INCIDENCE OF TAPPING PANEL DRYNESS IN RUBBER IN THE SMALL HOLDINGS OF MEENACHIL TALUK

By

SEBASTIAN MICHAEL

DISSERTATION

Submitted in partial fulfilment of the requirement for the

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Department of Plantation Crops and Spices

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DECLARATION

I hereby declare that this dissertation entitled **Incidence of Tapping Panel Dryness in Rubber in the small holdings of Meenachil Taluk** submitted in partial fulfilment of the course **Post Graduate Diploma in Natural Rubber Production** of Kerala Agricultural University is a bonafide record of research work done by me and that the dissertation has not previously formed the basis of the award to me for any degree diploma associateship fellowship or other similar title of any University or Society

Vellanikkara

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SEBASTIAN MICHAEL

CERTIFICATE

Certified that the dissertation Incidence of Tapping Panel Dryness in Rubber in the small holdings of Meenachil Taluk is a record of research work done by Sri Sebastian Michael 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 Sebastian Michael a candidate for the Post Graduate Diploma in Natural Rubber Production agree that the dissertation entitled Incidence of Tapping Panel Dryness in Rubber in the small holdings of Meenachil Taluk, may be submitted by Sri Sebastian Michael in partial fulfilment of the requirement of the Diploma

R Kesavachandran

Dr R Kesavachandran
(Major Advisor)
Assistant Professor
Dept of Plantation Crops & Spices College of Horticulture
Vellanikkara

Dr K R Vijayakumar
(Co Chairman)
Dy Director (Plant Physiology)
Rubber Research Institute of India Kottayam 9

Dr E V Nybe
(Member)
Associate Professor
Dept of Plantation Crops & Spices College of Horticulture
Vellanikkara

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

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SEBASTIAN MICHAEL

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Introduction

INTRODUCTION

Hevea brasiliensis known as the para rubber tree is the most important commercial source of natural rubber Latex the economic product from the tree is contained in an anastomosing type of latex vessel system situated in the bark It is obtained by wounding the bark by a process termed tapping When a cut is made on the trunk with a tapping knife the latex flows out because of very high turgor pressure in the latex vessels The initial flow of latex is due to elastic contraction of the walls after a sudden release of turgor as a result of tapping and subsequent flow is regulated by capillary forces After tapping the rate of flow can be expected to slow down with time because latex withdrawn over greater distance from the cut is subject to reduction in the pressure gradient and to greater resistance of an increasing length of partially collapsed vessels The flow rate is markedly decreased and the flow ceases after a time, also due to the formation of internal and external plugs in the latex vessels

A physiological phenomenon characterised by the absence of latex exudation either over part of the cut or its entire length is commonly observed in plantations This phenomenon referred to as tapping panel dryness is generally seen in two forms It may be related to season or caused by intensive exploitation in particular by over stimulation This is the reversible form of tapping panel dryness (TPD) The other form which is characterised by cell necro sis which spreads rapidly along the laticiferous mantles leads to total dryness and is irreversible In most cases complete dryness is associated with a brownish discolouration in and below the tapping cut and hence the disorder is commonly referred to as brown bast

The disorder was reported for the first time in Brazil in 1887 in *Hevea* in the Amazon forest and at the beginning of the cen tury in plantations in Asia (Rutgers and Dammerman 1914)

Tapping panel dryness is a serious problem in the small holdings and the incidence of dry trees may be as high as 30 per cent (Paardekooper 1989) But the data available on the actual extent of incidence in small holdings is scanty

Meenachil taluk is a major rubber growing region in the state A variety of high yielding clones are being grown in the area the most popular being the clone RRII 105 A general complaint from the planters is that the clone RRII 105 is highly susceptible to Tapping Panel Dryness (TPD) The present study has been formulated to study the extent of incidence of TPD in the small holdings of this area with the intention to evaluate whether the disorder is due to any defect in the nature of the exploitation system adopted

Review of Literature

REVIEW OF LITERATURE

Tapping panel dryness has been studied in India as well as in other major rubber growing countries of the world The salient works on the same are reviewed hereunder

2 1 General aspects of the disorder

The absence of any latex exudation either over part of the cut or over its entire length is generally referred to as dry ness Jacob and Prevot (1989) had classified dryness into two one form which may be related to season or caused by intensive exploita tion and in particular by over stimulation is reversible if this exploitation does not continue for too long The other form is ir reversible it induces cell necrosis which spreads very rapidly along the laticiferous mantles and leads to total dryness In most cases complete dryness is associated with a brownish discolouration in and below the tapping cut so the disorder is commonly referred to as brown bast

Compagnon *et al* (1953) had grouped the various forms of physiological disorders commonly considered as brown bast into the following five classes

1 Abnormal colour of the cut brown spots and cracks in the bark with eventual necrosis and stoppage of flow
2 Partial dryness without brown colour or necrosis
3 Woody burr formation resulting in deformation of the panel

4 Coagulation of latex on the tapping cut with no flow of latex

5 Total dryness without brown colour or necrosis

The actual onset of brown bast is preceded by an excessive dilution of latex with late dripping However it had been noticed that certain trees go dry with no earlier late dripping (Compagnon *et al* 1953)

2 2 Symptoms of the disorder

2 2 1 Reversible bark dryness

The symptoms of the phenomenon have been studied and reported by many workers Jacob and Prevot (1989) reported that examination of lengths of dry bark revealed a decrease in the length of the tapping cut affected in the case of trees tapped normally where seasonal bark dryness was observed It was sometimes found to occur in over exploited trees which displayed varying degrees of affectation of the incidence However the bark dryness diminished when non intensive tapping was resumed after sufficiently long resting period

The bark of such trees which diplayed partially dry zones was found not to differ histo cytologically or histochemically from healthy trees (de Fay 1981)

Histo cytological examination of the bark of trees which had been affected by bark dryness by overstimulation with ethylene or 2 4 D revealed symptomatological differences in comparison with the typical brown bast phenomenon (de Fay 1981 1988) It was reported that the bark thickened became spongy and hyper hydrated near the zone of application Small cracks were found to appear on the out side The outer phloem displayed dilatation of the parenchyma whose axial cells lying around the laticiferous mantles devided periclinal ly As a result the laticifers were crushed and rendered non func tional in that zone There were no stone cells and there was no tertiary formation around the necrotic zones and no lignified gum The phenomenon remained very local In addition only a few rare tylosoids were observed in the outer phloem (de Fay 1988) However most of the laticifers in the inner phloem were found to be cytologi cally normal and hence he suggested deep tapping to reach them

These symptoms were found to appear a few months after intensive hormone treatment

2 2 2 Irreversible bark dryness

Eschbach *et al* , (1983) found that the external symptoms varied with the type of clone and the seriousness of the disorder In addition to bark dryness browning of cortical cells appeared in certain zones which may or may not be concealed by the outer bark Bark cracking with a tendency to flaking may occur to various ext ents as may greater or lesser trunk deformation caused by neoformed ligneous nodules

Paranjothy *et al* (1975) and de Fay (1981) described the various symptoms observed as follows

In situ coagulation of latex and formation of tylosoids were reported Evagination of the neighbouring parenchyma cells were seen which invaded the laticifers These tylosoids were found to prolifer ate lignify their walls and accumulate tannins These two phenomena which occurred simultaneously were found to block the laticifers

Tissue degeneration in the phloem is manifested due to various reasons

i) Increased amount of tannins in the parenchyma cells surrounding the laticifers invaded by tylosoids which were responsi ble for the browning of the phloem

ii) Secretion of lignified gums was observed The rapid spread of the disease was related to the depositing of these gums on the wall of the laticifers

iii) Growth of stone cells by the sclerification of neo formed cells such as tylosoids

iv) Formation of hyper plastic tissue derived from the proliferation of tylosoids destroying the laticiferous network

v) Appearance of cambial cells which may develop and isolate necrotic phloem zones This may result in lignified nodules which are responsible for the deformation mentioned above

2 3 Biochemical characteristics of latex

Laticifers located in bark displaying early symptoms of bark dryness but which are still functional were found to display certain characteristic changes in their latex quality Varying decreases in pH Pi and R SH values have been reported which indicated a slowing of metabolic activity (Eschbach *et al* 1983 Van de Sype 1984 Serres 1985 and Jobbe Duval 1986)

2 4 Biochemical and physiological studies

Various biochemical and biophysical changes have been reported to take place at the later stage in trees showing the symptoms of the disorder The most common symptoms included a phase of excessive late dripping of latex and a simultaneous fall in the rubber content After a period of time the volume per tapping was found to gradually decline The colloidal stability of the latex was also found to be reduced resulting in particle damage flocculation of rubber particles *in situ* and early plugging of latex vessels (Chrestin 1985)

Studies of Chua (1967) showed that the reserves of starch and other soluble carbohydrates were not depleted Investigations by de Fay (1981) revealed abundance of starch grains in the wood of affected trees and the vascular rays were found to function normally

