A STUDY ON THE PERFORMANCE OF CLONES IN TWO LARGE ESTATES OF SOUTH KARNATAKA

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Dissertation
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DECLARATION

I hereby declare that this dissertation entitled "**A study on the performance of clones in two large estates of South Karnataka**" is a bonafide record of original work done by me during the course of placement/training and that this dissertation has not formed the basis for award of any degree, diploma, associateship or other similar titles of any other University or Society.

Vellanikkara,
12-11-1991.

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CERTIFICATE

Certified that this dissertation entitled "**A study on the performance of clones in two large estates of South Karnataka**" is a record of research work done independently by **Sri.M.V.Damodaran** 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.M.V.Damodaran,** a candidate for the Post Graduate Diploma in Natural Rubber Production, agree that this dissertation entitled "**A study on the performance of clones in two large estates of South Karnataka**" may be submitted by **Sri.M.V.Damodaran** in partial fulfilment of the requirement of the Diploma.

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Introduction

1. INTRODUCTION

Hevea brasiliensis (Wild ex-A. de Juss) Muell. Arg. is a perinnial tree belonging to the family Euphorbiaceae. Even though the genus Hevea has 11 species, natural rubber production in the world almost exclusively comes from the single species, the Para rubber tree. Natural rubber is one of the most versatile vegetable products and it has manifold uses. More than 35,000 articles are manufactured from this material and there is hardly any segment of life which does not make use of rubber based products. This has resulted in the tremendous increase in the demand of this product. Rubber plantations have profound influence in the economic and social life of the people of several countries. Over 30 million people in the world are dependent on natural rubber for their livelyhood (Saraswathyamma et al., 1988).

Commercial cultivation of the crop in India started in the year 1902 and has been making remarkable progress both in area and productivity. At present Hevea is being cultivated in over 4.4 lakh hectares in our country and the total production exceeds 3 lakh metric tonne per annum. The average productivity has increased from 300 kg per hectare per year to over 1000 kg per hectare. The major factor which contributed to this achievement

is the use of high yielding planting materials developed through the process of crop improvement.

Hevea brasiliensis is a perennial tree having economic span of over 30 years. Selection of planting materials is to be done most judicially as otherwise the disadvantage of a wrong selection will have to be born by the growers throughout the period of cultivation of this crop. A thorough knowledge about the performance of different planting materials for a particular agro-climatic situation, therefore, assumes paramount importance.

Eventhough rubber cultivation was started in the Karnataka State nearly half a century ago, its cultivation was intensified in the early sixties. In the beginning, this crop was cultivated in the lower elevation of Coorg and Dakshina Kannada Districts. Gradually its cultivation spread to Shimoga, Chikmagalur and Uttar Kannada Districts. The region is generally considered as outside the conventional rubber growing tracts of the country and is characterised by a distinct summer season. The annual rainfall is ranging from 2600 to 2700 mm, the bulk of which is received in the South West monsoon season. Conditions favourable for abnormal leaf fall and powdery mildew incidence are also prevailing. This situation warrants selection of clones judiciously so that they can perform better under peculiar climatic conditions. Proven and promising clones and high yielding seedling materials have been recommended

for planting in the earlier period in this region in the absence of location specific studies (Joseph, 1962; Jacob and Pillai, 1966).

The present investigation was taken up to study the yield performance of different planting materials used in two large estates located in Coorg and South Kannada Districts.

Review of Literature

2. REVIEW OF LITERATURE

2.1. Climatic influence

Pushpadas and Karthikakuttyamma (1980) has reported the soils of rubber growing belts of Karnataka to be highly weathered, acidic and poor in available nutrients except magnesium. It is also reported to be characterised by long spell of summer and severe down pour during South West monsoon favouring disease incidence.

In the final report in RRIM 600 series has highlightened the desirable characters of RRIM 600, Early high yield and high yielding in virgin and renewed bark is reported (RRIM Bull., 1974). The response to yield stimulant is reported to be quite good. Wind damage was reported to less for the clone. The clone is categorised under high yielding clones with a mean yield of above 1400 kgs/ha in A and B panel. Annual losses due wind damage in districts with high wind incidence was reported to be 1.22 and 0.38 percentage in districts with moderate wind speed. Cumulative dry tree incidence was reported to be of average 18 to 25 percentage over 9 years.

Alexander (1987) has evaluated performance of clones RRIM 600, PB 28/59 and GT-1 of two large estates in Kanyakumari

districts. He has reported RRIM 600 to be superior in yield to other two clones. Both RRIM 600 and GT-1 showed good agro-climatic suitability, wind resistance and were not prone to brown bast. For GT-1 no root disease was noted by him. It is reported to be less susceptible to Oidium and not effected by Phytophthora. Balanced branching, high seed production, white latex with good stability, good timber out turn and good drought resistance were the other benificial qualities reported by him for GT-1.

Saraswathyamma et al. (1988) has classified clones as Category I, II and III with their planting permissions and limitations. The agro-climatic conditions of different rubber growing areas and the suitability of clones to the respective areas as per their genetic capabilities had been pointed out in their work. According to these workers GT-1, PB 5/51, RRIM 623, RRIM 628, RRIM 701 and RRII-105 are suitable for areas having chance of severe incidence Phytophthora. GT-1, PB 5/51, PB 235 and PB 260 are reported to be suitable for area with high incidence of wind attack. GT-1, PR 105, PB 5/51, PB 235, PB 260, GT-1 and PR 107 are reported to be suitable for exposed areas for severe wind and pink disease. For areas of high incidence of Oidium RRIM 600, RRIM 703, RRII-105, PB 255 and PB 260 were recommended. GT-1, PR 107 and PB 260 were reported to be suitable for areas exposed to severe wind, pink disease and oidium infection. GL-1, RRII-118 and RRIM 600

were recommended for areas with strong wind, low rain fall and moderate to high drought, GT-1, PB 5/51, PB 28/59, PB 217, PB 235, PB 255, PB 260, PR 107, RRIM 600, RRII-105 and RRII-118 were reported to be considered for unidentified areas. The suitability of these clones to certain areas when compared to other clones had been assessed to be better for the locality.

Chandrasekhar et al. (1990) pointed out the soil moisture stress to increase the severety of yield depression due to wintering. The soil moisture stress on latex out put is reported to be experienced annually. The drastic reduction in yield during summer month was apparently due to the extremly low levels of soil moisture and high Vapour Pressure Defficit. GT-1 and RRIM 600 are suggested as drought resistant.

Mydin (1990) points out that the polyclonal seeds have special significance in problem areas. It is also reported that they can be used for raising plantations in non conventional areas of rubber plantation subjected to biotic as well as abiotic stresses. In such areas polycross seedlings are expected to perform better than clones, even under poor management.

Nazeer (1990) has reported the rubber plantations in Karnataka to be characterised by severe summer and the South West monsoon to contribute the major part of the rainfall.

2.2. Yield performance

The early rubber plantations were raised from unselected seedlings, the productivity of which were as low as 200 to 300 kg per hectare per year. Later, proven and promising clones and high yielding seedling materials have been recommended (Joseph, 1962; Jacob and Pillai, 1966). The sustained efforts of the plant breeders, started in the first quarter of the present century (Saraswathyamma, 1988) has succeeded in producing planting materials of increased productivity. The perfection of bud grafting by Van Helten and his co-workers in Indonesia, gave added impetus to the efforts of plant breeders to maintain the productivity level of selected mother trees. Hybridisation and clonal selection, ortet or mother tree selection, mutation and polyploidy breeding, micro-propagation etc. are being attempted as a part of crop improvement in rubber.

Krishnankutty et al. (1982) evaluated the yield performance of planting materials over 65 large estates. According to them PB 28/59 was the highest yielder for the first 5 years tapping with 1200 kg/ha followed by RRIM 605 and RRIM 600. For the first 10 years tapping PB 5/139 stood at the top with 1313 kg/ha followed by RRIM 605, PB 6/9, RRIM 623, PB 86, GG-1 and GG-2. They also reported variation in yield of a specific clone in different locations.

