COMPARATIVE STUDY ON THE YIELD PERFORMANCE OF IMPORTANT CLONES IN THE ESTATE SECTOR OF KOZHIKODE AND MALAPPURAM DISTRICTS

By

MURALIDHARAN, V.

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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

DEPARTMENT OF PLANTATION CROPS & SPICES
COLLEGE OF HORTICULTURE
VELLANIKKARA, THRISSUR

1991

DECLARATION

I hereby declare that this dissertation entitled **Comparative study on the yield performance of important clones in the estate sector of Kozhikode and Malappuram districts** is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title of any other University or Society.

Vellanikkara,
05--06--1991.

MURALIDHARAN, V.

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MURALIDHARAN, V.

CERTIFICATE

Certified that the dissertation entitled **Comparative study on the yield performance of important clones in the estate sector of Kozhikode and Malappuram districts** is a record of research work done independently by Sri. V. Muralidharan 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. V. Muralidharan, a candidate for the postgraduate diploma in Natural Rubber Production, agree that the dissertation entitled **Comparative study on the yield performance of important clones in the estate sector of Kozhikode and Malappuram districts** may be submitted by Sri. V. Muralidharan in partial fulfillment of the requirement for the diploma.

Dr. A.O.N. Panikkar
Jt Director (Research & Training)
Rubber Research Institute of India
Kottayam-686009
(Co-Chairman)

Dr. G. Sreekandan Nair
Professor and Head, Department
of Plantation Crops & Spices
College of Horticulture
Vellanikkara
(Chairman)

Dr. P.A. Nazeem
Associate Professor, Department
of Plantation Crops & Spices
College of Horticulture
Vellanikkara
(Member)

Dr. Alice Kurian
Associate Professor, Department
of Plantation Crops & Spices
College of Horticulture
Vellanikkara
(Member)

CONTENTS

1. INTRODUCTION

Hevea brasiliensis is the most important commercial source of natural rubber (NR). H. brasiliensis, the para rubber tree, is a native of Brazil and was introduced to Asia in 1876 through Kew Gardens, with seeds collected and brought from Brazil by Sir. Henry Wickham. The tree is now grown in the tropical regions of Asia, Africa and South America. The rubber tree is sturdy, quickgrowing and tall, and grows well in deep and well drained soils. A warm humid equable climate with a temperature ranging from 21 to 35°C and a fairly distributed annual rainfall of 200 cm and above is necessary for its good growth. It is adaptable to slightly varying soil conditions also. The leaves are trifoliate with long stalk. Alternating growth patterns of elongation and subsequent consolidation is a characteristic feature. Annual leaf fall (wintering) is followed by refoliation and flowering. The seeds contain an oily endosperm (37 per cent of seed weight) and 63 per cent kernel. The oil content of air dried kernel is about 47 per cent. The tree has well developed tap root and lateral root system.

Natural Rubber is recovered from the latex of the tree. Latex is synthesised in the laticiferous system contained in the tree. For commercial exploitation the bark of the main trunk is tapped. During tapping, which is a process of controlled

wounding, latex vessels are opened and the latex exudes which in turn is collected in collection cups.

The world NR production during 1989 is reported as 51.25 lakhs Tonnes, and consumption as 53.35 lakhs Tonnes. The total area under rubber cultivation the world over is 89.32 lakhs ha. The main rubber growing countries are Indonesia (31.11 lakhs ha), Malaysia (18.57 lakhs ha), Thailand (17.47 lakhs ha), China (5.87 lakhs ha), India (4.40 lakhs ha) and Sri Lanka (2 lakhs ha), Nigeria, Liberia, Vietnam, Zaire, Union of Myanmar, Philippines, Ivory Coast, Combodia, Brazil, Bangladesh, etc. also grow rubber.

Rubber cultivation in India was started on a commercial scale in 1902. Before independence, the area under rubber was less than 50,000 ha. In the fiftees and sixtees large scale expansion took place, consequent to the constitution of Rubber Board and the establishment of the Rubber Research Institute of India. The area has increased from 69,000 ha in 1950-51 to 4,40,000 ha in 1989-90. The production has increased from 15,830 Tonnes to 2,97,300 Tonnes and the productivity from 234 kg/ha to 1029 kg/ha during the same period. The progress had been spectacular by any standard. The use of high yielding cultivars had very commanding role in this remarkable performance of the NR industry. In the estate sector the area under high yield varieties increased from 65 per cent in 1956-57 to 99 per cent in 1989-90 and that

The profitability of a rubber plantation is very much dependent upon the planting materials used. Therefore maximum care and caution should be exercised to select the correct variety. The performance of cultivars is dependent on their inherent genetic constitution and the interaction of environmental factors. Therefore, the performance of clones vary widely in different locations. Hence it is always ideal to select the material suited for each locality by evaluating the performance of materials available in the region. All relevant factors like yield, disease resistance, wind susceptibility etc. should be taken into consideration. The desirable attributes of a clone are high initial yield, high average yield through out the economic life span, good vigour and branching habit, response to low intensity tapping, drought tolerance and tolerance to cold and other stress conditions. The environmental factors that influence the performance are soil type and terrain, pattern of rainfall, severity of wind, severity and duration of drought, etc. Due consideration of the characteristic of the planting material as well as the environmental constraints is hence very crucial and imperative when the selection of planting material is made. In such an environmax concept, choice of clones is aimed to maximise productivity of an area subject to the constraints prevalent. The predictable adverse interactions between secondary clonal effects and the inhibitory environmental factors is intended to be overcome. Information on the performance of materials in

varying environmental conditions is a basic requirement for this system. Clones for different regions could be chosen on the basis of their genetic potentialities and response to environmental conditions. The ideal condition would be the choice of specific clones possessing characters best suited to each locality.

Breeding programme in H. brasiliensis has been conducted with the main objective of evolving material with high production potential and adaptability to regional agroclimatic conditions. However detailed studies on the performance of these materials do not appear to have been attempted in each of the different agroclimatic regions. The main objective of the present study was to evaluate the performance of important clones in the estate sector of Kozhikode and Malappuram districts. The region comprising of Kozhikode and Malappuram districts are slightly varying in rainfall pattern, soil conditions etc compared to other rubber growing areas. An attempt has been made to evaluate the yield performance of the commercially important clones, GT 1, RRIM 600 and RRII 105 in the estate sector along with a few older clones. The clones were also evaluated for the Brown bast incidence and wind damage.

2. REVIEW OF LITERATURE

Available literature on the early history of the rubber plantation industry reveal that a very limited range of genotypes have paved the way for the industry in South East Asian countries (Haridasan and Nair, 1980). These materials, however, did contain good potentialities and could lead to the development of highly promising planting materials for commercial use. Evolution of planting materials in H. brasiliensis is mainly attempted through (1) hybridisation and clonal selection, and (2) ortet or mother tree selection. Special techniques like mutation and polyploidy breeding are also attempted but with only limited success (Panikkar 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).