Changes in latex flow pattern (Sethuraj 1968) and a reduction in turgor pressure (Sethuraj *et al* 1977) have also been reported In intensively tapped trees initial flow rate and turgor pressure were found to be reduced before the onset of dryness (Sethuraj *et al* 1976) A sharp increase in bursting index was reported by Eschbach (1983)

2 5 Probable causal factors

Early investigators have related the phenomenon to the reaction of the trees to wound healing (Rands 1921 Rhodes 1930) Fluctuation in the water relations as a consequence of excessive removal has been suggested to be the causative factor by Sharples *et al* (1924) An abnormally strong dilution reaction during latex flow was considered to favour the development of brown bast (Frey Wyssl ing 1932)

Schweizer (1949) associated brown bast with lack of organic reserves It was reported that by drastic tapping the phospholipids and proteins increased with a simultaneous reduction in the proteins and calcium contents In support of his view Schweizer induced conditions similar to brown bast by ring barking above the tapping cut followed by intensive tapping

A marked positive correlation between the stability of latex and potassium content had been obtained by Philpott (1951) A high content of potassium in the latex of brown bast affected trees was also reported

Vollemma (1949) and Compagnon *et al* (1953) observed that incidence of brown bast was greater during and after wintering

Compagnon *et al* (1953) had found that intensive exploita tion resulted in Cu and K deficiency But efforts to correlate miner al content with brown bast incidence have not so far yielded any convincing results However a significant correlation was obtained between K_2O/CaO ratio in leaves and the percentage of brown bast (coagulation at the tapping cut) by the studies of Beaufils (1954) Incidence of such conditions could be reduced by potash fertilizers A higher Mg/P ratio was also reported in latex in the succeptible clones (AVROS 308 and Gl 1) compared with resistant clones (PR 107) It was assumed that the above mentioned disorder (coagulation at the tapping cut) was an extreme case of latex instability and that Mg content of latex could be a determining factor But an increase in K content and K/Ca K/P ratio was observed by Pushpadas *et al* (1975) in the latices of brown bast affected trees So theoretically it can be speculated that the reported brown bast condition with high Mg content and coagulation at the tapping cut may well be distinct from the conditions of brown bast reported to be associated with a high K content

The results of later work showed that evidence of starch depletion or lowered sugar content in latex during the onest of dryness (Chua 1965) The dry bark contained almost the same amount of total sugars as that in the normal bark

It has been observed that conditions similar to brown bast induced by surgical treatments resulted in very low flow rate of dilute latex containing damaged bottom fraction particles and Chua (1965) suggested that such extreme rate of flocculation deep in the latex vessels may impede the flow eventually inducing dryness Role of divalent cation in promoting the destabilising effect of lutoids has also been reported (RRIM 1985) In the majority of cases of brown bast however a low dry rubber content (drc) of latex with late dripping was found to precede the onset of dryness Dilution of latex could cause osmotic shock to the lutoid particles causing them to swell and burst However the mechanism by which a reduction in the rubber content caused is not clear

The possible damage to all the membrane structures in latex cells and resulting impairment of nutrient supply and water exchange at plasmalemma was suggested by Chai Kim Chun *et al* (1969) and Pushpadas *et al* (1975)

A view has been expressed by Bealing and Chua (1972) that wound reaction might lead to a reduction in the permeability of the wall of the latex vessel resulting in a reduced availability of assimilates In the same work a progressive decline in the cation concentration of latices of the trees subjected to intensive tapping to induce brown bast have been reported Conversely a higher concentration of cations in latices of intensively tapped trees was reported in a later study by Paranjothy *et al* (1975) and it has been suggested that changes in cation concentration might play a role in the observed deterioration of lutoids With the aid of electron microscope evidence was provided for the flocculation of rubber particles around lutoid particles in such latices and a hypothesis was proposed that coagulation of rubber particles inside latex vessels due to decreased lutoid stability might be the causative factor for the onset of brown bast syndrome It was assumed that the histological characteristics of brown bast affected bark such as tyloses and stone cells follow the development of disorders caused by damaged lutoids while features such as tissue necrosis and hyperplasa of the surrounding cells followed the death of the vessels In these studies phloem necrosis could not be detected and hence the earlier concept that phloem necrosis or senescence could be the primary cause of the disorder was ruled out

Chrestin *et al* (1984) postulated that intensive tapping or intensive use of stimulants increased NAD (P) H oxidase activity at the lutoid tonoplast This would lead to damage to the lutoid membrane causing flocculation through the release of B Serum The existance of an endogenous NAD (P) H oxidase in lutoids which generates toxic forms of oxygen (O_2 H_2O_2 OH) responsible for the peroxidase degradation of organelle membrane in the latex from diseased tree was reported in further works of Chrestin (1985) This supplement the work done by Cretin and Bangratz (1983) Simultaneously decrease in concentration of latex cystol scavengers (reduced thiols and ascorbates) as well as virtual disappearances of scavenging enzyme activities (SOD and catalase) was reported (Chrestin 1984 1985) The combination of increased peroxidative activities and considerably diminished quantities of scavengers in latex from affected trees result in destablisation and lysis of lutoids leading to coagulation (Crestin 1989)

Tupy (1973) Tupy and Primot (1976) found that high intensity tapping and/or stimulation reduced the sucrose content of latex and that bark dryness was associated with low latex sucrose levels Tupy (1985) considered that inadequate sucrose availability for basic biological functions of latex vessels might result in their premature degeneration and in bark dryness

According to Eschbach *et al* (1986) a reduction in sucrose thiol and Mg contents and increase in redox potential (RP) were connected with a higher rate of bark dryness The reduced availability of assimilates and the essential enzyme systems could be the principal cause of more frequent occurrance of the disorder Guo (1990) found that thiols ascorbic acid and A serum protein contents in latex of GT 1 and RRIM 600 were lower in trees with brown bast than in healthy trees GT 1 less susceptible to brown bast showed greater reduction in proteins and thiols but a smaller reduction in ascorbic acid

Wickremasinghe *et al* (1987) in studies with RRIC 101 found that free proline concentrations in the bark and latex of brown bast affected trees were considerably higher than those of healthy trees Since proline accumulation in plants was often associated with water stress the results pointed to the involvement of water stress in this disorder Proline accumulation in latex could be used as an early warning signal for brown bast development

Paardekooper (1989) examined the records of a number of clones and found a positive correlation between incidence of dryness and susceptibility to wind damage suggesting that a certain form of dryness is induced by strain in the tissues associated with bending under wind stress Trees which have actually been damaged by wind often develop dryness

Numberous traumatism (mechanical such as tapping chemical or pathological infection) were reported to cause formation of ethy lene (Yeang and Pratt 1978) which was found to have an influence on biochemical anatomical and histological factors (Liebermann 1973)

Sivakumaran and Pakianathan (1983) induced dryness by punc turing the bark at four or five points along vertical strips on the panel and sealing the puncturing with drawing pins By repeating the operation weekly or fortnightly sharply reduced flow rates and a high incidence of dryness were induced in several clones

Lukman (1989) reported that the type of climate indirectly influenced the TPD incidence Wet regions gave a good chance for the growing of Secondary Leaf Fall disease This disease caused the trees to suffer and easy to be affected by TPD

The tapping panel dryness has been found to be non random in distribution in the field Affected trees tend to come in clusters suggesting that brown bast would be spreading along the rows Non randomness of dryness was statistically proved in Thailand in a field of seedlings (Paardekooper as reported in Rubber) and recently in Sri Lanka for five out of six clones on commerical estates (de Soyza *et al* 1983) The non random occurrance of brown bast suggested the involvement of a particular environmental factor since it seemed unlikely that the disorder would spread through the vessels via root grafts to neighbouring trees

Cultivars differ in the level of their susceptibility to brown bast Clones that are reported to be extremely vulnerable include PB 5/63 PB 28/59 and RRIM 628 (Paardekooper 1989) Seedling trees have been reported to be always more susceptible than bud grafts as confirmed by breeding experiments where legitimate seedlings were compared with buddings derived from them Among the different clones there appeared to be a negative correlation between incidence of dryness and plugging index long flowing clones tend to develop more brown bast

Observations of Commere *et al* (1989) showed that the clones with high metabolic activity (PB 235 PB 260) were highly sensitive to dry cut the clones with intermediary metabolism (GT 1 RRIM 600) had a medium reaction the clones with low metabolism (PR 261) showed greater resistance to dry cut Their experiments also showed that a connection existed between the height of the cut and illness severity The latter became more serious nearer to the union on the panel bottom

High yielding clones have been found to be more susceptible to tapping panel dryness compared to medium and low yielding clones (Sivakumar *et al* 1988)

Vijayakumar *et al* (1990) quantified the relative susceptibilities of clones to TPD and reported that the susceptibility of clone RRII 105 is 1 9 times greater than that of clone GT 1

In India data available on the actual extent of incidence of TPD in the small holdings is scanty An earlier survey conducted by the Rubber Research Institute of India in ten holdings each in Trivandrum Kottayam and Calicut regions showed 4 4 per cent incidence in clone RRII 105 (IRRDB Symp 1990) The range of incidence was from 0 1 to 16 7 per cent

