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

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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 Vaikom 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.

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CERTIFICATE

Certified that this dissertation entitled **"Major diseases affecting rubber and its control measures adopted by small growers of Vaikom Taluk"** is a record of research work done by **Sri. A.P. Sreedharan** under our guidance and supervision and that it has not previously formed the basis for the award of any degree **egree** or diploma to him.

We the undersigned members of the committee of Sri. A.P. Sreedharan, 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 rubber growers of Vaikom Taluk" may be submitted by Sri. A.P. Sreedharan, in partial fulfilment of the requirement of the Diploma.

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Introduction

1. INTRODUCTION

Commercial rubber planting was started in India since 1902. The weather conditions prevailing in India especially in Kerala are more or less the same as that of Brazil, the native place of the para rubber Hevea braziliancis (Muell. Arg.). Being a rainfed crop rubber tree is prone to the attack of some diseases which are seen mainly during rainy season. These diseases are affecting the rubber plants at various stages of growth and are reducing the growth considerably. Incidence of diseases finally reduces the yield from the trees.

In Kerala, different rainfall pattern is prevailing in the important areas of rubber planting. Therefore, the extent of incidence of diseases in different rubber growing areas are also different. In order to get a clear picture of the incidence of various diseases location specific study is found necessary. The major diseases affecting the rubber are abnormal leaf fall, pink disease and powdery mildew.

Disease management measures are always expensive and it is seen that about 10% of the total cost of cultivation is annually required for effective control of diseases in

a hectare. Details regarding the cost of planting, cost of upkeep, cost of disease control etc. can be available from the large estates as they keep records properly. But the details are not available from small holdings because they do not keep such details for their future use.

Hence, a study was taken up to evaluate the major diseases affecting rubber in the small holding sector of Vaikom Taluk of Kerala State and the control measures adopted by the small holding sector so that further strengthening of the extension strategies for that area.

Review of Literature

2. REVIEW OF LITERATURE

2.1 Abnormal leaf fall disease

The abnormal leaf fall disease of rubber was recorded in India during 1910 from the estates of Palappilly in Trichur district of Kerala State. The attention of growers was drawn to this disease where healthy seeds could not be obtained for planting because of pod rot which was followed by defoliation. In due course the disease spread to all other rubber growing districts. At present it is the most destructive disease of rubber in India. (Jayaratnam et al.,1980).

In 1876, Anton de Bary was the first to name the pathogen Phytophthora (plant destroyer) when he noticed potato late blight fungus Phytophthora infestans. The species of pathogen causing abnormal leaf fall disease is Phytophthora palmivora (Ervins et al.,1983).

2.1.1 The disease incidence

Incidence of the disease starts at the time of the South West monsoon under Kerala condition. A continous spell of rain of 250-300mm for 7-10 days, without intermittant sunshine is congenial environment of leaf fall (Thomson and Pillai, 1976). Relative humidity of

98% is more conducive for the disease. The mean temperature between 15.6°C and 28.9°C which is very much favourable for sporangial growth of the Pathogen and start of the leaf fall disease. The disease caused by Phytophthora palmivora which spreads rapidly through the plantations until the disease assumes epidemic proportions. (Tucker 1931, Wellman 1954). As the fungus attack not only the leaves but also the fruit, the green branches, and the stem. (Petch. 1936). Infection of shoots which is common on young plants during the monsoon season in phytophthora endemic areas lead to shoot die back (Rubber Board 1980, Radziah and Hashim, 1990).

Clones like PB 86, PRIM 600, PR 107, are found susceptible. But clones like RRII 105, GT I, Gl I, BD 10 are tolerant (Rubber Board 1980).

Health of the infected trees are debilitated by leaf fall die back and shoot rot. Heavy leaf fall was noticed upto an extent of 50% in sprayed areas of susceptible clones (Rubber Board, 1989). Abnormal leaf fall disease observed to cause 9-16% of yield loss in susceptible clones of Hevea brazilianzis of 10-25 years of age (Rubber Board 87-88). The disease adversely affected the growth and bark renewal of the trees. The disease increased plugging index and reduced the dry rubber content of the

latex (Sethuraj et al.,1984). Moderately tolerant clones like RRII 105, GT 1, PB 217 and Gl I are likely get protection with lower dose of fungicides according to rainfall pattern of the concerned region (Jayaratnam et al.,1987).

2.1.2 Control measures

Prophylactic spraying of 1% bordeaux mixture was more effective for the control of this disease and this is being adopted extensively by rubber growers at present. An integrated approach combining the biological, cultural and chemical control methods is most beneficial (Radziah and Hashim, 1990) Ramakrishnan and Pillai (1961) found 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.

The disease can be controlled by crown budding. The susceptible trees crown budded with BD 10, a tolerant clone even after 30 years of crown budding the tolerance displayed by these crown budded trees is remarkable. (Pillai et al.,1980).

2.2 Pink disease

The pink disease of rubber caused by the fungus Corticium salmonicolor (Berk & Br). The disease first occured in Sri Lanka in 1870 (Petch, 1921). In south India the disease was first recorded in 1908. (Pillai and George 1980). The disease appears generally at the fork region of a tree where several branches arise at the same level from main stem (Sharples 1936). Pink disease attacks rubber trees of all ages once the woody part is developed, but more damage is caused in plants of age ranging from two to twelve years (Pillai and George, 1980).

2.2.1 Incidence of the disease

During the initial stages of infection superficial growth of cobweb like mycelia will be noticed on the bark. The mycelial growth will be glistening white in colour. After the mycelial stage the pathogen penetrate the bark and cause extensive damage to the internal tissues. Exudation of latex is observed from the infected region. Later the foliage will become yellowish in colour and then dries up. The dried leaves will be noticed still sticking to the dried branches. A number of sprouts arising from the position just below the infected region can also be seen. In young plants of upto three years of age infection is mainly observed on the main stem at different

heights in the region of brown bark. In older trees the infection could be mainly at forking region or on the main stem or primary branches (Pillai et al;,1980).

2.2.2 Control of disease

Prophylactic spraying of bordeaux mixture on the main stem, forking region and main branches was practiced in all rubber growing countires. Later on application of 10 per cent bordeaux paste was recommended widely. In advanced cases of infection bordeaux paste may be applied on the infected region. When it dries up, the surface may be scraped so as to remove all pathogen and the infected bark and the fungicide is applied again upto 30cm above and below the infected region.

Calixin 2 per cent mixed with ammoniated rubber latex is also recommended (Edathil and Jacob, 1983). Application of Thiride (Tetra methyl thiuram di sulphide) 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). Thiride at a concentration of 7500 ppm also gives good performance (RRII, 1986). High pressure injection of streptomycin was also seen effective against the disease (RRII, 1986).

2.3 Powdery mildew

The powdery mildew disease was first recorded in Java in 1918 (Sharples, 1936). The disease is caused by the fungus Oidium heveae. The disease affects plants of all ages, from very young nursery seedlings upto mature plants. The pathogen attacks very small brown leaves and cause them to fall off and on mature leaves while powdery patches are produced (Petch, 1921).

2.3.1 Incidence of the disease

Powdery mildew disease caused by Oidium heveae infects plants of all ages. 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 developed leaves however resist the severity of the infection.

The young leaves, as a result of infection loose their shining appearance and attain a dull colour. A white or ash coloured powdery coating develops on the tender leaves covering both upper and lower surfaces. The leaves may appear crinkling and distortion of the leaf area caused due to uneven growth of leaf tissues. In cases of severe attack in an estate the ground may be covered with a carpet of shed leaves and the trees will be almost denuded of leaflets, retaining more or less bare leaf petioles on the trees with a broomstick appearance.