Attempts have already been made to ascertain the yield performance of selected planting materials in India. Among the recent studies to mention Krishnankutty et al. (1982) reported that performance of planting materials varied according to agro-climatic regions. The study also revealed that on a comparison of the 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 Srinivasan (1985) studied

the performance of 22 clones in important rubber growing regions and further made a comparative analysis of yield performance of clones in India and Malaysia. A comparative analysis of the Indian and Malaysian yield figures supported the earlier observation that the Malaysian mean yield is more than that of Indian in respect of all materials other than PB 86. Joseph and Haridasan (1991) studied consistency figures of yield and made a region wise analysis of yield of selected planting materials. Comparison with commercial yield reported in India and Malaysia was also done. Yield of different clones, under commercial planting, for a period of 15 years, indicated that all clones yielded better, in Malaysia, than India, except PB 86.

George et al. (1988) assessed the yield performance of selected clones in the context of planting policy, over three time periods of 15 years, in respect of 32 clones. The study showed that influence of planting materials on yield is significant. Stability of yield, in respect of different planting materials was also subjected to analysis. Saraswathyamma et al. (1988a) presented a detailed review of seeds and clones, planting material recommendations, clone identification, choice of planting materials and environmax planting, details of evolving primary, secondary and tertiary clones and their classification. Mention has also been 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. They mentioned that clones suited for different regions may be chosen on the basis of available informations on their genetic potentialities and response to environmental conditions.

Saraswathyamma et al. (1988b) highlighted the work done on crop improvement in Hevea by the Rubber Research Institute of India from 1954 onwards. Details regarding hand pollination, selection and evolution of clones, ortet selection and polyclonal gardens were provided. Mutation and polyploidisation techniques, used for crop improvement in Hevea were also reported. It was mentioned that selective hybridisation between superior clones, vegetative multiplication and evaluation of most promising selections have resulted in evolving clones with a production potential of more than 3000 kg/ha. Brief descriptions of important characteristics of few RRII clones were also included in their report. Marattukalam et al. (1990) evaluated the early performance of a few RRII clones selected from 46 new clones evolved through ortet selection by the RRII. Saraswathyamma et al. (1987) reported the performance of selected RRII clones. Mean yields of clones are reported separately for each sample area for RRII 105, RRII 203, RRII 208, RRIM 600 and GT 1. Important secondary traits like vigour at opening, girth increment on tapping, percentage of yield depression in summer, virgin bark thickness, etc were also analysed. The results indicated that the clones

show region wise response with regard to yield and secondary attributes. It was recommended that evaluation of planting materials at different environments is necessary to facilitate planting of the appropriate variety suited to each locality.

Marattukalam and Premakumari (1987) reported the early performance of a few Sri Lankan clones in India. All the clones were reported to be affected by wind as uprooting and trunk snap were very common in these clones. It was mentioned that these clones possess some good secondary characteristics like growth vigour, tolerance to certain diseases and good yield during the first three years of tapping. Cherian (1987) analysed commercial yields over 2000 kg/ha in estates and brown bast incidence. Estate averages of yield in India and details of planting materials which yielded over 2000 kg/ha in India were also reported. Break up of Malaysian yield groups and correlation of brown bast to tapping system were also discussed.

Sub group on Plantation Crops Agricultural Experts (1989), Government of India, complimented India's remarkable growth in natural rubber production and productivity. According to the report the national average of productivity was over 1000 kg whereas in all well managed estates and holdings productivity exceeds this. The report recommended systematic use of modern high yielding cultivars for new plantings and replantings. Mani

(1989) reported that apart from increase in area under rubber the important factor was the highest growth rate in productivity, which accounts for the spectacular increase in India's natural rubber production. It was pointed out that average Indian yield currently is nearly 80 per cent of the average yield obtained in Malaysia, the difference being attributed to more favourable agroclimatic factors prevailing in Malaysia. It was observed that the remarkable growth rate of productivity in India has been achieved through a significant increase in area under high yielding clones and also by adoption of better cultural practices.

3. MATERIALS AND METHODS

The data required for the study were obtained from the available records of Kinalur Estate and Thirumbady Estate in Kozhikode District and Pullengode Estate in Malappuram District. These estates were visited repeatedly and data was collected with the help of a questionnaire (Appendix I). The estates covered belong to the large growers group. Planting, upkeep operations, processing etc were done according to the recommendations of the Rubber Research Institute of India. The agroclimatic conditions are more or less similar in the three estates, with fertile soil and annual rainfall obtained is more than 200 cm/year. The rainfall pattern is almost similar in the three estates.

Data required for first analysis was collected for the period from 1st to 15th year of tapping. During this period, manuring, plant protection etc were comparable in the sample estates. Almost all popular clones are planted and are under tapping, in all the three estates.

General analysis of area and planting material

A general analysis of the planting materials used with reference to planted area was attempted. Recent trends in the planting policy for the last five years was also studied. Yield performance of GT 1 was compared with that of RRIM 600 and RRII 105 using 't' test:

$$t = \frac{\bar{X}_1 \times \bar{X}_2}{\sqrt{\frac{n_1 S_2^2 + n_2 S_2^2}{n_1 + n_2 - 2} \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}}$$

$\bar{X}_1$ = mean yield of RRIM 600

$\bar{X}_2$ = mean yield of GT 1

n_1 = sample size of 600

n_2 = sample size of GT 1

S_1^2 = variance of yield of RRIM 600

S_2^2 = variance of yield of GT 1

The data were tested for significance at 5 per cent level.

Secondary characteristics

Linear correlation between yield and rainfall was computed and this correlation was tested for significance at 5 per cent using 't' test:

$$t = \frac{r \sqrt{n-2}}{\sqrt{1-r^2}}$$

n = number of pairs of observation

r = sample correlation coefficient

An analysis of the other important secondary characteristics like brown bast incidence and wind damage was also done.

4. RESULTS AND DISCUSSION

The three estates chosen for the study were large plantation companies in the estate sector. year wise, clone wise area details of the estates are shown separately in Table 1 to 3. Kinalur Estate has got a rubber area of 2225 ha. Thirumbady Estate 1175 ha and Pullengode Estate 860 ha planted with different clones and seedling materials. All the three estates had a very systematic planting programme and selection of clones had been done with utmost care including old proven materials and new modern clones and experimental clones were also planted. All the estates have clones planted in the late fifties under tapping and a phased replanting programme is now being executed. Rain guarding, ethephon application from 18th year after commencement of tapping, aerial spraying against Phytophthora leaf fall and other plant protection measures like dusting were carried out systematically by all these estates. All the mature trees were rain guarded and tapping rest is not adopted as a practice by any of these estates.

The normal tapping task adopted was 300. Systems of tapping were S/2 d/3, S/2 d/2 and 2S/2 d/3, according to different fields. The average d.r.c. was 35 per cent, though it varied from 28-37 per cent, according to seasonal variations.

Table 1: CLONE-WISE AREA: KINALUR ESTATE

Sl. No.	Planting Material	Year of planting	Area (ha)
1	Gl 1	1954	49.30
2	PB 86	1955	45.43
3	PB 6/9	1955	4.30
4	Gl 1	1957	15.17
5	PB 86	1957	25.43
6	PBIG	1957	23.95
7	AV 255	1960	11.22
8	Tjir 1	1960	37.05
9	LCB 1320	1960	15.30
10	LCB 1320	1961	21.48
11	Tjir 1	1961	37.79
12	GG 2	1961	45.09
13	AV 255	1961	31.73
14	Tjir 1	1962	33.87
15	GG 1	1962	35.55
16	Tjir 1	1963	26.58
17	GG 1	1963	20.28
18	GG 1	1963	41.28
19	GG 2	1964	107.60
20	LCB 1320	1964	49.17
21	GG 1	1964	51.60
22	RRIM 605	1964	19.12
23	Tjir 1	1964	17.35
24	GG 2	1965	55.42
25	GG 2	1965	107.92
26	RRIM 605	1965	34.37
27	RRIM 623	1965	18.48

Table 1 contd...