Sulochanamma *et al* (1993) reported 17 9 per cent incidence in the clone RRII 105, from experimental plots under ½S d/2 6d/7 intensity of tapping

Measures of remedy

Trees which had developed complete dryness should be rested for six months after which tapping can be resumed in healthy bark often on a reduced cut length However the fact that in most trees brown bast will gradually spread throws doubt on the value of resting affected trees and usually only a small percentage of trees actually were reported to recover (Paranjothy and Yeang, 1978)

Detailed recommendations, for small holdings where brown bast is a particular problem because of the tendency to overtap, has been published by Anthony *et al* (1981) As a precautionary measure it was recommended that three months before starting tapping all trees should be provided with a single vertical isolation groove to the wood on the back guide line of the tapping panel from the cut to the base of the tree In the event of dryness developing this groove should ensure that it does not spread to the second panel In trees which develop partial or total dryness a further system of isolation groove is proposed Tapping should be resumed on the full cut but with periodic rest to minimise recurrence of the syndrome

Materials and Methods

MATERIALS AND METHODS

The study on the extent of incidence of Tapping Panel Dryness (TPD) and associated parameters in *Hevea brasiliensis* was carried out in the small holdings of Meenachil taluk of Kottayam district The aim of the study was to critically assess the incidence of TPD in the small holdings of Meenachil taluk and to evaluate whether the incidence is due to any defect in the exploitation system followed The methodology adopted for the study is detailed below

3 1 Jurisdiction of the study

The survey was conducted in selected small holdings of Meenachil taluk Kottayam district

3 2 General information on the areas selected

The major crop of the taluk is *Hevea* the same being planted on the uplands which are characterised by hillocks with varying degrees of slope ranging from moderate to steep The soil type in the uplands is oxisol More than 90 per cent of the planted area come under small holdings In majority of the cases the size of holdings is less than one hectare In nearly 80 per cent of the holdings plantation have been raised availing of subsidy from the Rubber Board

3 3 Selection of the holdings

Fifty four small holders who sell their produce as latex and representing different parts of the taluk had been selected for the study Only those holdings with less than two hectares of rubber area had been selected The other criteria for selection of the holdings were that they should be planted with a single clone in the same year tapping should be either on BO 1 or BO 2 panel no stimulation practices adopted and the yield data should be available at least for the year 1993 The holdings selected for the study had been planted predominently with the clone RRII 105 followed by clones RRIM 600 GT 1 and RRII 208 The holdings with other clones were not selected for the study as they formed a part of the estate only planted on experimental basis and hence separate production data of them were unavailable

3 4 Collection of data

Each of the selected holding was visited and data collected as per a pre tested interview schedule the details of which are given in Appendix I

3 4 1 General informations

The data collected included information on terrain of land clones year of planting planting density and management practices Data on cultural practices like manuring disease control measures weed control cover crop establishment etc were also collected

Spacing of the trees was randomly measured at five points In addition visual scorings were made for slope of the plantation soil depth rocky patches etc

3 4 2 Details of tapping

From each of the selected units details were collected regarding the standard adopted for tappability (girth and height of opening) system of tapping tapping task yearly bark consumption depth of tapping tapping rest provided rainguarding practices presence of outgrowths in the renewed bark etc

Five trees at random were closely examined for assessing quality of tapping From such trees bark depth of tapping wounding of cambium (if any) opening height bark consumption etc were recorded Bark thickness of ten trees in each holding was measured using a bark guage

Extent of injury on the renewed bark was scored as insignificant moderate or heavy Depth of tapping was categorised as normal shallow or deep Overall quality of tapping was assessed as good satisfactory or bad

3 4 3 Incidence of TPD

Trees with completely dry tapping cut were physically counted Each of the TPD affected tree was examined for opening of opposite panel or high panel Observations were also made to see if there was any abnormal incidence of TPD in locations such as surroundings of house and compound cattle shed low lying areas, canal/river banks, etc

Informations on the rest period given to affected trees and other treatments were also collected

The data collected from the holdings were subjected to statistical analysis for drawing valid inferences

Results

RESULTS

The survey on examining the incidence of tapping panel dryness in the small holdings of Meenachil taluk was taken up during the year 1994 The results obtained are presented below

4 1 Area classes of holdings

The data on the size of the holdings surveyed is presented in Table 1 The mean size of the holdings studied was 0 76 hectares and the range was from 0 20 hectares to 1 90 hectares Out of the 54 holdings surveyed two holdings (4%) belonged to the area class of 0 20 ha and less 21 holdings (39%) to the area class of 0 21 ha to 0 50 ha 26 holdings (48%) to area class of 0 51 ha to 1 00 ha and five holdings to the class of more than one ha

4 2 Frequency distribution of clones

The data on the clone wise distribution of the holdings is given in Table 2 The clones planted in the area under study included RRII 105 RRIM 600 GT 1 and RRII 208 Of the 54 holdings studied 48 holdings (89%) were planted with the clone RRII 105 three (5%) with the clone RRIM 600 two (4%) with GT 1 and one (2%) with RRII 208 This indicates a high preference for the clone RRII 105 among the small holders subjected to the survey As clones RRIM 600 GT 1 and RRII 208 together represented only around ten per cent of the holdings surveyed the data from these holdings were not considered for

Table 1 Frequency distribution of area classes of holdings

Area class	Number of holdings	Percentage of holdings
0 20 ha and less	2	3 74
0 21 ha to 0 50 ha	21	38 88
0 51 to 1 00 ha	26	48 12
Above 1 00 ha	5	9 26
Total	54	

Table 2 Distribution of clones in small holdings undergoing exploitation in BO 1 and BO 2 panels

Clone	Number of holdings	Percentage of holdings
RRII 105	48	88 9
RRIM 600	3	5 6
GT 1	2	3 7
RRII 208	1	1 8
Total	54	

analysis The holding under second year of tapping also was excluded from analysis unless otherwise stated as it was under a short period of exploitation only to have any significant effect on TPD

4 3 Planting density and density of trees under tapping

The data on planting density and density of trees under tapping are presented in Table 3 and 4 respectively The planting density in the holdings surveyed ranged from 460 to 540 trees ha ^{1} In nine per cent of the holdings the planting density was 460 trees ha ^{1} while in 26 per cent of the units it was between 461 to 500 The percentage of small holdings with planting density between 501 to 550 trees ha ^{1} was 65 The density of trees under tapping ranged from 300 to 500 trees ha ^{1} (Table 4) Among the holdings surveyed 15 per cent holdings had below 400 tapping trees ha ^{1} 31 per cent had 401 to 450 trees ha ^{1} and 54 per cent had 451 to 500 trees ha ^{1}

4 4 Other basic information of the holdings

4 4 1 Slope

The holdings surveyed were located on lands with varying degrees of slope and the data on the same are furnished in Table 5 Twenty five holdings were located in lands with flat to moderate slope (below 30% slope) whereas 29 holdings were on lands with steep slope (above 30% slope)

4 4 2 Rain guarding

Among the holdings surveyed rainguarding was found to be

Table 3 Frequency distribution of planting density classes

Sl No	Planting density/ha	Number of units	Percentage of units
1	460	5	9 24
2	461 to 500	15	25 73
3	501 to 550	34	65 03

Table 4 Frequency distribution of density classes of tapping trees

Sl No	Tappable trees/ha	Number of units	Percentage of units
1	< 400	8	14 82
2	401 to 450	17	31 48
3	451 to 500	29	53 70

Table 5 Frequency distribution of holdings based on slope

Sl No	Slope of the area	Number of units	Percentage of units
1	Flat to moderate slope	25	46 3
2	Steep area	29	53 7

practised in 35 per cent of the holdings while in the rest no rain guarded tapping was undertaken The pertinent data are furnished in Table 6

4 5 Tapping intensity

The tapping intensity followed in the holdings surveyed was ½S d/2 without any rest on Sundays In nine of the holdings sur veyed the tapping was found to be shallow while it was either opti mum or deep in the others Yield stimulants were used in none of the holdings

4 6 Yield attributes

Monthly yield of latex dry rubber content and mean dry rubber content in the rainguarded and non rainguarded holdings for clone RRII 105 are presented in Figs 1 2 and 3 Figure 4 shows the cumulative yield of dry rubber (excluding scrap) in the rainguarded and non rainguarded holdings in different months for the year 1993 Data on total number of tapping days were not available Cumulative yield from rainguarded and non rainguarded holdings were comparable from January 1993 to May 1993 Cumulative yield of non rainguarded holdings registered a fall from June onwards with widening of gap upto November There was slightly narrowing of gap in December The final difference in yield was 597 kg ha ^{1} Mean drc was 1 22 per cent higher in the non rainguarded holdings Mean yield of dry rubber from rainguarded holdings was 2433 kg ha ^{1} and from non rainguarded hold ings was 1836 kg ha ^{1} for the year 1993 (Fig 4)

