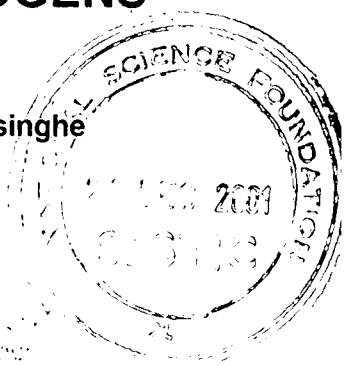
CHECK LIST OF RUBBER PATHOGENS IN SRI LANKA

C.K. Jayasinghe

National Science Foundation

CHECK LIST OF RUBBER PATHOGENS IN SRI LANKA

C.K. Jayasinghe



Use this manual
to search for pathogens
recorded on para rubber tree
in Sri Lanka since its
establishment in the latter part
of the 19th century.
Also provides
ready assistance for the
diagnosis of the diseases
distributed in plantations and
nurseries today and
includes the geographical
distribution of pathogens
with a literature guide
on authentification, biology, epidemiology
and
management.

Published by
National Science Foundation
Colombo

ISBN 955-590-032-9

Printed in Sri Lanka by
NATIONAL SCIENCE FOUNDATION
47/5, Maitland Place
Colombo, Sri Lanka

Foreword

Those interested in the sociological aspects of endeavour are frequently struck by convergence in such activity. Things tend to happen together at about the right time without any apparent co-ordination. The IRRDB's Plant Pathology Group met in China during October 1999 where the Group decided that there is a need for a manual of pathogens which afflict rubber cultivation. A few weeks later the secretary of the IRRDB happened to be in Sri Lanka courtesy of IBC Asia as a speaker at the Asia Rubber Marketing Conference. This provided a chance opportunity for meeting Dr. Jayasinghe who showed me the manuscript for his survey of the pathogens that have been encountered in Sri Lanka.

With its long history of rubber cultivation, Sri Lankan rubber trees have had ample opportunity to attract a wide variety of diseases and in consequence considerable expertise has been developed in their identification and containment. Nevertheless, Sri Lanka (and the whole of Asia and Africa) has been spared outbreaks of those diseases, which are particular to the Americas, notably South American leaf blight, based on *Microcyclus ulei*. Thus, the world is fortunate in that Dr. Jayasinghe's compilation is not comprehensive in this respect! On the other hand it appears to be comprehensive for the island of Sri Lanka and could form an excellent basis for a global survey.

Finally it is pertinent to observe that the author was unable to contribute directly at the IRRDB's Plant Pathology Group Meeting held in China, in spite of the obvious contribution which he would have made. It is hoped that the more widespread dissemination of this text may make some recompense for the limitations in scientific travel, and will of course provide a permanent record.

Dr. Kevin P. Jones
Secretary,
International Rubber Research
and Development Board
Hertford, UK.
11th January 2000

CONTENTS

Acknowledgements

I take this opportunity to express my sincere thanks to Miss. K.D.S. Samararatne and Mrs. T.H.P.S. Fernando for their assistance in preparation of the manuscript. I owe a sense of gratitude to Mrs. P. Amarasekera for her personal interest shown in word processing and preparation of the final proof. I also wish to express my sincere thanks to Mr. W. Amaratunge for photography and Mr. S. Kannangara for designing the cover page.

I would particularly like to express my appreciation to National Science Foundation (NSF) for undertaking the publication of this document

Finally I consider it is my duty to thank the Chairman of the Rubber Research Board and the Director of the Rubber Research Institute for allowing me to publish the document through NSF.

PREFACE

The primary objective of preparing this manual is to present pathogens recorded on rubber tree in Sri Lanka since the establishment of rubber plantation industries in the latter part of the 19th century. Author surveyed available literature since 1900 to 2000 and every effort was made to present a complete list of pathogens with the reference for the first record. It is hoped that this check list will be of valuable guide to Academics, Plant Pathologists, Estate Managers, Quarantine Officers and Extension Agents.

