85	16.64	53.58	28.54	57.67	29.54	11.00	5.49	26.860
October	21.26	10.63	49.94	22.46	18.66	27.85	14.62	44.66	56.06	7.60	27.374
November	15.65	10.07	1.50	5.64	24.55	25.79	1.06	5.16	8.34	-	9.776
December	0.09	4.20	1.70	1.18	1.52	7.78	5.03	-	0.38	-	2.288
TOTAL	246.41	265.66	294.19	285.34	270.28	275.09	306.86	296.47	290.82	293.90	282.50

Table 3. Number of rainy days (monthwise) in Chemony estate.

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	Average
January	-	-	2	3	-	-	-	-	1	-	0.6
February	-	-	2	-	1	-	1	-	-	-	0.4
March	1	-	4	2	1	1	4	3	-	2	1.8
April	4	1	13	4	4	4	12	6	3	9	6.0
May	15	4	10	17	10	8	10	12	19	6	11.1
June	26	24	28	30	23	27	27	28	29	26	26.8
July	24	25	29	29	19	23	26	23	28	25	25.1
August	25	27	25	27	12	25	28	23	22	23	23.7
September	10	28	12	15	18	15	26	14	8	6	15.2
October	14	12	17	18	14	17	10	18	16	4	14.0
November	8	6	4	3	9	9	3	4	8	-	5.4
December	1	8	1	3	1	7	2	-	1	-	2.4
TOTAL	128	135	147	151	112	136	149	131	135	101	132.25

Table 4. Details of area under rubber in Chemoni estate.

Type of planting	Year of planting	Clones	Area (ha)	Type of planting material
RP	1960	LCB 1320	24.03	BG
RP	1961	GG 1	22.05	Polyclonal seedlings in two plots.
RP	1961	LCB 1320	4.65	BG
RP	1963	RRIM 623	17.50	BG
RP	1963	RRIM 605	22.75	BG
RP	1964	Tjir 1	7.93	BG
NP	1966	RRIM 623	13.76	BG
NP	1966	RRIM 605	7.85	BG
NP & RP	1967	GG 1	20.39	Polyclonal seedlings in two plots (16.71 NP & 3.48 RP)
NP	1970	GT 1	5.16	BG
RP	1972	GT 1	40.17	BG
RP	1974	RRII 105	41.04	BG
RP	1974	RRIM 600	14.74	BG
RP	1976	GT 1	21.85	BG
RP	1976	RRII 105	4.08	BG
RP	1976	RRII 118	3.68	BG
RP	1976	RRII 208	5.29	BG
RP	1976	RRIM 600	6.16	BG
RP	1978	RRII 105	2.55	BG
RP	1978	RRII 118	2.35	BG
RP	1978	RRIM 701	2.43	BG
RP	1978	GT 1	20.71	BG
RP	1979	RRIM 600	11.52	BG
RP	1979	RRII 105	3.60	BG
RP	1979	RRIM 701	3.83	BG
RP	1979	PB 86	22.84	BG
RP	1980	RRIM 600	22.65	BG
RP	1980	GT 1	32.03	BG
RP	1980	PB 5/51	10.46	BG
RP	1980	PB 86	16.24	BG
RP	1980	RRIM 105	11.84	BG
RP	1981	PB 235	14.34	BG
RP	1982	PB 235	15.81	BG
RP	1982	PB 217	10.90	BG
RP	1982	RRII 105	13.25	BG
RP	1983	RRII 105	9.83	BG
RP	1983	GT 1	11.59	BG
RP	1989	Expl.clones	39.78	BG
RP	1990	GT 1	30.10	BG
RP	1992	To be planted	30.60	BG
			622.23	

RP - Replanting, NP - New Planting, BG - Budgrafts.

Table 5. Details of area under rubber in Pudukad estate.

Type of planting	Year of planting	Clones	Area (ha)	Type of planting material
RP	1957	PB 186	6.96	BG
RP	1957	Gl 1	6.26	BG
RP	1957	PB 86	5.68	BG
RP	1957	BD 10	3.00	BG
RP	1958	Gl 1	5.11	BG
RP	1958	PB 86	5.45	BG
RP	1958	LCB 1320	2.22	BG
RP	1958	PB 186	5.65	BG
RP	1970	GT 1	23.66	BG
RP	1970	RRIM 600	18.98	BG
RP	1977	GT 1	25.71	BG
RP	1977	RRII 105	0.81	BG
RP	1977	RRII 118	0.81	BG
RP	1977	RRII 218	0.81	BG
RP	1977	RRII 1	0.80	BG
RP	1979	RRIM 600	11.91	BG
RP	1979	PB 86	9.39	BG
RP	1982	RRII 105	26.96	BG
RP	1982	GT 1	13.92	BG
RP	1982	PB 235	5.20	BG
RP	1982	PB 86	9.19	BG
RP	1983	PB 235	7.28	BG
RP	1983	RRII 105	12.27	BG
RP	1983	PB 86	6.88	BG
RP	1984	PB 235	9.40	BG
RP	1985	PB 235	11.59	BG
RP	1986	GT 1	18.47	BG
RP	1987	GT 1	16.86	BG
RP	1988	GT 1	20.55	BG
RP	1989	PB 217 & GT 1	35.96	BG
RP	1990	PB 217 & RRII 105	31.83	BG
RP	1992	Proposed area	38.70	BG
			398.27	

RP - Replanting.

Soil conservation measures were adopted wherever found necessary by way of terraces and edakkayalas. Spacing adopted was 6.70x3.40 m for budgrafts and 6.10x3.00 m for seedlings. Pit size was of 75x75x90 cm dimension. The planting materials used were one year old budded stumps and polyclonal seedlings produced in their own estate nursery. On an average four rounds of strip weeding/ring weeding was the ususal practice during the initial years. There were no intercrops. Leguminous cover crops mainly Pueraria along with Calapagonium and Centrosema was planted in the first year itself. Manuring was regular in two equal split dozes. Discriminatory manuring after soil and leaf analysis was the usual practice. Thinning out of weaklings was also done during the immaturity period. Plant protection methods were also adopted regularly and systematically. The plants were sprayed with 1 per cent Bordeaux mixture up to third year. From fourth year to seventh year prophylactic spraying with copper oxychloride mixed in spray oil using micron sprayer and thereafter aerial spraying was the regular practice adopted in the areas. Sulphur dusting aginst Oidium using Shaw wallace micron 400 duster and application of Bordeaux paste in regions of rubber plants affected with pink disease were also practiced.