Table 6 Frequency distribution of rainguarded and non rainguarded holdings

Sl No	Particulars	Number of units	Percentage of holdings
1	Rainguarded holdings	19	35 19
2	Non rainguarded holdings	35	64 81

Fig 1 Monthly yield of latex in rainguarded and non rainguarded holdings

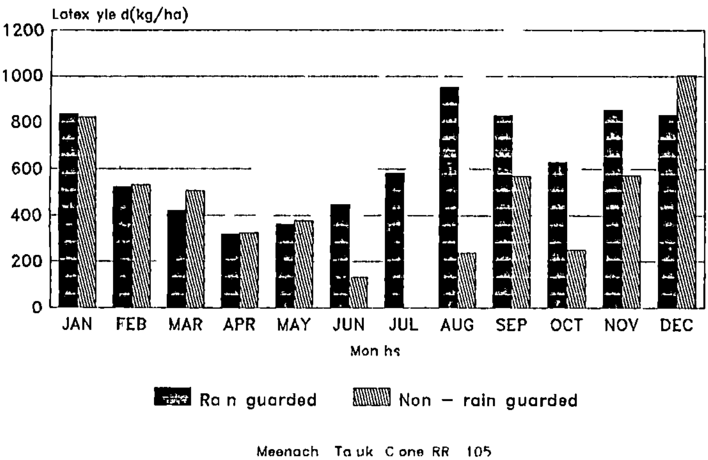


Fig 2 Monthly variation in drc in rainguarded and non rainguarded holdings

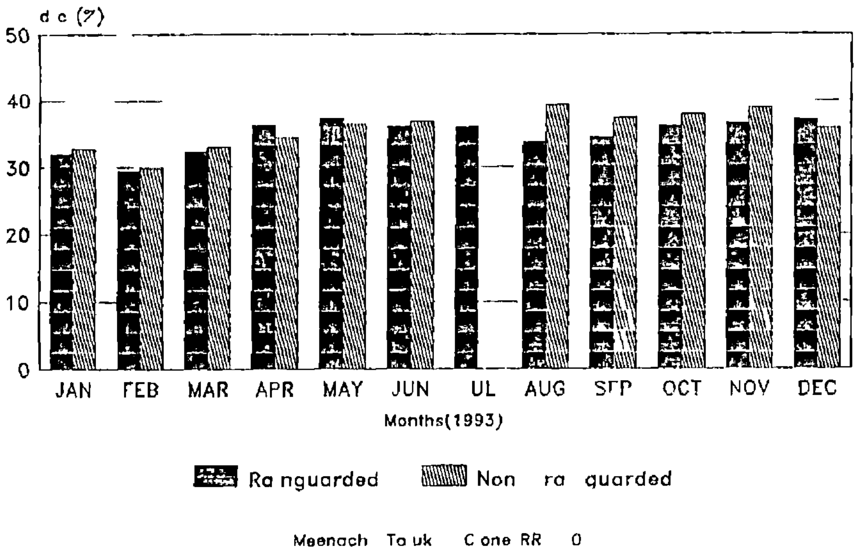


Fig 3 Monthly yield variation in dry rubber in rainguarded and non rainguarded holdings

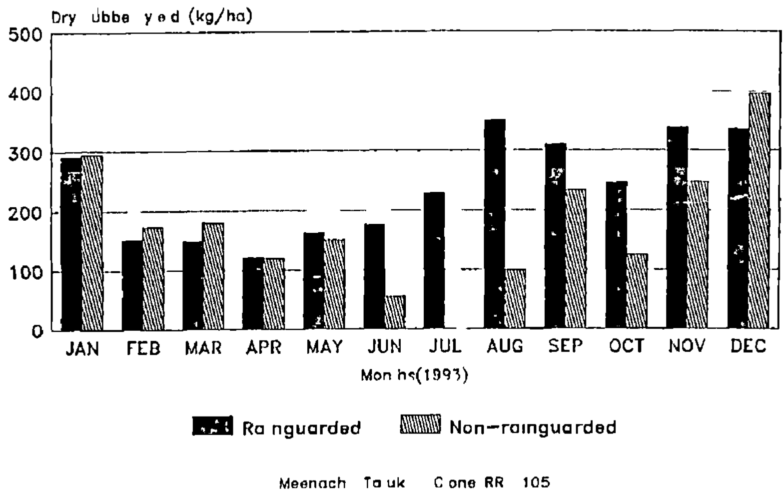
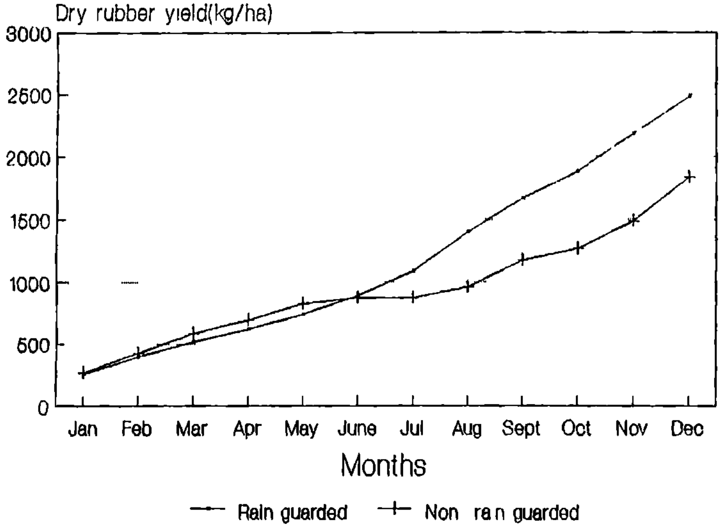


Fig 4 Cumulative dry rubber yield (Rainguarded 17 holdings & Non rainguarded 30 holdings)



4 7 Incidence of TPD

Mean percent incidence of TPD variation in the incidence and the frequency distribution of different incidence classes are shown in Fig 5 The mean incidence of TPD in terms of completely dry tapping cuts was eight per cent In 23 per cent of the holding the incidence was less than five per cent while it was five to ten per cent in 55 per cent of the holdings In 15 per cent of the hold ings complete drying of the cut was between 10 to 15 per cent It was 15 to 18 per cent only in six per cent of the holdings

Effect of duration of tapping on the incidence of TPD including the holdings under second year of tapping is presented in Fig 6 During the initial four years of tapping the incidence was below five per cent During subsequent years the incidence ranged from 3 per cent to 18 per cent

4 8 Correlation of incidence of TPD with yield attributes

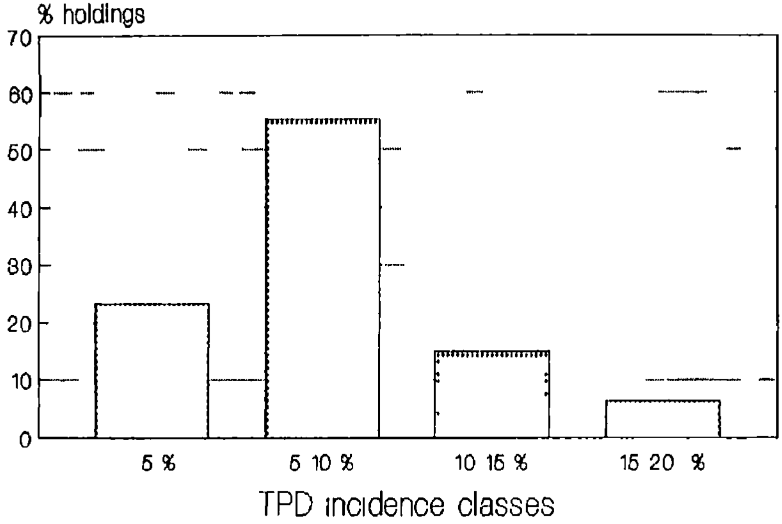
Coefficient of correlation (r) between selected yield at tributes and TPD are presented in Table 7 Mean data for dry rubber yield incidence of TPD annual bark consumption and mean annual drc in rainguarded and non rainguarded holdings and the test of signifi cance for these parameters are presented in Table 8 Data on annual yield of latex dry rubber (excluding scrap) per cent of dry rubber content number of trees affected by TPD in terms of completely dry tapping cut data on mean bark thickness and mean bark consumption for the year 1993 in the individual holdings under study are given

Table 7 Correlation coefficient (r) between selected yield attributes and TPD in *Hevea brasiliensis* (Clone RRII 105) in the small holdings of Meenachil taluk

	Non rainguarded holdings (30 Nos)	Rainguarded holdings (17 Nos)	Combined (47 Nos)
Yield Vs incidence of TPD	+0 2567 NS	+0 33458 NS	+0 28978**
Bark consumption Vs per cent incidence of TPD	+0 5202**	+0 2350 NS	+0 4510**
Density Vs per cent incidence of TPD	+0 15637NS	0 3132 NS	0 0272 NS
Bark consumption Vs yield	0 1651 NS	0 1270 NS	+0 0333 NS
Bark thickness Vs per cent incidence of TPD	0 2513 NS	0 3713 NS	0 3362**
Density Vs yield	0 3317 NS	+0 3428 NS	0 1849 NS
Density Vs Bark thickness			0 07668NS
Bark thickness Vs yield	0 2662 NS	0 0584 NS	0 04 NS
Bark thickness Vs Mean annual drc	+0 5696**	+0 5751*	+0 47869**
Mean annual drc Vs incidence of TPD	0 08375 NS	0 1954 NS	0 14609NS