The second part of this presentation consists the diseases presently distributed in rubber plantations and nurseries in Sri Lanka together with their distribution in the other rubber growing countries in the world. A comprehensive account on the symptoms of the diseases is given to make this manual a useful diagnostic guide to plant protection workers and rubber growers. A list of references have been provided under each pathogen as an aid to obtain literature on authentification, biology, pathology and their efficient management.

1 THE VISION

The para rubber tree (*Hevea brasiliensis* Muell. Arg) native to tropical rain forests of South America was first introduced to Sri Lanka in 1876. This initiated the development of the South East Asian rubber plantations which covers more than six million hectares today. With the spread of the coffee rust epidemic during the latter part of the 19th century in Sri Lanka, rubber was the second alternative crop available to fill the vacuum created by the collapse of the coffee plantations. With this background rubber industry began to develop and in 1890's increasing number of planters realised the potentialities of rubber thus, commercial planting of rubber commenced. By the year 1904 this agricultural commodity was cultivated over 10,000 ha and the extent increased to some 73,000 ha by 1908. During this era investigations on the diseases of the rubber tree were initiated. As the outcome of these studies Mr. J.B. Carruthers, Government Mycologist was able to report the first disease from the rubber plantations of Sri Lanka in 1903 as canker in rubber caused by the fungus, Nectria sp (Carruthers, 1903). Subsequently Mr. T. Petch, Botanist and Mycologist to the government of Ceylon discovered six fungal species pathogenic to leaf, two root disease causing fungi which were believed to have spread to cultivated rubber from the uncleared stumps of the jungle, a suspected canker condition with branch invading fungal pathogen and a fungal species which was also responsible for fruit rot. This was reported in Peradeniya Annual Report for 1905 which was included in Agriculture Bulletin of the Straits and Malaya States in 1906. The first scientific review on the diseases of rubber tree in Sri Lanka was published in 1911 in the book entitled "*The Physiology and Diseases of* Hevea brasiliensis" (Petch, 1911).

During the next decade, a number of significant new diseases have been discovered and knowledge on the disease scenario of the rubber tree expanded considerably. All these new information contributed to a publication entitled "*The Diseases and Pests of the Rubber Tree*", the most descriptive book on *Hevea* diseases ever published in Sri Lanka (Petch, 1921). Subsequent publications of Weir (1926), "*A Pathological Survey of the Para Rubber Tree* (Hevea brasiliensis) *in the*

Amazon Valley" and Murray (1930), "*Diseases of Rubber in Ceylon*" also contributed significantly to the diagnosis and management of the diseases of the rubber plantations. Since the middle of the 20th century several valuable reviews have been offered on the disease situation of the rubber tree in Sri Lanka in the publications of Peries, 1965, 1966 a,b; Liyanage, 1983 a,b; Peries and Liyanage, 1985, 1987; Liyanage and Jacob, 1992; Jayasinghe, 1999 a.

To date, almost after a century of the discovery of the first disease, more than 60 pathogens have been shown to be capable of attacking the rubber tree in Sri Lanka. Over the years a considerable change has taken place in the relative importance of the diseases and it was more prominent during the last two decades. Presently some of the traditional rubber diseases have become less economically significant due to the acceptance of newly bred clones tolerant to such diseases (Jayasinghe & Jayaratne, 1996) whilst some of these breeds succumbed to new pathogens threatening the natural rubber industry in the island (Liyanage *et al.*, 1986; Jayasinghe, 1997; Jayasinghe *et al.*, 1997). Extension of the rubber cultivation into new localities and non-adoption of correct cultural practices during the establishment and management of nurseries also contributed to the change in the disease scenario of the rubber tree (Jayasinghe, 1998). Nevertheless, the potential threat of the diseases of quarantine importance has increased tremendously due to increased trade and movement of tourists (Jayasinghe, 1992). At the same time extensive research commenced by *Hevea* Pathologists for nearly a century contributed immensely to the proper understanding of the disease scenario of the rubber tree and to a vast number of publications on the diagnosis, biology, epidemiology and management of significant diseases.

