MAJOR DISEASES AFFECTING RUBBER AND ITS CONTROL MEASURES ADOPTED BY SMALL GROWERS OF TELLICHERRY TALUK

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KERALA AGRICULTURAL UNIVERSITY
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DISSERTATION
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THRISSUR
1992

DECLARATION

I hereby declare that this dissertation entitled **"Major diseases affecting rubber and its control measures adopted by small growers of Tellicherry Taluk"** 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,
23-6-1992.

O.P. GANGADHARAN

CERTIFICATE

Certified that this dissertation entitled "Major diseases affecting rubber and its control measures adopted by small growers of Tellicherry Taluk" is a record of research work done by **Sri.O.P. Gangadharan** 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 Committee of **Sri.O.P. Gangadharan**, a candidate for the Post-Graduate Diploma in Natural Rubber Production, agree that the dissertation entitled "Major diseases affecting rubber and its control measures adopted by small growers of Tellicherry Taluk" may be submitted by **Sri.O.P. Gangadharan**, in partial fulfilment of the requirement of the Diploma.

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Introduction

1. INTRODUCTION

Rubber plantation industry in India is having an outstanding development in the extent as well as in the improvement of quality, in the latter half of this century. The total rubber area in India has increased from 1.5 lakh hectares in 1957-58 to 4.51 lakh hectares in 1990's and the production of rubber during the corresponding periods were 24.3 thousand tonnes and 329 thousand tonnes. Out of the total rubber area, 3.71 lakh hectares are spread under 66 lakh small holdings. Though the potential yield of the modern clones such as RRII 105, GT 1 and RRIM 600 is of 2000 kg/hectare, the average productivity in small holdings is estimated to be 980 kg/hectare/annum.

One of the major problems in achieving the yield potential in the small holding sector is the incidence of major diseases viz. abnormal leaf fall, pink and powdery mildew diseases. So far no detailed study has been conducted in Tellicherry taluk, to evaluate the severity of these diseases, their detection and control measures. The present study intends to evaluate the incidence of the three major diseases of rubber and the efficiency of control measures, adopted by small growers in Tellicherry taluk. The major diseases included in the study are:

1) Abnormal leaf fall disease caused by Phytophthora palmivora
2) Pink disease caused by Corticium salmonicolor and
3) Powdery mildew caused by Oidium heveae

Abnormal leaf fall disease is one of the major diseases of rubber plant during the maturity period, resulting in considerable loss of foliage, drying up of branches and die back which leads to heavy crop loss. Some clones are reported to be less susceptible to this disease eventhough all clones are found to be susceptible to abnormal leaf fall (Pillai et al., 1961).

Pink disease is one of the major stem diseases of rubber especially during immaturity period leading to drying up of branches and trunks leading to stunted growth.

The incidence is serious if the grower neglects its treatment. The recovery of the disease depends mainly on the ability of the grower to detect the disease at the initial stages and proper treatment with fungicides at the early stages of the development of the disease.

Powdery mildew disease is one among the potentially debilitating diseases of rubber. It is predominantly noticed on newly formed tender flush, during the refoliation period of January to March. Tender leaves appear with a powdery growth of fungus

on both the sides and later curl with edges rolling inwards. The leaves fall leaving the petioles attached to the twigs giving a broomstick appearance. After few days, the petioles also fall, making disease cycle complete. On older leaves the fungus produces necrotic spots, which reduces the photosynthetic efficiency of the foliage. Pillai et al. (1980) has reported clonal variation to powdery mildew disease incidence and severity to be dependent on the prevailing climatic conditions.

The present study is aimed to find out incidence of the three diseases and the response of different clones to the disease infected at different stages of growth in different locations of Tellicherry taluk. It is also intended to study the effect of various control measures adopted by farmers against the diseases and the various reasons for non adoption of control measures, especially by small growers.

The results of this survey can be beneficially used to evaluate the comparative tolerance of different clones and to formulate more effective and advanced control measures and to identify appropriate time for adoption of control measures. It will also help in assessing the impact of extension efforts by Rubber Board and to plan future strategies in extension programmes.

Review of Literature

2. REVIEW OF LITERATURE

Out of the three major diseases of rubber, abnormal leaf fall caused by Phytophthora palmivora and powdery mildew caused by Oidium heveae are the major leaf diseases. Pink disease caused by Corticium salmonicolor is the major disease of trunk and branches.

Severe leaf diseases which leave the trees bare of leaves, retard growth of the young plants thus, prolonging the immaturity period. The severe and repeated attacks of leaf diseases, reduce yield. The magnitude of yield reduction depends on the type of leaf disease, their severity as well as the effectiveness of disease control (Radziah and Ismail Hashim, 1990).

2.1 Abnormal leaf fall disease

Till, 1911, it was believed that plantation rubber was not subjected to any serious leaf disease and the same was correct as per the conditions then known to exist. The SALB (South American Leaf Blight disease) and abnormal leaf fall disease, which occurs in Ceylon, India and in Jawa are at present, serious menace to the crop (Petch, 1921).

It was Anton de Bary in 1876, first coined the name Phytophthora (plant destroyer) when he described potato leaf blight fungus Phytophthora infestans. The species of pathogen causing

abnormal leaf fall disease is Phytophthora palmivora (Ervins et al., 1983).

The disease was first noticed in 1905 in Sri Lanka and in 1910 at Palappally in Trichur district (Jayaratnam et al., 1987).

2.1.1 Factors influencing the disease

The disease occurs on an epiphytotic scale during the South West monsoon period. A continuous spell of rain of 250-300 mm for 7-10 days, without intermitant hot sunshine will mark the announcement of leaf fall. When continuous and heavy rainfall is received, the mean minimum temperature will be between 15.6°C to 28.9°C, which is very much favourable for sporangial formation of Phytophthora and consequent spread of leaf fall disease. Along with this, relative humidity also increases from 80-100 per cent. It is generally believed that wind and insects have major role in spreading the disease (Thomson and Pillai, 1976).

By the attack of Phytophthora, the leaves are shed with the leaflets still attached to the leaf petioles or stalks. The leaf blades usually show water soaked lesions but some times appear green and healthy. Normally drops of coagulated latex can be seen at the centre of leaf stalks. Phytophthora may also infect young pods, hindering their further development. The infected pods remain hanging on the trees, and under wet conditions, spores

are produced from the pods which later spread to the leaves. Infection of shoots, which is common on young plants during the monsoon seasons in Phytophthora endemic areas lead to shoot dieback (Radziah and Hashim, 1990).

It was Mc Rae (1919) who first studied the disease in detail. Ramakrishnan and Pillai (1961) identified a number of perennial, wild and cultivated host plants harbouring the pathogen.

Application of fungicide is only a short term remedy. However, an integrated approach combining the biological, cultural and chemical control methods is most beneficial. Chemical treatment is the most appropriate method of controlling disease (Radziah and Hashim, 1990).

One round of spraying one per cent Bordeaux mixture, before the onset of monsoon was recommended and is being continued to combat the disease even today. Ramakrishnan and Pillai (1961) found out that Bordeaux mixture is superior to copper fungicides like Fytolan and organic sulphur fungicides like Dithane Z-78. Due to disadvantages of high volume spraying, low volume spraying of oil based copper oxychloride fungicide in diluent oil is done through Micron sprayers, operated from the ground is also practiced.

Earlier a lighter sprayer, Minimicron 77 was introduced, but this could reach a height of only about 16 metres. Later it was replaced by heavier and more efficient sprayers like Shaw duster cum sprayer and Aspee Turblow sprayer to give a coverage upto 24 metres height.

The current recommendation is spraying of oil based copper oxychloride dispersed in diluent spray oil using either low volume airblast sprayers (Aspee Turblow or Shaw duster cum sprayer) from the ground or through aerial spraying by helicopters. Based on the age of plants, two rounds of spray using about 17 to 22 litres of fungicide oil mixture per hectare per round (1:6 proportion) with gap of 10 to 15 days or a single round of 30-37 litres of fungicide oil mixture per hectare (1:5 proportion) may be necessary. For aerial spraying, 6.2 litres of 40 per cent oil based copper oxychloride paste in 37 litres of diluent oil (8 kg of oil diserpersible copper oxychloride powder 58 per cent in 42 litres of oil) is used per hectare, before onset of monsoon (Radziah, 1990).

With regard to the clonal susceptibity, there was no difference in the retention of canopy in low rainfall areas, when the lower (2 kg of copper oxychloride 56 per cent) and higher

(8 kg of copper oxychloride 56 per cent) dosage were tested with clone RRII 105 and also with more susceptible clone RRIM 600, during 1991. But there was marked difference between the treatments in high rainfall area with regard to clone RRII 105 when a lower dose of 4 kg copper oxychloride 56 per cent and a higher doze of 10 kg of copper oxychloride 56 per cent were given. But in high rainfall area the unsprayed suffered a heavy leaf fall of 81 - 91 per cent. In RRIM 600, there was severe leaf fall, although better leaf retention was noticed in plots applied with higher doses (Thomson et al., 1992). High volume spraying is done nearly in 65,000 hectares, mostly in small holdings. The cost of spraying is almost double that of low volume spraying (Annual Report, Rubber Research Institute of India, 1986-87).