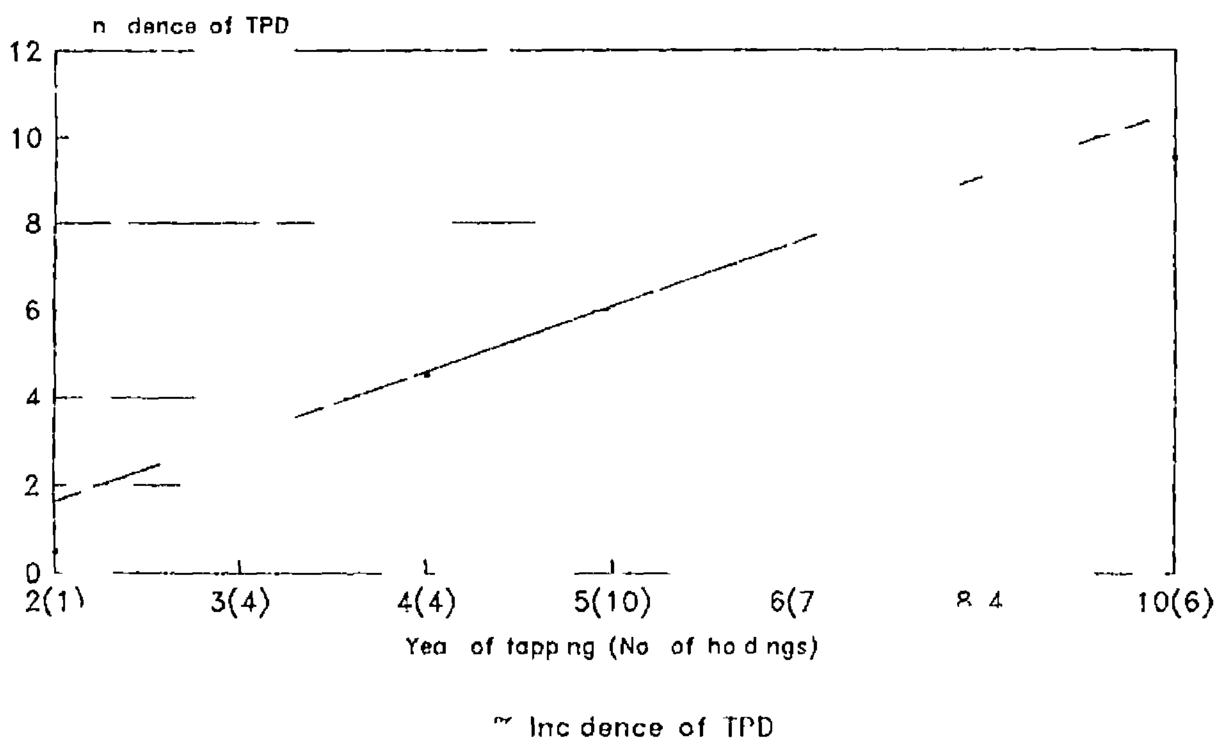
** Significant at 1% level * Significant at 5% level
NS Non significant

Fig 5 TPD incidence classes



mean(+SD) 7 56+3 75 CV(%) =49 60
Meenachil Taluk Clones RRII 105
RRIM 600 GT 1 & RRII 208

Fig 6 Relationship of tapping duration and TPD in clone RRII 105



Meenach Ta uk

in Appendix II separately for rainguarded and non rainguarded holdings

4 8 1 Correlation with planting density and bark thickness

Distribution of holdings of clone RRII 105 under different planting density classes is shown in Fig 7 Mean bark thickness under different planting densities are also shown in the figure The relationship between bark thickness and density of planting was found to be statistically non significant (Table 7) Similarly the relationship between the density and incidence of TPD was also non significant (Table 7) However bark thickness and incidence of TPD showed highly significant negative correlation (Fig 8 and 9 Table 7)

4 8 2 Correlation with bark consumption

Bark consumption showed significant (at 1% level) positive correlation with incidence of TPD (Table 7 Fig 10) Further analysis showed the relationship to be significant only in non rainguarded holdings but not in rainguarded holdings (Table 7)

4 8 3 Correlation with yield

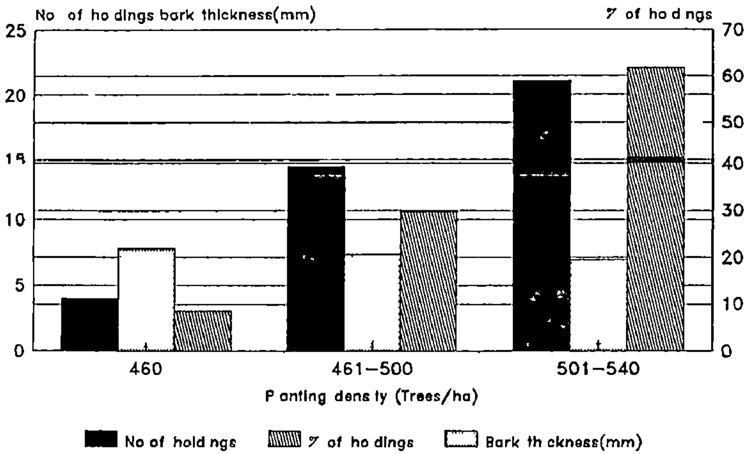
Yield of dry rubber (excluding scrap) during 1993 showed significant positive correlation with TPD incidence (Table 7 Fig 11) However the incidence of TPD among rainguarded and non rainguarded holdings were similar (Table 8) The mean annual dry rubber was 24 5 per cent less in the non rainguarded holdings Though mean

Table 8 Test of significance of yield attributes and per cent incidence of TPD between rainguarded and non rainguarded holdings (Clone RRII 105) in Meenachil taluk

	Rainguarded holdings	Non rainguarded holdings	t test
Dry rubber yield (kg/ha)	2433 00	1836 00	4 99**
Incidence of TPD	8 14	7 22	0 2475 NS
Annual bark consumption	22 82	21 57	1 8545 NS
Annual mean drc	34 83	36 05	2 0228*

** Significant at 1% level * Significant at 5% level
NS Non significant

Fig 7 Effect of planting density on bark thickness



Meenach Ta uk C one RR 105

Fig 8 Relationship between bark thickness and TPD in clone RRII 105

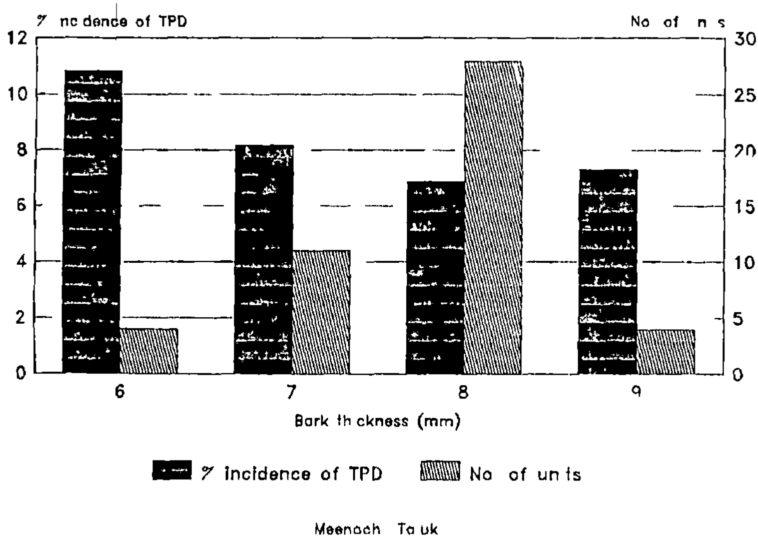
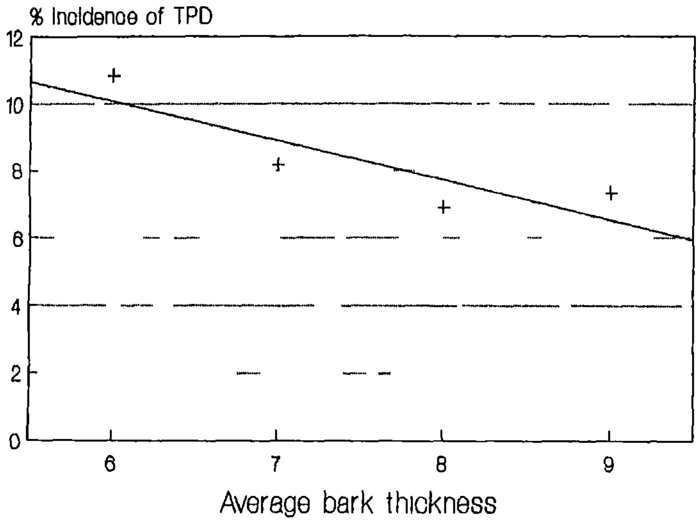