The leaf petioles are later shed. The trees will again refoliate and these new leaves may also be attacked if climatic conditions are favourable resulting in repeated defoliations. 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 stage for infection (Ramakrishnan and Pillai, 1962).

The climatic condition prevailing at the time of refoliation play a major role in determining the severity of disease. Prevalance of overhanging mist or heavy dew, cloudy days and cool nights and relative humidity of 75 to 80 per cent in the atmosphere at the time of refoliation are the environmental conditions which favour the disease development. Light drizzles favour the onset and spread of disease (Petch, 1936).

The economic impact of powdery mildew depends on the growth stage of the plants. Severe disease which lead the trees bare, retard growth of young plants, thus prolonging the immaturity period in yielding plants, severe and repeated attack of the disease reduce yield (RRII, 1986).

2.3.2 Control of disease

The effective methods of controlling Oidium is dusting with sulphur dust. Depending upon the intensity of disease three to six rounds of dusting may be required

at an interval of four to ten days to control the disease effectively, using 11 to 14 Kg of 325 mesh fine sulphur dust per round per hectare through out 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).

Cultivation of clones resistant or tolerant to the disease saves the annual recurring expenditure on plant protection operations and provides a permanent solution (Pillai et al.,1980).

In mature areas application of tridemorph 1.5% dust was found superior to sulphur dust. Spray application of carbendazin 0.05 per cent also was found to give better control than the conventional wettable sulphur. Repeated use of any systemic fungicide may lead to development of resistance to the fungicide by the pathogen. Alternative use of systemic and non-systemic fungicides are suggested (Jayaratnam et al.,1987).

Powdery mildew caused by Oidium heveae results in severe defoliation of rubber in tropical rubber growing countries. In severely affected areas if proper control measures are not adopted the yield falls such low levels

that tapping becomes uneconomic. PB 86 showed 20.1 to 31.8 per cent crop loss and RRIM 600 13.5 to 28.5 per cent crop loss (Jacob et al.,1992).

Materials and methods

3. MATERIALS AND METHODS

Vaikom taluk of Kottayam district was chosen for the study. Altogether there were 12,773 units in the Taluk comprising 5,700 Hectare. The average size of the holding was 0.40 Ha. The map of Vaikom taluk is given as Annexure I.

Terrain of the land were slopy (62 units) undulating (29 Units) and flat (9 units). Elevation was between 6 metres and 26 metres above MSL. Taluk map showing village wise details and the units surveyed is given in Annexure I and III. Individual farmers were contacted and data collected regarding the incidence of abnormal leaf fall, pink and powdery mildew diseases. (Name and address given as Annexure IV). The selected units were visited for the confirmation of data. The informations were collected based on the questionnaire prepared, in advance in cnsultation 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 farmer in detection of disease and proper treatment were collected.

The extent of the individual units surveyed ranged from 0.06 ha to 0.80 ha. There were 89 units having the extent below 0.50 ha. 11 units between 0.50 ha and 1.00 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 of the infected plantations of susceptible clones were also studied.

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

Abnormal leaf fall disease
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

Mild	:	Initial cobweb stage
Medium	:	Latex oozing stage
Severe	:	Sprouts and drying stage

The data collected after detailed survey were tabulated. Detection of the disease at the early stages of infection is important in the controlling of the disease. Therefore, the study was concentrated on the ability of the small growers to detect the disease at the early stages of incidence. Control measures adopted and rate of recovery after treatment were studied. Expenditure for chemical control, difficulties in adopting the treatment and suggestions for improving them were collected and presented in tables.

Results and Discussion

4. RESULTS AND DISCUSSION

Vaikom taluk comprises of fourteen villages Viz. Chempu, Velloor, Mulakkulam, Njeezhoor, Kaduthuruthy, Vadayar, Kulasekharamangalam, Vadakkemury, Naduvile, Vaikom, Thalayazham, Vechoor, Kallara and Manjoor.

Total area under rubber is about 5,700 Hectares (1,788 Ha. of mature area and 3,912 Ha of immature area) Total number of holdings are 12,773 and all the holdings are small in size. The size of the holding selected for the study was between 0.06 ha and 0.80 ha. Important clones cultivated were RRII 105, RRIM 600, GT 1, and clonal seedlings. Average yield obtained was 984 Kg/Ha/ Year. Terrane is flat, undulating and slopy. An extent of 3195 ha was new planted and 2505 was replanted (Annexure 1).

4.1 Major Diseases Affecting Rubber in Vaikom Taluk

Major diseases found infecting rubber in Vaikom taluk were abnormal leaf fall, pink and powdery mildew. Out of the one hundred units surveyed 23 units were seen infected with abnormal leaf fall (area 5.91 ha). About 16.31 per cent of the trees in the surveyed area were found infected with the disease. Infection of pink disease was found in

51 units (15.38 ha) only 3.09 per cent of the trees in the surveyed area were found infected. Powdery mildew was observed in 99 units (area 31.26 ha) and 91.68 per cent of the trees were found infected with this disease. Hence, the powdery mildew infection was found to be more severe in the area surveyed.

Combined infection of abnormal leaf fall, pink and powdery mildew was another feature of this study. A total of 48 trees were infected (0.30%) in an area of 1.24 ha. (3.92%). Cross infection of powdery mildew and pink was another finding. A total of 362 trees were seen infected in 50 Units (Table 1).

4.2 Abnormal leaf fall disease

4.2.1 Intensity of the disease

The data pertaining to the incidence of abnormal leaf fall disease is presented in Table 2. Nature of infection was mild in three units (1.92%) and medium in 12 (9.86%) severe infection was observed in eight units (6.89%). There was no infection in 77 units. The results indicated that most of the units in the surveyed area was free from the disease.

4.2.2 Clonal variation for abnormal leaf fall

Clonal variation for the disease infection is presented in Table 3. RRII 105 was the major clone in the

Table 1. Details of major diseases infecting rubber in Vaikom Taluk

Details of disease infection	No.of Unit	Area(ha)	No. of Trees
Total Surveyed	100	31.62	15534
Abnormal leaf fall	23	5.91 (18.69)	2535 (16.31)
Pink disease	51	15.38 (48.64)	481 (3.09)
Powdery mildew	99	31.26 (98.86)	14242 (91.68)
Abnormal leaf fall and Pink infection	00	00	00
Abnormal leaf fall and Powdery mildew infection	00	00	00
Abnormal leaf fall and Powdery moldew and Pink	6	1.24 (3.92)	48 (0.30)
Powdery mildew and Pink disease	50	15.12 (47.81)	302 (2.34)

The values in parentheses indicate percentage.

Table 2. Intensity of Abnormal leaf fall disease

Nature of infection	No. of Unit	Area (ha)	No. of trees
Mild	3	0.61	170
Medium	12	3.12 (9.86)	1300 (8.47)
Severe	8	2.18 (6.89)	1065 (6.85)
Total infection	23	5.91 (18.67)	2535 (16.4)
No infection	77	25.71 (81.33)	12999 (83.59)
Total	100	31.62	15534

The values in parentheses indicate percentage.

