THE PERFORMANCE OF RUBBER CLONES IN PULLENGODE ESTATE IN ERNAD TALUK OF MALAPPURAM DISTRICT

By

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DISSERTATION

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1994

DECLARATION

I hereby declare that this dissertation titled "**The Performance of rubber clones in Pullengode estate in Ernad Taluk of Malappuram 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, associateship or other similar title of any other University or Society.

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CERTIFICATE

Certified that this dissertation entitled "**The Performance of rubber clones in Pullengode estate in Ernad Taluk of Malappuram district**" is a record of research work done independently by **Sri.K. Ravindra Das** 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.K.Ravindra Das, a candidate for the **Post Graduate Diploma in Natural Rubber Prodution**, agree that the dissertation may be submitted by him in partial fulfilment of the requirements for the Diploma.

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INTRODUCTION

The para rubber tree, *Hevea brasiliensis* (Willd. ex. Adr. de. Juss.) Muell Arg. is the main source of natural rubber in the world. Among the eleven species of *Hevea* this is the single species which is commercially exploited. Natural rubber is nature's most versatile vegetable product, which has multifarious uses. There is hardly any segment of life which does not make use of rubber based materials and hence, this vital raw material possesses immense, strategic importance. The unique properties of natural rubber makes it indispensable when compared to synthetic rubber which is a highly priced petroleum compound.

The pioneers to venture for the first commercial rubber planting in India was the European planters who formed the 'Periyar Syndicate' in 1902 at Thattakad near Alwaye in the erstwhile Travancore state.

Though the rubber plantation industry faced many problems, its rate of growth over the years has been phenomenal. In India, rubber is now cultivated in an area of about 5 lakh hectares, of which 85 per cent is in Kerala. The average yield in 1950-51 was 284 kg/ha which rose to 1215 kg/ha during 1993-94 (Rubber Board, 1994). This four-fold increase in yield during the past 40 years is mainly due to the outstanding achievements in breeding of rubber.

Breeding and selection which aimed at evolving clones of rubber with high yield and secondary characters, was started by the

Rubber Research Institute of India since its inception in 1954. The institute had succeeded in establishing a series of new clones having high yield and other desirable characters. The remarkable achievement of the breeding programme is the production of RRII 100 series clones (Nair and George, 1968, George *et al.*, 1980 Annamma *et al.*, 1990).

The success of the rubber plantation and its economic viability depends upon so many factors. The most important among them is the genotype and phenotype of each clone. Moreover, yield is a complex character controlled by polygenes. Hence so many secondary characters are correlated with yield.

In India, research and experimental works have been carried out to find out high yielding clones with better performance. The studies have been mainly confined to the selected materials suitable for specific localities in the Southern districts of the State. The rubber growing regions of Kerala with widely varying conditions from the south to the north, rightly points out to the necessasity of scientific studies to evolve clones suitable for all the regions.

The rubber cultivation during the early years in Malappuram district deserves special mention while considering the significance of the study. The planters, especially the small holders were very doubtful about the success of the rubber plantation. There had not been any selection in the use of planting materials. Scientific methods were not followed either on selection of site or in the cultivation and maintenance. Locally available planting materials had been used for planting and that too planted along with other trees.

This practice had been continued almost upto the launch of the new planting subsidy scheme by the Rubber Board in 1979. The frequent visits and advisory services rendered by the Rubber Board officials since 1979 have gone a long way in changing the scene.

Reports on the performance of *Hevea* clones in the Northern part of Kerala is meagre (Saraswathy Amma *et al.*, 1987). The present study at Pullengode estate in Malappuram district was conducted in this context to analyse the various aspects related to the performance of clones, adoption of package of practices by the estate, and to identify the difficulties faced by the estate owners if any, on raising large scale plantations with various clones. The study also aims at identifying the best suited clone of rubber in Malappuram district where the agroclimatic conditions are different from other regions.

REVIEW OF LITERATURE

Hevea brasiliensis (Willd. ex. Adr. de Juss.) Muell, Arg. is one of the youngest domesticated crops in the world. Rubber breeding in South East Asia has produced outstanding success. By crop improvement alone, it was possible to achieve four increase in yield in forty years.

The systematic breeding studies undertaken at Rubber Research Institute of India, Kottayam, has helped in establishing a series of new clones. The productive capacity of a clone is dependent on the genetic constitution and its adaptibility to varying environmental conditions.

A brief review of literature on the performance of clones in different agro-climatic conditions and the factors influencing yield are described in the following pages.

2.1. Climatic factors

It has been observed that the climatic conditions prevailing in the rubber growing tract in India vary from region to region and also from year to year. Almost equally distributed rainfall is obtained in the Southern parts of the tract from the South West and North East monsoons. The northern parts receive mainly the South West monsoon alone. At the same time the variations in temperature and humidity are not very marked as in the case of rainfall. In Kerala, the temperature remains warm while humidity remains high in all the

rubber growing areas. The cultivation is confined mostly the slopes and hillocks which are liable to soil erosion and leaching. In India, rubber cultivation is presently concentrated in a narrow belt stretching from Kanyakumari district and lying west of the Western Ghats and parallel to it for approximately 400 km.