Both the estates are planted with different clones and seedling material. They have a very systematic planting programme. Judicious use of clones have been made (Table 4 and 5). Both the estates are engaged in replanting the old areas in a phased manner. Selective tapping used to commence when 50 per cent of the trees attain the prescribed girth for tapping, ie. 50 cm at a height of 125 cm in case of budgrafts. Rainguarding done from the first year of opening for tapping and application of yield stimulant from 18th year after commencement of tapping. All the tapping trees were rainguarded with polythene sheets. Two weeks tapping rest was given every year by the end of February in both the estates. Tapping task adopted was 300 and the system of tapping was ½S d/3 in all the tapping areas planted with RRII 105 and RRIM 600. The average d.r.c. was 34 per cent and is subjected to seasonal variations.

4.3 Yield performance

The yield performance of the two clones studied were presented in Table 6 and Table 7.

Average yield performance of RRII 105 for the first five years of tapping was 1250 kg and 1285 kg/ha/year in Chemoni estate and Pudukad estate respectively. Similarly the same for RRIM 600 was 982 and 996 kg. The estate wise yield figures are depicted in Table 6 and 7 and average in Table 7(a) along with yearwise mean yield per hectare per year of both the samples (Table 8 and 9). Though both the clones are found to be high yielders, the study confirms that RRII 105 is significantly superior

Table 6. Yield performance of RRII 105 and RRIM 600 of Chemony estate.

Clone	Yield kg/ha					Average for five years
	1st year	2nd year	3rd year	4th year	5th year	
RRII 105	747	1143	1335	1496	1528	1250
RRIM 600	621	959	1070	1108	1151	982

Table 7. Yield performance of RRII 105 and RRIM 600 of Pudukad estate.

Clone	Yield kg/ha					Average for five years
	1st year	2nd year	3rd year	4th year	5th year	
RRII 105	1022	1264	1200	1494	1447	1285
RRIM 600	715	963	984	1023	1295	996

Table 7(a) Average yield performance of RRII 105 and RRIM 600 for the first five years.

Clones	Yield kg/ha					Average for five years
	1st year	2nd year	3rd year	4th year	5th year	
RRII 105	884.5	1203.5	1267.5	1495.0	1487.5	1267.5
RRIM 600	668.0	961.0	1027.0	1065.5	1233.0	989.0

Table 8. Production and productivity of different fields from first year to fifth year in Chemoni estate.

Field No.	Year of planting	Clone	Area (ha)	1st year	2nd year	3rd year	4th year	5th year	Average for five years
1	1976	RRII 105	4.08	870.00	1054.65	1300.00	1312.80	1410.05	
2	1978	RRII 105	2.55	-	1431.37	1768.62	2078.00	1496.86	
3	1979	RRII 105	3.56	-	1055.00	1103.65	1407.30	1676.12	
4	1980	RRII 105	11.84	-	827.78	1157.60	1184.88	-	
5	1982	RRII 105	13.25	826.33	1232.67	1183.39	-	-	
6	1983	RRII 105	9.82	544.80	1253.46	1496.74	-	-	
	Average/ha/year			746.66	1142.50	1335.00	1495.78	1527.66	1250
1	1974	RRIM 600	14.74	736.22	940.70	992.33	1015.00	901.76	
2	1976	RRIM 600	6.16	604.70	884.57	970.29	1142.19	1264.77	
3	1979	RRIM 600	11.52	603.21	937.99	935.67	1168.05	1287.93	
4	1980	RRIM 600	10.66	777.48	999.24	1178.23	-	-	
5	1980	RRIM 600	10.78	615.95	1032.37	1275.95	-	-	
Average/ha/year				620.95	958.97	1070.49	1108.48	1151.48	982

Table 9. Production and productivity of different fields from first year to fifth year in Pudukad estate.

Field No.	Year of planting	Clone	Area (ha)	Yield kg/ha 1st year	2nd year	3rd year	4th year	5th year	Average for five years
1	1977	RRII 105	0.81	940.74	1071.19	1200.00	1493.82	1446.91	
2	1982	RRII 105	26.96	1102.37	1455.86	-	-	-	
Average yield/ha/year			27.77	1021.55	1263.62	1200.00	1493.82	1446.91	1285
1	1970	RRIM 600	18.99	701.31	968.88	1014.00	-	1294.76	
2	1979	RRIM 600	11.91	728.79	957.26	954.00	1023.17	-	
Average yield/ha/year			30.90	715.05	963.07	984.00	1023.17	1295.00	996

to RRIM 600 in respect of yield. The supremacy of RRII 105 over RRIM 600 is clearly established. This is based on the data on average yield from the 1976, 1978, 1979, 1980, 1982 and 1983 plantings of RRII 105 and 1974, 1976, 1979 and 1980 plantings of RRIM 600 of Chemoni estate. For the other estate, ie. Pudukad estate, it is based on the observations made from 1977 and 1982 plantings of RRII 105 and 1970 and 1979 plantings of RRIM 600.

The observations of the present study is in close agreement with the result of Joseph and Haridasan (1990). The superiority of RRII 105 in yield had earlier been reported by Krishnankutty et al. (1982). They have observed the average yield for the first 10 years for RRIM 600, but the other clone RRII 105 was not available among the 22 planting materials studied by them. From the reported data available for 10 years, the average yield for RRIM 600 is found to be 1205 kg/ha/year in Region A followed by 1119 kg in Region B.

The sample estates selected were having adequate number of plots planted with the two planting materials chosen for the study. The yield of both the clones of the two estates are presented in Tables 8 and 9 and Figures 1 and 2.

Performance of the two clones in different fields in both the estates indicated that clonal performance is not the same,

Fig. I. Yield performance of RRII 105 and RRIM 600 in Chemoni Estate.