Table 3. Clonal variation for Abnormal leaf fall disease infection

Clonae	No.of unit surve-yed	No.of unit infe-cted	Mild		Medium		Severe	
			Unit	Area (Ha)	Unit	Area (Ha)	Unit	Area (Ha)
RRII 105	88	18	2	0.31	11	3.24	5	1.35
GT 1	2	--	-	--	--	--	-	--
RRIM 600	3	1	-	-	1	0.24	-	--
Clonal seedlings	7	4	1	0.06	-	--	3	0.71
Total	100	23	3	0.37	12	3.48	8	2.06

surveyed area. Out of the 23 units infected by abnormal leaf fall 18 were of RRII 105, four clonal seedling area and one RRIM 600. Two units of RRII 105 had mild infection 11 had medium and the other had severe infection. About 4.90 ha with RRII 105 was seen infected out of the 5.91 ha. One unit of RRIM 600 was seen infected out of the three units and nature of infection was medium. Four out of seven units of clonal seedlings area were found infected with abnormal leaf fall. No infection was noticed in any of the two units planted with GT 1. Though there was clonal variation for the disease incidence was observed, no concluding results could be drawn due to the inadequate number of units for different clone. However, the relatively low incidence of the disease in the surveyed area could be due to the relative tolerance of RRII 105 (Pillai et al.,1980).

4.2.3 Control measures adopted

Table 4 summerises the details related to the control measures adopted for abnormal leaf fall disease and the cost incurred. Out of 100 units surveyed only eight (34.78%) units had taken prophylactic measures to prevent the disease. Spraying was also done in another eight units after the infection of the disease. Bordeaux mixture was used as the fungicide in the 16 (69.56%) units. Inadequate knowledge and lack of facilities might be the reasons to limit the use of low volume sprayers in the sprayed areas.

Table 4. Control measures adopted for Abnormal leaf fall disease

		No. of holding	Percentage
	Units surveyed	100	
	Units infected	23	
1.	Units where prophylactic spraying was done	8	34.78
2.	Units where spraying was done after infection	8	34.78
3.	Fungicide used		
	a) Bordeaux mixture	16	69.56
	b) Copper oxychloride	00	00
4.	Sprayers used		
	a) Rocker sprayer	16	69.56
	b) Power sprayer	NIL	--

		Actual cost	Cost on the basis of recommendation
		Rs. Ps.	Rs. Ps.
5.	1) Cost of chemical	840.00	1225.00
	2) Cost of labour	1250.00	1250.00
	Total	2090.00	2475.00

6. Farmer adopting recommended control measures:

Yes : 8

No : 15

For effective spraying of bordeaux mixture in one hectare of rubber plantation using rocker sprayer, the cost on the basis of recommendation was Rs.2475/- including labour. The actual cost incurred for the spraying of bordeaux mixture for the control of abnormal leaf fall disease was found to be Rs.2090.00. This shows that the quantity of chemicals used for spraying was inadequate.

4.2.4 Awareness of growers in plant protection technique

Table 5 presents the data pertaining to the awareness of growers in plant protection technique. Out of 2535 trees infected 705 trees (27.81%) have received prophylactic spraying. Spraying was alone done in 1230 (48.52%) trees after the infection of the disease. Out of 1935 trees treated 1140 (44.97%) trees recovered fully while 580 (22.87%) trees had partial recovery and 215 (8.48%) trees had no recovery. Detection of disease by growers was rated as seven poor, eight satisfactory and eight good. This shows that the awareness of growers in plant protection measures were poor. Though 69.56 per cent of growers could detect the disease satisfactorily they could save only 44.97 per cent of the trees from the disease. Defective methods adopted for preparing bordeaux mixture was observed as the main reason for the infection of the disease in the sprayed areas. Inadequate knowledge and lack of facilities were found to limit the use of low volume sprayers in the sprayed areas. Extension activities

Table 5. Awareness of growers in Plant protection technique Abnormal leaf fall disease

	No.	Percentage
No. of holdings surveyed	100	
No. of units infected	23	23
Total No. of trees	15534	
No. of trees infected	2535	16.31
No. of trees treated	1935	76.33
No. of trees with prophylactic spraying	705	27.81
No. of trees sprayed after infection	1230	48.52
No. of trees fully recovered	1140	44.97
No. of trees partially recovered	580	22.87
No. of trees with no recovery	215	8.48

Detection of disease

	No. of units	Percentage
Poor	7	30.43
Satisfactory	8	34.78
Good	8	34.78
Total	23	

may be strengthened to educate the growers in preparing bordeaux mixture and its application. No grower was found adopt low volume spraying though it is rather cheap.

4.3 Pink disease

4.3.1 Intensity of the disease

Data pertaining to the incidence of pink disease is presented in Table 6. Out of the 100 units surveyed 51 units were found infected. Mild infection was found in one unit (0.63%) Medium infection in 38 units (36.43%) and severe infection in 12 units (1.17%).

4.3.2 Clonal variation for pink disease

The clonal variation for the disease infection is presented in Table 7. Out of the four clones studied RRII 105 showed maximum infection. Forty eight units out of 88 were seen infected with pink disease. One unit of GT 1, and two units of RRIM 600 were also found infected. One unit of RRII 105 had mild, 37 had medium and 10 had severe infection of the disease. An extent of 13.99 ha. out of 15.38 ha. was found infected with the disease in clone RRII 105. One unit of GT 1 had severe infection out of two. Infection of pink disease was also found in two units of RRIM 600 out of three and no infection was noticed in the areas planted with clonal seedlings.

Table 6. Intensity of infection pink disease

	No. of Unit	Area(ha)	Trees
Mild	1	0.20 (0.63)	4 (0.02)
Medium	38	11.52 (36.43)	284 (1.82)
Severe	12	3.66 (11.57)	79 (0.50)
No infection	49	16.24 (51.35)	15167 (97.63)
Total	100	31.62	15534

The values in parentheses indicate the percentage.

Table 7. Clonal variation for pink disease infection

Clone	Total No. of holding		Nature of Infection					
	No. surveyed	No. infected	Mild		Medium		Severe	
			Unit	Area	Unit	Area	Unit	Area
RRII 105	88	48	1	0.20	37	10.75	10	3.04
GT 1	2	1	-	--	--	--	1	0.10
RRIM 600	3	2	-	--	1	0.77	1	0.52
Clonal seedling	7	-	-	--	--	--		--
Total	100	51	1	0.20	38	11.52	12	3.66

4.3.3 Relationship between age of the tree and pink infection.

The data presented in Table 8 indicate the incidence of Pink disease in trees of varying ages. The incidence of disease was more in trees between 4 and 13 years. Pillai et al., 1980 reports that the infection was more in trees between 2 years and 12 years. No conclusive result could be drawn as the number of units infected were less in surveyed areas. However it points to the need for adoption of appropriate control measures even in older areas.

4.3.4 Control measures adopted

Table 9 give the data pertaining to the control measures adopted against pink disease attack. Out of the 51 units infected control measures were adopted only in 36 units. Bordeaux paste was used as the fungicide. Out of the 36 units control measures were adopted only 50.41 per cent. A total of 121 trees (50.41%) recovered from the disease. While 37.08 per cent (89) had partial recovery and there was no recovery in 15.41 per cent (37) of the trees. Actual cost incurred for the treatment of the disease was Rs.162.00 including labour. The cost on the basis of recommendation was Rs,425.00 per ha.