Rubber requires a warm humid equable climate with a temperature ranging from 21°C to 35°C and a fairly distributed annual rainfall of not less than 200 cm per annum (Rubber Board, 1994).

A humid atmosphere without much variations is found to be ideal for successful cultivation of rubber. The relative humidity varies from about 70 per cent during January to 95 per cent during August in rubber growing regions in India (Pushpadas and Karthikakutty Amma, 1980).

Wind is another important factor having a tremendous influence on the performance of rubber plantations. High wind speed causes branch snap, trunk snap and uprooting. Clonal variation in susceptibility to wind damage was reported by Rao and Vijayakumar (1992). Nazeer *et al.* (1986) and Saraswathy Amma *et al.* (1987)

2.2. Soil factors

Rubber can be grown on soils poor in nutrient content, but of good physical properties. If the physical properties are good, an extensive root system develops, thus ensuring proper anchorage and absorption of water and nutrients. The fertility status of the soil

can be improved by adequate manuring and management practices (Pushpadas and Karthikakutty Amma, 1980).

2.3. Effect of agro-techniques on growth and yield of rubber

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

2.3.1. Advantage of clonal material

Joseph *et al.* (1980) reported 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.

2.3.2. Use of polybag plants

Ramachandran (1992) reported that use of 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.

2.3.3. 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^{-1}, but declined with further increase in density. However, as the density increased from 211 to 741 trees ha^{-1} the production cost was more than the revenue. The highest cumulative profit was released with a planting density of 399 trees ha^{-1}. The highest yield per tapper was also obtained with a density of 399 trees ha^{-1}.

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

2.3.4. Establishment of cover crops

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

2.3.5. 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 Malaysia (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 the stages of growth. In India, Nair (1956) suggested a blanket recommendation based on the soil fertility status and the observations from fertilizer trials on rubber conducted elsewhere. The experiments indicated that response of rubber is directly related to soil available nutrients and leaf nutrient status (Ananth *et al.*, 1966; Potty *et al.*, 1976). A descriminatory approach was therefore proposed as the most efficient and economic method for optimum fertilizer use (Pushpadas and Ahamed, 1980).

2.3.6. 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).

2.3.7. Plant protection measures

Rubber tree is susceptible to several diseases but their

economic importance and severity vary with climatic conditions, clones used 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 RRII 105 was tolerant to these disease. Recent experiments indicated an yield loss of 9-16 per cent in susceptible clones (RRIM 600 and PB 86) of 10 to 25 years age when prophylactic spraying against the disease was skipped for one season (Jacob *et al.*, 1989).

Powdery mildew caused by the fungus *Oidium heveae* attacks the immature leaflets when trees refoliate after the annual wintering, causing secondary leaf fall. The severity of the disease varies with the pattern of wintering, leaf age, elevation, clonal susceptibility and weather conditions prevailing at the time of refoliation (Lim, 1972). Saraswathy Amma *et al.* (1987) reported that RRII 105 and RRIM 600 were showing low disease intensity, while PB 235 was highly susceptible.

Pink disease caused by *Corticium salmonicolor* is [illegible] important stem disease of rubber. The fungus attacks the bark of the main stem and branches of 3-7 year old immature trees. Pink disease also occurs on mature trees. The clonal variation in pink disease was reported by George *et al.* (1980). They reported that RRII 105 and RRIM 600 were susceptible while PB 235 was moderately tolerant.

The severity of attack varies from one locality to another

according to rainfall pattern. Unlike other leaf and panel diseases which have well defined pattern of severity varying from clone to clone, pink disease shows more uniformity. A few clones are known to be of above average susceptibility, but most cultivars are prone to the disease (Liyanage and Jacob, 1992).

2.3.8. 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 seedling over a period of 25-28 years.

High intensity of exploitation is known to promote incidence of tapping panel dryness in plantations. 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 by Dijkman (1951).

2.4. Performance of clones

The performance of clones vary with region. Paardekooper (1964) and Jayasekera *et al*. (1977) reported that the genotype-environment interaction was significant in rubber. They suggested to conduct trials in diverse environments for proper evaluation of the performance of a clone.

George *et al*. (1980) reported the yield and secondary characters of the clone RRII 105 in trial plantings. Among the clones

studied, RRII 105 recorded the highest yield. Average yield for the first seven years of tapping was 75 g/tree/tap. According to studies conducted by Krishnankutty *et al.* (1982) the yield performance of clones in Malaysia and India varied significantly with the zones.

Nazeer *et al.* (1986) reported the results of the studies conducted on the performance of a few *Hevea* clones from RRII 100 series in large scale trials. Eleven clones out of the twenty two selected clones were evaluated for yield performance and secondary characters over a period of ten years. Out of this, RRII 105 showed higher yield of 65.57 g/tree/tap for five years.

Cherian (1987) reported the commercial yield of some of the clones in estate sector. Yield of estates having a production figure of above 2000 kg per hectare was also reported. The performance of a few Sri Lankan clones were studied by Joseph and Premakumari (1987). They reported that the clones were wind prone but exhibited good secondary characteristics like vigour in growth.