Krishnankutty et al. (1985) has pointed out the importance of choice of cultivars in rubber. They have reported the superiority of RRIM 600, GT-1, PB 28/59 and RRIM 605 over other planting materials. Lowest performance was given by TJIR-1. PB 86, RRIM 623, GG-1 and GG-2 were reported to be moderate yielders giving an average yield of above 1000 kg/ha.

Marattukulam and Premakumari (1987) has evaluated a few Sri Lankan clones using GT-1 as the control. Sri Lankan clones imported to India were found to possess some good secondary characters like vigorous growth and tolerance to certain diseases. The yield of RRIC clones during the first three years of exploitation was found promising compared to GT-1.

Saraswathyamma et al. (1987) evaluating the performance of few RRII clones together with GT-1 and RRIM 600 in three large estates has reported that the overall mean yield recorded for RRIM 600 and GT-1 to be 1104 kg and 843 kg per hectare respectively. RRII-105 showed highest yield with increasing trend accounting 1562 kg/ha/year. RRIM 600 showed a girth increment of 5 cm/year on tapping. The yield drop of RRIM 600 was more pronounced in summer than RRII-105.

Joseph and Haridasan (1990) reported the yield performance of 21 types of planting materials over 40 estates. They have also

compared the yield with that obtained for these planting materials in Malayasia. RRII-105 was found to be the highest yielder followed by PB 28/59 for the first 10 years of tapping. The lowest yielders were LCB 1320, RRIM 628 and PR 107. Variations in yield was reported to be more for RRII clones than RRIM 605 and PB 253. During the first 15 years tapping period PB 5/139 was found to be the best followed by RRIM 605. The performance of planting materials were reported to be better in Kanyakumari, Quilon, Thiruvananthapuram and Pathananthitta regions of the rubber belts other than any other regions. The yield performance of 10 clones were compared with that of Malaysia. All clones showed better yield in Malaysia than in India for the first 10 year period of tapping except for GL-1 that showed higher yield in India in the later years.

Marattukulam et al. (1990) evaluated the performance of few RRII clones selected from 46 new clones evolved through ortet selection by RRII. These clones are under experimental stage. Outstanding performance with regard to yield, vigour and other secondary characters were recorded for the clone RRII-5.

2.3. Influence of age on yield

This aspect of influence of age on yield had also been the subject of study by many workers while evaluating the performance of clones

The performance of 20 clones had been evaluated by RRIM (1976). The yield performance for the first 5 and 10 years showed RRIM 600 to be the best yielder with 1386 kgs and 2029 kgs per hectare respectively followed by GT-1, RRIM 623, GG-1, GG-2, GL-1, PB 86 and lastly by TJIR-1. GT-1 stood first during the first 11th to 15th year tapping period with a mean yield of 1920 kg/ha.

Krishnankutty et al. (1985) has reported the superiority of clones RRIM 600, GT-1, PB 28/59 and RRIM 605 over other planting materials after evaluating the performance of clones for the first 5th and 10th year of tapping. Joseph and Haridasan (1990) had also done similar work.

George (1988) evaluated the yield performance of selected varieties during the first 10 to 20 years tapping period and found PB 28/59, RRIM 605, PB 5/51 and GT-1 to be superior during the first 10 years. RRIM 605, PB 5/51 and RRIM 623 showed higher yield during the first 15 years. GG-2 topped the list followed by GG-1 when the first 20 year data was analysed.

2.4. Disease incidence

According to Alexander (1987), both RRIM 600 and GT-1 showed good wind resistance and were not prone to brown bast. No root disease has been reported by him for GT-1 and reported

to be less susceptible to Oidium and not effected by Phytopthora. Marattukulam and Premakumari (1987) reported certain good characters for earlier Sri Lankan clones with regard to vigorous growth and tolerence to certain disease. According to Saraswathiamma et al. (1987) RRIM 600 has been susceptible to pink disease. GT-1 showed varying degrees of infection. Both the two clones, RRIM 600 and GT-1 were reported to be susceptible to brown bast with 15 per cent incidence in ½Sd/2 system of tapping. Under ½Sd/3 system of tapping the incidence of brown bast was reported to be only 7 per cent. RRIM 600 and GT-1 had reported to have a wind damage incidence of 12 per cent and 2.3 per cent respectively. The incidence of Oidium was reported in GT-1 whereas RRIM 600 showed tolerance. Saraswathyamma (1988) had also suggested suitable clones plantable in certain disease prone areas, Marattukulam et al. (1990) and Mydin (1990) had also done similar works.

Materials & Methods

3. MATERIALS AND METHODS

With a view to evaluate the performance of planting materials in Karnataka region. the study was undertaken in two large estates namely Sampaje estate under Cochin Malabar Group and Sullia Rubber Division of the Karnataka Forest Development Corporation. A map of Dakshina Kannada and a map showing the distribution of Rubber plantation in Karnataka is enclosed as Annexure-1(a & b).

Sampaje estate of Cochin Malabar group of estates of Pierce Leslie is located at Sampaje, 120 KMs from Mangalore by the side of Mangalore-Mercara road. This unit having 227.12 ha is located at an elevation range of 550 to 650 metre from MSL. The terrain of the land of undulating gently slopy and steep, steeper than 1' in 2' in certain pockets. The soil is laterite formations and are severally coarse and well drained but eroded. It consisted of 8 types of planting materials viz., PBIG/GG-1, GG-2, GL-1, PB 86, BD-10, RRIM 605, RRIM 623 and GT-1.

Sullia Rubber Division of Karnataka Forest Development Corporation, has got its planting in 1346.66 ha under this division in 4 units viz. Duggaladka, Gontadka, Medinaduka and Kallugundi and all with in 15 KMs radial distance from Slullia. The agro-climatic condition are not widely different from that of 1st

sample unit Sampaje. Details of planting material are furnished in Table 2. This included 4 types of planting materials viz., TJIR-1 clonal seedlings, TJIR-1 clonal seedlings with PBIG/GG-1, polyclonal seedlings, mixed planting of TJIR-1 clonal seedlings with RRIM 600 bud grafts and RRIM 600 bud grafts.

The samples were located with in an identical agro-climatic tract hence selected for the study.

The details of weather parameters of the area were collected from Sampaje estate and Sullia Taluk Office for a period of 11 years from 1980 to '90. The temperature recording for the corresponding period also were obtained from the Hydro Meteriological Station at Puthur. All these places are located within an areal radius of 50 KMs having similar climatic conditions.

Soil conservation measures are not seen moderately adapted in both the estates and has caused heavy soil wash. The fertile top soil has been washed away in most of the mature area.

Intercropping had not been practiced in both the units. Cover crop establishment was understood to be satisfactory in Sampaje estate and the same could not be successfully established in the Sullia Rubber Division Plantings. Raingarding had been carried out in both the estates.

Collection of data

The details required for evaluating the performance of planting materials were collected from each unit as per a standard questionnaire appended as Annexure-2. Yield data was collected from the records maintained in the estate. The performance of the clones were evaluated by working out the mean yield per ha per year. Yield depression during summer was calculated using the formula

$$\frac{\text{Total yield for summer months (February to May)}}{\text{Total yield for the year}} \times 100$$

The units were visited during the tapping time for assessing the incidence of Brown bast, performance of tapping, etc. The secondary characters like wind fastness and disease incidence were also recorded. The intensity of oidium and the other diseases were also observed and expressed as percentage of plants infected. The present girth was measured at a height of 50 cm from the ground for clonal seedlings and at a height of 125 cm from the bud union for the bud grafted plants.

The data collected were tabulated to draw conclusive results for the two selected units.

Results & Discussions

4. RESULTS AND DISCUSSION

The performance of the planting materials used in the two large estates of South Karnataka were evaluated taking into consideration, the agro-climatic conditions prevailing in the locality.