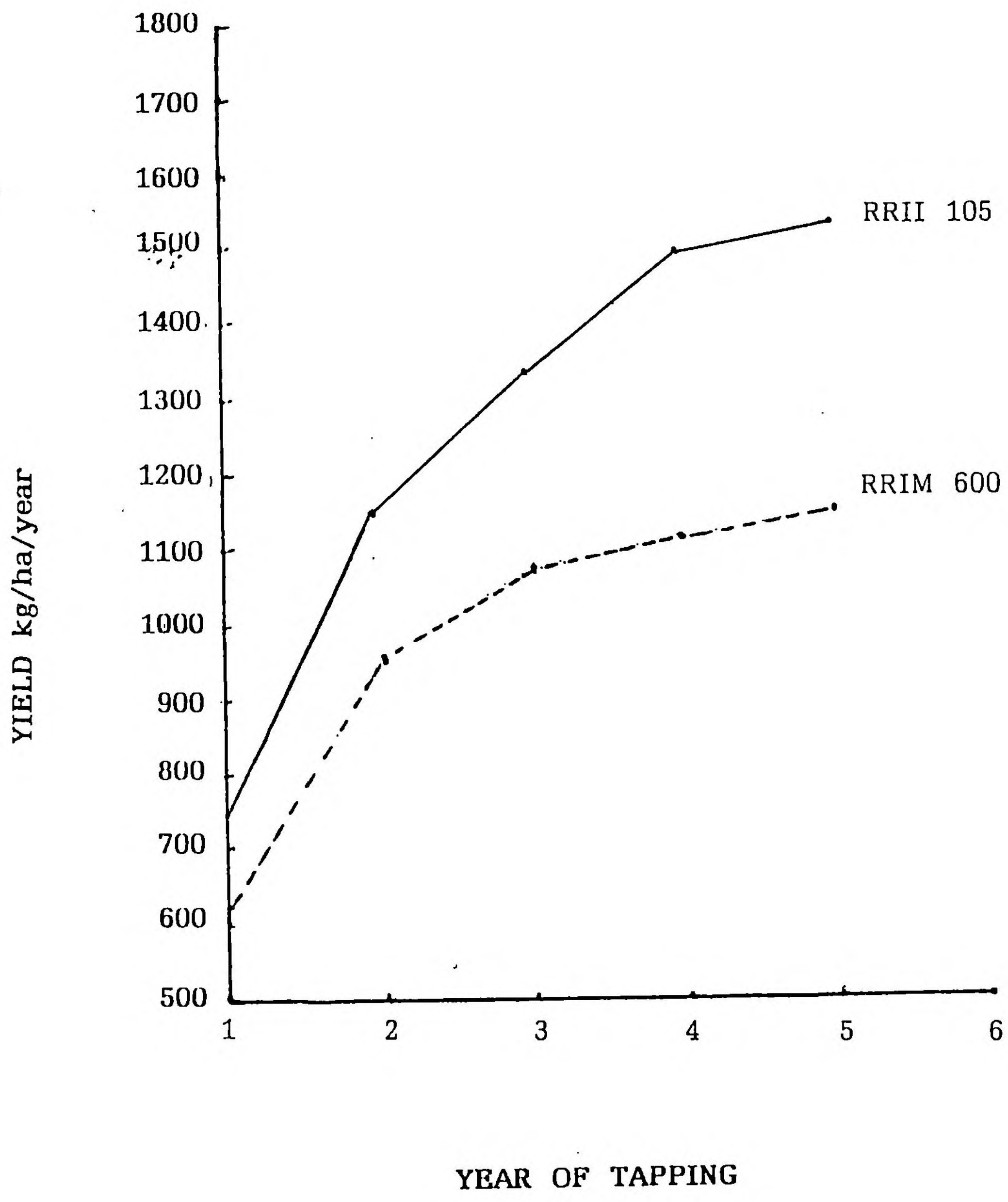
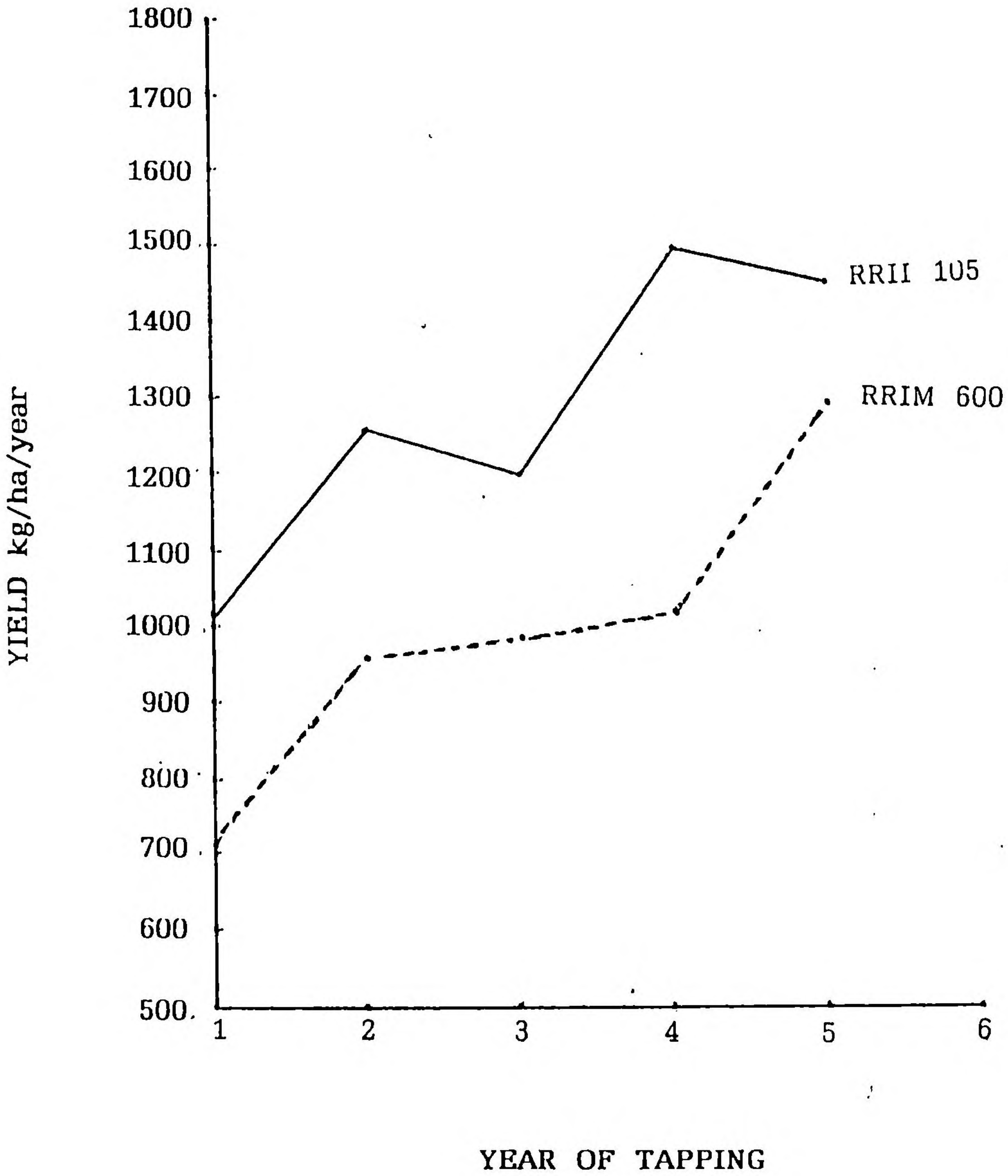