Saraswathy Amma *et al.* (1987) evaluated the performance of a few clones together with GTI and RRIM 600 in three large estates and reported the over all mean yield and other secondary characteristics. They stressed the necessity of selecting planting materials based on the regional performance.

Their studies showed that the influence of planting materials on yield was significant.

In India breeding for improved rubber planting materials was initiated in 1954 by the Rubber Research Institute of India and about 1500 clones were developed. The Rubber Board has recommended RRII 105 under category I. RRIM 600 and PB 235 were recommended for cultivation in the state as Category II. RRII 105 was developed in India by crossing Tjir 1 x Gl 1, while RRIM 600 was released from Malaysia and the parentage of this hybrid was Tjir 1 x PB 86. PB 235 was a hybrid between PB 5/51 and PB 5/78 which was released from Malaysia.

Joseph *et al.* (1990) studied the yield performance of different clones like RRIM 600, RRII 105 and GT 1 and published yield data for the first five years and 6 to 10 years. The yield for RRIM 600 for first year was 1129 kg, while corresponding figure for GT 1 was 1019 kg. In the case of RRII 105 the average yield for the first five years was 1412 kg/ha/year.

Abraham (1991) compared the performance of clones under category No.1 in the estate and small holding sectors of Pathanamthitta district. His study indicated that RRII 105 was significantly superior to RRIM 600 and GT 1 in respect of yield and tolerance to abnormal leaf fall disease. RRIM 600 kept the second position with regard to yield. The clone showed susceptibility to abnormal leaf fall and pink disease, and tolerant to *Oidium*. GT 1 was ranked third in respect of yield. But, it showed a fair degree of tolerance to wind, and pink disease.

Joseph and Haridasan (1991) reported the stability figures

of yield and also attempted a region wise analysis of yield of selected planting materials in India. The regional differences in the performance of planting materials were found to be significant.

Nair (1993) studied the performance of rubber clones in Pathanapuram taluk. He found that cent per cent of the growers used the planting materials of RRII 105 in view of its superior performance in the area.

The above studies pointed out to the need for evaluation of clones in different zones before taking up large scale planting.

MATERIALS AND METHODS

The Pullengode estate, established in 1906, is one of the well maintained estates in Malappuram District. The estate maintains a large number of rubber clones under uniform management conditions. A study was undertaken during 1993-94 in this estate to find out the performance of RRII 105, RRIM 600 and PB 235 in respect of growth, yield, pest and disease incidence and resistance to other environmental stresses.

3.1. Climatic factors

The parameters observed in the present study included rainfall, temperature and relative humidity.

The rainfall data are being recorded in the meterorological observatory of the Pullengode estate. The data on rainfall (cm) for five years from 1989-90 to 1993-94 were collected from the estate records.

The estate was maintaining the data on temperature and relative humidity upto 1984-85. Since the variations in these parameters were only negligible, the observations were discontinued since 1985. The data on maximum and minimum temperature ($^{\circ}C$) and relative humidity (%) recorded during 1984-85 were collected from the estate records.

Data were collected on the extent of wind damage in the three clones selected, from the estate records.

3.2. Soil factors

The details of soil conditions, topography and soil conservation work were collected from the estate records. The data were verified during field visits.

3.3. Agrotechniques adopted

3.3.1. Selection of clones

The estate was visited and the total area under each clone was divided into ten identical units of 3.50 hectares each. As the clones under the same year of planting were not available in the estate for comparison, clones under different age groups were selected. Areas planted exclusively with the clones RRII 105, RRIM 600 and PB 235 were selected for the study.

3.3.2. Planting materials and population density

The details on the type of planting materials used for planting (budded stump/seedling stump/polybagged/field budding), spacing, pit size, year of planting and establishment rate were collected from the records maintained by the estate.

3.3.3. Management of immature and mature plantations

The data on establishment of cover crop, fertilizer application, drought management measures like mulching and lime washing, branch induction, age at first tapping, tapping methods and plant

protection measures adopted in the estate were collected from the estate records.

3.4. Performance of clones

3.4.1. Girth

Girth of the three clones were measured in all ten units selected at the rate of 10 random plants per unit. Girth was measured at a height of 125 cm from the bud union using a tape and was recorded in cm. The data on average girth of plants under each clone from the third year to the seventh year were collected from the estate records and the regional office of Rubber Board.

3.4.2. Yield

The yield of the three clones in terms of latex and scrap during 1992-93 and 1993-94 were collected from the estate records. Since the clones differed in age, the average annual yield for the initial two years of tapping of the three clones were also collected for comparative evaluation.

3.4.3. Yield depression during summer

The data were collected from the estate records for the year 1992-93 and 1993-94.

3.4.5. Drc of latex

Samples of field latex were drawn at random from all the ten units under each clone at the rate of 10 per unit. The samples were

coagulated and drc was estimated by drying the samples by oven method (Alika, 1978).

3.4.6. Colour of latex

The colour of field latex of the three clones was assessed by visual observation.

3.4.7. Bark thickness

The thickness of the virgin bark and renewed bark was measured using bark gauge and recorded in mm.