Sl.No.	Planting material	Year of planting	Area (ha)
28	Tjir 1	1966	75.90
29	PB 6/9	1966	30.33
30	Tjir 1	1967	8.83
31	RRIM 605	1966	56.79
32	RRIM 605	1967	83.68
33	GG 1	1967	45.10
34	Tjir 1	1966	79.08
35	GG 1	1967	91.08
36	GG 2	1968	60.88
37	Tjir 1	1967	9.20
38	GT 1	1968	60.70
39	RRIM 623	1968	15.70
40	GG 1	1970	30.00
41	GT 1	1970	8.45
42	RRIM 623	1968	23.46
43	RRIM 605	1968	21.27
44	RRIM 600	1968	13.50
45	Polyclonal	1970	20.30
46	Polyclonal	1970	9.31
47	Polyclonal	1970	11.95
48	GT 1	1970	60.40
49	Mixed clones	1968 RP	4.00
50	RRIM 600	1970 RP	26.41
51	GT 1	1971 RP	50.00
52	GT 1	1972 NC	45.00
53	RRIM 600	1973 NC	7.50
54	PB 5/51	1971 RP	12.00
55	RRIM 600	1971 RP	35.10

Table 1 contd....

Sl.No.	Planting material	Year of planting	Area (ha)
56	RRII 105	1974	1.62
57	RRII 118	1974	1.71
58	RRII 208	1975	--
59	RRIM 600	1974	2.10
60	GT 1	1977	12.58
61	PB 5/86	1977 NC	11.33
62	RRIM 60	1977 NC	45.66
63	RRII 105	1979 RP	13.06
64	RRII 118	1979 RP	13.57
65	PB 6/9	1979 RP	21.66
66	GT 1	1979	14.15
67	RRIM 600	1979	56.30
68	RRII 105	1982 RP	20.16
69	PB 6/9	1982 RP	11.82
70	PB 5/51	1982 RP	24.00

		TOTAL	2225.00
			==========

Table 2: CLONE-WISE AREA: THIRUMBADI ESTATE

Sl.No.	Planting material	Year of planting	Area (ha)
1.	GG 1	1962	43.00
2.	GG 2	1962	7.55
3.	GG 1	1964	240.27
4.	GG 2	1964	15.00
5.	GG 1	1965	59.51
6.	GG 1	1965	51.45
7.	GG 1	1965	117.53
8.	GG 1	1965	15.14
9.	PB 6/9	1965	29.51
10.	GG 1 GG 2	1966	20.73
11.	GT 1	1967	14.79
12.	LCB 1320	1967	15.23
13.	RRIM 605	1967	8.27
14.	GG 2	1967	51.81
1.	GT 1	1970	72.44
16.	RRIM 623	1967	14.79
17.	GT 1	1971	2.00
18.	GT 1	1970	88.19
19.	GT 1	1970	37.30
20.	RRIM 600	1975	44.68
21.	RRIM 600	1978	32.90
22.	PB 6/9	1981	43.87
23.	PB 6/9	1983	31.30
24.	RRIM 605	1983	30.53
25.	GT 1	1984	10.74
26.	PB 6/9	1984	7.64
27.	RRII 105	1984	2.99
28.	GT 1	1985	15.29
29.	PB 235	1985	5.59
30.	GT 1	1987	19.52
31.	GT 1	1988	25.15
		TOTAL	1175.00

Table 3: CLONE-WISE AREA: PULLENGODE ESTATE

Sl. No.	Planting materials	Year of planting	Area (ha)
1.	Gl 1	1959	16.19
2.	Gl 1	1961	40.00
3.	PB 5/60	1962	20.00
4.	PB 86, PB 5/60, PR 107, RRIM 600	1963	60.00
5.	RRIM 600, GG 1	1964	60.00
6.	RRIM 501, RRIM 526, RRIM 605, RRIM 607 RRIM 623	1966	42.38
7.	PBIG (GG 2)	1967	52.22
8.	RRIM 600, RRIM 605, RRIM 607, RRIM 623	1968	48.58
9.	PB 28/83, RRIM600, GT 1, GG 2	1969	57.08
10.	RRIM 605, RRIM 623, PB 6/9, PB 28/83, PB 2/3, PB 5/51, PB 5/63, GG 2	1970	62.75
11.	RRIM 600, GG 2, Gl 1	1971	62.34
12.	RRIM 600, GT 1, PR 107, RRII 102, RRII 105 RRII 106, RRII 107, RRII 109, RRII 116, and polyclonal	1972	29.14
13.	RRIM 600, GT 1, PB 5/51, PR 107, RRIM 118, GG 2	1974	45.75
14.	RRIM 600	1975	29.02
15.	PB 5/60	1963	41.65
16.	RRIM series	1964	20.00
17.	LCB 1320	1965	3.25
18.	RRII 105	1967	10.12
19.	RRII 105, GT 1, RRIM 600, PB 5/60	1983	9.21
20.	RRII 105	1985	7.94
21.	RRII 105, RRIM 600, PB 235	1986	17.25
22.	Experimental clones	1987	20.24
23.	RRII clones	1988	28.46
24.	RRIM 600 and experimental clones	1989	33.31
25.	PB 235	1990	16.68
26.	Proposed area	1991	65.00
		TOTAL	860.00

4.1 Yield performance of RRII 105, GT 1 and RRIM 600

Average yield performance of GT 1 for the first five years of tapping was 900 kg/ha/year and that for 5-10 years 1670 kg and the first ten year average worked out to 1285 kg. Similarly yield figures for RRIM 600 for the first five years of tapping was 890 kg/ha/year and for the period from 5-10 years, it was 1125 kg/ha. The average yield for first 10 years of tapping was 1071 kg. These figures are depicted in Table 4 and 5. Comparing yield performance of RRIM 600 and GT 1, applying the statistical tool of 't' test, revealed no statistical difference between the initial five years yield (Table 6). The yield figures for 5-10 year gave a favourable edge for GT 1 because the yield average for GT 1 was 1570 kg/ha, against 1252 kg/ha of RRIM 600. The average annual yield during the first ten years of tapping was 1285 kg/ha for GT 1 against 1071 kg/ha for clone RRIM 600. This is due to the comparatively better performance of GT 1 in windy and slightly summer conditions. The susceptibility of RRIM 600 to Abnormal leaf fall is likely to be a factor for the less yield. On the whole both the clones are high yielders and should find place in the planting programmes in the agroclimatic zone comprising Malappuram and Kozhikode districts.

Yield performance of GT 1 and RRII 105 (Table 7) was compared. The results showed that RRII 105 is definitely superior to GT 1 in terms of yield. The average yield of RRII 105 for

Table 4: YIELD (kg/ha/yr) OF GT 1 AND RRIM 600 FOR THE FIRST FIVE YEARS.