4.1. Rainfall, temperature and humidity

The region selected for the study is subjected to comparatively longer period of dry spell followed by a torrential rainy period ranging from June to September. The mean monthly rainfall pattern for the period from 1980 to 1990 in the area are furnished in the Table 1. It could be seen that the highest mean rainfall was recorded for the month of July (1006.48 mm for Sullia and 903 mm for Sampaje). The rainfall is confined mainly to the months of June to September. Mean annual rainfall recorded for the period was 3746.19 mm for Sullia and 3694 mm for Sampaje. A congenial climatic condition favouring the attack of Phytopthora, bark rot, patch canker etc. prevailed in this region. This precarious situation warrants the adoption of timely plant protection measures like prophylatic spraying with copper fungicides and the use of organomercuric fungicides as panel protectants. The rubber plants in this area were also subjected to moisture stress condition during the period from November to May. This warrants efficient water management system in this area.

Table 1. Mean monthly rainfall (mm), temperature (°C) and humidity

Month	At Sullia			At Sampaje			Temperature at Puthur		Humidity recorded at Hevea Breeding Station, Nellana for 1989	
	Total rainy days received for 11 years	Mean rainy days	Mean rain fall (mm)	Total rainy days	Mean rainy days	Mean rain fall (mm)	Max. (°C)	Min. (°C)	Morning (%)	Evening (%)
January	7	0.63	8.25	6	0.5	15	36.4	15	90	32
February	1	0.09	0.83	3	0.3	10	38.3	15.9	94	25
March	13	1.18	22.31	21	2	43	39.7	17.9	94	33
April	52	4.72	53.04	68	6	93	39.2	20.2	90	81
May	79	7.18	125.04	123	10	179	37.9	20.1	94	63
June	290	26.36	889.53	290	26	170	37.9	20.1	94	63
July	239	21.72	1006.48	319	29	903	32	19.2	97	85
August	322	29.27	958.27	310	28	811	31.6	19.2	95	85
September	161	14.63	307.8	228	21	390	33.2	19.3	96	74
October	176	16.00	285.07	191	16.8	328	35.5	19.3	-	-*
November	68	6.18	75.50	67	6	106	35.9	16.4	-	-
December	14	1.27	14.03	20	2	27	36.3	15.5	75	40
	1422	129.2	3746.19	1646	149.6	3694	-	-	-	-

Rainfall and temperature mean of 11 years (1980-90)
Sullia and Sampaje are within 50 KM areal radius from Puthur

*Not available

The temperature range as furnished under Table 1 indicate that the mean maximum temperature goes up to 39.7°C and the mean minimum goes down to 15°C. Dew formation occurres during the night especially during the summer. This peculiarity favours the prevelence of "powdery mildew" disease caused by Oidium spp.

High humidity of the air in the morning and during evening for most part of the year is noted in the region. The relative humidity in the morning hours is well above 90 per cent in all the months except December. The relative humidity in the afternoon is relatively lower and is around 30 to 40 per cent from December to March. High relative humidity in the morning hours, when tapping is done, is of special significance to rubber because high yield is associated with high turger pressure in the latex vessels which in turn is influenced by humidity. High humidity for most part of the year also has some beneficial effects on the plants growth because many plants can absorb moisture directly from the air and the rate of photosynthesis generally increases with humidity. However, the combination of high temperature and high humidity that prevail in this region creates highly favourable conditions for the proliferation and growth of numerous pathogenic microorganisms.

4.2. Planting materials

The details of planting materials in Sampaje and Sullia estates is presented in Table 2 and 3 respectively. Sampaje estate consists of 244.62 hectares planted with PBIG/GG-1 and GG-2 clonal seedlings and budgrafts of the clones GL-1, PB 86, BD 10, RRIM 605 + RRIM 623 (mixed planting), RRIM 623 and GT-1. The major portion (70.96 hectares) is planted with PBIG/GG-2 clonal seedlings. GT-1 is planted in an area of 37.10 hectares followed by PB 86 with an extent of 24.04 hectares. Sullia rubber division is planted with 4 types of planting materials viz., TJIR-1, TJIR-1 + GG-1 + GG-2, TJIR-1 + RRIM 600 and RRIM 600. The major portion was occupied by clonal seedlings of TJIR-1, followeed by budgrafts of RRIM 600.

4.3. Exploitation systems

The details of exploitation systems adopted in Sampaje and Sullia rubber division are given in Table 4 to 6. In Sampaje estate a mean total number of 52957 trees were under tapping during the last 5 years from 1986 to 1991 in a total mature area of 199.87 hectares. More than 84 per cent of the plants were exploited in the half spiral, third daily system and the rest in alternate daily system. Ladder tapping was adopted in an area of 22 hectares (11 per

Table 2. Clonewise area (ha) planted in Sampaje estate

Year of planting	Clonal seedlings		Budgrafts					
	PBIG/GG-1	PBIG/GG-2	GL-1	PB 86	BD 10	RRIM 605 & RRIM 623 (mixed)	RRIM 623	GT-1
1959	-	-	1.34	8.05	-	-	-	-
1961	-	-	16.60	-	-	-	-	-
1962	-	-	-	-	12.49	-	-	-
1963	9.23	9.35	-	-	-	6.34	-	-
1964	-	41.90	-	15.99	-	-	-	-
1965	-	19.71	-	-	-	31.18	-	-
1966	2.63	-	-	-	-	-	-	-
1970	-	-	-	-	-	-	15.26	-
1980	-	-	-	-	-	-	-	9.80
1988	-	-	-	-	-	-	-	8.89
1989	-	-	-	-	-	-	-	9.84
1990	-	-	-	-	-	-	-	8.57
	11.86	70.96	17.94	24.04	12.49	37.52	15.26	37.10

Area under slaughter tapping clearing for replanting - 17.45 ha
(of '57 and '59 plantings)

Total area - 244.62 ha

Table 3. Clonewise planted area in Sullia Rubber Division of Karnataka Forest Development Corporation (hectares)

	Clonal seedlings		Budgrafts	
	TJIR-1	TJIR-1 + GG-1 + GG-2	TJIR-1 (C.S) + RRIM 600 Bud	RRIM 600
1961	6.06	-	-	-
1962	117.79	-	-	-
1964	-	-	50.00	-
1965	72.72	-	-	-
1966	118.28	-	-	-
1967	20.20	88.00	5.00	-
1968	231.41	-	-	44.00
1969	104.00	-	-	193.65
1970	8.00	-	-	156.51
1971	-	-	-	86.92
1972	-	-	-	20.12
1973	8.00	-	-	12.00
1974	-	-	-	4.00
	686.46	88.00	55.00	517.20

Total - 1346.66 ha

Table 4. Details of planting materials in mature area and exploitation methods in Sampaje estate

Year of planting	Planting materials used	Year of opening for tapping	Tapping system	Area in ha (having trees @ 300/ha)	No. of trees for 5 years 86-87 to 90-91 (Mean)	Panel under tapping	Tapping task (trees)
1959	GL-1	1968	½S | + ½Sd/2	1.34	612	HO-3	135
1959	PB 86	1968	"	8.05	2042	"	135
1961	GL-1	1970	⅓Sd/3	16.60	4050	BII-3	300
1962	BD 10	1972	½S | + ½Sd/2	12.49	2785	HO-2	135
1963	GG-1	1972	"	9.23	3539	BII-3	300
1963	RRIM 605 & 623	1972	½Sd/2	6.34	1098	BII-3	300
1963	GG-2	1972	½Sd/3	9.35	2423	BII-3	300
1964	GG-2	1973	"	41.90	11578	BII-2	300
1964	PB 86	1973	⅓Sd/3	15.99	3587	BII-3	300
1965	RRIM 605 & 623	1975	"	31.18	7482	BII-4	300
1965	GG-2	1975	"	19.71	4292	BII-1	300
1966	GG-1	1974	"	2.63	559	BI-5	300
1970	RRIM 623	1979	"	15.26	4633	BII-1	300
1980	GT-1	1987	"	9.80	4277	BO-3	30
Total				199.87	52957		