3.4.8. Disease incidence

Pink disease and abnormal leaf fall occurs during heavy rainy season in varying proportions. Powdery mildew is predominantly noticed on newly formed tender flushes during the refoliation period of January-March. The estate takes proper prophylactic measures in the entire area to control the incidence. The data maintained by the estate on the intensity of diseases in the three clones, were collected.

3.4.9. Tapping panel dryness

The data on the intensity of tapping panel dryness in the three clones during 1993-94 were collected from the estate records.

3.5. Investment and maintenance cost

The data on the expenses incurred by way of labour cost and

material cost during the immaturity period of seven years for the 1986 planting were collected from the estate records.

All the above data were collected using a pretested interview schedule as described in Appendix-I.

The data obtained were tabulated, summarised, presented and discussed.

RESULTS AND DISCUSSION

A study was conducted in Pullengode estate to evaluate the performance of RRII 105, RRIM 600 and PB 235 during 1993-94. The results are being discussed in the following pages.

4.1. Climate factors

Intensive rainfall is obtained in the area during the south-west monsoon period extending from June to September. The North East monsoon is not so heavy as in the case of the former. The average rainfall in the area ranged from 239.15 cm in 1990-91 to 350.98 cm in 1993-94 (Table 1). The data showed that June and July were the wettest months. The total rainfall during the five different years was well above the minimum requirement of 200 cm.

The details of temperature and humidity of the area during 1984-85 are furnished in Table 2. The data furnished for temperature did not indicate wide variations. It ranged from 24-36°C. The temperature recorded lies with in the optimum range of 21-36°C for rubber. The relative humidity varied from 72 per cent in May to 87 per cent in July. The parameter was found to be ideal for the growth of rubber.

4.2. Soil factors

The data furnished in Table 3 indicated that the soil types in the estate were lateritic, or red. The soil was deep and acidic and rich in plant nutrients.

Table 1. Data on rainfall (cm) at Pullengode estate for the period from 1989-90 to 1993-94

Month	Year				
	1989-90	1990-91	1991-92	1992-93	1993-94
April	19.01	2.99	10.76	5.40	4.12
May	15.18	30.67	9.43	45.55	26.22
June	54.09	57:26	98.78	64.46	58.72
July	59.79	56.13	95.25	87.61	75.81
August	29.27	43.73	23.43	60.78	36.36
September	39.48	3.37	6.77	35.88	13.86
October	43.66	32.28	35.83	15.05	42.68
November	5.55	5.65	8.94	26.25	12.10
December	0.97	0.30	-	-	1.23
January	2.36	-	-	-	2.81
February	-	0.53	0.14	5.15	0.92
March	0.18	6.24	-	4.85	9.26
Total	269.54	239.15	289.33	350.98	284.09

Table 2. Data on temperature and humidity for the year 1984-85

Year	Month	Temperature (°C)		Humidity (%)	
		Maximum	Minimum	Maximum	Minimum
	April	32	27	80	73
	May	32	27	72	68
	June	27	24	87	80
	July	27	24	87	83
1984	August	29	24	84	79
	September	30	26	80	75
	October	30	25	78	73
	November	31	26	76	70
	December	28	26	77	69
	January	29	26	77	66
1985	February	32	27	75	65
	March	32	26	78	67

Table 3. Soil conditions in Pullengode estate

	RRII 105	RRIM 660	PB 235
Soil type	←------ Laterite and red loam ------→		
Acidity	←---------- Acidic ----------→		
Type of soil conservation work	←---------- Terracing ----------→		
Topography of land	←---------- Steep slopes ----------→		

Soil conservation works were also carried out effectively in the estate.

The topography of the area planted with the selected clones were slopy.

4.3. Adoption of agrotechniques in rubber

The clonewise details of area, year of planting and opening for tapping are furnished in Table 4.

The details furnished in Table 5 showed that the clones of RRII 105, RRIM 600 and PB 235 were planted with polybag plants having advanced growth. Joseph and Nair (1984) reported the advantage of using polybag plants having advanced growth in enhancing growth.

The plant population density ranged from 420-445 plants per hectare. The planting distance adopted was 6.7 cm x 3.4 cm under the rectangular method. The necessity of adopting optimum spacing is stressed by Ng *et al*. (1979).

Establishment of cover crops using *Pueraria phaseoloides* was followed in the estate during the early years of planting rubber (Table 5). Potty *et al*. (1980) related the increased growth rate in early stages with cover cropping.

The drought management practices like mulching and lime washing were being adopted to reduce damage of young rubber plants during summer. Potty *et al*. (1980) also reported the beneficial effects of mulching and lime washing in immature rubber.