In another experiment conducted on high volume spraying with Bordeaux mixture, on the clone GT I with various doses of 1 per cent mixture, the result indicated that the spray volume of 3000 litres per hectare has given satisfactory protection, for the clone GT I. But the lower dosage of 1000 - 2000 litres per hectare were quite inadequate for giving satisfactory leaf retention (Thomson et al., 1992).

2.1.4 Effect on yield

Abnormal leaf fall disease was observed to cause 9-16 per cent yield loss in susceptible clones of Hevea brasiliensis of

10-25 years age when prophylactic spraying was skipped for one season. The disease adversely affected growth and bark renewal of the trees. The disease increased the plugging index and reduced the dry rubber content of the latex (Jacob et al., 1989).

Pillai and Ramakrishnan (1961) compared the yield in protected and not protected areas with Bordeaux mixture and found that there was an yield loss of 37.68 to 50.46 per cent in clones BD 5, Tjir 1 and GT 1. Sparse canopy due to the leaf fall permits more light and encourage weed growth. Moderately tolerant clones like RRII 105, GT 1, PB 217 and GT 1 are likely to get protection with lower dosages of fungicides according to rainfall pattern of the region concerned (Jayaratnam et al., 1987).

2.1.5 Control of abnormal leaf fall disease by crown budding with tolerant clones

To control the Phytophthora leaf fall disease, an early experiment was done by crown budding trees of clone PB 86 and Tjir 1 with BD 10, a tolerant clone and even after 30 years of crown budding, the tolerance displayed by these crown budded trees is remarkable.

In addition, the yield of RRIM 628 and RRIM 600 were higher, when it was crown budded with disease tolerant clones of Phytophthora (Pillai et al., 1980).

2.1.6 Biological control of Phytophthora

The volatile chemical from onion, garlic, fir needles, cherry and citrus leaves killed sporangia of Phytophthora infestations (Jayarajan and Bhat, 1991).

The ideal method of disease control is to breed varieties of plants that are resistant to the diseases prevalent in a country.

The clone RRIC 52 is reported to produce a material which is concluded as phytoalexin which causes disruption of phytophthora zoospores (Peris, 1974).

2.1.7 Effect of streptomycin on phytophthora causing abnormal leaf fall disease

An experiment conducted with streptomycin in controlling phytophthora on the clone RRIM 701 was found successful under laboratory conditions (Thankamma and Kothandaraman, 1974).

2.2 Pink disease

The pink disease is caused by the infection of the fungus Corticium salmonicolor (Berk & Br). As per the history of the disease, it occured on coffee in Sri Lanka in 1870 (Petch, 1921).

The infection of the fungus, on Hevea was reported from Jawa in 1901 and from India in 1908 (Pillai and George, 1980).

In Hevea, the disease appears generally to orginate at the fork region of a tree or where several branches arise at the same level from main stem (Sharples, 1936). It is seen on the rubber plants of all ages but more damage is caused in plants of age ranging from two to twelve years (Pillai and George, 1980).

2.2.1 Nature of infection

The incidence of pink disease is found during South West monsoon season and the infection will be wide spread during the period ranging from June to September. In young plants, the infection is seen on the main shoot at different heights in the brown bark region. In older plants, the infection is found common in the fork region of the branches and also in branches. Pink disease is also seen in the base region of the young plants, and also in tapping panels of the older trees.

Pink disease is considered to be the most important stem disease and is found to be very serious in recent years in the plantings of highly susceptible clones like RRII 105 and PB 217. Severe incidence of the disease is being noticed in plantations, where the mature trees of these clones are found adjacent to the immature areas.

Percentage of pink disease affected plants varied from 6.48 to 59 per cent in the different years plantings of PB 217,

RRII 105, PB 235 and GT 1. Maximum incidence was noticed in PB 217 (Annual Report of Rubber Research Institute of India, 1989-90).

2.2.2 Mode of infection

The mode of infection is seen in three stages. The initial stage is the infection in the superficial bark, like cobweb appearance of mycelia. At this stage mycelium is hyaline and the mycelial growth may extend upto a distance of 30 - 60 cm, on the bark, both downward and upward, from the point of infection.

Due to the ramification of the mycelium inside the bark and wood regions, extensive damage is caused to the internal tissues. At this stage, ex udation of latex is seen on the bark of the plant from the infected portion. By this time, extensive damage is caused to the internal tissues and bark by which the translocation of food materials and water in the plant system is arrested. This results in the yellowish discolouration of the leaves and final drying up of the plant part from the infected region.

By this time, a number of sprouts arise from the portion of the plant below the infected region which is the main symptom of the disease. At its advanced stage, the foliage will be sticking on the drying branches.

In the case of advanced stage of infection, small pink coloured cushion like structures called 'Pustules' are seen. This pustules consist of irregularly polygonal pseudoparenchymatous cells, which develop into the unicellular hyaline spores called 'necator spores'. Another characteristic development in highly advanced stage is the formation of pink crusts on the lower surface of the affected branches.

The infection of pink disease in young plants may cause considerable reduction in stand per hectare and affect the growth of the surviving plants (Ramakrishnan and Pillai, 1962).

2.2.3 Control measures

The common practice of the treatment of pink disease was spraying Bordeaux mixture, in the first decades of the century in all rubber growing countries. Later application of 10 per cent Bordeaux paste was recommended widely. In the cases of advanced infection, Bordeaux paste may be applied on the infected region. When it dries up, the bark surface may be scraped so as to remove all pathogen and the infected bark and the fungicide is applied again upto 30 cm above and below the infected region.

Calixin 20 per cent mixed with ammoniated rubber latex is also recommended (Edathil and Jacob, 1983). Application of Thiride (Tetramethyl thiuram disulphide) mixed with petrolium

bye products like Mahathotex wax was also found effective (Edathil and Pillai, 1976).

A new fungicide carrier pidivyl China clay compound was recommended with calixin one per cent or propiconazole (Jacob and Edathil, 1986).

Two spraying rounds of the chlorothionil formulation at 2 or 3 per cent a.i. applied twice at fortnightly interval cured 55.8 per cent and 50 per cent of trees suffering various stages of disease severity, respectively (Radziah et al., 1992).

The treatment with pidivyl China clay compound and application after slight scraping of the bark in the affected region was observed to be superior to other treatments. Thiride at a concentration of 7500 ppm also gives good performance (Annual Report of Rubber Research Institute of India, 1986).

2.3 Powdery mildew

The powdery mildew disease is caused by Oidium heveae. The first recorded appearance of this disease was made in the Melang district of West Jawa by Arens in 1918. The incidence of this disease was recorded in Malaysia by Steinmann (Sharples, 1936). The term mildew is usually applied to fungi which form superficially white powdery patches on leaves and green stems, all of them are strictly parastitic on the plants on which they

occur. It attacks very small brown leaves, first unfolding and cause them to fall off. On fully formed leaves, white powdery patches are produced (Petch, 1921).

2.3.1 Symptoms of the disease

Powdery mildew disease caused by Oidium heveae infects plants of all ages from very young nursery seedlings upto mature plants in the field. The young leaves in the bronze, greeny bronze and palegreen stages are liable to the infection. The fungal infection is observed between bud break till they are past the dark green stage or to the time cuticle matures, which varies from clone to clone (Pillai et al., 1980). Fully hardened leaves however resist the severity of the disease infections.

Severely affected young leaflets shrivel, turn black to varying extent and drop. Older infected leaves also undergo premature defoliation. The affected leaves which escaped defoliation remain on the trees, bearing heavily sporing colonies which eventually dry up, producing translucent yellow patches which later turn brown when the leaf tissues die.

The pathogen of the disease favours cool weather with intermittant showers or dew drops. Plantation in high elevation experience the disease throughout the year, because of the cool climate.

The trees growing in poor eroded soils and replanted areas where the soil fertility status is very low, the trees exhibit much slower rate of growth, thereby exposing the leaves in a susceptible age for infections for comparatively longer period and as a result infections of powdery mildew is severe (Ramakrishnan and Pillai, 1962).

2.3.2 Clonal susceptibility

The intensity of infection is found to vary among different clones. But this clonal susceptibility is influenced by the time of refoliation of environmental factors prevailed. It is observed that clones of PB 86 and GT 1 are comparatively tolerant to the disease (Paardekooper, 1955).

2.3.3 Damage caused by the disease

Repeated defoliation of the tender leaves, weakens the rubber trees, resulting in the rapid depletion of stored reserve food from the plant. As the disease damages considerable leaf laminae, the photosynthetic efficiency of the leaves is reduced considerably. The food materials removed by the parasite also causes further drain of assimilatory products. Repeated defoliation after refoliation produced considerable reduction in yield.