With the above background this manual is intended to create awareness on all pathogens recorded since the beginning of the cultivation of para rubber in Sri Lanka. All diseases currently present in rubber plantations together with the causative agent have been listed as the relative importance of any disease may change over the years. A comprehensive account on the symptoms is given under each disease enabling to diagnose the maladies in rubber plantations and nurseries. A literature guide pertaining to identification, biology, pathology and management of each pathogen is also presented together with their geographical distribution.

2 PATHOGENS RECORDED ON RUBBER IN SRI LANKA

Available literature on pathogenic records (Petch, 1905; 1911; 1921; Weir, 1926; Anon, 1960; Anon, 1988; Chee, 1976; Review of Applied Mycology; Review of Plant Pathology; Annual Reports of the Rubber Research Institute of Ceylon/Sri Lanka) was surveyed before compiling this document (Table 1) and every effort was made to present a complete list of pathogens recorded on rubber in Sri Lanka. Since the first report of the pest attack on rubber in 1903 (Carruthers, 1903) 63 pathogens have been recorded comprising 60 fungi, a virus, a nematode and an alga. The names of many of the fungi have changed with time and presently accepted nomenclature (Hawksworth *et al.*, 1995) is followed when listing the pathogens according to the alphabetical order. However, other names cited in the literature are given under the synonyms. If the pathogen has been described under one of the synonyms in it's original record, that name is given with the reference citation in the 3rd column. The fungi recorded on dead tissues are excluded totally and fungi recorded on unspecified substrates are included only if that citation is extremely important. The systematic classification of pathogenic fungal genera (Table 2) has been based mainly on "*Ainsworth & Bisby's Dictionary of Fungi*" 8th edition (Hawksworth *et al.*, 1995).

Table 1. ***Hevea*** **pathogens recorded in Sri Lanka with the reference to the first published record**

Pathogen	Disease	Reference
Alternaria **sp.** Syn: *Macrosporium* sp.	MACROSPORIUM LEAF DISEASE	Weir, 1926 as *Macrosporium* sp.
Aplosporella **sp.** Syn: *Haplosporella crypta* Petch	HAPLOSPORELLA BRANCH DISEASE	Weir, 1926 as *Haplosporella crypta.*
Aschersonia **sp.** (Telemorph, *Hypocrella reineckiana* Henn. has also been recorded from *Hevea*)	NODULES ON LEAVES (ORANGE GALLS) (associated with scale insects)	Petch, 1921.
Ascochyta heveae **Petch**	ASCOCHYTA RIM BLIGHT	Petch, 1921.
Bipolaris heveae **(Petch) Von Arx** Syn: *Helminthosporium heveae* Petch *Drechslera heveae* (Petch) M.B. Ellis	BIRD'S EYE SPOT	Petch, 1905 as *Helminthosporium heveae.*
Botryodiplodia theobromae **Pat.**	LEAF SPOTS & DIE BACK	Petch, 1911.
Cephaleuros parasiticus **Karst.** Syn:*Cephaleuros mycoidea* Karst. *Cephaleuros virescens* Kunze	ALGAL SPOT	Munasinghe, 1961 as *Cephaleuros mycoidea.*
Cercosporella **sp.**	CERCOSPORELLA LEAF DISEASE	Weir, 1926.
Ciliospora gelatinosa **Zimm.**	CILIOSPORA BARK DISEASE	Weir, 1926.