Fig 9 Influence of bark thickness on incidence of TPD



Meenachil Taluk Clone RRII 105

Fig 10 Effect of bark consumption on incidence of TPD

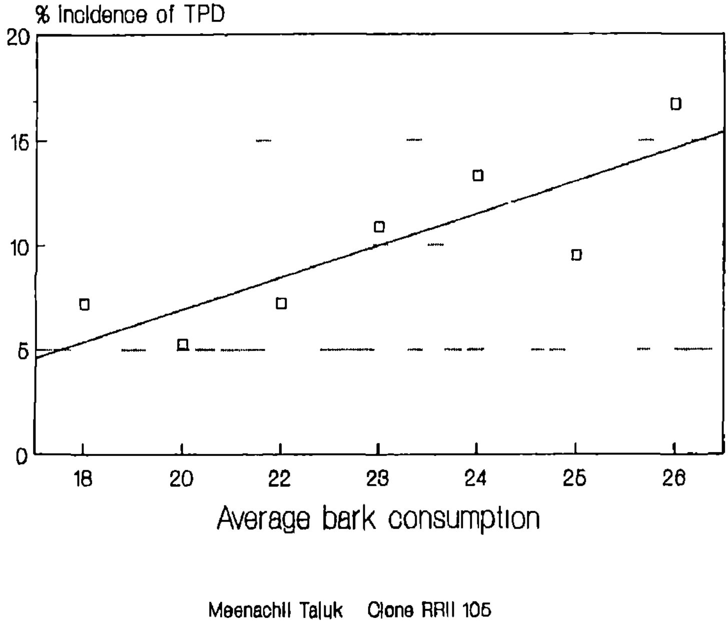
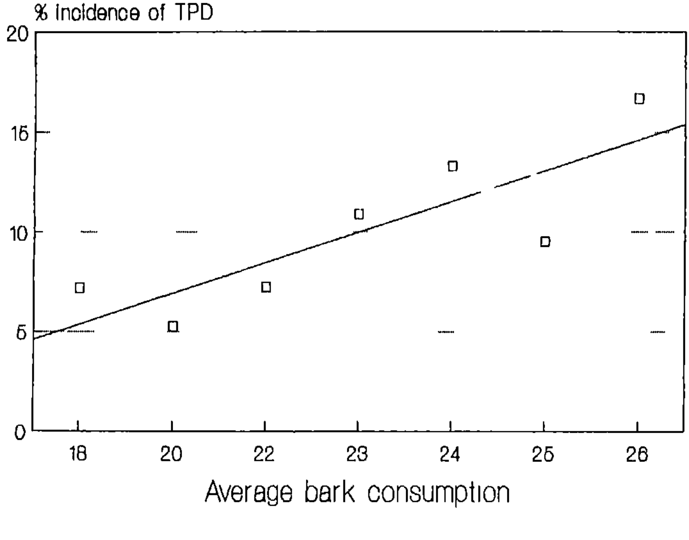
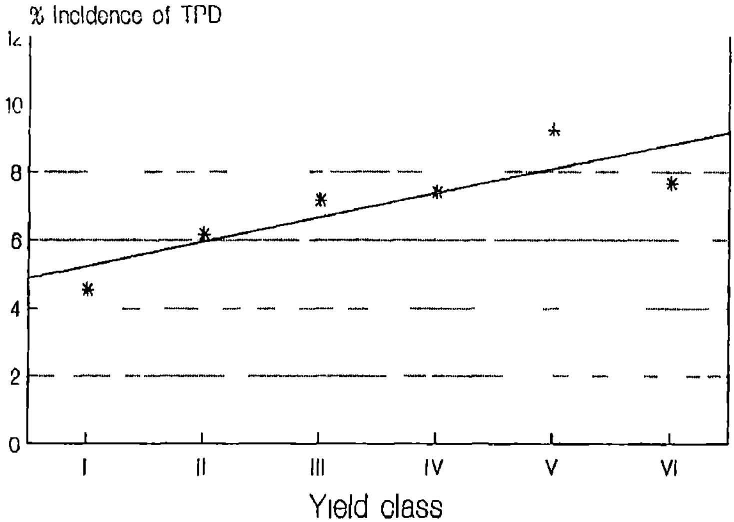


Fig 10 Bark consumption x % incidence of TPD



Meenachil Taluk Clone RRII 105

Fig 11 Effect of latex yield on incidence of TPD



Meenachil Taluk clone RRII 105

annual drc was negatively correlated to TPD incidence it was non significant

4 9 Effect of bark thickness and yield on incidence of TPD

Eventhough bark thickness and yield are related to TPD incidence (Table 7 Fig 9 and 11) significant relationship was not observed between bark thickness and yield (Table 7) Simiarly, bark thickness and mean annual drc are positively and significantly correlated at one per cent level (Table 7 Fig 12) Though mean annual drc and TPD incidence are negatively correlated the relationship is statistically non significant (Table 7) Mean drc among the rain guarded and non guarded holdings were significantly different from each other at five per cent level (Table 8)

4 10 Special features of the incidence

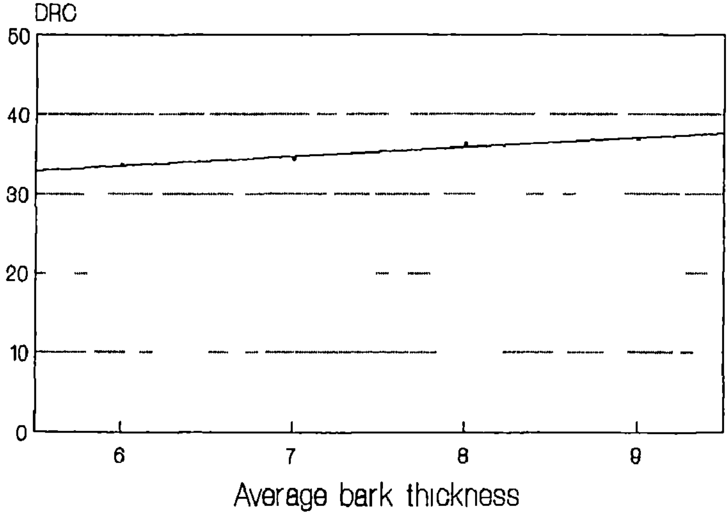
The present study showed that holdings which took more than normal time to attain tappability have lesser incidence of TPD (Fig 13)

Generally high incidence of TPD was observed near house holds and cattle sheds in low lying areas banks of river canals etc

4 11 General observations

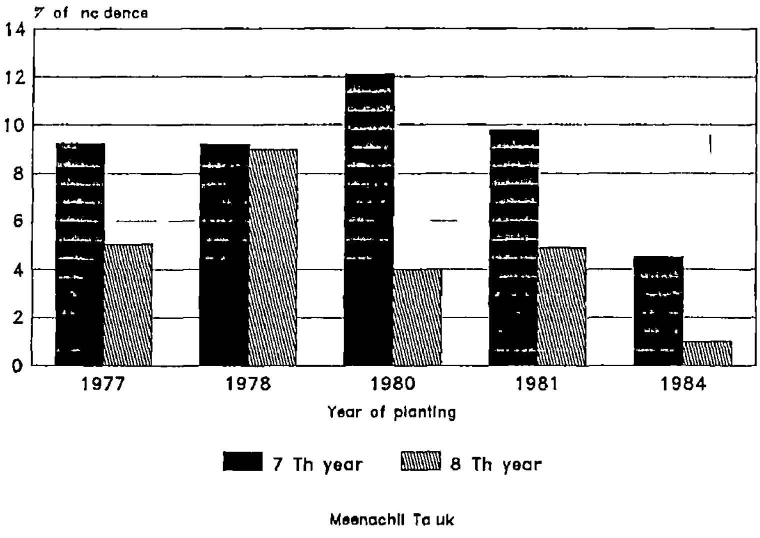
In the case of clone RRII 105 dryness was seen affected in

Fig 12 Influence of bark thickness on drc



Meenachil Taluk Clone RRII 105

Fig 13 Effect of immaturity period on incidence of TPD



the BO 1 panel tapping itself in the majority of cases In the case of trees of the clones RRIM 600 and GT 1 the dryness started in the BO 2 panel tapping stage and they had only comparable girth conditions with other trees in the holding (Table 9)

In the trees which had been tapped in the opposite panel when the original cut got dried up it was seen that the dryness had spread to that panel also within a few weeks or few months of tapping (Table 10) In two trees of clone RRII 105 the BO 2 panel was also found to be dry without tapping of the panel

4 12 Treatment of affected bark

In four holdings the affected bark was seen treated with Bordeaux paste which did not improve the condition of the affected bark even though more than a year had elapsed after the treatment In the other holdings no treatment was given to the affected bark (Table 11)