½Sd/2 - Half spiral alternate daily tapping system | = Upward tapping
½Sd/3 - ,, third daily ,,
BO-3 - Original tapping panel on virgin bark - tapping for 3rd year
BI - Tapping on 1st renewed bark the no. indication year of tapping
BII - Tapping on the 2nd renewed bark ,,
The stand of rubber trees under this estate was around 300 per hectare

Table 5. Details of extra tapping undertaken in Sampaje estate

Month	Year				
	1986	1987	1988-89	1989-90	1990-91
January	10	6	10	-	-
February	-	-	1	-	-
June	-	-	-	4	3
July	8	5	6	9	12
August	8	11	8	4	7
September	7	10	8	10	12
October	7	11	9	11	13
November	8	8	10	11	12
December	10	9	9	13	14
January	-	-	5	12	10
Total	58	60	66	74	83

Abstract 1986 to 1990-91

1986	58
1987	60
1988-89	66
1989-90	74
1990-91	83
Total	341

Table 6. Details of planting material wise exploitation in Sullia Rubber Division

Sl. No.	Year of planting	Planting materials used	Year of opening for tapping	Tapping system	Physical extent of planted area (ha)	Effective mean area for 86-87 to 90-91 @ 300 tree/ha	Mean No. of trees for 5 yrs from 86-87 to 90-91	Panel under tapping	Tapping task (No. of trees)
1	2	3	4	5	6	7	8	9	10
I. Duggaladka Unit									
1	1966	TJIR CS	1975	½Sd/2	90.00	90.00	36967	BII-2	240
2	1967	TJIR CS & GG-1, GG-2	1976	"	88.00	72.36	21908	BII-2	"
3	1968	RRIM 600 BGs	1978	"	24.00	19.26	5871	BI-2	"
4	1968	RRIM 600 "	1978	"	20.00	11.25	3439	BI-2	"
5	1969	TJIR-1 CS	1979	"	59.00	38.26	11541	BII-1	"
6	1969	RRIM 600 BGs	1979	"	35.00	32.65	9868	BI-2	"
7	1972	"	1982	"	20.12	15.93	4692	BO-1-3	"
8	1973	"	1983	"	12.00	11.21	2831	BO-1-2	"
9	1974	"	1983	"	4.00	2.86	880	BO-1-2	"
				Sub total	352.12	293.78	97997		

Contd.

CS = Clonal Seedlings; BGs = Budgrafts
BO-1 panel = Original virgin bark
BO-2 " = 2nd virgin bark
BI " = Ist renewed bark
BII " = 2nd "
The number indicates the year of tapping cur

Table 6. Continued

1	2	3	4	5	6	7	8	9	10
II. Gontadka Unit									
1	1961	TJIR-1 CS	1971	½S| + ½Sd/3	6.06	6.06	2135	BII-5 & HO-2	145
2	1962	"	1972	½Sd/2	117.79	109.08	33012	BII-5	240
3	1964	TJIR-1 CS + RRIM 600 BGs	1974	"	50.00	50.00	16646	BII-4 & BII-3	"
4	1965	TJIR-1 CS	1975	"	72.72	61.26	18845	BII-1	"
5	1966	"	1976	"	28.28	21.46	6663	"	"
6	1967	"	1977	"	20.20	20.20	7011	"	"
7	1967	TJIR-1 CS + RRIM 600 BGs	1977	"	5.00	4.96	1534	"	"
8	1968	TJIR-1 CS	1978	"	112.00	81.42	24786	"	"
				Sub total	412.05	354.44	110632		
III. Medinadka Unit									
1	1969	RRIM 600 BGs	1979	½Sd/2	38.00	21.91	6470	BI-3	"
2	1969	TJIR-1 CS	1979	"	45.00	45.00	15500	BII-3	"
3	1970	"	1980	"	8.00	6.59	1891	BII-1	"
4	1970	RRIM 600 BGs	1980	"	35.00	34.30	10044	BII-1	"
5	1970	"	1980	"	79.11	50.88	14972	BII-1	"
6	1971	"	1981	"	39.97	37.81	12777	BII-1	"
				Sub total	245.08	196.49	61654		

Contd.

Table 6. Continued

1	2	3	4	5	6	7	8	9	10
IV. Kallugundi Unit									
1	1968	TJIR-1 CS	1978	½Sd/2	40.64	33.80	10056	BII-1	240
2	1968	"	1978	"	12.00	12.00	3674	"	"
3	1968	"	1978	"	26.30	26.30	8932	"	"
4	1969	RRIM 600 BGs	1979	"	48.30	48.30	11977	"	"
5	1969	"	1979	"	40.00	32.81	11944	"	"
6	1973	TJIR-1 CS	1981	"	8.00	6.40	1856	BI-1	"
7	1968	"	1978	"	40.47	40.47	15276	BI-2	"
8	1969	RRIM 600 BGs	1979	"	32.35	32.14	9524	BI-1	"
9	1970	"	1980	"	42.40	36.45	10473	"	"
10	1971	"	1981	"	46.95	34.94	15558	"	"
				Sub total	337.41	303.61	99270		
			GRAND TOTAL		1346.66	1148.32	369553		

Table 7. Number of tapping days received for 5 years from 1986-87 to 1990-91 in the two estates

	Sampaje estate					Sullia Rubber Division				
	86-87	87-88	88-89	89-90	90-91	86-87	87-88	88-89	89-90	90-91
April	25	25	25	24	23	25	25	26	25	24
May	26	24	25	26	26	25	25	26	24	26
June	24	26	26	26	26	26	26	26	26	26
July	27	27	25	25	25	27	27	26	26	26
August	24	24	25	26	26	25	24	26	26	25
September	25	25	26	25	24	26	26	25	26	24
October	26	25	26	24	25	24	24	25	23	24
November	24	25	25	25	26	25	25	25	24	26
December	27	27	27	26	26	26	26	27	26	26
January	26	25	25	26	26	23	24	24	26	25
February	12	13	12	11	12	18	12	8	8	8
March	26	27	27	27	26	17	24	27	27	25
Total	292	293	294	291	291	287	288	291	287	285

cent of the total). Tapping task was 135 for ladder tapping and 300 for the rest. In most of the areas second renewed bark on B II panel were under tapping. It is noted that in addition to the normal tapping, extra tappings were also undertaken in Sampaje estate. Table 5 presents the additional tapping carried out.

In Sullia Rubber Division, there were four units with a total area of 1347 hectares. The datails of exploitation system are presented in Table 6. The tapping system followed was half spiral alternate daily system except for ladder tapping where it was done at an interval of 3 days. The trees were tapped for the last 5 years on B II and B I panels except for a small area (36 hectare) in Duggaladka Unit. The tapping task was found to be 240 for regular tapping in ½Sd/2 system and was 145 for ladder tapping in ½Sd/3 system.

The details of number of tappable days obtained is presented in Table 7. It is observed that maximum number of tapping days could be obtained for the two sampled estates as rain gaurding was done in both the estates. Month wise tapping day received for the two plantations had been tabulated and included as Table 7.