Pathogen	Disease	Reference
Colletotrichum acutatum **Simmonds ex Simmonds**	COLLETOTRICHUM LEAF DISEASE	Brown & Soepena, 1994 (first report on isolation). Jayasinghe *et al.*, 1997 (disease establishment and proving *C. acutatum* as the main cause of CLD in Sri Lanka).
Colletotrichum dematium **(Pers. ex Fr.)Grove** Syn: *Vermicularia dematium*	ANTHRACNOSE ON SEEDLINGS	Weir, 1926 as *Vermicularia dematium* .
Colletotrichum gloeosporioides **(Penz.) Sacc.** Syn: *Gloeosporium heveae* Petch *Colletotrichum heveae* Petch *Colletotrichum ficus* Koorders *Gloeosporium alborubrum* Petch [Telemorph, *Glomerella cingulata* (Stonem.) Spauld. & Schrenk has also been isolated from diseased tissues]	COLLETOTRICHUM LEAF DISEASE	Petch, 1905 as *Colletotrichum heveae.*
Coniothyrium **sp.**	CONIOTHYRIUM STEM DISEASE	Petch, 1911.
Corticium salmonicolor **Berk. & Br.** Syn: *Corticium javanicum* Zimm.	PINK DISEASE	Petch, 1906 as *Corticium javanicum*
Corynespora cassiicola **(Berk. & Curt.) Wei**	CORYNESPORA LEAF FALL	Liyanage *et al.*, 1986.
Diaporthe heveae **Petch** [Anamorph, *Phomopsis* (Sacc.) Bubak has also been recorded from *Hevea*]	DIAPORTHE BRANCH DISEASE	Weir, 1926.
Diplodia **Fr.**	DIE-BACK	Petch, 1911.

Pathogen	Disease	Reference
***Fracchiaea brevibarbata* (Berk. & Br.)**	FRACCHIAEA BRANCH DISEASE	Weir, 1926.
***Fracchiaea depressa* Petch**	FRACCHIAEA BRANCH DISEASE	Weir, 1926.
***Fusarium* sp.**	FUSARIUM BARK DISEASE	Weir, 1926.
***Fusarium solani* (Mart.) Sacc.**	FUSARIUM WILT	Liyanage & Dantanarayana, 1983.
***Fusicladium* sp.**	STEM LESIONS	Weir, 1926.
***Ganoderma lucidum* (Leys. ex Fr.) Karst.**	RED ROOT DISEASE (WET ROT)	Bryce, 1921.
***Ganoderma pseudoferreum* (Wakef.) Over. & Steinm.** Syn: *Fomes pseudoferreus*	RED ROOT DISEASE	Petch, 1921 as *Fomes pseudoferreus.*
***Geotrichum* sp.**	GEOTRICHUM ASSOCIATIONS ON ROOTS (Saprophytic colonization on rubber roots)	Jayasinghe & Wettasinghe, 1996.
***Guignardia heveae* Syd.**	GUIGNARDIA RIM BLIGHT	Petch, 1921.
***Hendersonia heveae* Petch**	ON UNSPECIFIED SUBSTRATE	Anon, 1960.
***Macrophomina phaseolina* (Tassi) Goid.** Syn: *Rhizoctonia bataticola* (Taub.)	MACROPHOMINA ROOT DISEASE	Small, 1927 as *Rhizoctonia bataticola.*

Pathogen	Disease	Reference
***Marasmius equicrinis* Mull.**	HORSE HAIR BLIGHT	Petch, 1921.
***Marasmius rotula* Berk. & Br.** (*Marasmius* spp.)	THREAD BLIGHT	The disease was first reported by Petch, 1921. The name of the pathogen was stated by Weir (1926).
***Meliola* sp.**	SOOTY MOULD	Bryce, 1921 (disease symptoms have been described by Petch, 1921 also).
***Meloidogyne incognita* (Kofoid & White) Chitwood**	ROOT KNOT NEMATODE INFESTATION	Jayasinghe & Wettasinghe, 1993.
***Nattrassia mangiferae* (H. & P. Syd.) Sutton & Dyko** Syn: *Dothiorella mangiferae* (H. Sydow & Sydow)	FOOT CANKER AND SUDDEN WILT	Jayasinghe & Silva, 1994.
Hendersonula toruloidea Nattrass	CANKER	Carruthers, 1903
***Nectria* sp.**		
***Oidium heveae* Steinm.** Syn: *Acrosporium heveae* (Steinm.)Subramanian	OIDIUM LEAF FALL (POWDERY MILDEW)	Gadd, 1925.
***Pestalotiopsis palmarum* (Cooke) Steyaert** Syn: *Pestalozzia palmarum* Cke.	LESIONS ON SEEDLINGS	Petch, 1911 as *Pestalozzia palmarum.*
***Pestalozzia guepini* Desm.** (*Pestalozzia* sp.)	LESIONS ON SEEDLINGS	Petch, 1905.