Table 4. Clone-wise details of area, year of planting and opening for tapping

Clone	Area (ha)	Year of planting	Year of opening for tapping
RRII 105	3.51	1983	1990
RRIM 600	28.95	1975	1982
PB 235	1.21	1986	1992

Table 5. Management practices adopted in Pullengode estate for the different clones

Practices	Practice followed for		
	RRII 105	RRIM 600	PB 235
Planting materials	Poly bag plants	Do	Do
Spacing	670 cm x 340 cm	Do	Do
Establishment of cover crop	Established. But faded due to shade effect	Do	Do
Type of cover crop	*Pueraria phaseoloides*	Do	Do
Soil conservation	Terraces taken	Do	Do
Manuring	Discreminatory application of chemical fertilizer	Do	Do
Drought management	Mulching and white washing	Do	Do
Plant protection	Prophylactic spraying as recommended by the Rubber Board	Do	Do
Tapping system followed	½ S/d/3	½ S/d/2	½ S/d/3
Other details	Selective pruning of shoots and branches, branch induction, periodical panel/wound dressing with fungicides	Do	Do

The estate adopted regular plant protection measures against important pest and diseases. The relevance of adopting appropriate plant protection measures is stressed by Rubber Board (1994).

The details of manuring done for different clones are furnished in Table 6. Manuring, except addition of organic manures, was followed as per the recommendations of the Rubber Board. Discreminatory fertilizer application as suggested by the Rubber Board (1994) was done after soil and plant analysis from fifth year onwards.

4.4. Performance of clones

The performance of the clones were evaluated by studying the increments in girth, yield, dry rubber content (drc), bark thickness, yield depression during summer and disease incidence.

4.4.1. Girth

The average annual girth of the plants of the three clones from the third year to the seventh year is furnished in Table 7. The clone RRII 105 showed a girth of 17.5 cm in the third year while it was 14.5 cm and 14.6 cm for the clones RRIM 600 and PB 235 respectively. It was also noticed that the clone RRII 105 continued to maintain the higher girth during the ensueing years upto the end of the sixth year. The data indicated that the increment in growth rate during later years for RRIM 600 and PB 235 were higher when compared to that of RRII 105. By the end of the seventh year, the girth difference was not marked. When RRII 105 recorded a girth of 51 cm, RRIM 600 and PB 235 recorded a girth of 50 cm and 50.1 cm respectively.

Table 6. Details of manuring for the clones RRII 105, RRIM 600 and PB 235

Year after planting	Type of fertilizer mixture	Quantity applied/ year/ha (kg)*
1	NPK 12:12:6	85
2	"	340
3	"	430
4	"	340
5	NPK 12:12:12	250
6	"	250
7	"	250

* There will be slight variations in the quantity of the ingredients of NPK 12:12:12 based on the results of leaf and soil analysis

Table 7. Average girth (cm) of the three clones from the third year to the seventh year

Clone	Girth at tappable height (cm)				
	Years after planting				
	3	4	5	6	7
RRII 105	17.50	26.00	28.50	40.00	51.00
RRIM 600	14.50	21.60	26.80	38.00	50.00
PB 235	14.60	24.00	27.80	38.20	50.10

The data thus indicated that the clones attained more or less the same girth by the end of the seventh year. The average girth of the trees was recorded during April 1994 at the opening height and is given in Table 8. The girth of the clones RRII 105 ranged from a minimum 66.9 cm to a maximum 70 cm in the ten units studied. RRIM 600 recorded a minimum girth of 89.5 cm and a maximum of 94 cm, PB 235 recorded a minimum girth of 50.8 cm and the maximum of 55 cm. The difference in girth among the clones is due to the difference in the age of trees.

4.4.2. Yield

The yield performance of the three clones of different ages, RRII 105 (11 years), RRIM 600 (19 years) and PB 235 (8 years) in the estate is given in Table 9. The average yield from the clone RRII 105 recorded for two years in 1992-93 and 1993-94 were 1364 kg/ha/year and 1536 kg/ha/year respectively. The yield in the same period from the clone RRIM 600 was 1433 kg/ha/year and 1390 kg/ha/year. The yield for the clone PB 235 for the above period was 165 kg/ha/year (tapped only for 7 months) and 624 kg/ha/year (Table 9). Since the three clones selected for the study belonged to different age groups, the initial yield of the three clones for the first two years were collected and furnished in Table 10.

The data revealed that the highest yielder during the first year was RRIM 600, with an yield of 202.79 kg/ha/year, followed by PB 235 giving an yield of 165 kg/ha/year. The clone RRII 105 recorded

Table 8. Average girth of different clones at the height of opening for tapping (cm) during the month of April 1994

Units	RRII 105 (11*)	RRIM 600 (19*)	PB 235 (8*)
R 1	68.8	90.0	50.8
R 2	69.0	92.0	54.6
R 3	67.3	91.5	52.5
R 4	70.0	93.0	53.8
R 5	67.5	93.5	55.0
R 6	66.9	90.0	51.6
R 7	70.2	94.0	54.9
R 8	69.5	92.3	52.7
R 9	68.0	93.2	53.6
R 10	67.5	89.5	50.9
Mean girth	68.47	91.9	52.04

* Years after planting

Table 9. Total yield per hectare per annum of the clones (kg)

Clone	Yield during 1992-93			Yield during 1993-94		
	Latex	Scrap	Total	Latex	Scrap	Total
RRII 105 (1990*)	890	474	1364	1186	350	1536
RRIM 600 (1982*)	1025	408	1433	1012	378	1390
PB 235 (1992*)	102	63	165	330	312	624