Fig. II. Yield performance of RRII 105 and RRIM 600 in Pudukad Estate.



with regard to productivity (Tables 8 and 9), although both the clones in all the fields showed a rising trend. The data for the year of opening (first year of tapping) is not strictly comparable as the estate open individual fields for tapping either in April or in September depending on the number of trees which have attained tappable girth. The first year yield of RRII 105 planted in 1983 at Chemoni estate is an example, wherein the trees were opened in September and hence comparatively lower annual yield (Table 8). During the third year of tapping the performance was poor in the case of 1979 plantings of RRII 105 (1103.69 kg/ha) compared to 1768.62 kg/ha of 1978 plantings. The third year productivity of RRIM 600 showed a variation ranging from 935.67 kg in the case of 1979 plantings to 1275.95 kg/ha with regard to the 1980 plantings. This was not, however, very much pronounced at Pudukad estate. It may be mentioned that in Pudukad estate, the terrain of different fields does not show much variation compared to that in Chemoni. It will be useful to analyse the factors responsible for the variation in productivity in the different fields in the same estate taking into consideration soil and microclimatic aspects. This is in agreement with the findings and suggestions of Saraswathyamma _et al_. (1988).

4.4 Secondary characters

During the study efforts were also made to evaluate some of the main secondary characters which have indirect effect on the yield performance. The details of wind damage, pink disease, brown bast, Oidium, Abnormal leaf fall and girthing were given in Table 10 and 10(a). The clones studied were RRII 105 and RRIM 600.

4.4.1 Wind damage

The results indicated that 7 per cent of trees were affected by wind in the case of RRII 105 and 5.35 per cent in respect of RRIM 600. Therefore wind is not a serious problem with regard to both the clones in Mooply Valley area of Thrissur district. This results agrees with the observations made by Abraham (1991).

4.4.2 Pink disease

Eventhough the incidence of pink was observed in both the clones, it is comparatively more in RRII 105. The percentage of trees affected by Pink in RRII 105 is 9.45, whereas in the case of RRIM 600 it is 7.2, while Abraham (1991) has reported higher values of incidences in Pathanamittha taluk. Incidence of Pink disease in the present investigation was less when compared to southern districts which can be attributed to comparatively low rainfall received in Thrissur district and the timely detection and treatment of the disease by the management had reduced the damage.

Table 10. Secondary characters of selected clones (RRII 105 and RRIM 600).

Name of estate	Clone	Percentage of incidence				
		Pink	Wind damage	Brown bast	Oidium	Abnormal leaf fall
Pudukad	RRII 105	8.7	7.2	5.1	10	10
	RRIM 600	6.4	5.8	3.5	41	30
Chemoni	RRII 105	10.2	6.8	6.2	15	10
	RRIM 600	8.0	4.9	4.0	50	30

Table 10(a) Secondary characters of selected clones (RRII 105 & RRIM 600) Average of both estates.

Clone	Percentage of incidence				
	Pink	Wind damage	Brown bast	Oidium	Abnormal leaf fall
RRII 105	9.45	7.00	5.65	12.50	10
RRII 600	7.20	5.35	3.75	45.50	30

4.4.3 Brown bast

Here also the results indicated that 5.65 per cent of trees were affected with brown bast in the case of RRII 105 followed by RRIM 600 with 3.75 per cent of incidence. The low percentage of incidence may be attributed to the adoption of low intensity tapping, ie. ½S d/3. This is almost in agreement with the findings of Abraham (1991). Higher incidence of brown bast was reported by Muraleedharan (1991) where the intensity of tapping is higher.

4.4.4 Oidium

Incidence of *Oidium* was noticed in both the clones. The percentage of incidence was 12.5 in RRII 105 and 45 in RRIM 600. The susceptibility of these clones to *Oidium* was already reported by many workers (Annamma *et al.*, 1990; Abraham, 1991). The present results indicated that RRIM 600 is more susceptible to *Oidium*. More rounds of dusting with sulphur is warranted in the areas where planting was carried out with the clone RRIM 600.

4.4.5 Abnormal leaf fall

The results of the study indicated that 10 per cent of trees under clone RRII 105 was affected with *Phytophthora* while in the case of RRIM 600 it is 30 per cent. The incidence of this disease is low in RRII 105 when compared with the other clone RRIM 600. This is in conformity with the earlier observations made by Annamma *et al*. (1990). The low incidence of *Phytophthora* can be attributed to the adoption of regular and timely prophylactic spraying in the estates.

4.4.6 Girthing

The average girth measurements from the end of third year to the end of seventh year were collected from the estate records in respect of both the sample estates selected (Table 11). On evaluation RRII 105 showed slightly better performance than RRIM 600 during the gestation period. However the data revealed that the girth increment is generally poor when compared to the accepted girth increment at seventh year period for commencement of tapping (Rubber Board, 1992).