2.3.4 Control measures

The cheap and effective control measures against powdery mildew disease is dusting with sulphur talc. Depending upon the intensity of the disease, three to six rounds of dusting with sulphur at the rate of 11-16 kgs/hectare may be required at interval of four to ten days to control the disease effectively throughout the refoliation period. Trials conducted at RRII have shown that systemic fungicide Bavistin at 0.2 per cent as a water spray is effective against powdery mildew disease in the nursery and in young plants (Thomson et al., 1984). Alternate fungicides such as 'sulflo' (a flowable formulation of sulphur) was more persistant than sulphur dust and a wettable formulation of sulphur was less effective. The three formulations of sulphur reduced sporulation even when they were applied 7 days after the leaflets were inoculated. The systemic fungicide Prochloras (Sportek 45 EC, Octava 50 WP), Triodimenol (Bay fidan 250 EC) 'Triademefor' (Bay leton 25 WP) and Tri demorph (Calixin 75 EC) showed good protection and eradicative action when applied in oil (0.5 kg/ha/round). Tridemorph was lesss effective if applied beyond 48 hours after inoculation.

2.3.5 Economics of controlling powdery mildew disease

The girth, bark renewal and yield were increased and weed growth was suppressed in the case of trees which has been

treated with fungicides for 2 years (Wastie and Mainstone, 1969).

2.3.6 Reduction in yield or crop loss

In experiments to assess crop loss, it is observed that in the clone PB 86 when unprotected, the defoliation was complete and the refoliation sparse while the RRIM 600, the defoliation was moderate with repeated refoliation. The clone PB 86 showed 7.7 to 11.8 per cent more disease resulting in a crop loss of 20.1 to 31.8 per cent.

In the clone RRIM 600, there was 7.5 to 18.4 per cent more disease in unprotected plots resulting in a crop loss of 13.5 to 28.5 per cent. In this clone, the girth increment was not affected, but bark renewal was poor in the unprotected plots, with four rounds of dusting the yield could be maintained steadily higher than that in unprotected blocks through out the year (Jacob et al., 1992).

Materials and Methods

3. MATERIALS AND METHODS

Tellicherry Taluk of Cannanore District was chosen for the study. Altogether there were 16,851 rubber planting units in the taluk, comprising of 16,016.54 ha. The average extent of the holding comes to 0.95 ha. The map of Tellichery taluk is given as Annexure-Ia and b.

Out of the 45 villages of Tellicherry taluk, 18 villages were in coastal area with coconut and paddy, as the main crop. Four villages were having very few units under rubber cultivation and the remaining 23 villages occupied the major rubber growing areas of the taluk. The study was conducted in the selected units of all the 23 villages with number of units in the village ranging from 1 to 12. A total of hundred units were surveyed with an area of 98.83 ha, occupying 45,552 trees.

The terrain of the land were sloppy (66 units), flat (8 units) and steep (26 units). The elevation was below 1000 ft. MSL. A taluk map showing the village wise details and the units surveyed is given as Annexure I and III.

Individual farmers were contacted for collecting the data, pertaining to the incidence of abnormal leaf fall, pink and powdery mildew diseases. (Name and address given as Annexure-IV) The selected units were visited for confirmation of data. The informations were collected based on the questionnaire prepared, in

advance in consultation with the experts (Annexure-II). Details regarding different age groups, year of planting, planting materials used, clone wise nature of infection of each disease, number of trees affected, control measures adopted, rate of recovery from the disease, cost of plant protection measures adopted and knowledge of the farmer in detection of the disease and proper treatment were collected.

The extent of the individual units surveyed ranged from 0.14 ha to 4.26 ha. There were 27 units having the extent below 0.50 ha, 31 units between 0.50 and 1.00 ha, 34 units between 1.00 and 2.00 ha, 8 units between 2 and 3 ha, and one unit above 4.00 ha. The details of the units surveyed are given in Annexure-IV. The village wise distribution of the units surveyed is also given in Annexure-III. Various control measures adopted by the growers and method of application were also evaluated. Adoption of prophylactic treatment and its frequency of treatment were recorded. External factors affecting the disease, intensity and proximity to infected plantations of susceptible clones were also studied.

The severity of the disease was assessed, based on the scores given for each diseases. The details are as follows:

Abnormal leaf fall disease,
Pink and Powdery mildew

Mild	:	Infection below 25 per cent
Medium	:	Infection between 25 and 50 per cent
Severe	:	Infection above 50 per cent

Pink disease

X - Infection at initial cobweb stage

Y - Infection at latex oozing out stage

Z - Sprouts and drying stage

The data collected after detailed survey was tabulated, presented and discussed. Since detection of the disease at an early stage is an important factor, in controlling the disease, a thorough study was made about the ability of the small growers to detect the disease at the initial stages of incidence. The control measures adopted and the rate of recovery after treatment were also studied. The expenditure for chemical control, difficulties in adopting the same and suggestions for improvement were also collected. The reasons for low yield as compared to the potential yield of the clones were also traced.

Results and Discussion

4. RESULTS AND DISCUSSION

4.1 Incidence of major disease of rubber

Details of the incidence of major diseases in Tellicherry taluk is presented in Table 1 and is depicted in Fig. 1, 2 and 3

Out of the 100 units surveyed, abnormal leaf fall disease occured in 88 holdings, covering an area of 71.26 ha and the percentage of infection was 72 per cent, 84 units were infected with pink disease covering an area of 84.20 ha and the percentage of infection in the infected units was 4.9 while 91 units were infected by powdery mildew disease covering an area of 80.84 ha and the precentage of infection was 81.79. Most of the units were found infected by more than one disease (Table 1 and 2 and Fig. 1 2 and 3 In 67 units, trees were found infected with all the three diseases.

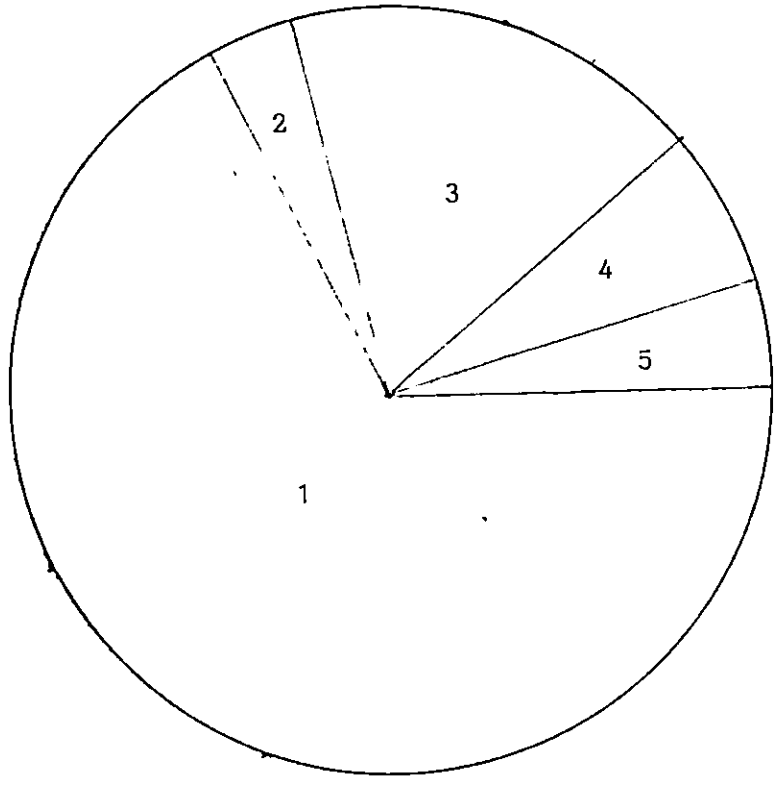
4.2 Detection of disease symptoms and plant protection techniques

The ability of the grower to detect abnormal leaf fall, and pink was rated as 82 per cent and 77 per cent, respectively (Table 3). Whereas the ability to detect powdery mildew disease was only 24 per cent. Hence the growers should be educated to identify powdery mildew disease during the early stages of infection.

Table 1. Incidence of three major diseases of rubber in Tellicherry taluk

Name of diseases	Total units infected		No. of trees infected	Total trees	Percentage
	Unit	Area			
1. Total surveyed	100	98.83	-	45552	-
2. Abnormal leaf fall disease	88	71.26	24373	29776	72.10
3. Pink disease	84	84.20	1800	37050	4.90
4. Powdery mildew disease	91	80.84	39001	40246	81.79