* Year of opening for tapping

Table 10. Yield data for the initial two years of tapping in three clones (kg/ha)

Clone	First year*	Second year**	Percentage increase over first year
RRII 105	92.29	459.17	20.70
RRIM 600	202.79	480.42	17.76
PB 235	165.00	624.00	18.90

* 1989-90 for RRII 105, 1982-83 for RRIM 600 and 1992-93 for PB 235
** 1990-91 for RRII 105, 1983-84 for RRIM 600 and 1993-94 for PB 235

the lowest yield of 92.29 kg/ha/year. During the second year, it was indicated that there was an average increase of 20.7 per cent yield for the clone RRII 105, 17.76 per cent for RRIM 600 and 18.9 per cent for the clone PB 235.

The results on the initial yield obtained from the three clones and the increasing trend in yield noticed is encouraging and in agreement with the yield performance of these clones reported in the earlier studies. The findings of Krishnankutty *et al.* (1982) and Krishnankutty and Srinivasan (1985) also agree with the results of the present study in respect of RRII 105 and RRIM 600. Joseph *et al.* (1990) studied the yield performance of different clones like RRIM 600, RRII 105 and GT 1 and recorded yield data for the first 5 years, and 6-10 years. The yield for RRIM 600 for the first year was 1129 kg, corresponding figure for GT 1 was 1019 kg. In the case of RRII 105 the average yield for the first five years was 1412 kg/ha/year.

In the present study the performance in yield of the clones RRII 105, RRIM 600 and PB 235 in general was found better than the national average productivity. The results are in agreement with the findings of George *et. al.* (1980), Abraham (1991) and Nair (1993). This might be due to the favourable agro-climatic conditions existing in this region. But, further studies are required to arrive at a realistic conclusion on the yield performance of the three clones.

4.4.3. Colour of latex and dry rubber content

Latex, usually white milky substance, is the main produce from rubber tree. The colour of latex obtained from the three clones

are furnished in Table 11. It was seen that there was slight difference in the colour of latex among the clones. RRII 105 and RRIM 600 produced white latex whereas it was light yellow for PB 235. The colour of latex is a genetic factor.

The observation on the dry rubber content of latex (%) of the three clones are given in Table 11. The range of drc was marked in PB 235. It ranged from 27 to 39.9 with a mean of 31.45 per cent. RRIM 600 recorded the highest drc of 39.75 per cent followed by RRII 105 (39.65%).

The dry rubber content is a factor determining yield of rubber. The increase in volume of latex collected in each tapping, season and clone affect dry rubber content of latex. Therefore, further studies are needed to confirm the results of this study.

4.4.4. Yield depression during summer

Yield depression during summer was noticed for all the clones, RRII 105, RRIM 600 and PB 235. Yield depression is mainly associated with the depletion of soil moisture, decreased atmospheric humidity and high temperature. The data on yield depression during summer for the three clones in 1992-93 and 1993-94 are furnished in Table 12. The yield depression during the year 1992-93 and 1993-94 for RRII 105 was 17.92 and 14.87 per cent respectively, whereas, it was 17.7 and 20.07 per cent respectively for RRIM 600 and 19.40 per cent for PB 235. The data on mean depression in yield for the three clones indicated that RRII 105 recorded the lowest value of 16.29 per cent, followed by RRIM 600 (18.88%) and PB 235 (19.4%). Saraswathy

Table 11. Colour of latex and the range of drc of the three clones

Clone	Colour	Range of drc (%)	Mean (%)
RRII 105	White	38-41.3	39.65
RRIM 600	White	37-42.5	39.75
PB 235	Light yellow	27-35.9	31.45

Table 12. Yield depression (%) in summer in RRII 105, RRIM 600 and PB 235 during 1992-93 and 1993-94

Clone	1992-93	1993-94	Mean
RRII 105	17.92	14.87	16.29
RRIM 600	17.70	20.07	18.88
PB 235	-	19.40	19.40

Amma and Setnuraj (1975) found that there existed a distinct clonal variation in yield depression during summer.

4.4.5. Bark thickness

The trees under RRIM 600 selected for the study were opened for tapping during 1982. Tapping is done on virgin bark, panel BO 2. RRII 105 was opened for tapping during 1990 and is being tapped on virgin bark BO 1. In the case of PB 235, the trees were opened for tapping during 1992 and tapping is continued on BO 1. The data recorded on the thickness of virgin bark and renewed bark is shown in Table 13. The thickness of the virgin bark for the clone RRII 105 ranged from 8-10 mm, while that for the renewed bark from 4-6 mm. For the clone RRIM 600, it ranged from 7-10 mm and 6-8 mm respectively for virgin bark and renewed bark. The clone PB 235 showed the range of 7.5 mm to 8 mm thickness for virgin bark and 4 mm to 5 mm for the renewed bark.

4.4.6. Disease incidence

The data on the intensities of the diseases viz. abnormal leaf fall, pink disease and powdery mildew, in the three clones are furnished in Table 14.