Clone	1st year	2nd year	3rd year	4th year	5th year	Average
GT 1	657	753	810	934	1341	900
RRIM 600	526	788	842	934	1356	890

Table 5: YIELD PERFORMANCE OF GT 1 AND RRIM 600 FOR THE 6th to 10th YEAR PERIOD

Clone	6th year	7th year	8th year	9th year	10 year	Average
GT 1	1299	1477	2193	1714	1660	1670
RRIM 600	1230	1314	1403	1181	1136	1252

Table 6: GT 1 Vs RRIM 600

(GT 1 & RRIM 600)
1 2

Sl.No.	Sample size	Means	Variance	't'
1	12	543	33103	1.67^{NS}
2	12	438	10196	

the first five years of tapping was 1742 kg/ha against 900 kg/ha for GT 1 for the same period and for six to eight years average yield for RRII 105 was 2330 kg against 1657 kg for GT 1 (Table 8). The average yield for the first eight years of tapping for RRII 105 was 2037 kg against 1278 kg for GT 1. The 't' test proved RRII 105 to be significantly superior to GT 1 (Table 9). Hence the supremacy of RRII 105 over GT 1 with regard to yield is clearly established. This observation is based on the data on average yield from 1974 plantings of Kinalur Estate. The other two estates had only limited data and that too for only two years. The field experience in the performance of these clones in the small holding sector also confirm soundness of the above observation regarding yield of both the clones. Krishnankutty et al. (1982) has reported the superiority of RRIM 600 and GT 1 in yield. They have reported the mean yield for the first 15 years of RRIM 600, RRIM 605 and GT 1. Clone RRII 105 was not included in the 22 planting materials studied by them. Clonal seedling trees of Tjir 1 is reported to be the lowest yielder with 730 kg. From the reported data available for first ten years, PB 5/139 was the highest yielder with 1313 kg. It was followed by RRIM 605 (1269 kg), PB 6/9 (1224 kg), RRIM 623 (1188 kg) and PB 86 (1161 kg). For RRIM 600 the highest yield was obtained in region A with 1205 kg, followed by region B with 1199 kg. Performance of PB 6/9 was reported to be best in region A and that of GT 1

Table 7: YIELD (kg/ha/yr) of GT 1 and RRII 105 FOR THE FIRST FIVE YEARS

Clone	1st year	2nd year	3rd year	4th year	5th year	Average
GT 1	657	753	810	934	1341	900
RRII 105	995	1544	1803	2463	1899	1742

Table 8: YIELD (kg/ha/yr) OF GT 1 and RRII 105 FOR THE 6th to 8th YEAR PERIOD

Clone	6th year	7th year	8th year	Average
GT 1	1299	1477	2196	1657
RRII 105	2065	2179	2744	2330

Table 9: RRII 105 Vs GT 1

RRII 105 & GT 1
1 2

Sl. No.	Sample size	Means	Variances	't'
1	8	794	42124	2.96[x]
2	8	480	37119	

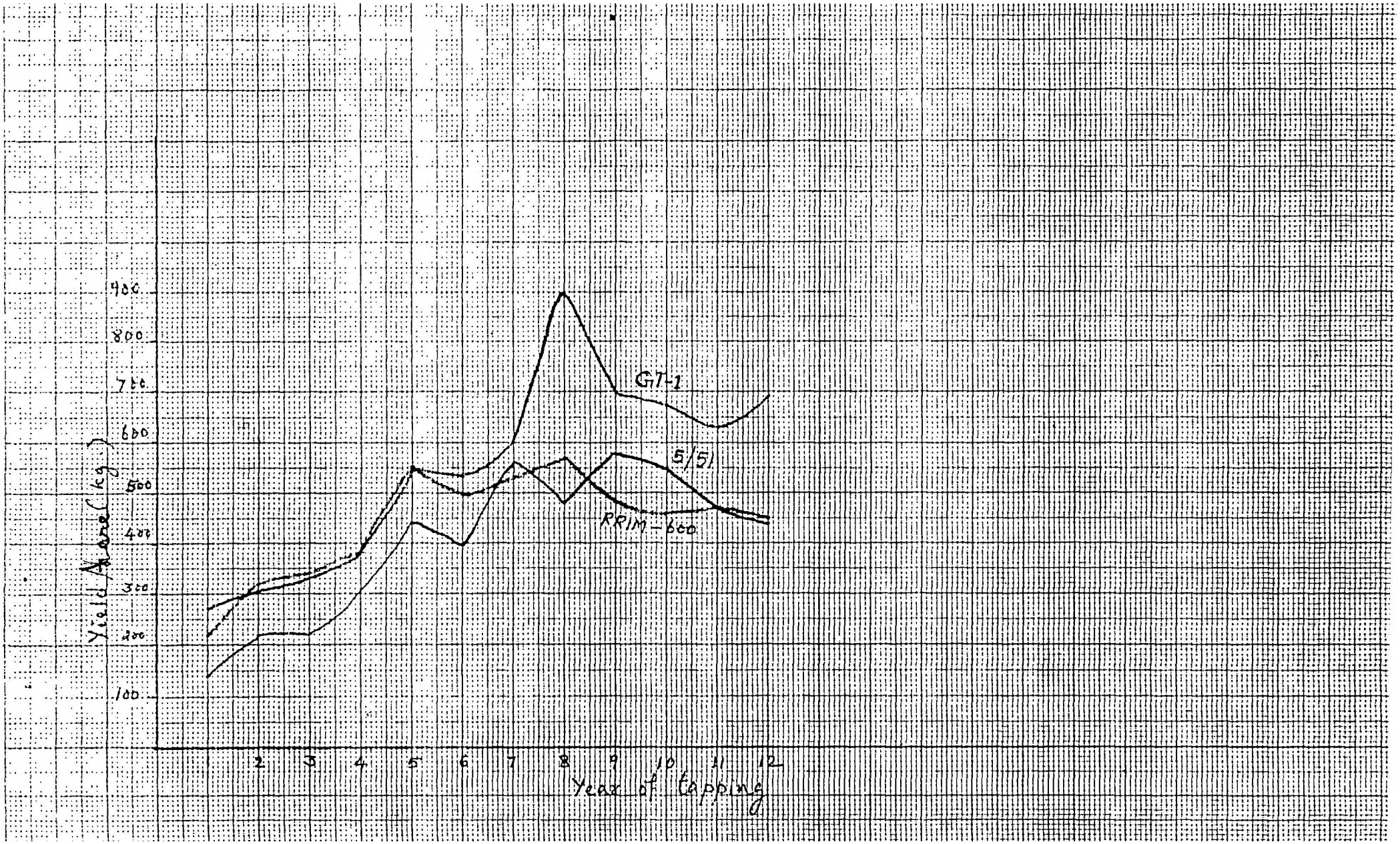
better in region E. A comparison of yield performance of these clones in Malaysia with that in India indicated that except PB 86, all the other clones (PB 28/59, PBIG/GG, GG 2, PB 5/51, LCB 1320, RRIM 600 and RRIM 623) yielded much higher in Malaysia than in India. Krishnankutty and Srinivasan (1985) analysed performance of large estates located in Tamil Nadu and Kerala. Yield performance of 16 popular materials was evaluated for the first ten year of tapping. Krishnankutty et al. (1985) while studying the yield performance of important clones in major rubber growing regions reported that average yield of GT 1 for 10 years is 1325 kg/ha. The observations of the present study is in close agreement with the above, the 10 year average yield of GT 1 being 1285 kg/year. The present study is also in agreement with the results of Joseph et al. (1990).