Pathogen	Disease	Reference
***Phellinus lamaoensis* (Murr.) Heim** Syn: *Fomes lamaoensis* Murr. *Hymenochaete* sp.	BROWN ROOT DISEASE	Petch, 1905 as *Hymenochaete* sp.
***Phellinus noxius* (Corner) G.H.Cunn.** Syn: *Fomes noxius*	BROWN ROOT DISEASE	Murray, 1938.
***Phoma heveae* Petch**	DIEBACK OF YOUNG SHOOTS	Weir, 1926.
***Phoma* sp.**	DIEBACK OF BRANCHES	Murray, 1929.
***Phomopsis heveae* (Petch) Boedijn** (Telemorph, *Diaporthe* sp. has also been recorded from *Hevea*)	DIEBACK OF BRANCHES (Not the primary cause but associated with dieback)	Anon, 1960.
***Phyllosticta heveae* Zimm.**	BROWN LEAF BLIGHT	Petch, 1905.
***Phyllosticta ramicola* Petch**	LESIONS ON GREEN STEMS	Petch, 1921.
***Phytophthora citricola* Sawada**	PHYTOPHTHORA LEAF FALL	Liyanage, 1989.
***Phytophthora meadii* McRae**	PHYTOPHTHORA LEAF FALL & BLACK STRIPE	Petch, 1921.
***Phytophthora palmivora* (Butl.) Butl.** Syn: *Phytophthora faberi*	PHYTOPHTHORA LEAF FALL & BLACK STRIPE [Conditions like TOP CANKER AND PATCH CANKER are also believed to be caused by *Phytophthora* spp.]	Petch, 1910 as *Phytophthora faberi.*
***Phytophthora* sp.**	POD ROT	Petch, 1905

Pathogen	Disease	Reference
***Poria hypobrunnea* Petch.**	PORIA ROOT DISEASE (RED ROOT DISEASE)	Petch, 1921.
Pythium complectens Syn: *Pythium vexans* de Bary	COLOURED CANKER (Type of PATCH CANKER)	Young, 1955.
***Rigidoporus microporus* (Fr.) Overeem** Syn:*Rigidoporus lignosus* (Kl.) Imazeki *Fomes lignosus* Klotzsch *Fomes semitostus* Berk.	WHITE ROOT DISEASE	Petch, 1905 as *Fomes semitostus.*
***Rosellinia bunodes* (Berk. & Br.) Sacc.**	ROSELLINIA ROOT DISEASE (BLACK ROOT ROT)	Park, 1937.
***Sclerotium rolfsii* Sacc.**	COLLAR & HYPOCOTYL ROT	Jayasinghe *et al.*, 1988.
***Sphaerella heveae* Petch**	SPHAERELLA RIM BLIGHT	Petch, 1921.
***Sphaerostilbe repens* Berk. & Br.**	SPHAEROSTILBE ROOT DISEASE (STINKING ROOT ROT)	Petch, 1907.
***Spicaria* sp.**	BARK LESIONS	Weir, 1926.
***Thanatephorus cucumeris* (Frank) Donk** Syn: *Corticium solani* (Prill. & Delacr.) Bourd. & Galz. *Pellicularia filamentosa* (Pat.) Rogers.	TARGET LEAF SPOT DISEASE	Jayasinghe, 1993.