4.4.6.1. Abnormal leaf fall

The clone RRII 105 was found to have a fair degree of tolerance to the incidence of abnormal leaf fall disease. RRIM 600 showed the high incidence, while PB 235 recorded medium incidence (Table 14).

Table 13. Bark thickness (mm) of the three clones during 1993-94

Clone	Range of thickness (mm) of	
	Virgin bark	Renewed bark
RRII 105 (1983*)	8 - 10	4 - 6
RRIM 600 (1975*)	7 - 10	6 - 8
PB 235 (1986*)	7.5 - 8	4 - 5.5

* Year of planting

Table 14. Incidence of Abnormal leaf fall, Pink disease and Powdery mildew in RRII 105, RRIM 600 and PB 235 during the year 1993-94

Clone	Abnormal leaf fall			Pink disease			Powdery mildew		
	Intensity			Intensity			Intensity		
	Low	Medium	High	No. of trees observed	No. of trees infected	Percentage	Low	Medium	High
RRII 105	Low	-	-	100	10	10	Low	-	-
RRIM 600	-		High	100	8	8	Low	-	-
PB 235	-	medium	-	100	7	7	-	-	High

George *et al.* (1980) reported the same findings for the clone RRII 105. Abraham (1991) also reported that RRII 105 was tolerant to abnormal leaf fall disease, while RRIM 600 was susceptible. Jacob *et al.* (1989) found that RRIM 600 was highly susceptible when prophylactic spraying was stopped for one season. The difference observed in the present study might be due to the appropriate prophylactic spraying given in the estate.

4.4.6.2. Pink disease

Clonal variations were noticed in susceptibility to the disease infection. The incidence of pink disease was found to be 10 per cent for the clone RRII 105, 8 per cent for RRIM 600 and 7 per cent for the clone PB 235. The findings are in agreement with the findings of George *et al.* (1980). They have reported the susceptibility of the clone RRII 105 to pink disease in trial plantings. The clone RRIM 600 was also susceptible to the disease whereas PB 235 was not so severely affected (Table 14).

4.4.6.3. Powdery mildew

The secondary leaf fall disease due to Oidium affects all the clones in the estate, but the intensity varies with the clones. The disease incidence was noticed in the refoliation period. The data furnished in Table 12 indicated that RRII 105 and RRIM 600 recorded a low disease intensity. PB 235 showed a high degree of incidence. Similar results are reported by Saraswathy Amma *et al.* (1988).

4.4.7. Tapping system

The details of the tapping system adopted in the estate for all the clones, RRII 105, RRIM 600 and Pb 235 are furnished in Table 15. The estate follows the recommendations of the Rubber Board. Winter tapping is also done in the estate, and no tapping rest is given. Adverse effect on these practices are not yet observed. Rain-guarding is been adopted in the estate. 35-40 tapping days are additionally obtained by this system of tapping in an year.

4.4.8. Tapping panel dryness

Tapping panel dryness (Brown bast) though interpreted on many ways, is supposed to be a physiological disorder in most of the high yielding clones. The data on the incidence of brown bast in the three clones are given in Table 16. The clone RRII 105 recorded panel dryness of 3 per cent, while it was 6 per cent for RRIM 600. Panel dryness was not yet noticed for PB 235. The trees under this clone were opened for tapping during 1992 only and hence studies are to be continued to get conclusive results. The moderate incidence of brown bast noted in the present study might be due to the low intensity of tapping adopted for the clone RRII 105 and also due to the difference in the age of the trees among the three clones. The details of tapping system followed for the three clones are furnished in Table 15. The table showed that when RRII 105 and PB 235 were tapped under ½ s/d/3 system, RRIM 600 was tapped under ½ s/d/2 system.

4.4.9. Wind damage

The data on wind damage are furnished in Table 16. The

Table 15. Clone-wise details of tapping system

Clone	Frequency	Intensity (%)
RRII 105	½ S/d/3	67
RRIM 600	½ S/d/2	100
PB 235	½ S/d/3	67

Table 16. Incidence of brown bast and wind damage in RRII 105, RRIM 600 and PB 235 during 1993-94

Clone	Brown bast			Wind damage		
	No. of trees observed	No. of trees infected	Percent-age	No. of trees observed	No. of trees infected	Percent-age
RRII 105	100	5	5	100	3	3
RRIM 600	100	10	10	100	6	6
PB 235	100	5	5	100	0	0

incidence of wind damage noticed in the estate was comparatively negligible. The average intensity of wind damage from the second year of planting to the current year for the clones, RRII 105, RRIM 600 and PB 235 were found to be 5 per cent, 10 per cent and 5 per cent respectively. This agrees with the findings of Nazeer *et al.* (1986) and Saraswathy Amma *et al.* (1988), except for the clone PB.235. Trunk damage was not observed, perhaps due to the sturdy nature of the trunk of all the clones included in the study. Since the estate has not taken any preventive measures, it is necessary to take appropriate steps to reduce the chances of wind damage.