4.2 Yield performance of old clones PB 5/51, PB 86 and Gl 1

The above three clones account for a sizable percentage in the mature area of the three sample estates. The yield data is presented in Table 10. For the clone Gl 1 the first five year average was 931 kg/ha and for the period from 5-10 years the figure was 1606 kg. It has however, declined to 1190 kg during the 10-15 year period. In case of PB 86, the first five year average was 771 kg/ha and that for 5-10 year period 1341 kg. Here again a decline in yield was noted for 10-15 year period with the yield being 939 kg/ha/year. The case of PB 6/9 was also

Table 10: YIELD PERFORMANCE OF CLONES OF LOCAL IMPORTANCE KINALUR ESTATE

Clones	1st year	2nd year	3rd year	4th year	5th year	Average
Gl 1	669	667	1050	1094	1173	931
PB 86	356	618	944	1010	926	771
PB 6/9	716	919	1539	1517	1489	1240
			6th to 10th YEAR PERIOD			
Gl 1	1457	1440	1393	2028	1712	1606
PB 86	1307	1354	1442	1559	1062	1343
PB 6/9	1509	1255	1193	1593	1359	1380
			10th to 15th YEAR PERIOD			
Gl 1	1497	1356	1203	981	990	1190
PB 86	1131	988	963	808	810	939
PB 6/9	1361	1213	1294	1433	1055	1171
			16th to 20th YEAR PERIOD			
Gl 1	976	736	1062	960	1859	1119
PB 86	795	714	928	936	997	874
PB 6/9	1188	874	1000	832	1072	993
			ABOVE 20 YEARS			
Gl 1	1743	1059	800			1200
PB 86	1125	1154	1561			1280
PB 6/9	1190	1538	980			1236


Yield / Acre (kg)
900
800
700
600
500
400
300
200
100
1
2
3
4
5
6
7
8
9
10
11
12
Year of Capping
GT-1
5/51
RRIM - 600

similar one. The average yield of PB 6/9 for first five year was 1240 kg, 1380 kg for 5-10 year period and declined to 1171 kg/ha. Details depicted in Table 10. So it is suggestive that these materials need replacement with high yielding modern clones after appropriate stimulation and intensive exploitation. The burden these materials imposing on the productivity and profitability of the company needs a detailed study. The replanting programmes therefore, have to be reviewed frequently. The feasibility of improving the pace of replanting has to be explored taking all relevant technical, economical and managerial aspects.

4.3 Yield performance of new RRII clones

Yield performance of RRII 118 and RRII 208 was recorded from the experimental plot at Kinalur Estate (Table 11). Both these clones appear to be promising ones based on their performance. First five year yield average of RRII 118 was 1210 kg/ha, for the 6-8 year period the yield was 1799 kg/ha and the average for the first 8 year period being 1505 kg. Details are depicted in Table 11. This clone (RRII 118) has showed good initial yield performance at Kinalur Estate and the yield figures showed a steady rising trend. This may be due to the good vigour and girth increment which characterises this clone, and the adaptability of the clones to this particular location. However, it has to be mentioned that in the small holding sector the performance

Table 11: YIELD PERFORMANCE OF TWO MODERN RRII CLONES

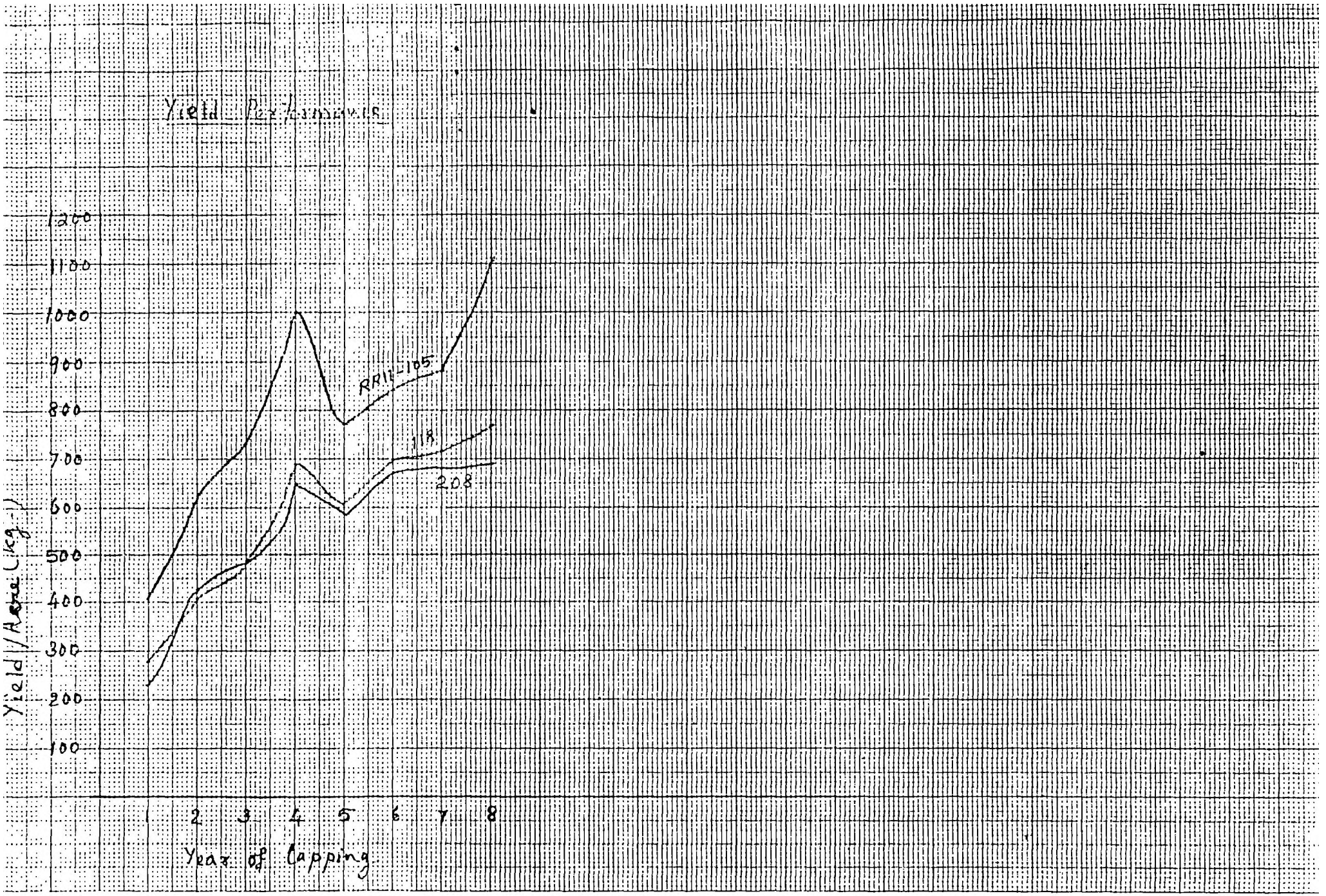
Year of tapping	Yield kg/ha/year	
	RRII 118	RRII 208
1	682	566
2	995	1047
3	1181	1198
4	1699	1603
5	1487	1447
Average for 1st 5 years	1209	1172
6	1724	1660
7	1766	1682
8	1909	1697
Average for 6th to 8th years	1430	1362