Though Thiride was effective against pink disease, no grower applied it due to lack of awareness. Being a

Table 8. Relationship between age of the tree and pink infection and its percentage

Sl.No.	Age of tree	No. of units	Total No. of trees	No.of trees infected	Percentage
1	3	1	190	3	1.57
2	4	6	965	32	3.31
3	5	4	590	36	6.10
4	6	3	385	16	4.15
5	7	4	720	41	5.69
6	8	7	985	37	3.75
7	9	1	340	14	4.11
8	10	2	370	26	7.02
9	11	7	910	32	3.51
10	12	5	760	21	2.76
11	13	3	725	60	8.27
12	14	2	302	19	6.29

Table 9. Control measures adopted for pink disease

Adoption of control measures		Total	Percentage
1.	No. of units surveyed	100	
2.	No. of units infected	51	51
3.	No. of holders adopting control measures	36	70.58
4.	Fungicide used		

		Total	Actual cost of chemical	Actual cost of labour	Total
			Rs. ps.	Rs. ps.	Rs. ps.
	a) Bordeaux paste	36	101.00	61.00	162.00
	b) Thiride	Nil			
			Recommended Cost		
5.	Farmers adopting recommended dose of control measures	8	225.00	200.00	425.00
6.	Farmers adopting prophylactic foliar spray	8			
7.	Farmers adopting foliar spray covering fork region and trunk	Nil			
8.	Awareness of farmers about Thiride	4 NOs			
9.	Availability of Thiride - Not locally available				

10.	Recovery	Trees	Percentage
	No. of units treated	367	
	No. of trees treated	240	65.39%
	No. of trees recovered fully	121	50.41%
	No. of trees recovered partially	89	37.08%
	No. of trees without recovery	37	15.41%

petroleum based compound leaching away of thiride during rainy season is prevented. Due to severe leaching bordeaux paste requires repeated application and hence cost increases. Though four growers were aware of thiride it was not available for their use. Therefore, an awareness may be created among growers about thiride and its use. About 34.78 per cent of the growers only undertaking prophylactic foliar spray against abnormal leaf fall and nobody was adopting foliar spray along with spray trunk and fork region of the trees. This can be attributed for the disease infection.

4.3.5 Method of preparation and application of Bordeaux paste

Table No. 10 showed that methods of preparation and application of bordeaux paste was improper. Out of 36 units treated only six growers preapred Bordeaux paste properly and eight units could apply properly. Though 70.58 per cent of the growers think that the disease was serious and they were unaware of proper treatment methods against the disease.

4.3.6 Nature of inspection of trees by growers

Regarding the frequency of inspection by growers to the plantation Table 11 showed that 13.72 per cent of the growers visit daily, 35.29 per cent growers weekly while 50.98 per cent of the growers visit once in a month.

Table 10. Method of preparation and application of Bordeaux paste

	Proper	Improper	Total
Method of preparation	6	30	36
Method of application	8	28	36

Growers view of the disease

	No. of growers	Percentage
Serious	36	70.58
Not serious	15	29.41
Total	51	

Table 11. Nature of inspection of trees by growers for pink disease

No. of units surveyed	100
Total No. of trees	15534
Total Area	31.02 ha
No. of units infected	51
Area infected	15.38 ha
No. of trees infected	367

Nature of inspection	No. of Unit	Percentage
Daily	7	13.72
Weekly	18	35.29
Monthly	26	50.98

Early detection and treatment reduces the intensity of the disease considerably. More awareness is needed about this disease.

4.3.7 Disposal of infected plant parts

Table 12 presents the details regarding the disposal of infected plant parts by the growers. Though there were five units with trees having chopped crown and eight units with trees having pruned branches and twigs, no grower was found burning it properly. Careless handling of the infected plant parts will cause the infection to the other trees also. (Pillai et al.,1980).

RRII 105 was the main clone in the surveyed units. Jayaratnam 1980 reported that RRII 105 have average susceptibility to the disease. Out of the 51 units infected 48 of them were RRII 105. RRIM 600 had severe infection. Out of the three units, two units had infection and one GT 1, out of two had also severe infection, though it was considered as less susceptible. As the number of holding of GT 1 were very less, no conclusion can be drawn regarding the severity of infection of the disease. Bordeaux paste has only less sticking property while thiride being a petroleum compound have high sticking property and not leached during rainy season and is reported to be very effective in the treatment of pink disease. But no grower was observed

Table 12. Disposal of infected plant parts

No. of units with crown chopped trees	:	5
No. of units with branches chopped trees	:	8
No. of units burning the pruned branches and twigs	:	Nil

using it. Use of thiride is comparatively cheap also. Therefore, the use of thiride may be popularised for the treatment of pink disease. Besides, 29.41 per cent of growers still believe that the disease was not so serious and hence they were reluctant to adopt control measures. In the case of trees having chopped crown due to severe infection it will take time to develop new crown resulting drastic reduction in yield. Therefore, extension activities may be strengthened to educate the growers about the disease and its control.

4.4 Powdery mildew

4.4.1 Intensity of the disease

Data pertaining to the intensity of the disease is presented in Table 13. Nature of infection was mild in seven units (5.34%) medium infection in 17 units (17.96%) and severe in 75 units (75.52%). One unit was found uninfected with powdery mildew among the surveyed units. Refoliation was complete in 43 units (43.43%) and refoliation was spread over two months in 56 units (56.56%).

4.4.2 Clonal variation for powdery mildew disease

Table No. 14 presents the data regarding the clonal variation for the disease. Out of the 100 units surveyed 99 were found infected. RRII 105 being the major clone

Table 13. Nature of infection Powdery mildew

		No.of holding infected	Area (ha)	No. of trees infected
	Total surveyed 100		31.62	15534
1.	Mild	7	1.69 (5.34)	790 (5.54)
2.	Medium	17	5.68 (17.96)	2196 (15.41)
3.	Severe	75	23.88 (75.52)	11257 (79.04)
4.	Not infected	1	0.36 (1.13)	170 (1.09)
5.	Defoliated/refoliated			
	a) Within 2 weeks	43	13.15 (42.06)	5513 (38.70)
	b) Spread over 2 months	56	18.47 (59.08)	8729 (61.29

Values in parentheses indicate the percentage.

Table 14. Clonal variation for Powdery mildew disease infection

Clone	Total No. of holdings infected	Area	%	Mild		Medium		Severe	
				No.of unit	Area (ha)	No.of unit	Area (ha)	No.of unit	Area (ha)
RRII 105	87	27.10	85.10	9	2.69	61	19.46	17	5.35
GT 1	2	0.70	2.21	-	-	2	0.70	-	-
RRIM 600	3	1.53	4.83	1	0.52	2	1.01	-	-
Clonal Seedlings	7	1.93	6.10	-	-	2	0.26	5	1.67
Total	99	31.26	98.84	10	3.21	67	21.43	22	7.02

and was planted in 88 units found infected in 87 units (87.87%). Mild infection was observed in nine units, medium infection in 61 units and severe infection was observed in 17 units. All the two units of GT 1 and three units of RRIM 600 and seven units of clonal seedlings area were also found infected.

4.4.3 Control measures adopted

Table No.15 presents the details of control measures adopted by growers for powdery mildew disease. Fourteen per cent of growers (6.17 Ha) were observed to undertake control measures (19.75%). Sulphur mixed with talc (70: 30) is being dusted. Dusting was done only after the infection of the disease. Dusting of the fungicide was recommended from the time of bud break at an interval of four to ten days to control the disease effectively, using 11 to 14 Kg of 325 mesh fine sulphur dust per round per hectare. In the dusted areas the growers had used the fungicide below the quantity recommended.