Pathogen	Disease	Reference
***Ustulina deusta* (Hoffm. ex Fr.) Lind** Syn: *Ustulina zonata* Lev.	USTULINA ROOT ROT.(BLACK THREAD ROOT ROT) & USTULINA STEM ROT (DRY ROT)	Petch, 1921. as *Ustulina zonata.*
***Venturia emergens* Petch**	VENTURIA BRANCH DISEASE	Weir, 1926.
***Verticillium* sp.**	BARK LESIONS	Weir, 1926.
Virus (name not cited)	BARK CRACKING	Peries & Brohier, 1965.
***Xylaria thwaitesii* Cooke**	BLACK ROOT DISEASE	Petch, 1923.
***Zukaliopsis heveae* Petch**	ZUKALIOPSIS LEAF DISEASE	Weir, 1926.
***Zygosporium oscheoides* Mont.**	LEAF LESIONS	Anon, 1960.

Systematic Arrangement of Fungal Genera Pathogenic to Rubber

This section lists all generic names of fungi pathogenic to rubber in Sri Lanka according to their systematic position. The orders within the class are arranged alphabetically and genera coming under each order are also arranged in the same manner. Only exception to this format is the arrangement of genera of Deuteromycetes (Mitosporic fungi) where the genera are listed alphabetically without following further subdivisions.

Table 2. Systematic position of fungi pathogenic to rubber

PHYCOMYCETES

Peronosporales

Phytophthora de Bary

Pythium Pringsh.

ASCOMYCETES

Dothideales

Guignardia viala & Ravaz

Venturia Sacc.

Zukaliopsis Henn.

Hypocreales

Hypocrella Sacc.

Nectria (Fr.) Fr.

Sphaerostilbe Tul. & C. Tul.

Meliolales

Meliola Fr.

Phyllachorales

Glomerella Spauld. & H. Schrenk

Sphaeriales (Xylariales)

Diaporthe Nitschke

Fracchiaea Sacc.

Rosellinia De Not.

Sphaerella Ces. & De Not.

Ustulina Tul. & C. Tul.

Xylaria Hill ex Schrank

BASIDIOMYCETES

Aphyllophorales

Corticium Fr.

Ganoderma P. Karst.

Marasmius Fr.

Phellinus Quel.

Poria Pers.

Rigidoporus Murrill

Ceratobasidiales

Thanatephorus Donk

DEUTEROMYCETES (MITOSPORIC FUNGI)

Alternaria Nees

Aplosporella Speg.

Aschersonia Mont.

Ascochyta Lib.

Bipolaris Shoemaker

Botryodiplodia (Sacc.) Sacc.

Cercosporella Sacc.

Ciliospora Zimm.

Colletotrichum Corda

Coniothyrium Corda

Corynespora Güssow

Diplodia Fr.

Fusarium Link

Fusicladium Bonord.

Geotrichum Link

Hendersonia Berk.

Macrophomina Petr.

Nattrassia B. Sutton & Dyko

Oidium Link

Pestalotiopsis Steyaert

Pestalozzia De Not.

Phoma Sacc.

Phomopsis (Sacc.) Bubak

Phyllosticta Pers.

Sclerotium Tode

Spicaria Harting

Verticillium Nees

Zygosporium Mont.

3 DISEASES PRESENTLY DISTRIBUTED IN RUBBER PLANTATIONS AND NURSERIES

The disease scenario of the rubber tree in Sri Lanka has not remained static over the years. Among the more than 60 diseases recorded since its establishment, only around 20 diseases are distributed in plantations and nurseries today (Table 3). The virulence and the incidence of these diseases vary in each year depending on the climatic conditions prevail. However, type of clone planted, elevation and cultural conditions under which the crop is grown and microclimate of the site also play a significant role in disease development and spread. This chapter also presents a comprehensive account on the symptoms of each disease listed in Table 3 as an aid to diagnose the current disease problems in the island.