Table 12: RRII 105 Vs RRII 208

	RRII 105 & RRII 208			
	1		2	
Sl.No.	Sample size	Means	Variances	't'
1	8	794	42124	2.52[x]
2	8	551	23152	

Table 13: RRII 105 Vs RRII 118

	RRII 105 & RRII 118			
	1		2	
Sl.No.	Sample size	Means	Variances	't'
1	8	794	42124	2.17[x]
2	8	579	26917	


Yield Per Tapping (Kg)
1200
1100
1000
900
800
700
600
500
400
300
200
100
RRII-105
118
208
1
2
3
4
5
6
7
8
Year of Tapping

of RRII 118 can not be compared with this performance as per initial observations, which incidentally indicate need for location specific cultivars. First five year average yield of RRII 208 was 1171 kg and 5-8 year average yield 1680 kg/ha. The average for the first 8 year tapping worked out to 1425 kg/ha. However, these clones deserve further evaluation on a larger scale. Though these new clones were found to be performing well, RRII 105 recorded significantly superior yield than RRII 118 and RRII 208 (Table 12 and 13).

4.4 Secondary characters

Secondary attributes like brown bast incidence and wind damage were assessed. For studying the above the clones GT 1, RRIM 600 and RRII 105 were chosen (Table 14). The results indicated that 8.44 per cent of the trees were affected by wind during the first 20 years, in case of GT 1. In the case of RRIM 600, 12.77 per cent, the incidence as 12.77 per cent and was only 8.02 per cent for RRII 105. It may be pointed out that RRII 105 is a comparatively newer clone and only 16 years data were available. However, it can be seen that wind damage has not posed a serious problem in the sample area considering the damage observed. A detailed observation on the extent and types of wind damage however is warranted.

TABLE 14: SECONDARY CHARACTERS OF SELECTED VARIETIES

	GT 1 (20 year period)	RRIM 600 (20 year period)	RRII 105 (16 year period)
Wind dageme (% of trees affected)	8.44	12.77	3.02
Brown bast (% of trees affected)	9.91	12.34	Nil

Over the 20 year period Brown bast has been found in 9.91 per cent trees of GT 1 and 12.34 per cent for RRIM 600 for the same period. For the cloneRRII 105, the incidence was rather negligible. This may be due to the S/2 d/3 system of tapping adopted for RRII 105 as against S/2 d/2 for other clones. The special care and discriminatory fertiliser application based on soil and leaf analyses given to RRII 105 would have also accounted for the superiority of the clone.

Saraswathyamma (1985) has also reported the suitability of GT 1 for wind prone area and the variation among clones for their response to dfiferent environmental conditions. The results in general indicate that all the three clones included under Category I of the planting material recommendation of the Rubber Board are suitable for the areas covered in this study. However, variations in performance indicate scope for further choices.

The following categories for selection of clones is made in the report of Saraswathyamma et al. (1985).

1.	Severe Phytophthora	:	GT 1, PB 5/51, RRIM 623, RRIM 628, RRIM 701, RRII 105.
2.	High incidence of Phytophthora and Pink.	:	GT 1, PB 5/51, PB 235, PB 260.
3.	Subjected to severe wind	:	GT 1, PB 5/51, PR 107, Gl 1, PB 217.
4.	Exposed to severe wind and Pink.	:	GT 1, PR 107, PB 5/51, PB 235, Gl 1, PR 107.
5.	High incidence of Oidium	:	RRIM 600, RRIM 703, RRII 105, PB 255.
6.	Exposed to severe wind, Pink and Oidium.	:	GT 1, PR 107, PB 260.
7.	Strong wind, low rainfall moderate to high drought.	:	Gl 1, RRII 118, RRIM 600.
8.	Unidentified areas	:	GT 1, PB 5/51, PB 28/59, PB 217, PB 235, PB 255, PB 260, PR 107, RRIM 600, RRII 105, RRII 118.

It may however be noted that the clones suggested for a particular locality only indicate that their performance in the concerned trait will be better than that of other clones currently available. The ideal condition would be the choice of specific clones possessing characters best suited to each locality.

5. SUMMARY

A study was undertaken on the performance of Hevea brasiliensis clones RRII 105, RRIM 600 and GT 1 which are under Category I of the planting material recommendation. Available information on clones RRII 118, RRII 208, PB 5/51, PB 86 and Gl 1 were also collected. The data were gathered following a questionnaire designed for the purpose.

The study covered Kozhikode and Malappuram districts of Kerala. Three estates (Kinalur, Pullengode and Thirumbady) were selected for the purpose, which togehter cover an area of 4260 ha under this crop.

The performance of RRII 105 was significantly superior to GT 1 and RRIM 600 in terms of yield. The yield results obtained from the estates given indications that this clone can yield more than 2500 kg/ha/year in the area. The yield average obtained for first eight years was 2037 kg/ha/year.

It was observed that GT 1 and RRIM 600 performed equally well in the respective estates. GT 1 was slightly superior on long term performance in the area reported. This is due to the agroclimatic conditions prevalent in the location.

It was seen that PB 86, PB 5/51 and Gl 1 are medium yielders and the yield trend indicated the need for replacement of these clones after intensive exploitation.

The clones RRII 118 and RRII 208 (Kinalur Estate) showed good promise.

Observation on wind damage indicate that 8.44 per cent of trees were affected in case of GT 1 and 12.77 per cent in the case of RRIM 600 during 20 years from planting. In case of RRII 105, 3.02 per cent trees were affected during 10 years from planting.

Brown bast incidence was found to be 9.91 per cent for GT 1 over 20 year period and 12.34 per cent for RRIM 600 for the same period. Brown bast incidence was not found to be a serious problem for the clone RRII 105 in these areas.