Cost incurred for the purchase of chemical was also found less when compared to the cost on the basis of recommendation by Rubber Board. Rupees 403/- only incurred as the cost of chemical and labour. Where as it was Rs.660/- towards the cost for dusting at the recommended dose.

Table 15. Control measures adopted for Powdery mildew

				Area	Trees
1.	No. of units surveyed	-	100	31.62	15534
2.	No. of units infected	-	99	31.26 (98.86)	14242 (91.68)
3.	No. of holding adopting control measures	-	14	6.17 (19.73)	3050 (21.41)

4. Time of adoption of control measures

	Before infection	After infection
	--	14
5. Rounds/ha.		3
6. Fungicide used	Recommended dose/ha	Below average dose/ha
Sulphur dust	--	14
7.		
a) Cost of chemical	Rs. 336.00	Rs. 198.00
b) Cost of equipment	Rs. 75.00	Rs. 75.00
c) Cost of labour	Rs. 125.00	Rs. 130.00
Total	Rs. 536.00	Rs. 403.00

The values is parentheses indicate percentage.

Cost of plant protection measure per hectare

1. Abnormal leaf fall

Control measures adopted by small rubber growers were not sufficient to control the disease properly. It was observed that the actual cost incurred for the purchase of chemical was far below than that was recommended by Rubber Board. The cost incurred was Rs.840.00 for the purchase of chemical whereas the cost would be Rs.1225.00 as recommended for rocker spraying. Thus the insufficient quantity of chemical used for spraying was the main reason for the infection of the disease in the sprayed plantations. Control of the disease was almost total in the units where prophylactic spraying was adopted.

2. Pink disease

In the control of pink disease the growers of the surveyed area were using only the half of the quantity of the chemical recommended by Rubber Board. Therefore, the control measures adopted were found to be inadequate. The cost of chemical recommended for effective control of the disease was Rs.225.00. But the actual cost incurred was only Rs.101.00. It was clear that the use of insufficient quantity of chemicals was the main reason for the incidence of the disease in the surveyed units.

3. Powdery mildew

The percentage of growers adopting control measures against powdery mildew was very low when compared to other

Table 16. Cost of plant protection measures per hectare

	Disease		Cost of chemical	Cost of labour	Total
1.	Abnormal leaf fall disease	% of growers			
	Rocker spraying				
A.	Bordeaux Mixture				
	a) Actual cost incurred	69.56(16/23)	840.00	1250.00	2090.00
	b) Cost as per recommendation		1225.00	1250.00	2475.00
2.	Pink Disease	70.58(36/51)			
A.	Bordeaux paste				
	a) Actual cost incurred		101.00	61.00	162.00
	b) Cost as per recommendation		225.00	200.00	425.00
3.	Powder mildew	14.14(14/99)			
	Sulphur dusting				
	a) Actual cost incurred		198.00	130.00	328.00
	b) Cost as per recommendation		336.00	324.00	660.00

two diseases. It was 69.56 per cent and 70.58 per cent against abnormal leaf fall and Pink disease respectively. Per cent of growers adopting control measures against powdery mildew was observed to be 14.14 only. Lack of proper awareness about the disease and control measures can be the reason. Actual cost incurred for the purchase of chemical was Rs. 198.00. It would be Rs. 336.00 as per recommendation. So the growers were not adopting recommended control measures against the disease. It was observed that the quantity of chemicals to be used was only limited while the cost of labour was same in treatment of abnormal leaf fall and a little high in the treatment of powdery mildew. But in the treatment of pink disease the labour cost was far below than the recommended.

Effect of Different Control Measures Adopted in Controlling the Disease

The recommended control measure for abnormal leaf fall is prophylactic spraying of bordeaux mixture. Out of the 23 units infected eight units had undertaken the prophylactic spraying. Another eight units had sprayed after the infection of the disease. About 610 (86.52%) out of 705 trees could be saved by prophylactic spraying. Whereas 870 (70.73%) trees only recovered partially in the

Table 17. Effect of different control measures adopted in controlling the disease

Disease control measures adopted	No. of holdings		Percentage
1. Abnormal leaf fall disease	23		
A. Fungicide used	Prophy-lactic	After infection	
a) Bordeaux mixture	16	8	8 69.56
b) Copper Oxychloride	Nil		

B. Method of application	No.of trees saved	Fully	Part-ially	Fully	Part-ially	Non
		610	95	-	870	360
		TOTAL			TOTAL	
		705			1230	
1) Rocker sprayer		16			69.56	
2) Micron sprayer		NIL				

	No. of Trees	
2. Pink disease	367	
A. Fungicide used	240	70.58

	No. and percentage of trees recovered					
	No.	Partial %	No.	Complete %	Not recovered No.	%
1. Bordeaux Paste	89	37.08	121	50.41	37	15.41
2. Thiride	NIL			NIL	NIL	

3. Powdery mildew	No. of holdings	Percentage
A. Fungicide used	99	
	No. of trees treated	
1. Sulphur dust	14	3050 14.14

B. Method of application		No. of trees recovered		
		Fully	Parti-ally	Not re-covered
1. Power duster	14	660 (4.63)	2520 (17.69)	510 (3.58)
2. Rocker sprayer		Nil	Nil	Nil

units when spraying was done after the infection of the disease.

Infection of Pink disease was observed in 51 units but control measures were adopted only in 36 units. Fungicide used was Bordeaux paste. The control measures were adopted only in 70.58 per cent of trees (240). About 37.08 per cent (89) trees had partial recovery 50.41 per cent (121) trees had complete recovery while 15.41 per cent (37) trees had no recovery from the disease.

Powdery mildew was seen infected 99 units out of the 100 units surveyed. Number of units adopted control measures was only 14 and trees treated were 3050 (21.41%). Dusting of fine sulphur was the recommended control measure for powdery mildew. Rate of recovery after the dusting was; fully recovered 660 (4.63%) trees, partially 2520 (19.69%) and no recovery 510 (3.58%) trees, observed to be 14.14 only. Lack of proper awareness about the disease and control measures can be the reason. Actual cost incurred for the purchase of chemical was Rs.198.00 whereas it would be Rs.336.00 as per recommendation. So the growers were not adopting recommended control measures against these diseases. It is observed that the quantity of chemicals to be used is only limited while the cost of labour was same in the treatment of abnormal leaf fall and

a little high in the treatment of powdery mildew. But in the treatment of pink disease the labour cost was far below than the recommended.

Detection of Disease and Knowledge of Plant Protection Technique

Ability of the grower to detect abnormal leaf fall and pink was rated as 69.56 and 70.58 respectively. Whereas the ability of the grower to detect powdery mildew was only 14.14 percent. Farmer's knowledge of plant protection technique was 34.78 in the case of abnormal leaf fall and 15.68 per cent in the case of pink disease. Whereas 26.26 per cent of the growers could adopt plant protection technique in the case of powdery mildew therefore, growers should be given proper education to detect the diseases at an early stage and to undertake proper plant protection measures.

Table 18. Detection of disease and knowledge of plant protection technique

		Abnormal leaf fall		Pink		Powdery mildew	
1.	Total holdings infected	23		51		99	
		No.	%	No.	%	No.	%
2.	No. of holdings where disease is properly detected and percentage	16	69.56	36	70.58	14	14.14
3.	Farmers knowledge of plant protection technique No. and percentage	8	34.78	8	15.68	26	26.26

Summary and Conclusions

5. SUMMARY AND CONCLUSION

The major diseases affecting rubber in Vaikom taluk were powdery mildew, pink and abnormal leaf fall. Powdery mildew was more serious and infected about 99 per cent of the holdings surveyed. Dusting of sulphur at the time of refoliation can control the spread of the disease. Use of the chemical at the recommended dose was not adopted by the growers. This can be the main reason for the spread of the disease.