Fig. 1. Incidence of three major diseases combinations

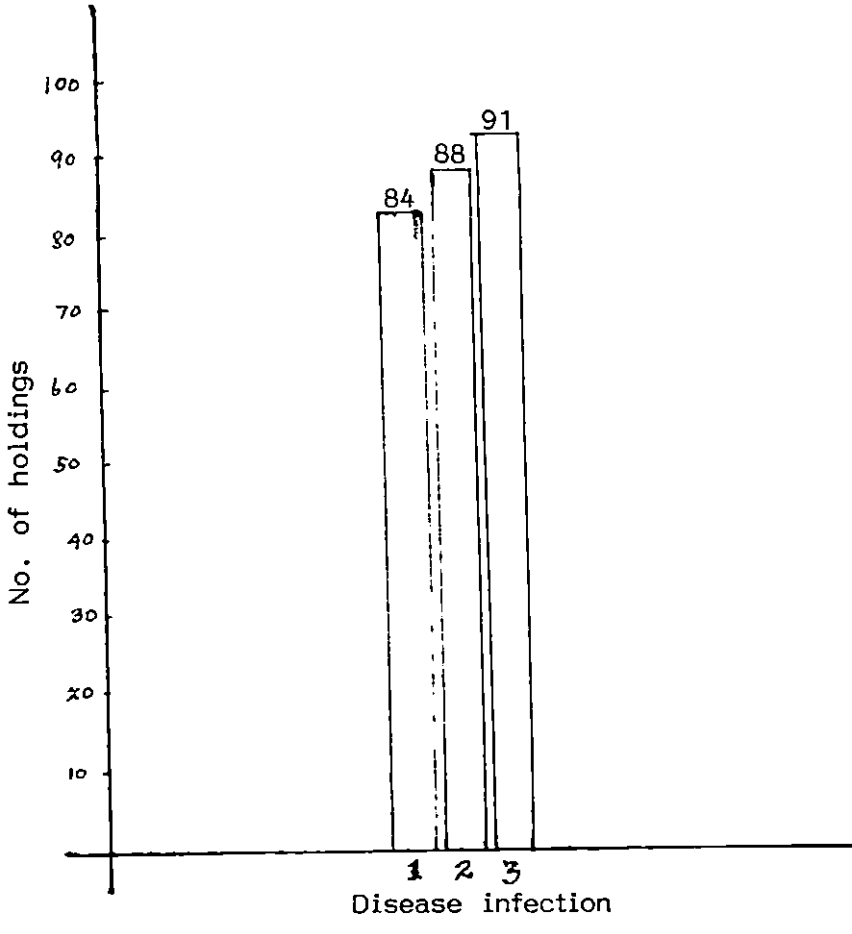


	Units
1. Abnormal leaf fall disease, Pink and Powdery mildew	67
2. Pink disease	4
3. Abnormal leaf fall and Powdery mildew	16
4. Pink and Powdery mildew disease	8
5. Pink and Abnormal leaf fall disease	5

Table 2. Combined infections of three diseases

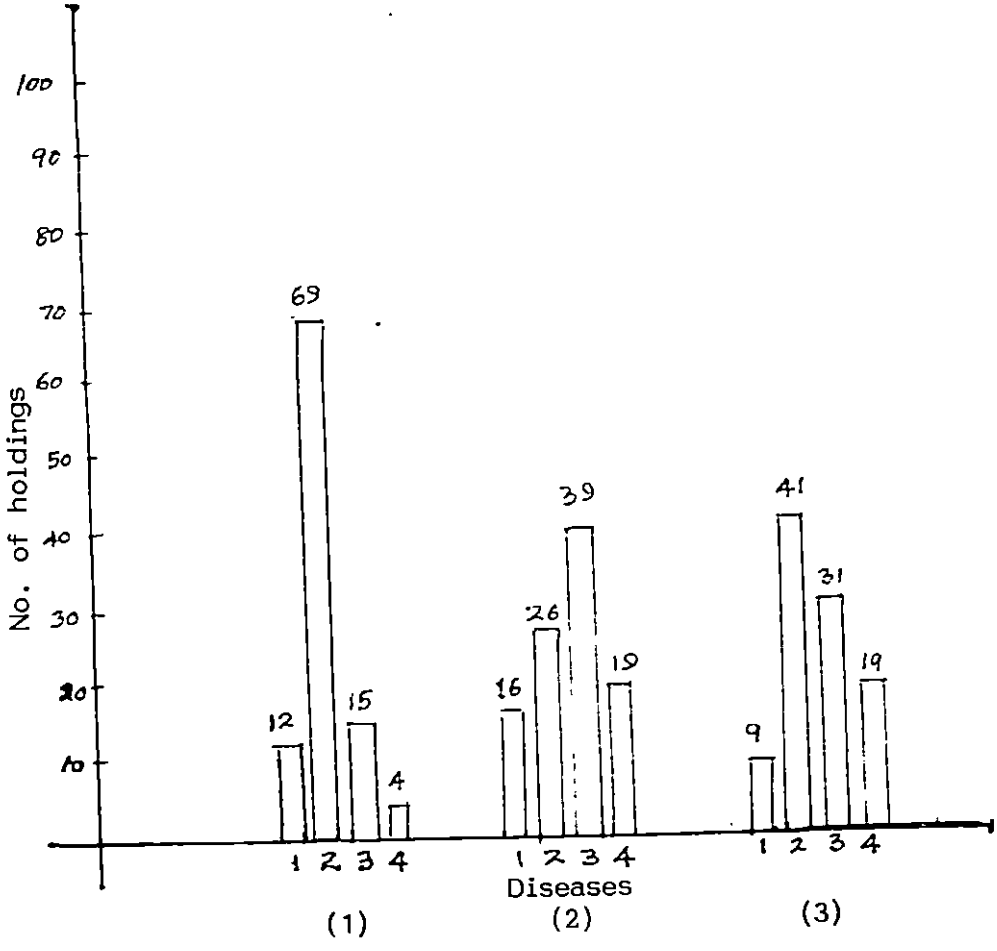
Sl.No.	Name of diseases	No. of units infected
1	Abnormal leaf fall and powdery mildew	16
2	Abnormal leaf fall, pink and powdery mildew diseases	67
3	Pink only	4
4	Pink and abnormal leaf fall disease	5
5	Pink and powdery mildew	8
	Total units surveyed	100

Fig. 2. Disease infection



	Units
1. Pink disease	84
2. Abnormal leaf fall disease	88
3. Powdery mildew disease	91

Fig. 3. Nature of infection of three diseases



1. Abnormal leaf fall disease
2. Pink disease
3. Powdery mildew disease

1. No infection; 2. Mild infection; 3. Medium infection; 4. Severe infection

Table 3. Detection of the disease and knowledge of plant protection technique

	Abnormal leaf fall		Pink		Powdery Mildew	
1) Total holdings infected	88		84		91	
	No.	%	No.	%	No.	%
2) No. of holdings wherein disease is properly detected and its percentage	68	77	69	82	22	24
3) Farmers knowledge of plant protection technique in number and percentage	66	75	64	76	25	27

Table 4. Knowledge of planter on plant protection techniques

Sl.No.	Name of the disease	Number of units			
		Poor	Satis-factory	Good	Total units
1	Abnormal leaf fall	9	70	9	88
2	Pink	15	60	9	84
3	Powdery mildew	56	27	8	91

Eventhough the growers were well versed on the common symptoms of abnormal leaf fall and pink diseases, they were not conversant with the powdery mildew disease (Table 3 and 4). Plant protection measures were not adopted to control powdery mildew due to unavailability or high cost of plant protection equipment and chemicals. The growers also expressed their inability to conduct the dusting in the early hours of the days which is highly essential for effective control of the diseases.

4.3 Abnormal leaf fall disease

The data pertaining to the incidence of abnormal leaf fall disease is presented in Tables 5 to 7.

4.3.1 Nature of infection

Out of the 88 holdings where abnormal leaf fall was observed, the infection was severe only in 6.34 per cent of the holdings. In 79.24 per cent of the holdings, the infection was in a mild form (Table 5). This low rate of infection may be due to the tolerance of RRII 105, which is the popular clone in the surveyed area (Plate 1).

4.3.2 Control measures adopted

The details of control measures adopted by the small holders against abnormal leaf fall disease is presented in Table 6.

Plate 1. Abnormal leaf fall disease infected area, RRII 105

Table 5. Nature of infection of abnormal leaf fall disease

	No. of holding	Total area infected in ha	Total trees	Percentage
Total number surveyed	100	98.83	45552	-
1) Mild	69	56.47	23237	79.24
2) Medium	15	10.27	4842	14.40
3) Severe	4	4.52	1697	6.34
Total	88	71.26	29776	
No infection	12	26.52	15776	26.83

Mild - Infection below 25 per cent; Medium - between 25-50 per cent and Severe - above 50 per cent

Table 6. Abnormal leaf fall disease - Control measures adopted

	No. of holdings	Percentage
No. of units surveyed: 100		
1) No. of units where spraying done before infection	57	57.00
2) Fungicide used:		
i) Bordeaux mixture	45	78.94
ii) Copper Oxychloride	12	21.05
3) Sprayers used:		
i) Rocker sprayer	45	78.94
ii) Power sprayer	12	21.05
4) Farmers adopting recommended control measures:		
a) Yes	8	14.03
b) No	49	85.96
5) Cost of Chemical	Rs.545.00	
Cost of labour	Rs. 51.25	
Total	Rs.596.25	

Control measures were adopted against abnormal leaf fall by 57 per cent of the growers. Out of that 78.94 per cent used high volume spraying with Bordeaux mixture using rocker sprayers. Oil based copper fungicide was used by 21.05 per cent of the growers using power sprayers (Plate 2). Eventhough 57 per cent of the holdings were sprayed before infection, only 14 per cent were sprayed with the correct proportion and dose while 86 per cent were sprayed with inadequate dose of the chemical. This clearly indicate that there is an extension gap regarding the actual recommendation of the Board and the practices followed by the growers.