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QUESTIONNAIRE FOR COLLECTION OF DATA ON THE PERFORMANCE OF CLONES UNDER CATEGORY NO.I

1. Name of Estate :
2. Location :
   District Taluk Village
3. Name and address of Owner :
4. Area under rubber (With year of planting, extent, planting material, No.of plants, spacing). : a) Immature rubber b) Mature rubber.
5. Type of soil and nature :
6. Topography :
7. Early History
   a) Intercropping :
   b) Leguminous cover :
8. Lie of the land
   a) Flat :
   b) Slopy :
   c) Steep :
9. Type of planting
   a) Replanting :
   b) Newplanting :
   c) Interplanting :
   d) Others :
10. Cultural Operations
   a) Contour line planting :
   b) Square planting :
   c) Pits size taken :
   d) Soil conservation by contour terraces :
   e) Individual terraces :
   f) Edakayyalas :
   g) Silt pits :
11. Method of planting
   a) Seed at stake planting/ Field budding :
   b) budded stumps :
   c) Polybag planting :
      Green bud :
      Brown bud :
   d) Stumped budding :
   e) Others :

12. Weeding
    a) Clean weeding :
    b) Slashing of weeds :
    c) Weedicide application :
    d) Others :

13. Manuring
    a) Pit manuring (Compost/cowdung/Mussoriphos etc.) :
    b) Type of mixtures :
    c) Quantity :
    d) Method of application :
    e) Mulching :

14. Other Maintenance operations :
    a) Prunning :
    b) White washing :
    c) Irrigation :
    d) Firebelt :

15. Spraying/Plant protection Operations adopted :

    Type of fungicide

    a) Bordeaux Mixture :
    b) Oil based fungicide dissolved in spray oil and doze. :

16. Disease incidence
    a) Abnormal leaf fall :
    b) Oidium :
    c) Pink disease :
    d) Shoot rot :
    e) Root disease :
    f) Deficiency of nutrients :
    g) Others :

17. Natural Calamities
    a) Wind damage :
    b) Drought :

18. Wintering
    a) Time :
    b) Nature :

19. Particulars of Mature area and Yield.

Year of planting	Extent	Year of opening for tapping	No. of trees opened	Type of planting material	No.of days tapped	Yield Year of tapping	Sheet Kg.	Scrap Kg.	Latex	Others	Total yield	Yield per hectare.	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)

20. Rain guarding adopted or not :

Yield stimulant applied and method of application and frequency. :

Time of tapping :

Panel. A, B, C, D, :
Depth of tapping
(deep/Shallow/Optimum depth)

21. Interplanting :

Other trees :

Medicinal plants :

22. Brown Bast incidence :

23. Growth of plants and Bark renewal Panel diseases :

24. Remarks if any :

****

NUMBER OF RAINY DAYS/YEAR (MONTH-WISE)

PULLENGODE ESTATE

1970-71		1971-72		1972-73		1973-74		1974-75		1975-76		1976-77		1977-78	
Month	Days	Month	Days	Month	Days	Month	Days	Month	Days	Month	Days	Month	Days	Month	Days
Apr	18	Apr	10	Apr	6	Apr	10	Apr	14	Apr	19	Apr	15	Apr	15
May	15	May	17	May	19	May	14	May	19	May	26	May	11	May	21
Jun	19	Jun	27	Jun	16	Jun	27	Jun	12	Jun	30	Jun	15	Jun	26
Jul	30	Jul	23	Jul	25	Jul	26	Jul	30	Jul	30	Jul	30	Jul	25
Aug	23	Aug	20	Aug	18	Aug	29	Aug	22	Aug	28	Aug	20	Aug	21
Sep	15	Sep	17	Sep	19	Sep	9	Sep	20	Sep	26	Sep	12	Sep	20
Oct	24	Oct	14	Oct	24	Oct	18	Oct	14	Oct	23	Oct	17	Oct	23
Nov	7	Nov	4	Nov	12	Nov	7	Nov	6	Nov	9	Nov	17	Nov	22
Dec	Nil	Dec	4	Dec	5	Dec	3	Dec	Nil	Dec	Nil	Dec	4	Dec	Nil
Jan	4	Jan	Nil	Jan	Nil	Jan	Nil	Jan	2	Jan	Nil	Jan	Nil	Jan	Nil
Feb	1	Feb	Nil	Feb	Nil	Feb	Nil	Feb	3	Feb	1	Feb	2	Feb	1
Mar	1	Mar	Nil	Mar	Nil	Mar	4	Mar	5	Mar	4	Mar	2	Mar	5

TOTAL RAINFALL PER YEAR (IN INCHES)

1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78
122-79"	128-27"	113-49"	104-86"	128-74"	160-08"	98-72"	130-45"

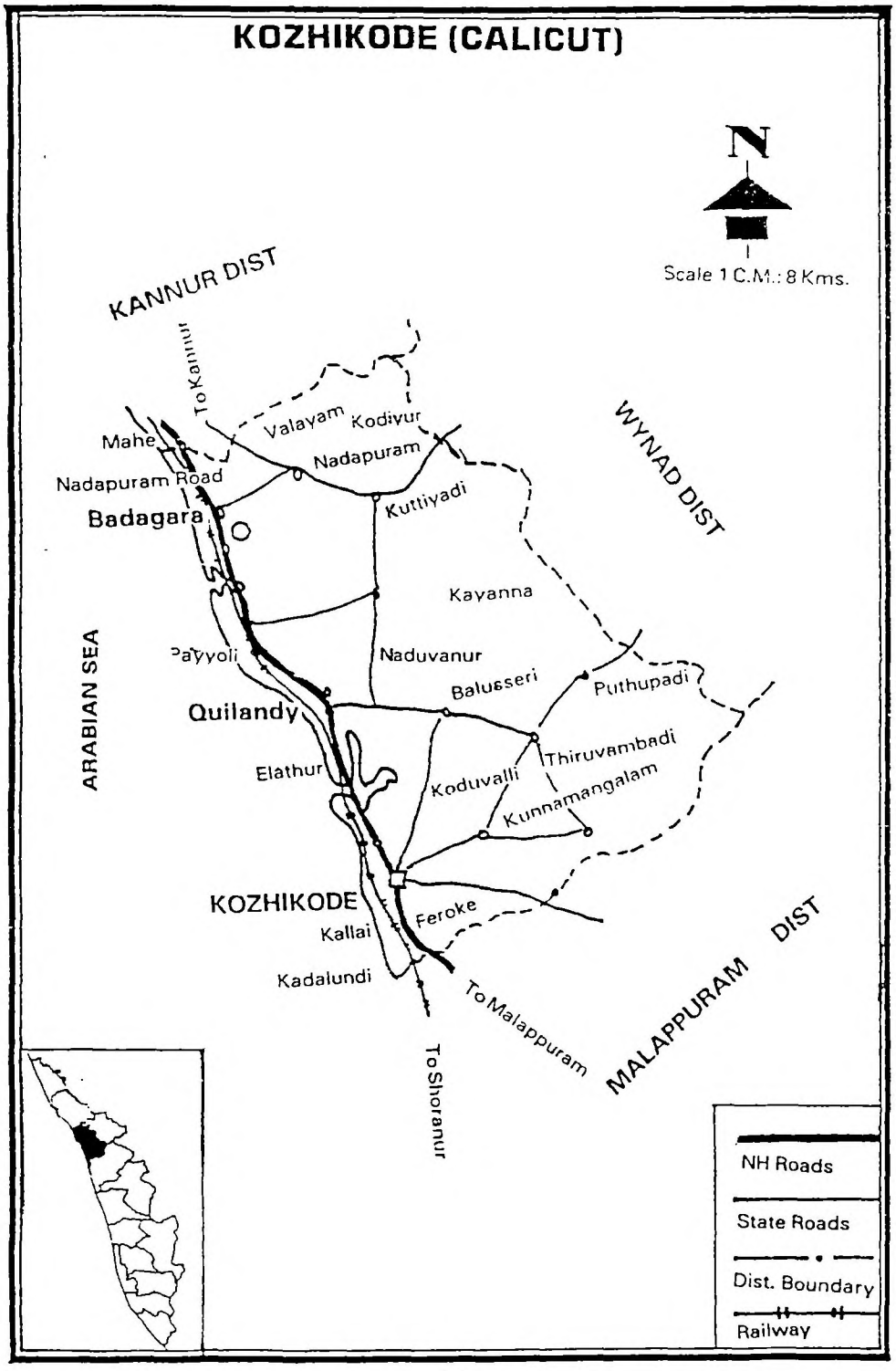
NUMBER OF RAINY DAYS/YEAR (MONTH-WISE)