In fection of pink disease was not so serious in the surveyed area. About 10.7 per cent of the trees were seen infected. Detection of the disease at the early stages of infection and treatment of the trees was more important in the control of pink. It was obvious that the farmers knowledge in plant protection techniques were poor. No grower was seen adopting thiride treatment against pink though it was recommended as effective to bordeaux paste. Lack of awareness of growers can be the main reason.

Abnormal leaf fall was the least serious among the three diseases. The clone RRII 105 showed average tolerance to the disease and that can be the reason for the mild infection of the disease in the surveyed units.

The study showed extension activities among the growers were highly inadequate. RRII 105 being the main clone, the leaf retention during monsoon was satisfactory even without prophylactic spraying. Therefore, prophylactic spraying was not seen as generally accepted practice among the growers of Vaikom taluk.

Powdery mildew disease was very common in the surveyed units. But, many of the growers were neglecting it. All clones were seen infected with the disease. Repeated dusting of sulphur mixed with talc can control the infection effectively if sprayed at bud break. Four to six rounds of dusting should be done for the control of the disease.

Extra weeding in plantation become necessary due to leaf fall and hence maintenance cost is higher. Unavailability of plant protection equipments was another difficulty faced by the growers. To overcome these difficulties disease tolerant clones may be planted in future. Moreover, the extension methods are to be strengthened to educate the growers about the diseases and its timely control.

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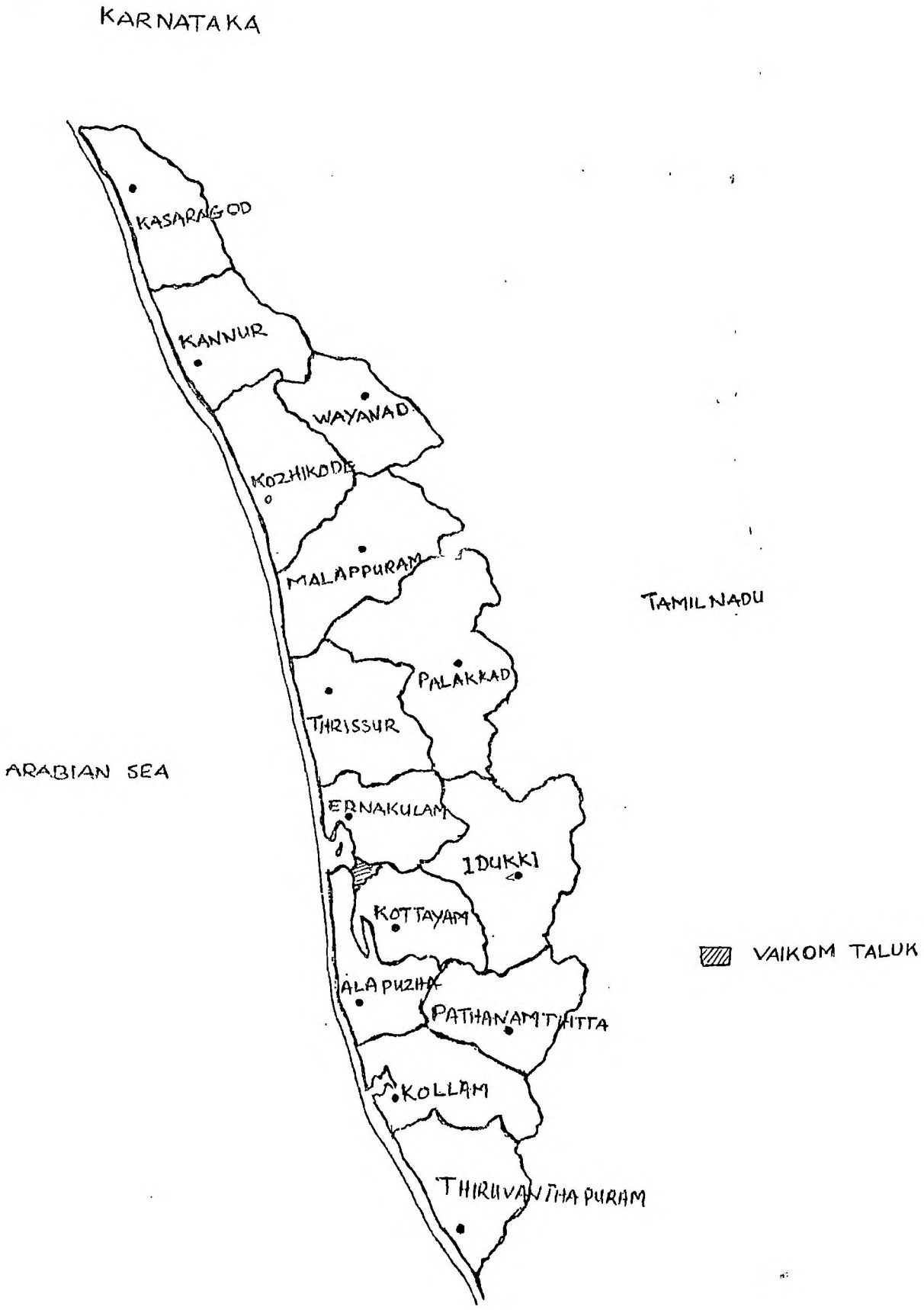
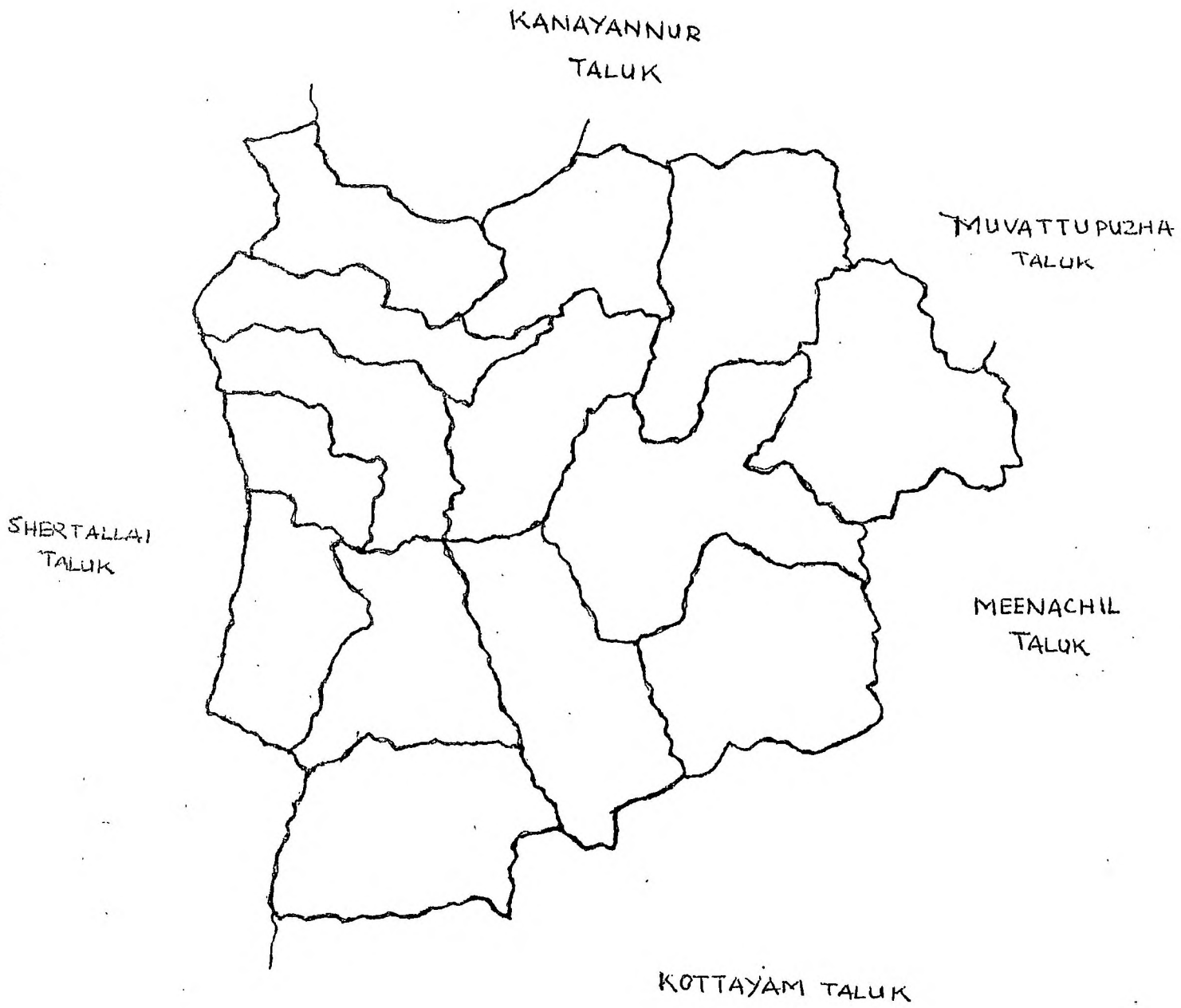
ANNEURE I