4.5. Investment and maintenance cost

The data collected on cost of cultivation and maintenance for the first seven years is furnished in Table 17. The total investment and maintenance cost of one hectare of rubber plantation in the estate was Rs.28,200/- as per the estate records. Out of these the cost of materials came to Rs.20,000/- (71%) and the balance was spent towards labour charges. Rubber Board estimated the total investment cost for the first seven years as Rs.30,000/-. This difference might be due to the better facilities enjoyed by the estate for carrying out the different operations.

Table 17. Estimated cost of cultivation for one hectare rubber plantation during the immaturity period of seven years

Year	Amount (Rs.)	Material cost (Rs.)	Labour cost (Rs.)
1	12,000		
2	4,200		
3	2,300		
4	2,400	20,000 (71%)	8,200 (29%)
5	2,400		
6	2,600		
7	2,300		
Total	28,200		

SUMMARY AND CONCLUSION

The study aimed at evaluating the performance of three clones of rubber viz. RRII 105, RRIM 600 and PB 235 in Ernad taluk of Malappuram district. Ten identical units in each clone were selected and details on girth and yield characters were gathered. The secondary characters such as resistance to diseases, tapping panel dryness, wind damage, yield depression during summer, dry rubber content, colour of latex etc. were studied.

The study was conducted through personal visits and with the help of a pre-tested questionnaire. Some of the details were collected from the Rubber Board Regional Officer, Nilambur and from the records maintained in the Pullengode estate.

The results of the study showed that the over all performance of the clones RRII 105 and RRIM 600 were satisfactory under the prevailing agro-climatic conditions in Malappuram district and in the hilly tract of Pullengode area. Available information from the estate showed that the highest yield was recorded for the clone RRII 105. It showed a fair degree of tolerance to abnormal leaf fall and pink disease than the other clones, but was susceptible to brown bast. The trees are being kept under the low frequency tapping system to control the occurrence of tapping panel dryness. The clone showed the lowest depression in yield of 16.19 per cent during summer. The clone recorded a dry rubber content of 39.65 per cent.

The clone RRIM 600 occupied the second place in the overall performance and yield. The incidence of abnormal leaf fall and pink disease was not so severe. The powdery mildew and brown bast incidence were low. The yield depression during summer was 18.88 per cent. It recorded the highest dry rubber content of 39.75 per cent.

Since the trees of the clone PB 235 were opened only in 1992, the yield pattern is not possible to be explained as it has not reached the stable stage. More data are required for a realistic comparison with the other clones. The susceptibility to abnormal leaf fall and powdery mildew was high. Incidence of pink disease was low. Tapping panel dryness was also not observed, perhaps being in the second year of tapping under low frequency system. The clone had light yellow latex of low dry rubber content of 31.45 per cent.

In general Pullengode estate maintains the clones, RRII 105, RRIM 600 and PB 235 selected for the study under scientific and uniform conditions. The performance of the clones, except the slight variations inherant with each clone in growth, yield, susceptibility and tolerance to disease incidence, is found to be excellent. The clones are suitable for this region under the existing agro-climatic conditions and the recommended cultural practices.

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APPENDIX-I

Performance of rubber clones in Pullengode Estate of Ernad Taluk in Malappuram District

Interview Schedule for Survey

1. Name and address of the grower :
2. Location of the estate :
3. Area owned by the grower :
   (a) Mature area .....hect
   (b) Immature area .....hect
5. Year of planting :
6. Clone/Variety : RRII 105, RRIM 600, PB 235
7. Type of planting material :
8. Planting distance :
9. Intercropped or not :
10. Topography and types of soil :
11. Soil conservation work done or not :
12. Average rain fall/year (cm) :
13. Average temperature (°C) :
14. Average Relative Humidity (%) :
15. Establishment of cover crop :
16. Fertilizer application
    a) Frequency :
    b) Type of the mixture :
    c) Quantity applied :

17. Other upkeep operation if any

    (a) Weeding :

    (b) Mulching :

    (c) Irrigation :

    (d) Drainage :

    (e) Miscellaneous items :

18. Major diseases noticed

    (a) Pink disease :

    (b) Abnormal leaf fall :

    (c) Powdery mildew :

    (d) Brown bast :

19. Control measures adopted :

    (a) Pink disease :

    (b) Abnormal leaf fall :

    (c) Powdery mildew :

    (d) Brown bast :

20. Annual girth increment of different clones :

	(Years)				
	3rd	4th	5th	6th	7th

21. Average girth of plant/unit :

22. Incidence of wind damage :

23. Control measures adopted :

24. Year of commencement of tapping :

25. Tapping system adopted : Intensity and Frequency

    (a) Normal tapping :

    (b) Upward tapping :

26. Bark thickness (virgin) :

27. Tapping on rain guarding :

    (a) Panel tapped & intensity :

28. Thickness of the renewed bark :

29. Winter tapping :

30. Tapping rest :

31. Wintering & intensity :

32. Colour of the latex :

33. D.r.c. :

34. Average yield/block

    (a) Yield of latex/day/unit :

    (b) Dry yield/year :

35. Yield depression in summer :

36. Total investment cost including land value upto the tapping stage :

37. Total yield/hectare/year for the last two years :

    (a) Sheet rubber :

    (b) Scarp :

    (c) Others if any :