4.3.3 Clonal variation for abnormal leaf fall

The rubber holdings in the surveyed area were occupied mainly by RRII 105, followed by GT 1, RRIM 600 and PB 235. Among the clones, RRII 105 was found to be more tolerant to the disease (Table 7). Twelve units with RRII 105 did not exhibit abnormal leaf fall disease infection. Even when infected, the severity was only in mild form (82.2%). Only 2.73% of RRII 105 had severe infection while in GT 1, 9 per cent of the plants showed severe infection. It is clear from the data that GT 1 is more susceptible to abnormal leaf fall, compared to RRII 105. As the number of holding with RRIM 600 and PB 235 was only two, it is not possible to arrive at any conclusion regarding abnormal leaf fall infection in these clones.

Plate 2. Micron spraying against abnormal leaf fall disease

Table 7. Clonal variation for abnormal leaf fall disease infection

Clone	Total No.of holdings affected		Nature of infection							
			Mild		Medium		Severe		Without infection	
	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
GT 1	11	12.50	7	63.60	3	27.27	1	9.00	--	-
RRII 105	73	82.95	60	82.20	11	15.07	2	2.73	12	14.11
RRIM 600	2	2.27	1	50.00	1	50.00	-	-	--	-
PB 235	2	2.27	1	50.00	-	-	1	50.00	--	-
Total	88	100.00	69	-	15	-	4	-	12	-

4.4 Pink disease

The data collected for pink disease incidence in the surveyed units is presented in Tables 8 to 12.

4.4.1 Nature of infection

Though the infection was noted in 84 per cent of the units surveyed, the number of trees actually infected were only 4.9 per cent and was severe only in 2.6 per cent of the units. The result indicate the infection of pink disease to be, not so severe in the surveyed area. The nature of infection was mild in 30.95 per cent, medium in 46.42 per cent and severe in 22.6 per cent (Table 8).

The nature of infection for pink disease was classified as mild (initial cobweb stage) medium (the latex oozing out stage) and severe (sprouting and drying stage). Out of 100 holdings surveyed, only 16 were free from pink disease.

4.4.2 Age of the tree and pink disease incidence

The data presented in the Table 9, indicate the incidence of pink disease in trees of varying maturity. The disease incidence was more in trees between 3 and 10 years. No conclusive result could be drawn since, the number of trees below 3 years in surveyed units were rather low.

Table 8. Nature of infection of Pink disease

	No. of holding	Total No. of trees	Trees infected	Percentage
1) Total number surveyed	100	-	-	-
2) Mild	26	11898	899	7.5
3) Medium	39	14056	613	4.35
4) Severe	19	11096	288	2.6
Total	84	37050	1800	4.9

Table 9. Relationship between age of the tree and pink infection and its percentage

Sl. No.	Age of trees	No. of units	Total No. of trees	No. of trees infected	Percentage
1	3	12	3865	128	3.05
2	4	13	3279	235	7.16
3	5	11	4447	148	3.32
4	6	12	4454	116	2.60
5	7	12	4548	166	3.65
6	8	8	6108	750	12.27
7	9	2	970	33	3.40
8	10	2	311	17	5.46
9	11	10	6898	167	2.42
10	12	1	920	20	2.17
11	13	1	1250	20	1.60

Out of the 100 units surveyed, infection of pink disease was observed in 84 holdings and 73.80 per cent of the growers were found adopting control measures against the disease. Out of the 62 cases where plant protection measures against pink disease was practiced, 87.00 per cent of the growers used Bordeaux paste (Plate 3) and 13 per cent used Thiride (Table 10). Among the two fungicides, Thiride was found to be more effective (Table 11).

It is observed that 58 per cent of growers adopted prophylactic spraying against abnormal leaf fall disease and 29 per cent of the growers used to spray branches and fork regions also, which reduced pink infection considerably. Lack of prophylactic treatment favoured the incidence of the disease in the remaining units.

With regards the frequency of inspection, 78.57 per cent of the growers inspected their plots weekly while 14.28 per cent visited daily and 7.14 per cent visited once in a month.

4.4.4 Clonal susceptibility to pink

The data presented in Table 12 clearly indicates that RRII 105 is susceptible to pink disease. Out of the 100 holdings surveyed, 69 numbers had pink infection. Severe infection of

Plate 3. Treatment to control Pink disease

Table 10. Detection of the disease; control measures adopted against pink disease

	Total	Percentage
1) No. of units surveyed	100	
2) No. of units infected	84	84.00
3) No. of holders adopting control measures	62	73.80
4) Inspection for detection of disease		
a) Daily	-	14.28
b) Weekly	-	78.57
c) Monthly	-	7.14
5) a) Farmers adopting recommended dose of control measures	49	79.00
b) Farmers adopting inadequate dose of control measures	13	21.00
6) Farmers adopting prophylactic foliar spray	58	58.00
7) Farmers adopting trunk and fork application	29	50.00
8) Fungicide used		
a) Bordeaux paste	54	87.00
b) Thiride	8	13.00

Table 11. Recovery of disease (Pink)

No. of infected		No. of plots treated		No. of treated				No. recovered			
				With Bordeaux paste		With Thiride		With Bordeaux paste		With Thiride	
Units	Trees	Units	Trees	Units	Trees	Units	Trees	Units	Trees	Units	Trees
84	1800	62	1695	54	1562	8	133	54	755	8	92

Table 12. Clonal variations for pink disease infection

	Total No. of holdings affected	Total No. of trees infected	Nature of infection		
			X	Y	Z
GT 1	11	322/6471	7	2	2
RRII 105	69	709/27689	19	34	17
RRIM 600	2	12/200	--	1	--
PB 235	2	750/2690	--	2	--
Total	84	1800/37050	26	39	19

pink in RRII 105 was noticed in 4 holdings while 36 had medium infection. The clone GT 1 had only low infection in 9 holdings, but none of the holdings had severe infection. The data of RRIM 600 and PB 235 are not sufficient to draw any valid conclusion.

4.5 Powdery mildew

4.5.1 Nature of infection

The details collected are presented in Table 13. The powdery mildew infection was observed in 91 holdings, out of the 100 surveyed. Severe infection was observed in 20.87 per cent of the holdings (Plate 4 and 5) and 34.06 per cent had medium infection. Only 9 per cent of the holdings were free from powdery mildew infection. The results show that powdery mildew is a very serious disease of rubber in Tellicherry taluk.

Defoliation/refoliation time can be taken as an index to study the severity of damage caused by powdery mildew. If period of defoliation/refoliation is for a short duration, the plants will get over the infection quickly. When the period is prolonged the damage is found to be severe. Ramakrishnan and Pillai (1962) has confirmed the phenomenon. In the present study, it indicates that in 97.8 per cent of the holdings the period of defoliation/ refoliation was spread over 2 months (Table 13. This clearly shows that powdery mildew infection in this area was very severe and causes heavy loss to the crop.

Plate 4. Powdery mildew disease (severely infected leaflets)

Table 13. Nature of infection of powdery mildew disease

	No. of holdings infected	No. of trees infected		Percentage
		Area	Trees	
1) Mild	41	43.27	20724	45.04
2) Medium	31	22.95	13412	34.06
3) Severe	19	14.62	6110	20.87
Total	91	80.84	40246	
4) Not infected	9	17.99	5306	9.00
5) Defoliated/ refoliated	91			22.41
a) Within 2 weeks	2			2.20
b) Spread over 2 months	89			97.80

Plate 5. Powdery mildew disease-severely infected(after defoliation)

It may be due to the poor fertility status of the soil and severe drough conditions prevailed. In such situations, the trees exhibit a much slower rate of growth of the leaves thereby exposing the leaves in a susceptible stage for infection for comparatively longer periods (Ramakrishnan and Pillai, 1982).

4.5.2 Control measures adopted against powdery mildew

Out of the 91 holdings infected by powdery mildew, only 8.79 per cent adopted proper control measures (Table 14). Sulphur dust was used in 87.5 per cent of the holdings while the others used wettable sulphur. The disease was effectively controlled, where 4 rounds of dusting with sulphur dust (Plate 6).

4.5.3 Clonal variation for powdery mildew

The popular clone RRII 105 was found to be severely infected (18.42 per cent) by powdery mildew (Table 15). Out of the 100 units surveyed only 9 per cent holdings were free from the disease, while all others had powdery mildew infection at varying intensity. The clone GT 1 was severely infected in 45.45 per cent of the cases and none of the holdings were free from infection. As the number of holdings with RRIM 600 and PB 235 were less in number, no clear conclusion about the disease intensity in these clones could be arrived at.