MAP OF KERALA



ANNEXURE 1b

MAP OF VAIKOM TALUK



ANNEXURE - II

Major diseasesaffecting Rubber and its control measures by Small rubber growers of Vaikom Taluk

PROFORMA

1. Name and address of the owner :

2. Register No./Permit No. :

3. Year of planting : Age :

4. Extent of the area : Ha.

5. Terrane of land : Sloppy/Flat/Steep

6. Proximity of water source : Inside the plot/outside the plo

7. Approximate elevation :

8. Planting material : Clonal/Bud (Clone)

9. Average yield/Ha/Annum :

10. Proximity to other Estate : Adjuscent/ 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 :

b) Intensity of infection : Mild/Medium/Severe

...2/-

c)	No.of trees affected	: (Total present in the holding)
d)	Trees with crown chopped	: Without treatment/Even after treatment
e)	Control measure adopted	: Yes/No.
i)	Fungicide used	: Bordeaux mixture/Bordeaux paste/ Thiride others.
ii)	Mode of application	:
iii)	Prophylatic spraying done or not	: HIgh volume/Low volume Micron/ Aerial/Not sprayed
iv)	Whether sprayed on trunk fork branches with 1% bordeau mixture	: Yes/No Date of spraying: Interval of spraying Monthly/2 months
v)	Whether removed parts buried	: 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)	Extent of recovery	:
l)	Additional information if any	:

...3/-

m) Suggestions of the farmer :

12.2 ABNORMAL LEAF FALL DISEASE

a) Nature of infection	:	Mild/Medium/Severe/No infection
b) Whether prophylatic spraying done or not	:	Yes/No
c) Chemical used	:	Bordequx 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 to individual plant	:	Mild/Medium/Severe
j) Knowledge of planter in preparation of Brodeaux mixture	:	Poor/Satisfactory/Good
k) Knowledge of the farmer in spraying techniques	:	Poor/Satisfactory/Good
l) In case of RRII 105 checking whether the plants are actually tolerant to abnormal leaf fall disease	:	
Incidence	:	
extent	:	
severity	:	

...4/-

m) Extent of recovery :

n) Other information if any :

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

12.3 POWDERY MILDEW DISEASE

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

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

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

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

e) Cost of dusting : I round/ IInd round/IIIrd Round
Cost of Chemical
Cost of Labour

f) No.of trees defoliated/ refoliated : Within 2 weeks/spread over 2 months

g) Leaf retension after dusting : Good/Average/Poor

h) Knowledge of the farmer in dusting technique : Poor/Satisfactory/Good

i) Extent of recovery : a) Completely recovered
b) Partly recovered
c) No effect

j) Other information if any :

k) Remarks

SIGNATURE

Annexure III

Village-wise distribution of units surveyed in Vaikom Taluk

Sl. No.	Name of Village	Total units	Serial No. of Units
1.	Chempu	9	43, 57, 58, 59, 60, 62, 63, 64, 65.
2.	Velloor	3	54, 55, 68
3.	Mulakkulam	12	26, 27, 28, 29, 49, 50, 56, 73, 74, 75, 76, 77.
4.	Njeezhoor	14	3, 4, 5, 6, 7, 18, 19, 20, 21, 22, 23, 24, 25, 44.
5.	Kaduthuruthy	13	1, 2, 8, 16, 34, 35, 36, 41, 42, 51, 81, 82, 100.
6.	Vadayar	12	30, 31, 32, 33, 37, 38, 39, 40, 52, 61, 66.
7.	Kulasekharamangalam	4	67, 69, 70, 72
8.	Vechoor	6	71, 78, 79, 80, 93, 95
9.	Kallara	16	17, 45, 46, 47, 48, 83, 88, 89, 90, 91, 92, 94, 96, 97, 98, 99.
10.	Manjoor	11	9, 10, 11, 12, 13, 14, 15, 84, 85, 86, 87.

Annexure IV

Name and Address of the surveyed units

Sl. No.	Name and address of the grower
01.	Sri. Joseph Augustine, Pulickal, Kattampack. PO.
02.	Sri. John Antony, Kottarathiparampil, Kattampack. PO.
03.	Sri. P.K. Santhakumaran, Santhimandiram, Kappumthala. PO.
04.	Sri. Chacko Paily, Kottarathiparampil, Kappumthala. PO.
05.	Sri. Pailo Philip, Kottukappallil, Kappumthala. PO.
06.	Smt. Mary Mathew, Madathikunnel, Kappumthala. PO.
07.	Sri. Mathew Antony, Vadakkekara, Kappumthala. PO.
08.	Sri. Ulahannan Paul, Ettumamkaran, Muttuchira. PO.
09.	Sri. Ouseph Mathew, Venginikkal Parampu, Manjoor. PO.
10.	Sri.K.K. Raghavan, Kattathukunnel Kizhakkethil, Manjoor.PO.
11.	Sri. K.K. Govindan, Kattathukunnel, Manjoor. PO.
12.	Sri. K.J. Antony, Kunnumthottiyil, Omalloor, Manjoor. PO.
13.	Sri. P.R. Rajagopalan, Poothettukunnel, Omalloor, Manjoor. PO.
14.	Sri. K. Mathai, Thottathil, Manjoor. PO.
15.	Sri. Joseph, Kunnuthottiyil, Manjoor. PO.
16.	Sri. Thomas Mathai, Parambithadathil, Muttuchira. PO.
17.	Sri. Jose Mathew, Palaparampil, Kallara. PO.
18.	Smt. Lakshmi, Olippurathu, Njeezhoor. PO.
19.	Sri. T.M. Thomas, Thevarmattathil, Pazhuthuruthu. PO.
20.	Sri. P. Ponnappan Nair, Karukappillil, Thiruvampady. PO.