4.4. Yield performance

The yield performance in Sampaje and Sullia Rubber Division is given under Table 8 to 12 for different planting materials for

Table 8. Yield performance of different clones in Sampaje estate (kg/ha)

Planting materials	86-87	87-88	88-89	89-90	90-91	Mean
I. Clonal seedling						
1. GG-1	1380.18	1382.60	1246.20	1438.82	1307.00	1350.96
2. GG-2	998.26	1348.76	1290.94	1222.66	1391.13	1250.35
II. Budgrafts						
1. GL-1	645.26	925.64	1177.57	1056.00	864.54	933.81
2. PB-86	1134.00	1113.00	1419.30	1190.53	1004.57	1172.28
3. BD-10	673.92	926.36	934.83	1274.19	1171.55	996.17
4. RRIM 623	1267.69	1045.87	806.19	940.94	1309.96	1074.13
5. RRIM 623 & 605	1232.45	1036.91	1192.99	1171.54	1169.71	1160.72
6. GT-1	Not tapped	Tapping started in '88	804.18	1320.61	1394.48	1173.09
Total	7331.76	7779.14	8872.2	9615.91	9612.94	9111.51
Mean	1047.39	1111.30	1109.02	1201.91	1201.61	1138.93

Table 9. Statement of dry rubber content in field latex of Sampaje estate, for the past 5 years

Month	1986-87 %	1987-88 %	1988-89 %	1989-90 %	1990-91 %
April	37.47	35.60	37.80	39.40	37.55
May	35.50	36.39	36.80	38.56	38.48
June	31.65	31.22	35.32	36.62	33.92
July	30.43	31.08	31.00	32.16	30.12
August	31.13	31.97	28.77	27.85	27.05
September	31.25	32.52	39.28	33.03	32.33
October	33.95	34.12	32.96	34.26	34.27
November	34.06	34.12	35.15	35.21	35.36
December	35.32	34.86	35.05	35.47	36.76
January	34.66	34.80	34.09	35.47	37.40
February	35.46	35.20	34.43	35.95	38.25
March	35.10	36.88	37.48	38.73	42.65

Table 10. Yield performance of clones in Sullia Rubber Division of Karnataka Forest Development Corporation (kg/ha)

Planting materials	86-87	87-88	88-89	89-90	90-91	Mean
Clonal seedlings						
TJIR-1	899	1033	1030	1048	946	991.27
TJIR-1 + GG-1 & GG-2	1168.5	1055.6	1170.5	1062.5	1087.1	1108.85
Budgrafts						
RRIM 600	1053	1200.6	1112.4	1086.1	1081.7	1106.78
RRIM 600 + TJIR-1 (C.S)	1147	1139.8	1348	1365.2	1184.3	1236.99
Total	4267.5	4429	4660.9	4561.8	4299.1	4443.89
Mean	1066.87	1107.25	1165.22	1140.45	1074.77	1110.97

Table 11. Mean monthly yield (kg/ha) for planting materials in Sampaje estate (1986-87 to 1990-91)

Months	Clonal seedlings		Budgrafts					
	PBIG/GG-1	PBIG/GG-2	GL-1	PB-86	BD-10	RRIM 623	RRIM 623 & RRIM 605	GT-1
January	153.54	132.98	111.63	127.91	138.15	99.14	113.25	160.06
February	29.05	25.25	22.17	29.79	24.51	18.28	36.16	24.93
March	61.97	56.94	65.69	72.55	77.13	51.48	47.89	58.77
April	64.38	52.45	57.44	64.06	64.32	44.62	48.39	36.42
May	75.85	63.07	60.14	72.30	54.43	64.63	57.08	49.52
June	116.20	96.41	69.87	89.97	54.39	83.72	94.65	83.55
July	147.85	110.76	79.37	100.52	52.91	99.41	116.16	97.10
August	135.53	109.13	72.28	100.61	51.87	103.04	117.14	91.12
September	156.25	120.01	87.48	104.31	39.39	117.32	109.01	145.74
October	160.52	139.86	86.42	112.95	97.27	126.44	120.25	110.10
November	184.14	156.22	106.19	146.35	158.42	128.55	138.69	142.85
December	201.21	187.27	124.13	150.96	164.00	137.50	162.05	162.95
Total	1350.96	1250.35	933.81	1172.28	996.17	1074.13	1160.72	1173.09

Table 12. Monthly yield (kg/ha) of planting materials in Sullia Rubber Division
Mean yield for 5 years (1986-87 to 1990-91)

Month	Clonal seedlings		Budgrafts	
	TJIR-1	TJIR-1 & PBIG/GG-1 and GG-2	RRIM 600	TJIR-1 C.S + RRIM 600
January	105.94	140.67	132.79	144.32
February	29.17	25.09	36.00	36.38
March	57.79	62.56	69.32	71.24
April	60.04	65.84	75.15	70.65
May	63.62	70.31	80.72	77.60
June	67.93	76.65	82.76	88.08
July	68.52	76.32	91.61	78.24
August	61.04	63.20	84.77	72.40
September	93.94	100.76	125.22	116.54
October	103.69	127.87	33.66	130.81
November	129.25	163.84	154.21	167.39
December	150.54	137.74	174.23	189.34
	991.27	1108.85	1106.78	1236.99

The data had been worked out from

1.	15	fields planted with TJIR-1 clonal seedlings in an area of	686.46 ha
2.	1	,, 2 PBIG/GG-1 and GG-2 plants	88.00 ha
3.	15	,, RRIM 600 budgrafts	517.20 ha
4.	2	,, ,, and TJIR-1 clonal seedlings	55.00 ha
	33		1346.66 ha

the period from 1986 April to 1991 March. All the planting materials used in Sampaje estate performed well with regard to yield (Table 8). The maximum yielder was GG-1 with 1350 kg/ha followed by GG-2 with 1250 kgs/ha. The rest were in the order, PB 86, GT-1, RRIM 605 + RRIM 623 (mixed planted area) and RRIM 623, BD 10 and GL-1 were found to be the poor yielders. The performance of GT-1 with regard to yield per hectare and the rising yield trend is worth noting. The GG-1 and GG-2 were on the 15th-20th year of tapping and the performance recorded is in conformity with the earlier workers (George et al., 1988). All these plantings except GT-1 were being tapped on renewed bark and as such the relatively higher yield obtained in this study could mainly be attributed to higher girth which facilitate cutting of more number of latex vessels. The drc of latex in Sampaje estate is found to be well within the range as in the traditional belts (Table 9).

In the Sullia Rubber Division maximum yield was obtained for the area from mixed planted with TJIR-1 clonal seedling and RRIM 600 (1237 kg) followed by TJIR-1 clonal seedling mixed with GG-1 and GG-2 (1109 kg). RRIM 600 yielded 1107 kgs and TJIR-1 clonal seedling yielded 901 kgs per hectare per annum. The performance of all the clones tried were satisfactory.

A meaningful comparison of the performance of planting materials in South Kannada with that of traditional rubber growing belt is not possible, because of the lack of yield data of clones of comparable age in the traditional tract. It is observed that the performance of clones like GL-1 reported by Krishnankutty et al. (1984) for traditional belt is comparable to the observation made in this study. The relative performance on TJIR-1 was reported to be poor in the traditional belt (Krishnankutty, 1984) while this material performed well in Sullia Rubber Division. A similar trend though not of the same extend, is observed for clones like RRIM 605, RRIM 623 and PB 86. However the clone GT-1 performed very well in this region. The yield of RRIM 600 is available only from Sullia rubber division. Where this clone yielded much higher than TJIR-1 monoclonal seedlings and mixed planting of this materials with GG-1 and GG-2 (Table 10). George (1988) evaluating the performance of clones over 20 years found that GG-1 and GG-2 ranked first even through budgrafts of many popular clones yield higher than GG-1 and GG-2 when the production for first 10 years only was considered. Krishnankutty et al, (1985) reported the superiority of RRIM 600 and GT-1 and that clones like PB 86, RRIM 623 are moderate yielders. Alexander (1987) also reported higher yields for RRIM 600 and GT-1 under Kanyakumari condition. The observation in the present study also

confirm the above findings with respect to the performance of these budgrafts in South Karnataka region. Chandrasekhar et al. (1990) also reported good performance of clone RRIM 600 and GT-1 under Maharashtra condition, where the duration of drought is longer than in South Karnataka. The average yield is higher in the mixed planting of TJIR with polyclonal materials (GG-1 and GG-2) than pure TJIR-1 stand (Table 10). This shows that the polyclonal materials perform better than TJIR-1. It is also seen that there is no appreciable difference in productivity between Sullia and Sampaje.