In all the cases treated or untreated the dried up bark was seen adpressed to the newly formed tissue inside The dried bark cracked and or flaked and the newly formed tissue could be seen through the cracks In the newly formed bark tissues latex was seen close to the cambium only The outer bark portion of these tissues was brownish in colour and the inner portion was yellowish grey

In two trees severe deformity and swelling was seen on the bark up to about ten feet height Bark dryness started in these trees on BO 1 panel tapping but deformity and swelling was seen on

Table 9 Average girth conditions of trees of clone RRIM 600 and GT I (Affected by TPD and unaffected)

Sl No	Clone	Year of planting	Average girth of trees	
			Normal trees	TPD affected trees
I	RRIM 600 (two holdings)	1977	70 cm	72 cm
2	GT 1	1980	75 cm	75 cm
3	GT I	1984	68 cm	69 cm

Table 10 TPD incidence in subsequent panel after drying up of first panel

Sl No	Number of trees observed	Panel tapped	Present condition of panel	Duration of tapping after which the incidence occured in the panel
1	12	BO 2	Dry	2 3 months
2	7	BO 2	Dry	1 2 months
3	4	BO 2	Dry	2 3 weeks
4	2	BO 1	Dry	BO 2 also dry without tapping of the panel

Table 11 Treatment of TPD affected trees by the small holders of Meenachil taluk

Sl No	Details of treatment given	Number of holdings	Percentage of holdings
1	Recommended treatment	Nil	Nil
2	Bordeaux paste application	4	7 41
3	No treatment	50	92 59

both panels Latex was seen deep inside the bark but the panels were unsuitable for tapping due to uneven surface and burr formation The swellings had woody tissue inside and the bark covering was thin Latex was seen on the bark portion of these tissues

4 13 Details of rest given to affected trees

Out of the 54 holdings surveyed in 30 holdings (54 per cent) the TPD affected trees were rested for a year or more before resuming normal tapping on them In 15 holdings (27 per cent) the duration of rest given was 6 12 months In six holdings (11 per cent) three to six months of rest were given In three holdings (eight per cent) no resting of the trees was resorted to and the trees were tapped on the next panel or high panel when the tapping panel got dried up due to TPD The data on the rest period given to the affected trees is furnished in Table 12

Table 12 Details of rest given to TPD affected trees

Sl No	Details of rest given	Number of holdings	Percentage of holdings
1	1 year and above	30	53 70
2	6 12 months	15	26 85
3	3 6 months	6	11 11
4	Not rested	3	8 34

Discussion

DISCUSSION

The salient results obtained in the study are discussed hereunder

5 1 Incidence of Tapping Panel Dryness

In clone RRII 105 high incidence of TPD in terms of completely dry tapping cut has been reported Sulochanamma *et al* (1993) reported 17 9 per cent of incidence in clone RRII 105 from experimental plots under ½S d/2 6d/7 intensity of tapping In another trial 15 72 per cent of incidence was reported (RRII Annual Report 1993) The present study shows that the general incidence of TPD in RRII 105 in the small holdings of Meenachil taluk is not alarmingly high

5 2 Latex yield and TPD incidence

Incidence of TPD is related to latex output and intensity of tapping (Sivakumar *et al* 1988 Kang and Hashim 1989) In the present study also positive correlation was observed between dry rubber yield per unit area and incidence of TPD Absence of such correlation within the rainguarded and non rainguarded holdings might be due to small sample size

Data shows that comparable incidence of TPD is encountered in rainguarded and non rainguarded holdings without realising comparable yield Mean annual yield in the non rainguarded holdings was

24 5 per cent less when compared to the yield from rainguarded holdings

The significant correlation with dry rubber yield (eventhough for only one year rather than with cumulative yield) indicate that incidence of TPD with in reasonable limits need not result in lower yield in the holdings Such reductions are likely only as a result of abnormally high incidence Hence in plantations where TPD incidence is very little yield performance has to be critically examined to verify if there is any under exploitation

Though bark thickness had highly significant positive correlation with mean annual drc there was no correlation between annual mean drc and TPD incidence This might be due to transient changes in drc due to the small percentage of affected trees

5 3 Bark thickness and incidence of TPD

Ng Ai Peng (1993) reported reduction in bark thickness with increasing density in planting In the present survey such correlation could be not observed since planting density of the holdings surveyed varied between 460 ha $^{-1}$ to 540 tree ha $^{-1}$

In the holdings under survey the mean bark thickness showed variation from 6 mm 9 mm and this parameter had highly significant correlation with TPD Higher incidence in thin bark situations is mainly due to the physical difficulties to tap thin bark which result in profuse wounding of cambium The absence of correlation between bark thickness and yield suggests direct effect of bark thickness on TPD incidence

5 4 Bark consumption and incidence of TPD

Though bark consumption for the year 1993 only was considered it showed highly significant correlation with TPD incidence This relationship was pronounced in holdings where rainguarding was not practised and non significant in the rainguarded holdings This indicates practice of recovery tapping to a large extent by the farmers who do not resort to rainguarding Bark consumption showed only non significant correlation with yield

The present study showed that incidence of tapping panel dryness was not alarmingly high in clone RRII 105 in the small holdings Meenachil taluk It also indicated that low incidence of the syndrome might be often at the cost of yield Other than tapping intensity bark thickness and bark consumption were important factors which contributed to the incidence of TPD Planting density upto 550 trees ha^{-1} did not have any effect on bark thickness and consequently on the incidence of TPD

Summary and Conclusion

SUMMARY AND CONCLUSION

The study was conducted to find out the extent of incidence of TPD and related parameters in the rubber growing small holdings of Meenachil taluk Fifty four small holders who sell their produce as latex and representing different parts of the taluk were selected for the study Holdings with trees tapped either on BO 1 or BO 2 panel only were included in the study

The study revealed that the small holders have high preference for the clone RRII 105 due to its inherent capacity for faster growth higher yield and disease resistance Rainguarded tapping is not being practised on a large scale as only 35 19 per cent of the holdings resorted to this practice Tapping intensity in the surveyed holdings was invariably ½S d/2 without any rest on Sundays

Planting density varied from 460 ha^{1} to 550 ha^{1} and density of trees under tapping varied from 300 ha^{1} to 500 ha^{1} Planting density upto 550 ha^{1} was found not to have any effect on bark thickness or incidence of TPD

The mean incidence of TPD in terms of complete dry cuts was 7 56 per cent for the clone RRII 105 During the initial four years of tapping the incidence was below five per cent in the holdings surveyed

In the present study positive correlation was observed between dry rubber yield per unit area and incidence of TPD Mean bark thickness showed highly negative correlation with incidence of TPD Also bark thickness was found to have highly significant positive correlation with annual mean drc But no correlation was observed between annual mean drc and TPD incidence Bark consumption showed highly significant correlation with TPD incidence and non significant correlation with yield This indicates induction of TPD by recovery tapping without concomitant increase in yield Thus comparable incidence of TPD was encountered in rainguarded and non rainguarded holdings without realising comparable yield

Low incidence of TPD was observed in plantations with slower growth High incidence of TPD was generally observed near house holds and cattle sheds in low lying areas banks of rivers and canals etc

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Appendices

APPENDIX I

CASE STUDY ON THE INCIDENCE OF TAPPING PANEL DRYNESS IN THE RUBBER SMALL HOLDINGS OF MEENACHIL TALUK

QUESTIONNAIRE

1	Name of the farmer	
2	Address	
3	Reg No /Ref No of holding	
4	Year of planting	
5	Clone	
6	Area in hectares	
7	Spacing	Square/rectangular/contour ft
8	No of trees under tapping (including trees untapped due to TPD)	
9	Year and month of opening	
10	Average girth at opening	
11	Height of opening	
12	Percentage of trees which attained tappability at the time of opening	
13	Task undertaken by the tapper (with details if he is undertaking tapping in other holdings)	
14	Quality of tapping	Good/Satisfactory/Bad
15	Whether shallow or not	
16	Extent of injury	Nill/Insignificant/Moderate/ Heavy
17	Bark consumption (CM/year)	

18 Bark thickness (MM)
(below tapping cut 10
trees at random)

19 Frequency of tapping

20 Details of rest given

21 Rainguarded or not

22 Details of extra tapping

23 Presence of out growth in renewed bark — Nil/Slight/Moderate/Heavy

24 Yield performance (whatever details available to be collected)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Latex (kg)												
Mean drc												
Scrap (kg)												
No of tapping days												

25 No of trees in which the original tapping cut is completely dry (include data for all available)

26 No of trees affected by TPD in which opposite panel was opened

a) No of trees where opposite panel is yielding

b) No of trees where opposite panel is dry

27 No of trees affected by TPD in which high panel was opened for upword tapping

		BO 1	BO 2	HO
28	Present condition of affected trees	Yielding/ dry	Yielding/ dry	Yielding/ dry
	No of trees			