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Sl. No.	Name and address of the grower
21.	Sri. Luke Augusthy, Puthenpurackal, Thiruvampady. PO.
22.	Sri. Kuriakose M.J., Kurukottil, Njeezhoor. PO.
23.	Smt. Bhavani, Olippurathu, Njeezhoor. PO.
24.	Sri. P.D. Neelakandan Namboothiri, Madathilparampil, Njeezhoor. PO.
25.	Sri. Thomas Mathew, Odavallickal, Pazhuthuruthy. PO.
26.	Sri. K.A. George, Kumbalassery, Mulakkulam South. PO.
27.	Sri. Krishnan Nair, Mukkattu, Mevelloor. PO.
28.	Sri. Damodaran, Pukkottel, Peruva. PO.
29.	Sri. Krishnankutty. S., Kuttidayil, Peruva. PO.
30.	Sri. V.S. Narayanan Nair, Vrindavanathil, Thalayola - paramba. PO.
31.	Sri. P.V. Thomas, Paruthikattil, Thalayolaparambu. PO.
32.	Sri. Varkey Mathew, Kalayil, Thalayolaparambu. PO.
33.	Sri. Ulahannan Joseph, Pattel, Thalayolaparambu. PO.
34.	Sri. Ramakrishnapillai, Kottarathil, Keezhoor. PO.
35.	Sri. V. Joseph, Meenpallil, Arunoottimangalam. PO.
36.	Sri. Augustine, Naduviledathu, Keezhoor. PO.
37.	Sri. Karunakaran Nair, Kottarathil, Keezhoor. PO.
38.	Sri. K.J. John, Kollamparampil, Thalayolaparambu. PO.
39.	Sri. Narayanan Nair, Pattermadom, Keezhoor. PO.
40.	Smt. Pappi Kalyani, Manthakuthial, Keezhoor. PO.
41.	Sri. Kurian Joseph, Vadakkevettikuzhiyil, Poozhikol. PO.
42.	Sri. C.M. Joseph, Chelekkal, Arunootimangalam. PO.

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Sl. No.	Name and address of the grower
43.	Sri. T.K. Rajan, Rajamandiram, Brahmamangalam. PO.
44.	Sri. Varkey Joseph, Kazhanchikattil, Kappumthala. PO.
45.	Sri. Varkey Joseph, Manackaparampil, Ayamkudy. PO.
46.	Sri. Soman, P.V., Padinjare Malieckal, Ayamkudy. PO.
47.	Sri. Ouseph Mathai, Nediyakala, Ayamkudy. PO.
48.	Sri. Kunjarkan Vasu, Padinjare Malieckal, Ayamkudy. PO.
49.	Smt. K. Rajamma, Kalappurackal, South Mulakkulam. PO.
50.	Smt. Lakshmikutty Amma, Kalapurackal, South Mulakkulam. PO.
51.	Sri. Augusthy Luka, Parackal, Keezhoor. PO.
52.	Sri. P.K. Chacko, Mangottil, Keezhoor. PO.
53.	Sri. Luka Abraham, Arackal, Keezhoor. PO.
54.	Sri. K.P. Joseph, Kuttikottel, Keezhoor. PO.
55.	Sri. Kurian Ouseph, Kallakkattu, Keezhoor. PO.
56.	Sri. Manikandan Nair, Mangara, Mulakkulam South. PO.
57.	Sri. Kunjan Pappy, Navodayam, Brahmamangalam. PO.
58.	Sri. P.P. Uthuppan, Thadathil, Brahmamangalam. PO.
59.	Smt. Usha. K., Karthika, Vadakara. PO.
60.	Smt. Mary Lukose, Makkiyil, Vadakara. PO.
61.	Sri. Narayanan Namboodiri, Veliman Kovil, Midayikunnam. PO.
62.	Sri. Muraleedharan.A.V. Ampalathumveliyil, Vadakara. PO.
63.	Sri. Balakrishnan. P.V., Balakrishnan Bhavan, Vadakara. PO.
64.	Sri. Sankara Narayanan, Padinjarethekkinezhathu, Vadakara.PO.
65.	Sri. Damodaran Nair, Sindhu Bhavan, Vadakara. PO.
66.	Sri. Ouseph Mathai, Chakkalayil, Midayikkunnu. PO.

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Sl. No.	Name and address of the grower
67.	Sri. P.K. Thomas, Puthenmanayil, Pothi. PO.
68.	Sri. Kuriako Thomas, Puthan Manayil, Pothi. PO.
69.	Sri. Chacko Scaria, Plakottayil, Midayikunnu. PO.
70.	Sri. Mathan Mathew, Palachuvattil, Midayikunnam. PO.
71.	Sri. P.V. Varkey, Palakottayil, Pothi. PO.
72.	Sri. O. J. Mathew, Oliyanattil, Pothi. PO.
73.	Smt. Ambika Devi, Kunnathu, Peruva. PO.
74.	Smt. Saraswathiamma, Kuthuvelil, Peruva.
75.	Sri. K.K. Thomas, Kureethottathil, Peruva. PO.
76.	Sri. Ulahannan Markose, Kappikara, Peruva. PO.
77.	Sri. P.P. George, Manadiyil, Peruva. PO.
78.	Sri. Ouseph Varghese, Thekkeparampil, Valachira, Kaduthuruthy. PO.
79.	Sri. Ouseph Issac, Thekkeparampil, Valachira, Kaduthuruthy. PO.
80.	Sri. P.T. Luckose, Pathukkary, Valachira, Kaduthuruthy.PO.
81.	Sri. K.O. Xavier, Kalaripparampil, Manjoor. PO.
82.	Sri. P.J. Joseph, Panakkaparampil, Manjoor. PO.
83.	Sri. Purushothaman. V.R., Marangattil, Ayamkudy. PO.
84.	Sri. Varkey Issac, Vanchippurackal, Kaduthuruthy. PO.
85.	Sri. J.J. Thomas, Thiparampil, Muttuchira. PO.
86.	Sri. Ouseph, Thaiparampil, Muttuchira. PO.
87.	Sri. N.T. John, Namattathil, Manjoor. PO.
88.	Sri. Sunny. P.K., Puthukkariyil, Kaduthuruthy. PO.

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Sl. No.	Name and address of the grower
89.	Smt. Parvathi Antharjanam, Kallara South. PO.
90.	Sri. Radhakrishnan Nair, Malikayil, Kallara South. PO.
91.	Sri. P.N. Narayana Pillai, Puthuparampil, Kallara South. PO.
92.	Sri. P.U. Thomas, Parappurathu, Kallara South. PO.
93.	Smt. Padmakumari. K., Vattukulathil, Kallara South. PO.
94.	Sri. Sukumaran, Puthenparampil, Perumthuruthu. PO.
95.	Sri. Chummar Joy, Thekkeputhanparampil, Perumthuruthu. PO.
96.	Sri. Kora, Mollethazhathu, Kallara South. Po.
97.	Sri. Prabhakaran, Choorakuzhiyil, Kallara South. PO.
98.	Sri. Chandy, Kochuvarikkamanthottiyil, Kallara. PO.
99.	Sri. Joseph, Moolekarottu, Kallara. PO.
100.	Sri. K.T. Mathew, Kandarappallil, Manjoor. PO.