4.5. Monthly variation in yield and summer depression

The mean monthly yield for 1986-91 is shown in Table 11 and 12. Maximum yield obtained was during the month of December in both the estates. The yield from June to January contributed a major share towards the total yield. Yield obtained during the period from February to May were considerably less, with February as the lowest yielding month. The extent of summer yield depression is presented in Table 13. Maximum depression in yield was noted in clone BD 10 (30%) and the lowest (14%) was recorded in the case of GT-1. RRIM 600 performed moderately well with a summer yield depression of 21 per cent. The depression in yield during summer months may be due to soil moisture stress and use of food reserves for refoliation and flowering during the period.

Table 13. Depression in yield during summer (FMAM)

Estates and planting materials used	Percentage of yield depression
Sampaje Estate	
Clonal seedlings	
1. PBIG/GG-1	23
2. PBIG/GG-2	21
Budgrafts	
1. GL-1	27
2. PB 86	25
3. BD 10	30
4. RRIM 623	19
5. RRIM 605 & RRIM 623 (mixed)	16
6. GT-1	14
Sullia Rubber Division	
Clonal seedlings	
1. TJIR-1	21
2. TJIR-1 & PBIG/GG-1 and GG-2 (mixed)	16
Budgrafts	
1. RRIM 600	20
2. TJIR-1 & RRIM 600 (mixed)	20

Mean yield for the period from 1986-87 to 1990-91 is evaluated

FMAM - Months of February, March, April and May

The yield pattern obtained in the study is in agreement with Chandrasekhar et al. (1990). However GT-1 showed more drought resistance than RRIM 600 in the sampled areas. GT-1 and RRIM 600 has been reported as drought tolerent clones.

4.6. Plant girth

The performance of various planting material with respect to girth measurements recorded are given in Table 14. The figures indicated that the clonal seedlings GG-1 and GG-2 and TJIR-1 performed outstandingly with regard to girth increment while noting the year of planting. They were found superior to the budgrafts of the same age group. Good performance of seedlings were reported by earlier investigators (Joseph, 1962). The overall girthing of GT-1 in the sampled areas is found to be very encouraging since it has recorded girth measurement of 69 cms for the 1980 planting. This may be due to the tolerance exhibited by the clone towards drought condition. These findings are in close agreement with the observations recorded by Chandrasekhar et al. (1990).

4.7. Disease incidence

The major diseases observed in the sampled area were abnormal leaf fall, powdery mildew and bark rot. The extent of damage given by each pathogen and the response of the planting

Table 14. Average present girth recordings of different planting materials (in cms)

Year of planting	Sullia Rubber Division		Sampaje Estate							
	TJIR-1 CS	RRIM 600 BGs	PBIG/ GG-1	PBIG/ GG-2	GL-1	PB-86	BD-10	RRIM 623	RRIM 623 & RRIM 605	GT-1
1959	-	-	-	-	108	126	-	-	-	-
1961	135	-	-	-	81	-	-	-	-	-
1962	123	-	-	-	-	-	120	-	-	-
1963	-	-	136	132	-	-	-	-	94	-
1964	-	86	-	125	-	108	-	-	-	-
1965	120	-	-	123	-	-	-	-	85	-
1966	126	-	104	-	-	-	-	-	-	-
1967	123	-	-	-	-	-	-	-	-	-
1968	89	84	-	-	-	-	-	-	-	-
1969	90	86	-	-	-	-	-	-	-	-
1970	87	84	-	-	-	-	-	97	-	-
1971	-	76	-	-	-	-	-	-	-	-
1972	83	80	-	-	-	-	-	-	-	-
1973	-	79	-	-	-	-	-	-	-	-
1974	-	78	-	-	-	-	-	-	-	-
1980	-	-	-	-	-	-	-	-	-	69

Table 15. Response of different planting materials to wind damage and incidence of abnormal leaf fall, pink disease, brown bast, bark rot and powdery mildew diseases (in percentage) over 6 years from 85-86 to 1990-91

Name of planting materials used	Wind damage	Abnormal leaf fall	Pink disease	Brown bast	Bark rot	Powdery mildew
I. Sampaje estate						
1. PBIG/GG-1	12	30	2	13	7	25
2. PBIG/GG-2	4	30	2	10	6	30
3. GL-1	6	20	1	9	8	10
4. PB-86	4	40	1	5	5	20
5. BD-10	14	40	1	11	5	30
6. RRIM 605 & RRIM 623	3	45	2	6	5	20
7. RRIM 623	5	40	1	5	7	20
8. GT-1	2	15	1	1	0	15
II. Sullia Rubber Division						
1. TJIR-1	3	25	2	9	6	30
2. RRIM 600	4	40	1	4	5	20

material are presented in Table 15. The mixed plantings of RRIM 605 and 623 recorded the maximum incidence of Phytophthora followed by RRIM 600, 623, BD 10 and PB 86 which were all equally infected. Powdery mildew incidence was maximum in the GG-2, BD 10 and TJIR-1. The clone GT-1 showed the maximum tolerance to abnormal leaf fall, powdery mildew, Bark rot, brown bast, pink disease and wind damage. GT-1 has been reported as a hardy clone by earlier workers in various other region (Marattukulam et al., 1980). The incidence of abnormal leaf fall, pink disease and powdery mildew were relatively moderate in GL-1.

Summary and Conclusion

SUMMARY AND CONCLUSION

The yield performance of all the planting materials used in the sampled estates were evaluated in the study in light of the agro-climatic peculiarities existing in the area. Promising clones and seedling materials recommended by earlier workers were seen planted in these estates. They were found to yield promisingly in this area. The rainfall and temperature data indicate a significant correlation with yield, yield depression and disease incidence.

A distinct summer period is observed in the area. It is seen that all the planting materials performed well with regard to production of rubber even though planting materials used were of conventional clones and seedling materials. PBIG/GG-1 yielded 1351 kgs followed by PB 86, GT-1 and RRIM 600. TJIR-1 produced the lowest yield of 991 kg/ha. The results indicates that promising clones and seedlings material recommended earlier had performed well in the area. GT-1 with good secondary attributes also performed well in the area. This highlightens the wide feacibility of raising plantations extensively in the area in the vast extends of unutilised plantable areas.

All the planting materials exhibited summer yield depression which may be due to soil moisture stress. The clone GT-1 has

shown the lowest degree of yield depression of 14 per cent. BD 10 showed the maximum depression of 30 per cent, GT-1 is found to be superior clone in the area with regard to the lowest yield depression. Noting the heavy down pour during South West monsoon followed by a pronounced drought period, added attention is to be given for prophylactic spraying against Phytophthora, raingarding the rubber trees for harvesting rubber during rainy period also, systematic application of fungicides against bark injections and panel dressing and taking up adequate soil conservation and water management steps. Incidence of abnormal leaf fall was high in GG-1 and GG-2 and brown bast was also noted to be high in GG-1 and GG-2 as 13 and 10 per cent respectively. Wind damage was maximum of 14 per cent in the case of BD 10. All the planting materials exhibited bark rot also except GT-1. Oidium incidence were high in the case of GG-2, BD-10, TJIR-1 and GG-1.

From the findings it is suggested that further planting in the Karnataka region can be attempted with high yielding clones with lesser degree of summer yield depression. Similar clones and polycross seedlings in high environmental and management problematic areas can be used for planting in South Karnataka region.