Table 11. Average girth at 125 cm height in cm from fourth year of planting (cm).

Clones	Years after planting				
	1982	1983	1984	1985	1986
1979 RP					
RRII 105	19.39	25.24	35.92	42.36	46.93
RRIM 600	22.08	27.32	37.34	42.94	45.19
1980 RP					
RRII 105	21.80	30.00	39.52	44.73	47.61
RRIM 600	19.84	28.96	36.54	42.41	46.55

Summary and Conclusions

5. SUMMARY AND CONCLUSION

A comparative study of the yield performance of two high yielding clones, RRII 105 and RRIM 600 were made. The former one is recommended under Category I irrespective of areas and the latter as Category II in traditional areas and as Category I in non-traditional areas. Two representative samples where both these clones were planted and under tapping for a pretty long period were selected and all the available data pertaining to yield were collected. The agroclimatic conditions in both the estates are similar. They were following the recommended package of practices by Rubber Board. The severity of the diseases were reduced by timely adoption of prophylactic/control measures. From the study it was observed that RRII 105 is superior to RRIM 600 in yield performance as well as in some of the secondary characters which are desirable for good planting materials.

The results of the study indicated that both the clones can be safely recommended for planting in the Mooply Valley area of Thrissur district, giving more preference and greater area for RRII 105. This study also supports the recent changes made by the Rubber Board in the planting material recommendations under Category I.

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Annexure

ANNEXURE I

QUESTIONNAIRE FOR COLLECTION OF DATA ON THE PERFORMANCE OF CLONES RRII 105 AND RRIM 600

1) Name of the Estate :

2) Location:-

(a) District :

(b) Taluk :

(c) Village :

3) Name and address of owner :

4) Area under rubber with year of planting, extent, planting material, No. of plants, spacing etc. :

(a) Immature (b) Mature

i) Year of planting:

ii) Extent:

iii) Planting material:

iv) No. of plants:

v) Spacing:

5) Type of soil :

6) Topography :

7) Early history

(a) flat

(b) slopy

(c) steep

9) Type of planting:-

(a) Replanting
(b) New planting
(c) Interplanting
(d) Others

10) Cultural Operations:-

(a) Contour planting
(b) Square planting
(c) Size of pits taken
(d) Soil conservation by contour terraces
(e) Individual terraces
(f) Edakkayyalas
(g) Slitpit

11) Method of planting:-

(a) Seed at stake planting
(b) Budded stumps
(c) Field budding
(d) Polybag planting:

green bud
brown bud

(e) Stumped budding
(f) Others

12) Cultural operations:-

(a) Weeding:

Ring weeding
Strip weeding

(b) Manuring — <u>Type of manure</u> — <u>Dose</u>

Pre-monsoon
Post-monsoon

13) Plant protection methods adopted:

Spraying:

Handoperated
Low volume
Aerial

14) Incidence of pink:-

Treatment

15) Incidence of Oidium:-

Treatment (dusting)

16) Other diseases, if any:-

17) Tapping:-

(a) Year of tapping
(b) Girth at which tapping commenced
(c) Whether puncture tapping adopted (if so, details)
(d) Method of tappin
(e) Height of opening for tapping
(f) Percentage of trees attained tappable girth at the time of marking

18) Rain guarding:

19) Application of yield stimulant (method of application and frequency)

20) Time of tapping:

21) Panel (A, B, C, D, Slaughter) (including bark renewal)

22) Depth of tapping (deep, shallow, optimum depth)

23) Interplanting:

Other trees
Medicinal plants

24) Brown bast incidence:

25 Growth of plants, bark renewal, incidence of panel disease.

26) Remarks, if any

Wind damage

27) Details of rainfall:

Temperature (minimum & maximum)
Relative Humidity
No. of rainy days in each
month (for five years)

28) Particulars of mature area and yield:

(a) Year of planting
(b) Extent
(c) Year of opening for tapping
(d) Number of trees opened
(e) Type of planting material
(f) Number of days tapped
(g) Yield

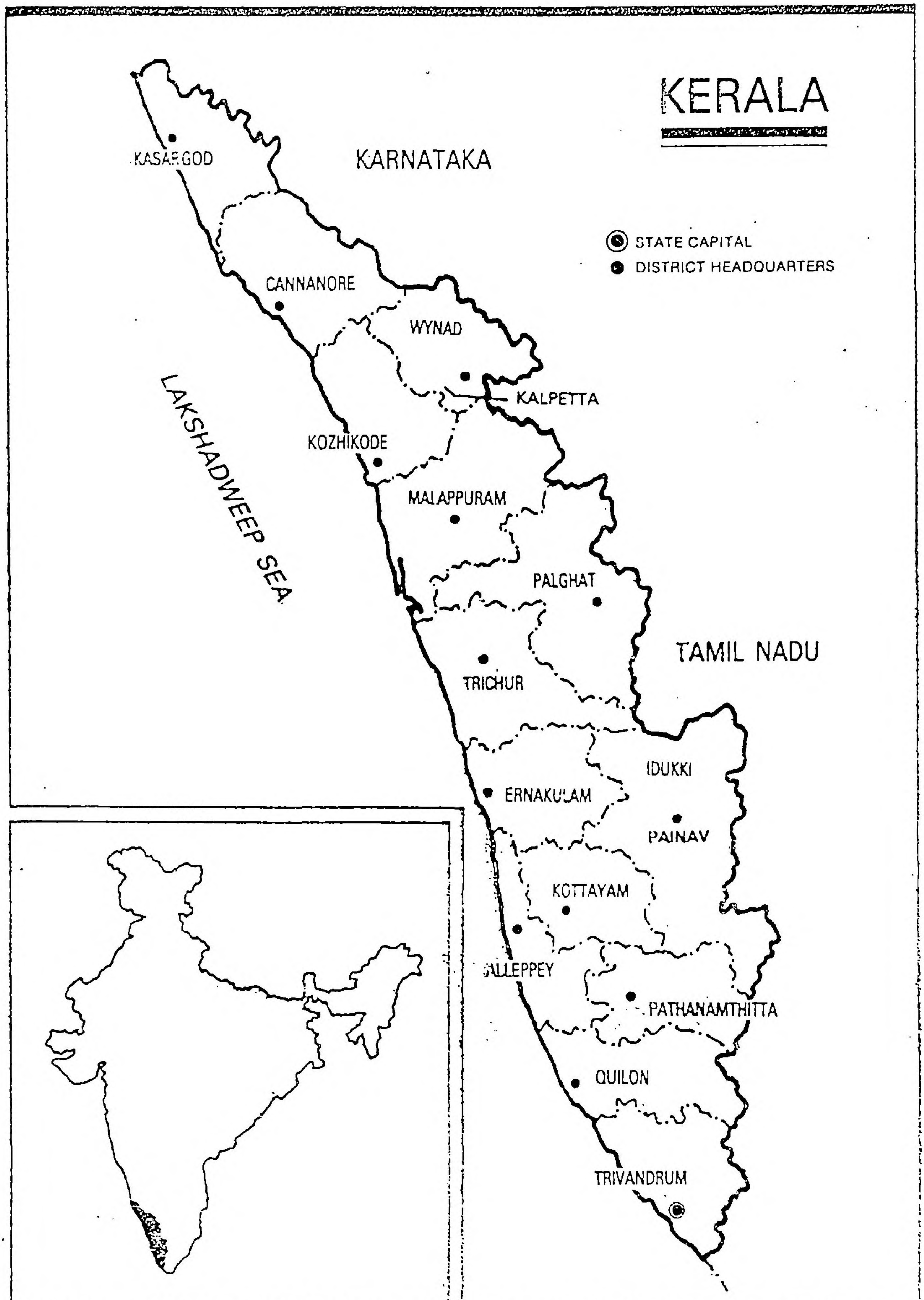
Year of tapping	Sheet	Scrap	Latex	Others	Total