Plate 6. Sulphur dusting against powdery mildew disease

Table 14. Control measures adopted against powdery mildew

	No. of holdings	Percentage
1) No. of units surveyed	100	
2) No. of units infected	91	91.00
3) No. of holders adopting control measures	8	8.79
4) Fungicide used		
a) Sulphur dust	7	87.50
b) Wettable sulphur	1	12.50
5) i) Cost of chemical	Rs.302.35 (for 4 rounds)	
ii) Cost of labour	Rs.131.80 (for 4 rounds)	
Total	Rs.434.15	

Table 15. Clonal variation for powdery mildew disease infection

Clone	Nature of infection						Total No. of holdings affected
	Mild		Medium		Severe		
	No.	%	No.	%	No.	%	
GT 1	1	9.09	5	45.45	5	45.45	11
RRII 105	37	48.68	25	32.90	14	18.42	76
RRIM 600	1	50.00	1	50.00	-	-	2
PB 235	2	100.00	-	-	-	-	2
Total	41		31		19		91

Pillai et al. (1980) reported that GT 1 is tolerant to the disease while in the present investigation, the clone was found to be severely infected in nearly 50 per cent of the area. Thus the present study clearly shows that the popular clones RRII 105 and GT 1 are susceptible to powdery mildew and the growers are to be kept aware of the seriousness of the disease and proper plant protection measures to be taken to check the incidence of the disease.

4.6 Expenses for plant protection measures for the three major diseases

The actual cost incurred for the control of abnormal leaf fall by the growers of Tellicherry taluk was Rs.596.25 per hectare while it was Rs.2500/- as per the recommendations of the Board, when Boredaux mixture was used (Table 16). This shows that the small growers are using only one fifth of the recommended dose of fungicide. When the grower uses microns to spray, there was no difference in case of actual and the recommended practice. Though majority of the growers had taken steps to control pink disease, the control measures adopted for pink disease also was found inadequate. The actual cost incurred was Rs.68.00 whereas it would be Rs.135/-as per recommendations. Thus the small growers were not adopting adequate control measures as per the recommendation of the Board. They were using less quantities

Table 16. Expenses for plant protection measures for the control of the diseases, per hectare

Disease	Cost of chemical	Cost of labour	Total	Percentage of units
1. Abnormal leaf fall disease				
A. Rocker sprayer with Bordeaux mixture				79.00
a) Actual cost	545.00	51.25	596.25	
b) Cost as per recommendation	1175.00 + 75.00	1250.00	2500.00	
B. Low volume spraying				1.70
i) Aerial				
a) Actual cost	1125.00	375.00	1500.00	
b) Cost as per recommendation	1125.00	375.00	1500.00	
ii) Micron				19.30
a) Actual cost	735.00	305.00	1040.00	
b) Cost as per recommendation	735.00	305.00	1040.00	
2. Pink disease				
A. Bordeaux paste				81.10
a) Actual cost	103.90	54.50	158.40	
b) Cost as per recommendation	225.00	200.00	425.00	
B. Thiride				12.90
a) Actual cost	18.00	50.00	68.00	
b) Cost as per recommendation	35.00	100.00	135.00	
3. Powdery mildew disease				
A. Sulphur treatment				8.84
a) Actual cost	302.35	131.80	434.15	
b) Cost as per recommendation	336.00	324.00	660.00	

of chemicals in case of abnormal leaf fall and pink and hence measures adopted were either insufficient or less effective. It was very conspicuous in the case of Bordeaux mixture spraying. The actual recommendation is 50 kgs of copper sulphate per hectare. In the case of low volume spraying with oil based fungicides the quantity of chemical used was satisfactory.

In the case of powdery mildew disease, only few farmers adopted control measures but were satisfactory. Since RRII 105 is highly susceptible to powdery mildew, the infection was found very common in Tellicherry taluk.

Summary and Conclusions

5. SUMMARY AND CONCLUSIONS

A survey was conducted to study the incidence of three major diseases of rubber, namely abnormal leaf fall, pink and powdery mildew in Tellicherry taluk of Kerala state. The clonal susceptibility, percentage of damage, control measures adopted by growers and its recovery from disease were evaluated. Out of the 100 units surveyed, abnormal leaf fall occured in 88 holdings, pink in 84 units and powdery mildew in 91 units. Most of the units were infected by more than one disease. In 67 units the trees were infected with all the three diseases. Among the incidence of three diseases, powdery mildew incidence was maximum in the area surveyed. The farmers' ability to detect the disease symptoms at early stages was very poor compared to the other two diseases. Maximum tolerance to abnormal leaf fall disease was noticed in RRII 105 and GT 1. Since the planting material was RRII 105 in majority of cases, the leaf retention during monsoon was satisfactory even without prophylactic spraying. Hence the growers who have planted with RRII 105 were found to forgo the generally accepted practice of prophylactic spraying with copper fungicides before the onset of monsoon. Generally mild infection of leaf fall was found not to cause crop loss. If spraying is not done in one season, susceptible clones experience crop loss. If the benefit can cover the expenditure on plant

protection, then spraying is advantageous. Prophylactic spraying was found necessary in Tellicherry taluk for all the clones except, RRII 105.

Maximum incidence of pink was noticed in RRII 105 and minimum in PB 235 among the four clones found in the surveyed area. Bordeaux paste was the common fungicide used for the control of pink disease. Only few growers knew the correct method of preparation and application of Bordeaux paste. Careless treatment of the infected part and improper disposal of the infected plant parts were found to provide large inoculum for the repeated infection of the disease. The growers failed to detect the disease at the initial stages or sufficiently early to carry out effective control measures. Use of Thiride may be popularised, since it was found more effective in rainy season. Growers are to be made aware of the early symptoms of the disease, so as to enable early detection. Demonstration classes with the help of visual aids would be of great use.

Though powdery mildew disease was very common in the surveyed area, most of the growers were found ignorant about the disease and its control measures. Prophylactic dusting is to be insisted at the time of bud break especially in areas where the incidence of powdery mildew was observed in the previous years. Four to six rounds of dusting should be done

when the disease is noticed to protect the tender flushes fully. RRII 105 was found susceptible to powdery mildew infection.

Due to leaf fall, extra weeding is also found necessary. Now powdery mildew disease appears to be the most severe disease in Tellicherry taluk.

The protective measures against powdery mildew are not adopted by the small growers mainly for want of plant protection equipments and its availability in time and the difficulty in procuring sulphur dust. Disease tolerant clones may be planted in future. Monoclone planting may be discouraged, to regulate the maladies of epidemics in future.

The need for an intensive extension education programme to create awareness among small growers about the disease and its timely control is evident from the present study.