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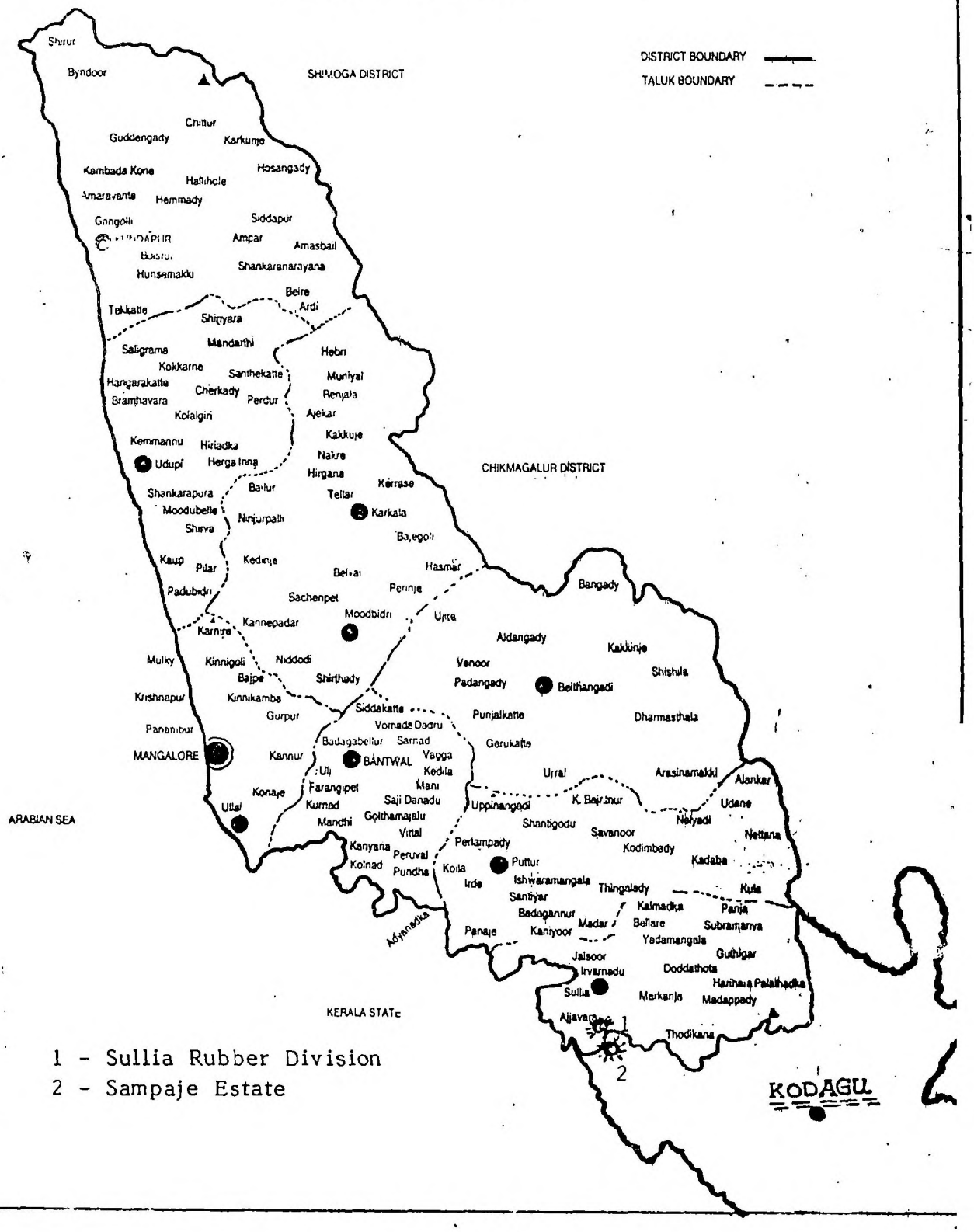
Annexures

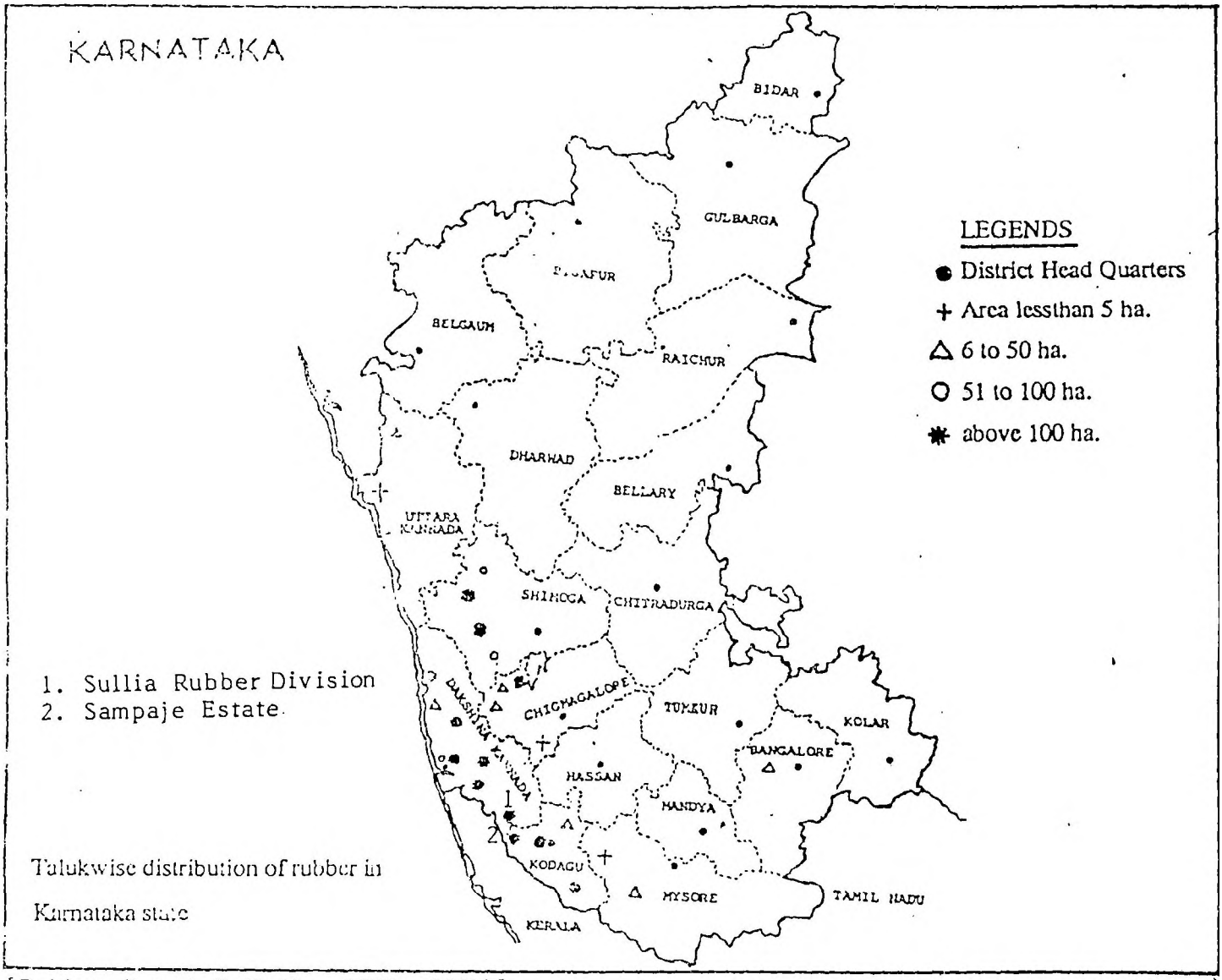
ANNEXURE-1(a)

SOUTH CANARA MAP

AND PART OF KODAGU



Annexure-I(b). Map on distribution of rubber plantation in Karnataka State



[Rubber Board Bulletin, 1990; 26(1)]

ANNEXURE-II

QUESTIONNAIRE FOR COLLECTION OF DATA ON THE PERFORMANCE OF CLONES

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) New planting :
   c) Interplanting :
   d) Others :

Contd.

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) Quality :

d) Method of application :

e) Mulching :

Contd.

14. Other maintenance operations

a) Pruning :

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 :

Contd.

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

Contd.