(h) Yield per hectare
(i) Remarks

Date:

Signature of Owner/Superintendent/
Manager of Estate.

ANNEXURE II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STATE CAPITAL
DISTRICT HEADQUARTERS
KARNATAKA
TAMIL NADU
LAKSHADWEEP SEA
KASARGOD
CANNANORE
WYNAD
KALPETTA
KOZHIKODE
MALAPPURAM
PALGHAT
TRICHUR
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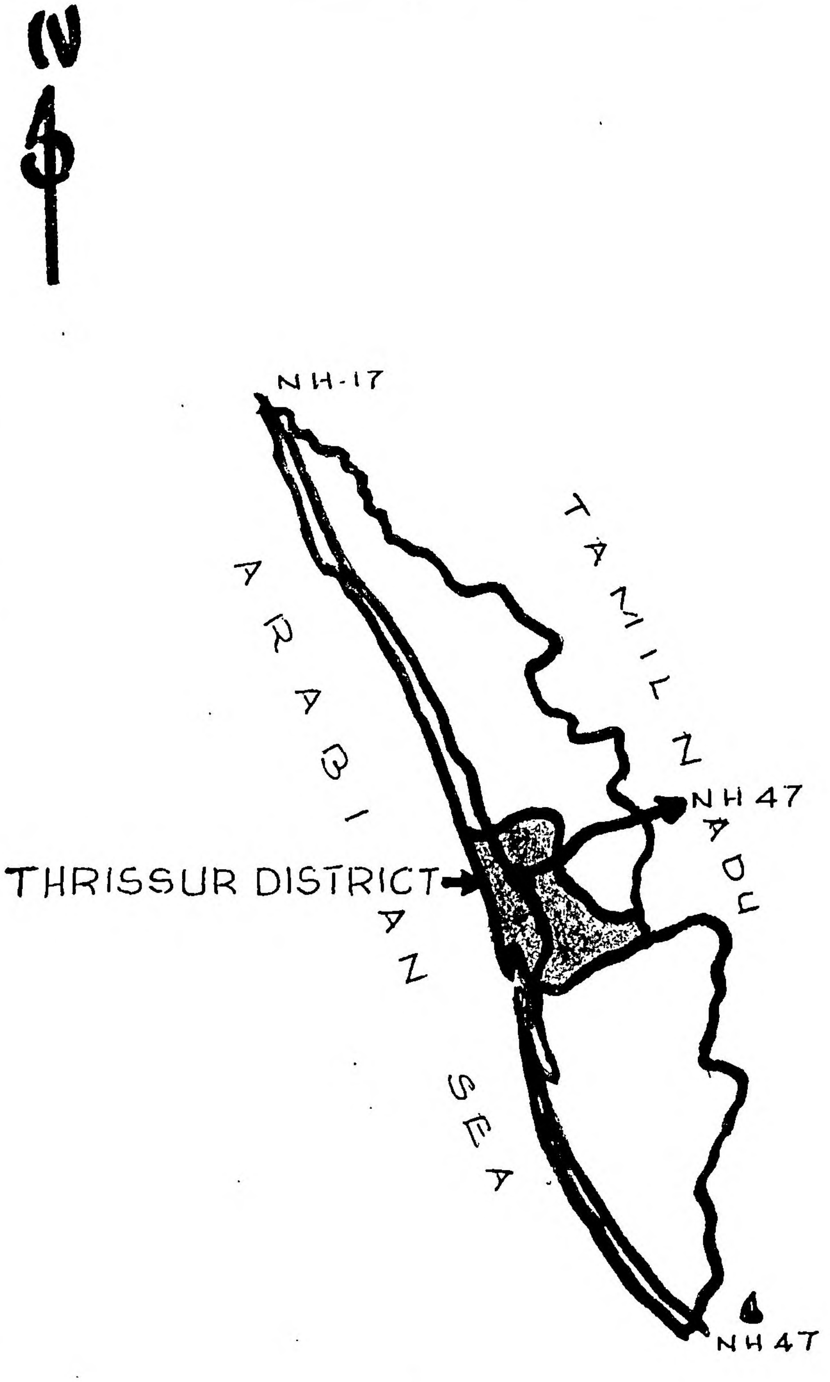
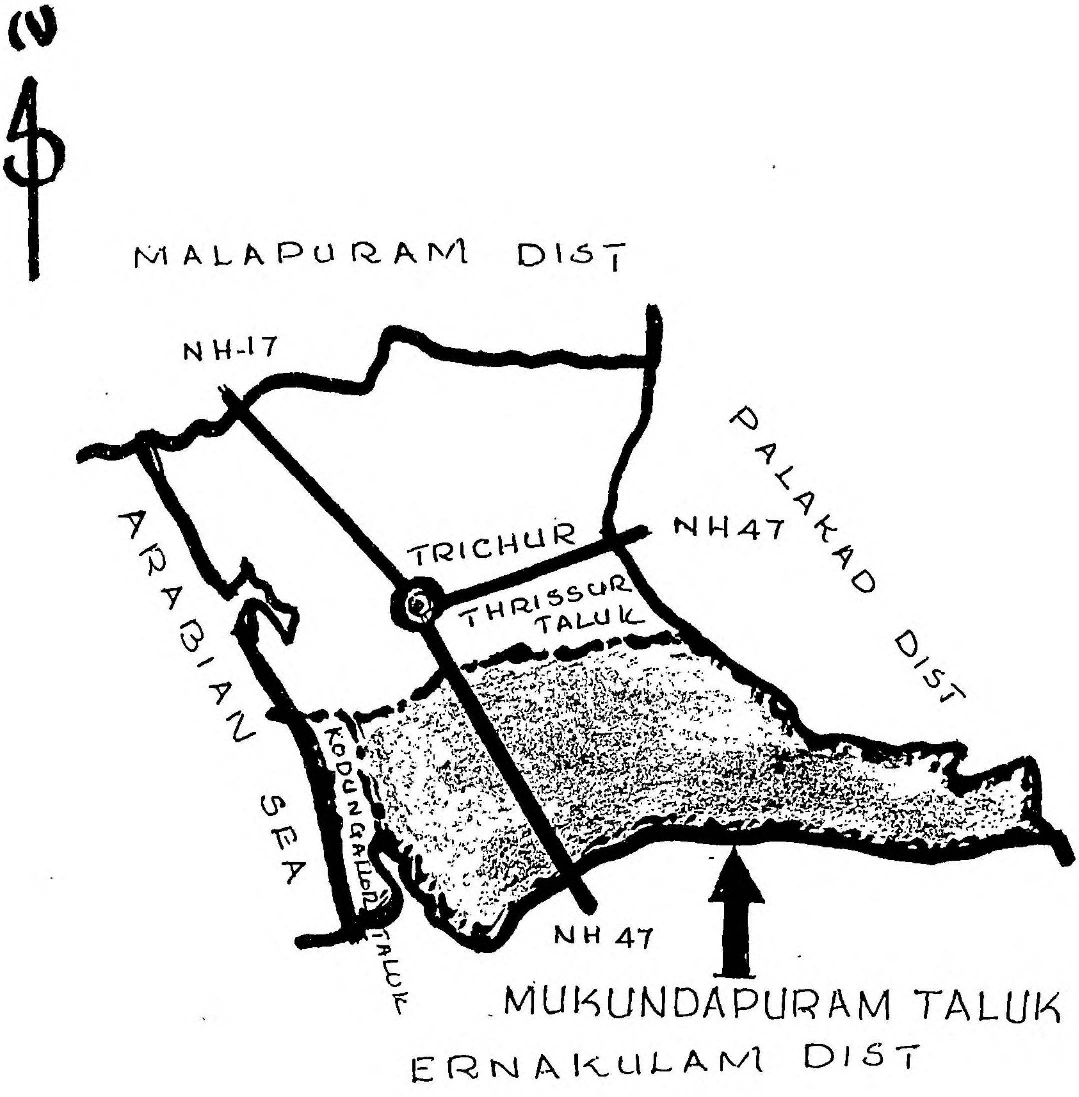
ALLEPPEY
PATHANAMTHITTA
QUILON
TRIVANDRUM