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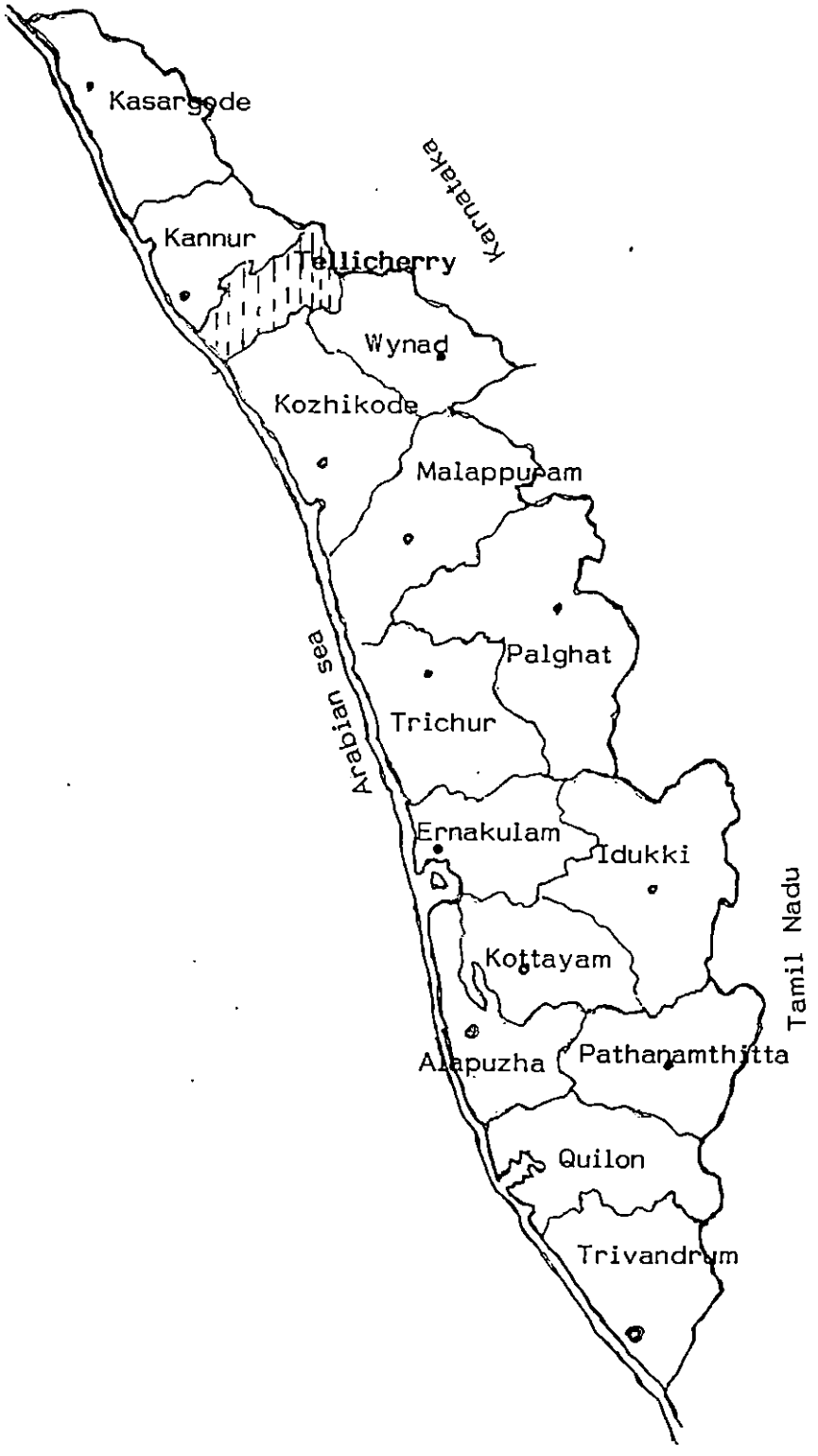
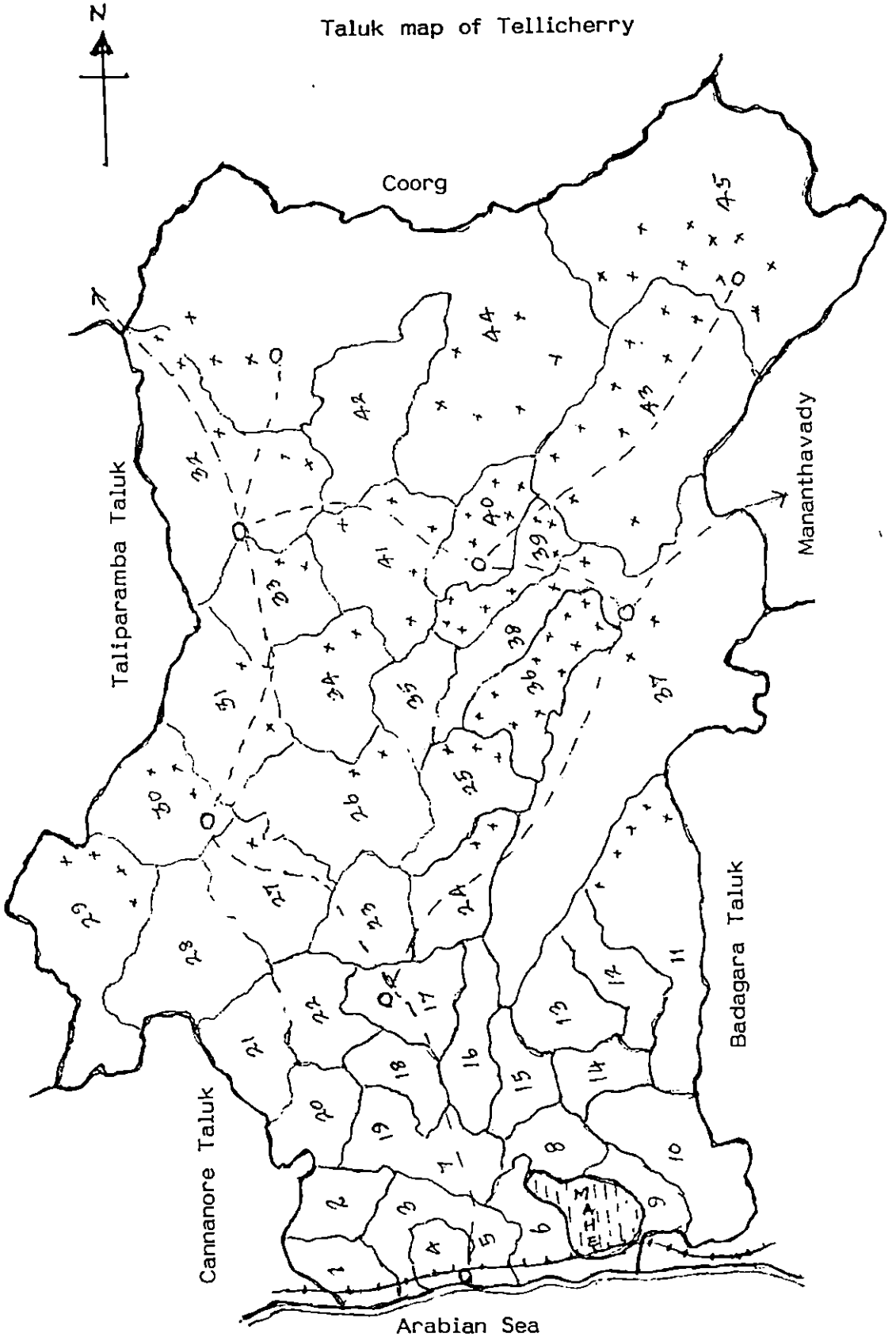
Annexure-Ia

Map of Kerala



Annexure-Ib

Taluk map of Tellicherry



Annexure-II

MAJOR DISEASES AFFECTING RUBBER AND ITS CONTROL MEASURES BY SMALL RUBBER GROWERS OF TELLICHERRY TALUK

PROFORMA

1. Name and address of the owner :
2. Register No./Permit No. :
3. Year of planting : Age
4. Extend of the area : ha.
5. Terrain of land : Sloppy/Flat/Steep
6. Proximity of water source : Inside the plot/Outside the plot
7. Approximate elevation :
8. Planting material : Clonal/Bud (clone)
9. Average yield/ha/annum :
10. Proximity to other estate : Adjacent/ Kms
11. Location of the holding :
12. Disease incidence (Name of disease) :
13. How the extension activity reached him in identifying the disease :
14. Remarks :

12.1 PINK DISEASE

a) Nature of infection : X/Y/Z*

b) Intensity of infection : Mild/Medium/Severe

c) No. of trees affected : (Total trees present in the holding)

d) Trees with crown chopped : Without treatment/Even after treatment

e) Control measures adopted : Yes/No

i) Fungicide used : Bordeaux Paste/Thiride/Others

ii) Mode of application :

iii) Prophyllatic spraying done or not : High volume/Low volume/Micron-AAerial/Not sprayed

iv) Whether sprayed on trunk, fork branches with 1% bordeaux mixture : Yes/No
Date of spraying :
Interval of spraying : Monthly/ 2 months

v) Whether removed part is burried : Yes/No

vi) Cost of control measures adopted : 1. Cost of chemical Rs.
2. Cost of labour Rs.

f) Reason for not adopting control measures :

g) Nature of inspection by the grower : Daily/Weekly/Monthly

h) If any infected plant is seen nearby : Yes/No Age

i) Knowledge of the planter in disease symptoms and its detection : Poor/Satisfactory/Good

j) Knowledge of the planter on plant protection technique : Poor/Satisfactory/Good

k) Additional information if any :

Note: X - Initial Cobweb stage; Y - Latex oozing out stage
Z - Sprouts and drying stage
Mild - Below 25%; Medium - Between 25-50%; Severe - Above 50%

12.2 ABNORMAL LEAF FALL DISEASE

a) Nature of infection : Mild/Severe/Medium/No infection

b) Whether prophylactic spraying done or not : Yes/No

c) Chemical used : Bordeaux mixture/Copper Oxychloride

d) Method of spraying : Rocker/Power sprayer/Helicopter

e) Interval of spraying : Two months/Once in a year

f) Spraying done after infection or before infection : After/Before

g) Cost of spraying :
1. Cost of chemical Rs.
2. Cost of labour Rs.

Total Rs.

h) Efficiency of spraying : Poor/Satisfactory/Good

i) Extent of damage of individual plants : Mild/Medium/Severe

j) Knowledge of the planter in preparation of bordeaux mixture : Poor/Satisfactory/Good

k) Knowledge of the farmer in spraying techniques : Poor/Satisfactory/Good

l) Other information if any :

m) Reason for not adopting control measures, if not already adopted :

12.3 POWDERY MILDEW DISEASE

a) Nature of infection : Mild/Medium/Severe/Not infected

b) Plant protection method adopted : Sulphur dusted/Not dusted

c) Time of application of the fungicide : Before/After infection started

d) Interval of sulphur dusting : Initial round/After 10 days/ after 20 days/30 days

e) Cost of dusting : Ist round 2nd round 3rd round

Cost of chemical :
Cost of labour :

f) No. of trees defoliated/ refoliated	: Within 2 weeks/Spread over 1 month
g) Leaf retention after dusting	: Good/Average/Poor
h) Knowledge of the farmer in dusting technique	: Poor/Satisfactory/Good
i) Remarks	:

Annexure-III

Village wise distribution of units surveyed in Tellicherry taluk

Sl.No.	Name of Village	Total units	Serial number of units
1	Kappad	6	10, 67, 21, 25, 49, 70
2	Kolakkad	3	72, 73, 82
3	Kottiyoor	10	6, 7, 11, 12, 13, 14, 15, 29, 54, 56
4	Kelakam	7	4, 2, 5, 8, 9, 55, 81
5	Manathana	5	19, 31, 48, 85, 86
6	Cheruvancherry	2	4, 75
7	Vekkalam	2	26, 84
8	Muzhakkunnu	5	34, 37, 42, 44, 99
9	Aralam	2	3, 100
10	Kolayad	12	22, 27, 28, 31, 52, 58, 60, 61, 63, 65, 71
11	Tholambra	5	36, 51, 78, 83, 98
12	Thillankery	2	66, 67
13	Keezhoor	2	40, 91
14	Chavassery	2	45, 97
15	Kolari	3	32, 33, 38
16	Koodali	4	35, 43, 66, 79
17	Pazhassi	1	87
18	Sivapuram	2	57, 77
19	Kannavam	3	41, 53, 64
20	Manantheri	2	59, 74
21	Thrippangottoor	5	92, 93, 94, 95, 96
22	Vellarvally	8	16, 78, 20, 25, 50, 68, 69, 76
23	Payam	7	39, 46, 47, 80, 88, 89, 90