29 Year in which the incidence occured (Ist year of tapping 2nd year etc) (if available)

30 Relative position of the trees affected (near to cattle shed house and compound etc)

31 Any other details requiring mention

32 Treatment of affected bark

33 Tapping rest given or not yes/No

34 Duration of tapping rest

35 General status of cultural operations

a) Manuring

Type of manure
Pre monsoon Kg/ha
Post monsoon Kg/ha

b) Disease control measures

c) Pest management

d) Weed status/control

e) Cover crop established or not

36 General status of plantation

a) Slope Flat/Gentle slope/Moderate/Steep

b) Soil depth Poor/satisfactory/good

c) Rocky patches %

d) Aspect South/North/East/West

e) Interplanted or not

37 Remarks if any

Place
Date

Signature
Name of Investigator

APPENDIX II

DATA ON ANNUAL YIELD BARK THICKNESS BARK CONSUMPTION AND TPD INCIDENCE IN SELECTED SMALL HOLDINGS OF MEENACHIL TALUK

I RAINGUARDED HOLDINGS

Code No of estate *	Area (ha)	Latex weight (kg)	drc	Dry weight (kg)	Mean bark thickness (mm)	Bark consumption (cm)	No of affected trees
1	2	3	4	5	6	7	8
2	0 90	6320 300	35 94	2260 330	7	25	17
3	0 60	5022 000	33 35	1674 830	6	25	40
12	1 90	13866 600	36 28	5110 960	8	22	49
14	1 37	7794 300	33 26	2571 490	8	22	45
17	1 00	7672 700	31 90	2632 140	7	20	32
18	1 20	8503 300	38 20	2989 210	9	20	48
19	1 24	8936 200	34 90	3167 500	9	20	36
20	1 00	6610 400	38 90	2417 340	9	20	38
22	0 60	4413 200	34 95	1533 160	8	25	31
36	0 38	3310 100	32 80	902 780	7	25	20
37	0 80	4127 800	37 80	1624 560	8	25	21
42	0 90	5827 000	33 10	2147 050	8	25	46
43	0 80	5630 500	34 30	1887 340	8	23	30
44	0 95	6404 40	33 70	2176 500	8	22	22
46	0 50	2800 400	33 70	984 400	8	22	8
47	0 66	3942 300	34 30	1250 350	8	22	12
48	0 52	3583 200	34 80	1159 120	8	25	17

* Addresses given in Appendix III

Contd

Appendix II Continued

1	2	3	4	5	6	7	8
51	0 50	3277 80	33 56	1100 020	8	20	18
54	0 92	10060 300	34 05	3425 530	7	22	30
2 NON RAINGUARDED HOLDINGS							
1	0 52	2666 900	40 08	1068 890	8	20	10
4	0 40	2372 400	34 82	812 280	8	22	14
5	0 85	3657 400	34 54	1200 880	7	20	4
6	0 58	3754 100	35 97	1259 730	7	20	16
7	0 40	1628 900	34 60	547 260	7	25	15
8	0 90	2868 100	36 20	998 810	8	20	18
9	0 80	3094 500	35 69	1083 680	9	22	22
10	0 67	3216 800	39 50	1162 090	8	25	26
11	0 60	2878 200	35 29	1024 620	8	22	19
13	0 32	2288 500	32 72	752 280	7	23	28
15	1 00	6722 800	37 54	2413 240	8	20	4
16	0 76	4584 000	36 60	1594 670	8	20	18
21	0 42	1657 800	34 36	547 470	8	18	7
23	0 80	3172 300	37 54	1165 420	8	22	30
24	0 40	584 900	36 40	212 900	6	18	1
25	0 50	3189 400	33 30	1038 310	6	26	40
26	1 37	4175 600	36 90	1467 290	8	20	40
27	0 76	2761 400	33 30	901 600	6	18	5
28	0 45	2361 000	38 70	806 260	8	18	20

Contd

Appendix II Continued

1	2	3	4	5	6	7	8
29	0 38	3161 900	38 80	1266 030	8	18	20
30	0 38	1868 500	38 30	641 480	7	22	18
31	0 40	2325 500	34 30	868 140	6	25	25
32	0 60	3323 000	38 10	1136 460	8	25	32
33	0 50	2589 500	38 30	818 760	8	23	16
34	0 45	2012 600	35 10	677 340	8	22	16
35	0 40	2243 900	35 80	807 180	8	22	12
38	0 80	3267 600	35 90	1065 290	8	25	25
39	0 50	2924 100	34 70	997 650	7	24	20
40	0 39	2343 700	32 30	766 390	7	20	8
41	0 26	1810 200	34 80	529 500	7	20	8
45	0 40	2190 900	37 60	648 570	8	20	4
49	1 00	4930 100	34 79	1715 180	8	22	40
50	0 40	1559 000	35 20	543 550	7	25	21
52	0 30	1406 900	33 57	439 860	6	30	6
53	0 85	3635 300	30 29	1101 130	7	22	18

APPENDIX III

Name and address of small holders surveyed

Code No of estate	Name and address
1	2
1	Sri Augustus M Roy Vaniappura Ramapuram Bazar P O
2	Sri C J Jose Cheemkallel Ramapuram Bazar P O
3	Smt Thressiamma Joseph Karakkattu Ramapuram Bazar P O
4	Smt Thressiamma Scaria Enthumplackal Poonjar South P O
5	Sri Jose Scaria Muthuthavalathil Poonjar South P O
6	Sri P C Mathew Padikara Poonjar South P O
7	Sri C A Thomas Srampickal Poonjar South P O
8	Sri Baby Varkey Vadakkel Poonjar South P O
9	Sri Joseph Joseph Vayalikkunnel Poonjar South P O
10	Sri Varkey Abraham Adattu Njandukallu Teekoy P O
11	Smt Ansamma Joseph Panackakuzhiyil Njandukallu Teekoy P O
12	Sri T T Varkey Thattamparambil Njandukallu Teekoy P O
13	Sri Jino Jacob Panackakuzhiyil Njandukallu Teekoy P O
14	Sri Babu Joseph Pallivathukkal Ramapuram Bazar P O
15	Sri Joseph George Cheemkallel Vellilappally Ramapuram Bazar P O

Contd

Appendix III Continued

1	2
16	Smt Rosamma George Cheemkallel Vellilappally Ramapuram Bazar P O
17	Sri Benny Mathew Chockathu Aimkombu Kadanad P O
18	Smt Thressiamma Augustine Mylackal Aimkombu Kadanad P O
19	Sri Jacob Mathew Chockathu Aimkombu Kadanad P O
20	Sri Augusthy Augustin Mailackal Aimkombu Kadanad P O
21	Sri T M Josekutty Vallikunnel Ezhacherry P O
22	Smt Annakkutty Mathew Chockathu Aimkombu Kadanad P O
23	Sri Mathai Varkey Thattamparambil 6th Mile Plasanal P O
24	Prof Joseph Meckathu Panackapalam Rubi Nagar Changanacherry
25	Sri C M Xavier Challavayalil Panackappalam Plasanal P O
26	Sri V C Pothen Vattakottayil Thekkummuri Puliyannoor P O
27	Sri Pius Thomas Nellippuzha Cherpumkal P O
28	Sri N J Stanislavos Nellippuzha Cherpumkal P O
29	Smt Thressiamma Nellippuzha Cherpumkal P O
30	Sri K K Joseph Kakkattil Thekkummuri Puliyannoor P O

Contd

Appendix III Continued

1	2
31	Smt Thankamma Philip Karamayil Cherpumkal P O
32	Sri V T Thomas Moothasseril Thekkummuri Puliyannoor P O
33	Smt Aley Ulahannan Puthuppallil Melukavumattam P O
34	Sri Thommen Joseph Nellamkuzhiyil Melukavumattam P O
35	Sri A M Mathew Ancheriyil Melukavumattam P O
36	Sri Noble Ezhakiel Vazhamattam Melukavumattam P O
37	Sri A T Thomas Edayanikkattu Melukavumattam P O
38	Sri V J Joseph Vettikuzhiyil Melukavumattam P O
39	Smt Thressiama Joseph Vettukallel Melukavumattam P O
40	Sri Thomas Mathai Kudilil Neeloor P O
41	Sri Jacob T A Thannickal Kurumannu P O
42	Sri m T Michael Mookenthottam Alamattam Kodumpidy P O
43	Sri Augustine T A Thannickal Maryland P O
44	Sri Sebastian Joseph Kallidickal Kadanad P O
45	Sri P T Thomas Pampackal Kollappally P O

Contd

Appendix III Continued

1	2
46	Sri N I Augustine Naduvilekoot Kadanad P O
47	Sri Joy Joseph Neduvilekoot Kadanad P O
48	Sri K J Mathai Kavalavazhiakel Alamattam Kodumpidy P O
49	Sri T O Mathew Thattamparambil Plasanal P O
50	Sri Varkey Abraham Olayethil (Edattu) Njandukallu Teekoy P O
51	Sri K S Sebastian Kallidickal Kadanad P O
52	Sri V C Joseph Vellookunnel Melukavumattam P O
53	Sri M V Thomas Meckattu (Kochukarotte) Panackappalam Plasanal P O
54	Sri Chacko Mathew Chockattu Aimkombu Kadanad P O