KERALA STATE

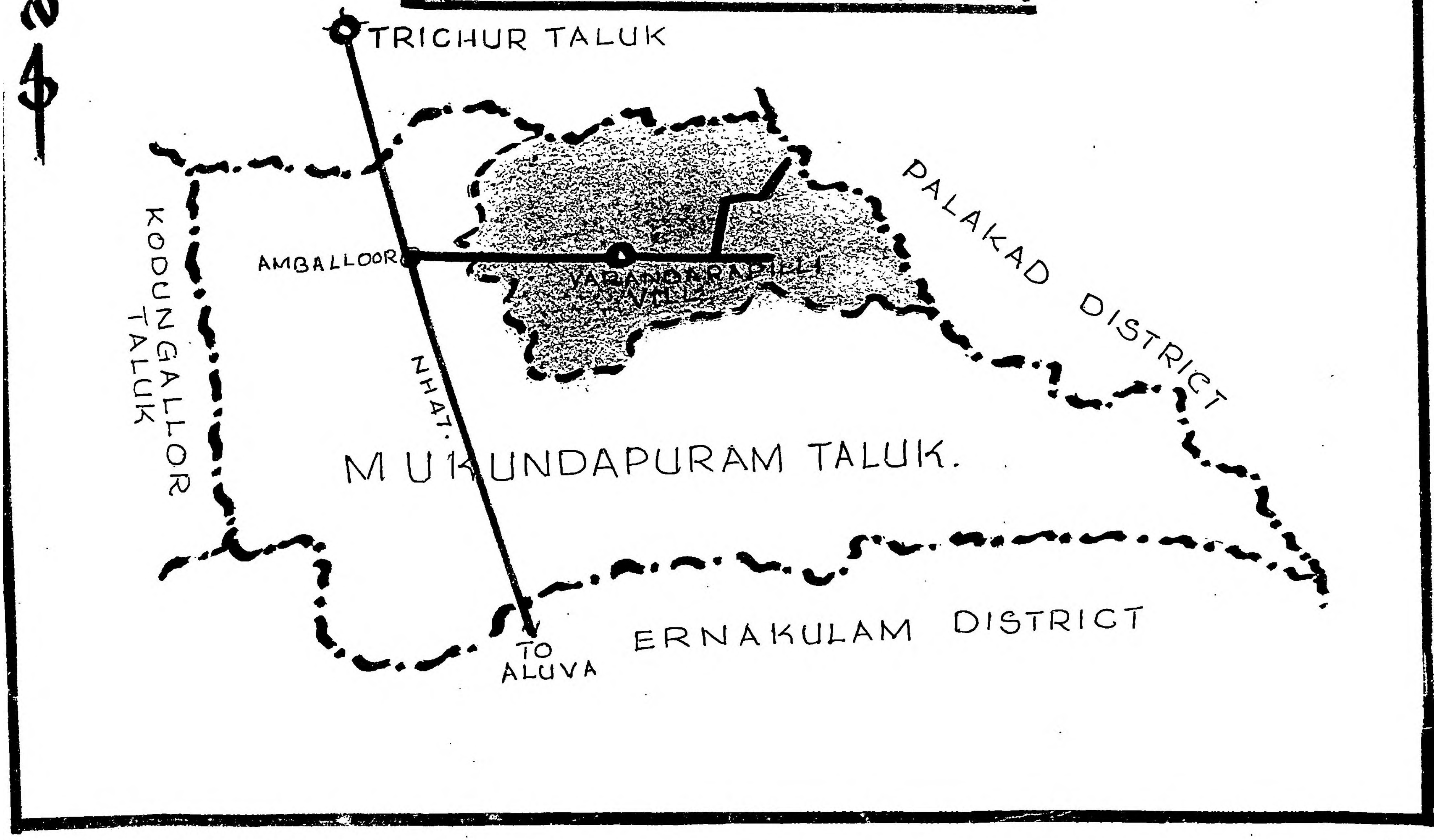


ANNEXURE III

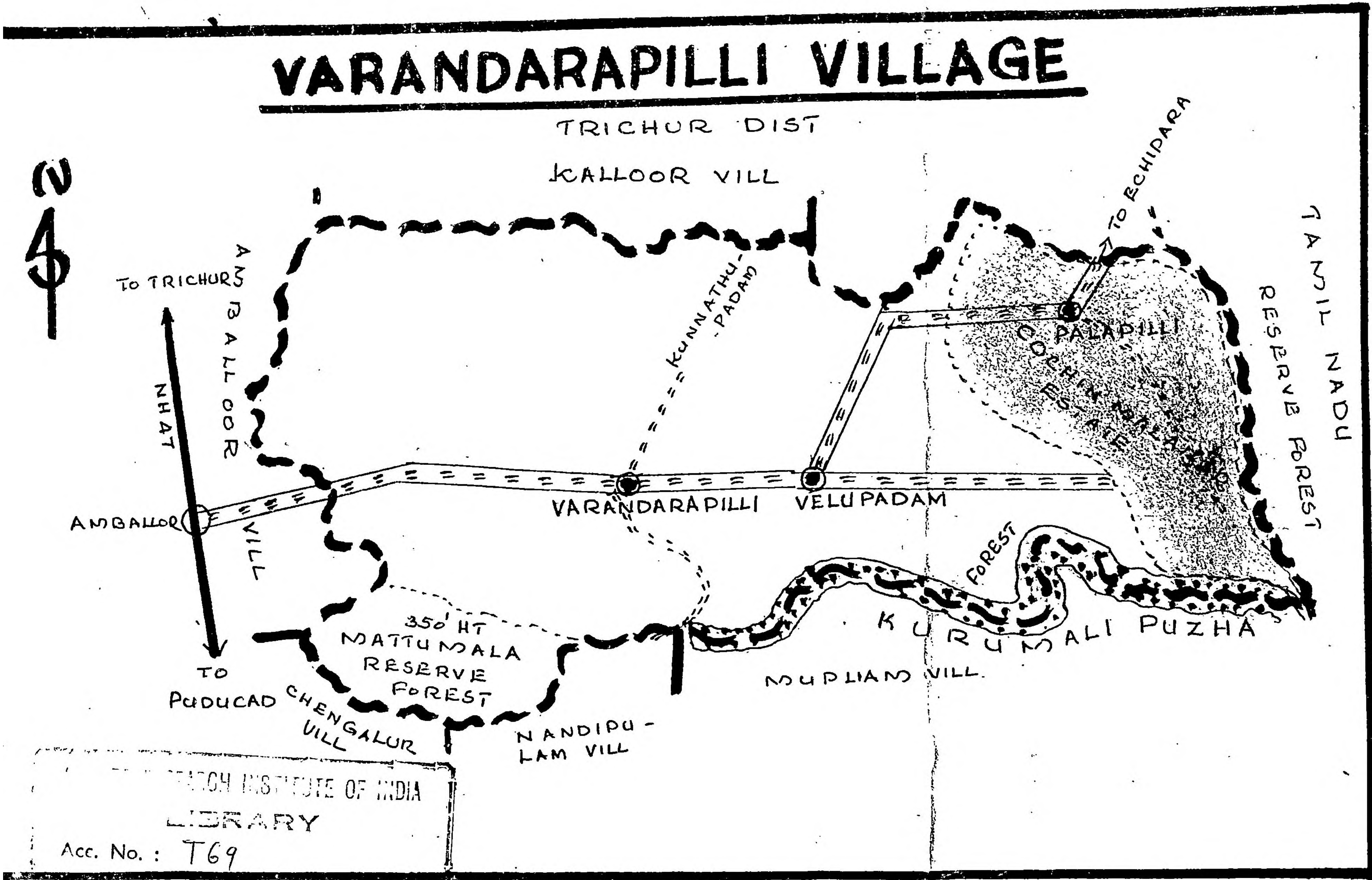
THRISSUR DISTRICT



MUKUNDAPURAM TALUK



ANNEXURE V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NHAT
AMBALLOR
TO PUDUCAD
KUNNATHU-PADAM
VARANDARAPILLI
VELUPADAM
PALAPILLI
COCHIN MALABAR ESTATE
TO ECHIDARA
TAMIL NADU
RESERVE FOREST
FOREST
KURUMALI PUZHA
MUPLIAM VILL
350' HT
MATTUMALA
RESERVE
FOREST
CHENGALUR VILL
NANDIPULAM VILL