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 :

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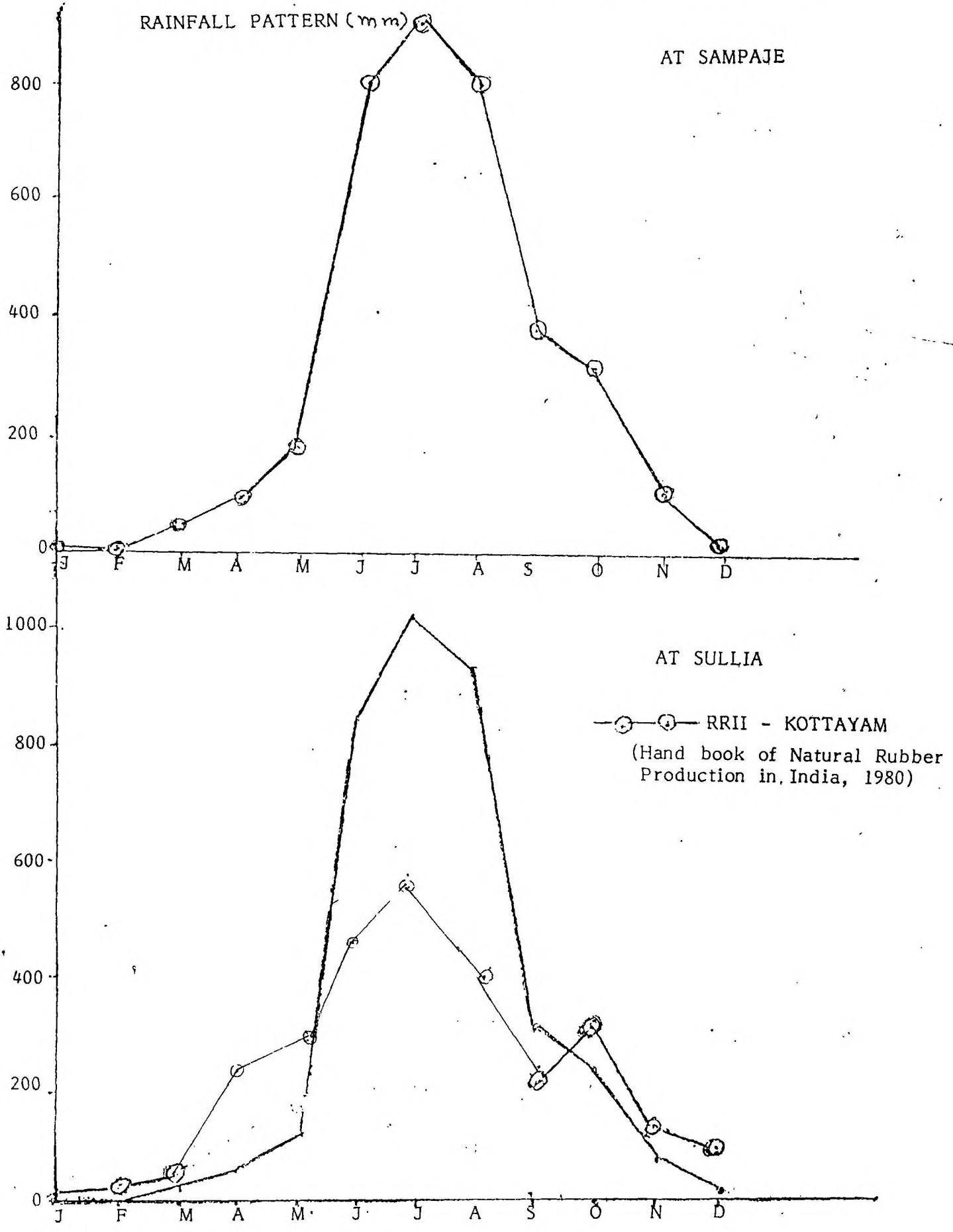
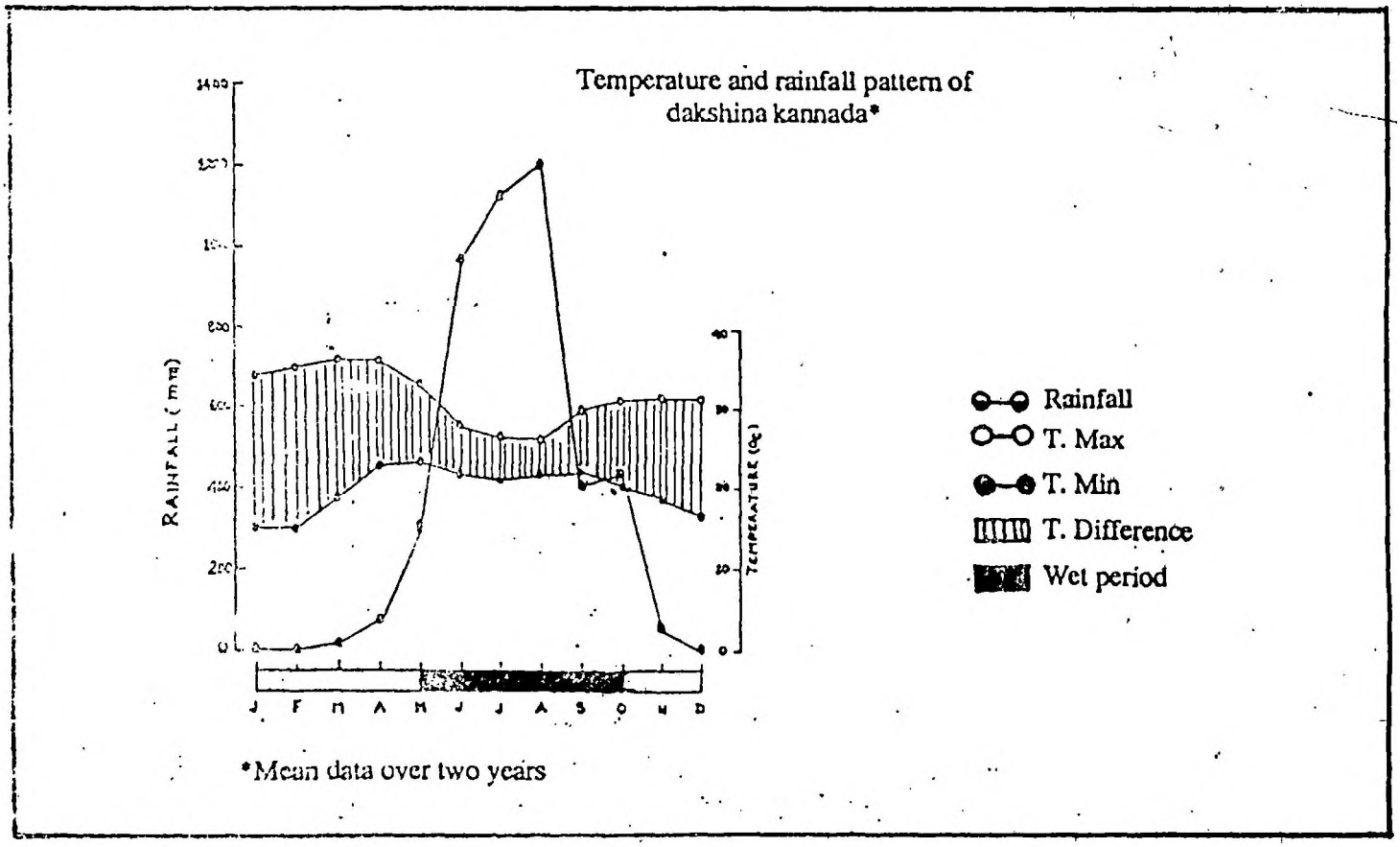
Annexure-III(a). Graph showing rainfall pattern at Sampaje, Sullia and Rubber Research Institute of India, Kottayam.



Annexure-III (b). Temperature and rainfall pattern of Dakshina Kannada



[Rubber Board Bulletin, 1990; 26(1)]