Annexure-IV

Name and address of the surveyed units

Sl.No.	Name and address of the grower
1	Sri.G. Neelakantan Nair, Adackathode, Kelakam,P.O.
2	Sri.Mathew Kaniyamparambil, Kelakam, P.O.
3	Sri.Joseph Chembarathinkal, Ambayathode
4	Smt.Mary Cheriyan, Panachiyil, Narikothemala
5	Sri.E.T.Luka, Eruppakkathu, Adackathod
6	Sri.Joseph, Pendanath, Chungakkunnu
7	Sri.K.K.Devasia, Kalappurakal, Kanichar
8	Sri.Mathen, Kurumbikulam, Adackathode
9	Sri.C.V.Chacko, Parumathara, Chettimpumba
10	Sri.T.T.Varkey, Thodangazhiyil, Chungakkunnu
11	SmtAnnamma Joseph, Kunnampally, Chungakkunnu
12	Sri.Joseph, Kalathil, Chungakkunnu
13	Smt.Thressia, Vadakke Amkkathe, Chungakkunnu
14	Sri.Thomas, Anikkethe, Chungakkunnu
15	Sri.Mathew Arikkathe, Chungakkunnu
16	Sri.V.A.Antony, Vadakkemalanjaral, Thettivazhy
17	Smt.Mary Michael, Koodakkathu, Thondiyil
18	Sri.P.N.Purushothaman, Parappallil, Perumpunna
19	Sri.P.A.Mathew, Pamplaniyil, Manathara
20	Smt.Elikutty Thomas, Vichattu, Peravoor
21	Sri.Mathai Kuriakose, Adhikarathu, Kolakkad
22	Sri.M.A.Joseph, Pyar land, Nedumpoil
23	Sri.Joseph, Kakkaramattathil, Kolakkad
24	Sri.Abraham Thomas, Malath, Poolakkutty
25	Sri.Aryappally Krishnan, Peravoor, Kunithala
26	Sri.T.J.Lukose, Thengumpallil, Perumpunna
27	Sri.Joseph, Padinharakochuveettil, Nedumpoil
28	Sri.A.V.Mathew, Ayathumkudy, Nedumpoil
29	Sri.Mathew, Thangamthottil, Chungakkunnu
30	Sri.Vattiyil Thomas, Madappuvachal,P.O., Manathara

Contd.

Annexure-IV. Continued

Sl.No.	Name and address of the grower
31	Smt.Mary Jacob, Madakakuzhy, Kolakkad
32	Sri.P.Gopalan Nambiar, Chandralayam, Porora,P.O.
33	Sri.Kariath, Sameera, Shabeena Manzil, Mattanur
34	Sri.A.M.Cheriyan, Akkal, Muzhakkunnu, P.O.
35	Sri.K.K.Abdul Khader, Kunnupuvath, Mundary,P.O.
36	Smt.Leelamma George, Vettikkattu, Tholambra
37	Sri.T.Sankara Varrier, Sreekailas, Muyhikkunnu Bazar
38	Sri.C.P.Narayanan Nambiar, Karayi, Mattannur College,P.O.
39	Sri.U.K.Narayanan, Oothoornikalayil, Iritty,P.O.
40	Smt.Chandroth Sara, Kunjamina, Vilakode,P.O.
41	Sri.K.Krishna Kurup, Thodikalam, Kannavanu, P.O.
42	Sri.P.N.Thankappan, Pathirikkal, Muzhakkunnu
43	Smt.P.K.Padmavathy, Padmalayalam, Pattanur
44	Sri.K.M.Varkey, Karithadathil, Perumpunna
45	Sri.P.Muhammed, Prathibha, Thona, Kannur-12
46	Sri.M.D.Mathai, Mezhukunnel, Payam,P.O.
47	Sri.M.K.Kunhiraman, Madathil, PPayam East,P.O.
48	Sri.T.V.Joseph, Thurakal, Thondiyil,P.O.
49	Sri.K.J.Chako, Kulavadikkara, Chegorne, Kanichar,P.O.
50	Sri.V.D.Varghese, Vadakkemulanjanal, Perumpunna
51	Sri.Ittiaviṛah Joseph, Pallivathukkal, Alachery,P.O.
52	Sri.K.Kunhikkannan, Kandmbilli, Kolayad
53	Sri.Karyankal Benny Bus, Edayar,P.O.
54	Sri.T.Chacko, Ezhumalyil, Chungakkunnu,P.O.
55	Sri.Joseph, M.V., Madappalikunnel, Kelakam,P.O.
56	Sri.K.J.Thomas, Kudipara House, Chungakkunnu,P.O.
57	Sri.V.Moidu, Sameera Manzil, Sivapuram,P.O.
58	Smt.Marykutty, K.C., Madhavappallil, Kolayad,P.O.
59	Smt.A.K.Shylaja, Chanchal Rubber Estate, Mananthora,P.O.
60	Sri.P.N.Prakasan, Chandroth, Alachery,P.O.

Contd.

Annexure-IV. Continued

Sl.No.	Name and address of the grower
61	Smt.Alice, Kudakachira, Kolayad,P.O.
62	Sri.Kolachery Raman, Machoormala, Thillamkery,P.O.
63	Sri.Variyath Joseph, Alacherry,P.O.
64	Sri.K.C.Sebastian, Kariankal, Edayar, Kannoth,P.O.
65	Sri.Marikkoli Chandran, Mattannur,P.O.
66	Sri.K.Mohan Namboodiri, Krishna Nivas, Kara-Kayani,P.O.
67	Sri.C.K.Divakaran, Thillankery,P.O.
68	Dr.M.T.Mathew, Manimala, Thondiyil,P.O.
69	Sri.Kolappurath Nanu, Perumparamba, Iritty,P.O.
70	Sri.Abraham Kunnel, P.O.Kolakkad
71	Sri.M.C.Mathew, Mattathil, P.O.Thondiyil
72	Sri.Fabian Thomas, Ayilookunnel, Kolaklad,P.O.
73	Sri.Mathew Thottathil, P.O.Poolakutty
74	Sri.A.K.Rajagopalan, eivens Manager, Maratheri,P.O.
75	Sri.Joseph, Adihirayil, Cheruvancherry,P.O.
76	Sri.Puthenpurackal Narayanan, Maringodi, Perumponnu,P.O.
77	Sri.A.K.Mayan, Soudha Industries, Sivapuram,P.O.
78	Sri.C.V.Ulahannan, Cheruparambil, Tholembra,P.O.
79	Sri.P.M.Easwaran Namboodiri, Pattannur,P.O.
80	Sri.EmmanualThodukayil, Kunnoth, Kiliyanthara,P.O.
81	Sri.P.J.Baby, Parakottil, Kelakam,P.O.
82	Sri.Joseph, Pampadiyil, Kanichar,P.O.
83	Smt.Mary Thomas, Cheriyakal, Tholembra,P.O.
84	Sri.Chacko, Kunnath House, Perumpunna,P.O.
85	Smt.Rosa, Kokkatt, Manathara,P.O.
86	Sri.A.J.Mathew, Edavathuthazhe, Manathara,P.O.
87	Sri.Kuniyil Mammed, Cheriyandi House, P.R.Nagar, P.O.
88	Sri.T.K.Kunhiraman Nair, Harimandiram, Madathil, Iritty
89	Sri.Ulahanna, Parackal, Uilamana, Kiliyanthara,P.O.
90	Sri.M.G.George, Mundayaniyil, Kiliyanthara,P.O.

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Annexure-IV. Continued

Sl.No.	Name and address of the grower
91	Sri.Thomas, Uzhunnalil, Puthussery, Iritty,P.O.
92	Smt.Aleyamma Abraham, VKK Estate, Cheruvancherry, P.O.
93	Sri.Cheriyan Skariah, Panachal, Narikkottumala,P.O.
94	Sri.Abraham Abraham, V.K.K.Estate, Cheruvanchery,P.O.
95	Smt.Annamma Abraham, Narikkottumala,P.O.
96	Smt.Aleyamma Kuriakose, Illickal, Narikodi,P.O.
97	Sri.N.V.Narayanan, Nalla Veedu, P.O.Chavassery
98	Sri.Konnayil Thomas, Pothukuzhy, P.O.Tholembra
99	Smt.M.S.Ammini Amma, Valiplackal, Edathotty, Muzhakunnu,P.O.
100	Sri.Joseph, Madokkavunkal, Karikkottukari, Koomathode,P.O.