Month	1978-79	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91
	Days	Days	Days	Days	Days	Days	Days	Days	Days	Days	Days	Days	Days
Apr	15	9	14	12	8	2	12	12	8	8	20	17	4
May	17	13	16	14	21	14	8	15	8	15	11	13	19
Jun	30	26	28	26	22	22	28	30	24	27	26	28	28
Jul	30	27	25	22	22	18	24	23	16	20	27	19	26
Aug	30	20	26	28	21	19	23	26	13	20	25	17	25
Sep	7	23	16	22	9	22	15	18	17	15	25	19	4
Oct	18	16	17	17	14	13	15	8	19	22	10	26	17
Nov	11	17	11	6	9	5	6	13	10	10	8	9	5
Dec	7	5	2	4	Nil	6	1	4	3	8	4	1	1
Jan	Nil	Nil	Nil	Nil	Nil	3	2	2	Nil	Nil	Nil	3	Nil
Feb	3	Nil	1	Nil	1	2	1	2	Nil	4	Nil	Nil	1
Mar	2	7	10	1	Nil	7	5	7	Nil	5	2	1	3

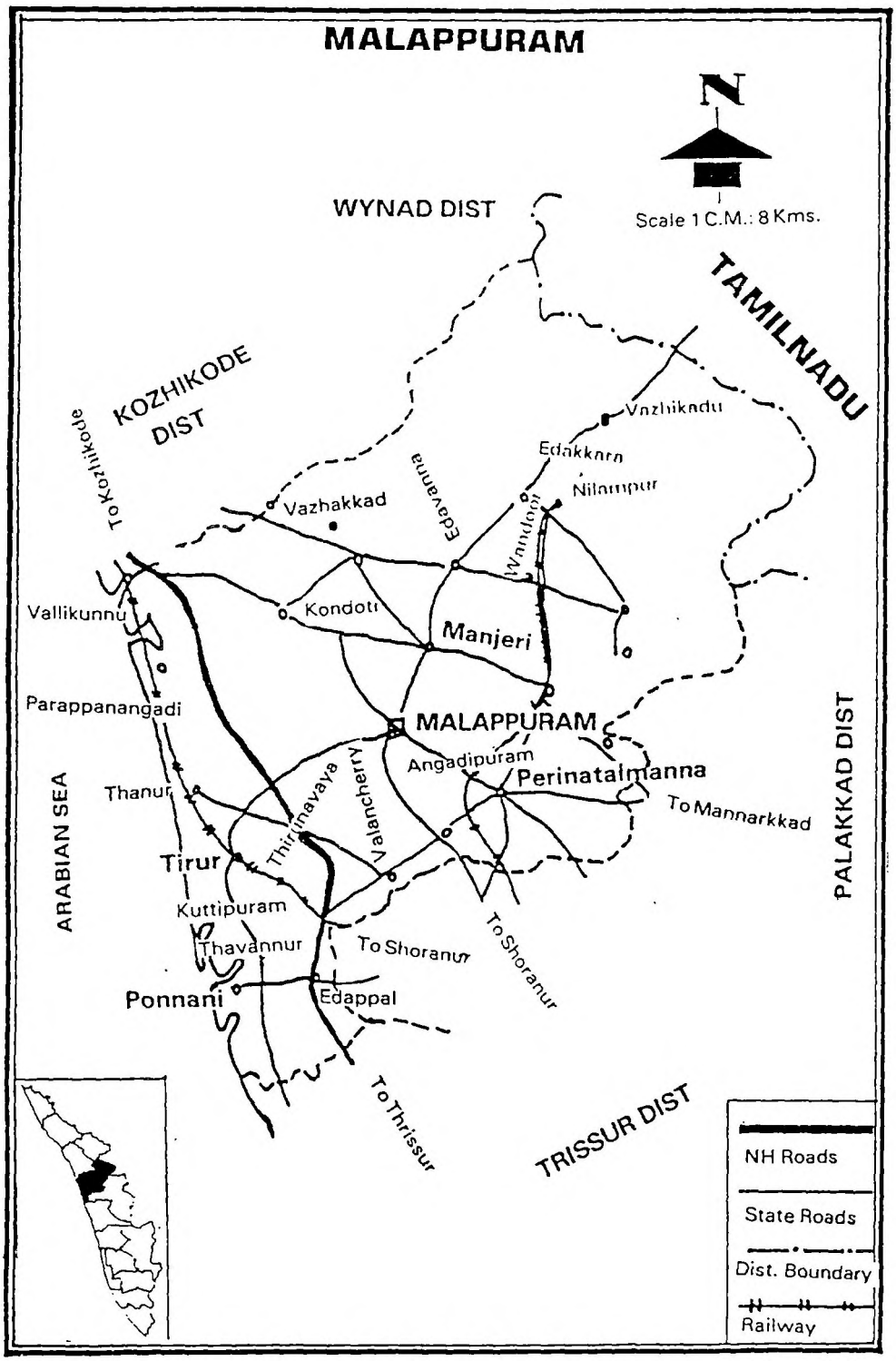
TOTAL RAINFALL PER YEAR (IN INCHES)

1978-79	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91
133-80"	144.33"	160.39"	144.89"	108.70"	114.70"	128.87"	113.61"	101.53"	88.93"	122.35"	106.11"	94.36"

ANNEXURE - I


KOZHIKODE (CALICUT)
N
Scale 1 C.M.: 8 Kms.
KANNUR DIST
To Kannur
Valayam
Kodiyur
Mahe
Nadapuram
Nadapuram Road
Badagara
Kuttiyadi
WYNAD DIST
Kayanna
ARABIAN SEA
Payyoli
Naduvanur
Balusseri
Puthupadi
Quilandy
Elathur
Koduvalli
Thiruvambadi
Kunnamangalam
KOZHIKODE
Feroke
Kallai
Kadalundi
To Malappuram
MALAPPURAM DIST
To Shoranur
NH Roads
State Roads
Dist. Boundary
Railway

ANNEXURE - II


MALAPPURAM
N
Scale 1 C.M.: 8 Kms.
WYNAD DIST
TAMILNADU
KOZHIKODE DIST
To Kozhikode
Vazhakkad
Edavanna
Vazhikadu
Edakkara
Nilampur
Wandoor
Vallikunnu
Kondotti
Manjeri
Parappanangadi
MALAPPURAM
Angadipuram
Perinatalmanna
To Mannarkkad
Thanur
Tirur
Thirunavaya
Valanchery
Kuttipuram
Thavannur
To Shoranur
To Shoranur
Ponnani
Edappal
To Thrissur
TRISSUR DIST
ARABIAN SEA
PALAKKAD DIST
NH Roads
State Roads
Dist. Boundary
Railway