Observations of the intensive studies carried out by the *Hevea* Pathologists for nearly a century have provided a wealth of information on biology, pathology and epidemiology of all the significant pathogens. This has facilitated the recommendation of low cost efficient management systems for a viable rubber industry in Sri Lanka even under the present economic crisis. Most of these findings have been published in the refereed journals and/or presented in the international conferences. Sri Lanka has contributed immensely to the world literature to understand the *Hevea* pathology and in 1987, Chee states "The number of contributions from Sri Lanka is notable since it is only the fourth natural rubber producing country" in his presentation entitled "International collaboration in research on *Hevea* diseases". References have been included to these valuable publications in this chapter enabling the reader to obtain literature on authentification, biology, pathology and management of respective pathogens. In compiling the literature guide every effort was made to quote only the recent literature mainly from Sri Lanka. In failure relevant publications from other rubber growing countries are cited.

Table 3. Diseases presently distributed in rubber plantations and nurseries of Sri Lanka and their distribution in other rubber growing countries in the world.

Disease name	Causal agent	Present distribution
Leaf Diseases		
POWDERY MILDEW	*Oidium heveae* Steinm	Widely distributed in China, Philippines, South and South East Asia (India, Indonesia, Malaysia, Sri Lanka, Thailand & Vietnam) and Central Africa (Cameroon, Gabon, Ivory Coast & Nigeria). Not reported from Brazil.
COLLETOTRICHUM LEAF DISEASE	*Colletotrichum acutatum* Simmonds ex Simmonds *Colletotrichum gloeosporioides* (Penz.) (Penz.) Sacc.	Found in all rubber growing countries in Asia, Africa & Tropical America.
PHYTOPHTHORA LEAF FALL	*Phytophthora meadii* McRae *P. Palmivora* (Butl.) Butl. *P. citricola* Sawada	Widely distributed in rubber growing countries covering China, South and South East Asia, Central Africa (except Gabon) and South America.
CORYNESPORA LEAF FALL	*Corynespora cassiicola* (Berk. & Curt.)Wei	Recorded from all rubber growing countries in Asia (except in China) and Africa.
BIRD'S EYE SPOTS	*Drechslera heveae* (Petch) M.B. Ellis	It has been recorded virtually in all rubber growing countries in Asia, Africa and Tropical America. But no recent reports from Tropical America and Africa excet from Ivory Coast.
TARGET LEAF SPOT	*Thanatephorus cucumeris* (Frank) Donk	Serious disease only inTropical America. Recent reports are from Thailand, ivoory Coast and Sri Lanka.

Disease name	Causal agent	Present distribution
NODULES ON LEAVES	*Aschersonia* sp.	Distributed in all rubber growing countries.
SOOTY MOULD	*Meliola* sp.	Found in all rubber growing countries.
ALGAL SPOT	*Cephaleuros parasiticus* Karst.	Widespread in China, South and South East Asia, Africa and Tropical America.
Stem & Branch Diseases		
PINK DISEASE	*Corticium salmonicolor* Berk. & Br.	China, South and South East Asia (India, Indonesia, Malaysia, Sri Lanka & Vietnam), Tropical America and Africa
PATCH CANKER (STEM CANKER)	*Phytophthora* spp.	Distributed in Asia, Africa and Tropical America, in countries where Phytophthora leaf fall is severe.
USTULINA STEM ROT (DRY ROT)	*Ustulina deusta* (Hoffm. ex Fr.) Lind.	Distributed widely in all rubber growing countries in Asia and Africa. Not reported from Tropical America.
STEM ROT (PHELLINUS STEM ROT)	*Phellinus noxius* (Corner) G.H. Cunn.	Reported from South and South East Asia
DIE-BACK	Pathogenic die-back: *Colletotrichum* spp. *Phytophthora* spp. *Corynespora* sp. Secondary die-back: *Botryodiplodia* sp. *Phomopsis* sp.	Seen in all rubber growing countries in Asia, Africa and Tropical America.

Disease name	Causal agent	Present distribution
THREAD BLIGHT	*Marasmius rotula* Berk. & Br. *Marasmius cyphella* Dennis & Reid *Marasmius palmivorus* Sharples	Reported from South East Asia (Indonesia, Malaysia & Sri Lanka), Central Africa (Ivory Coast & Nigeria) and Tropical America (Brazil).
HORSE HAIR BLIGHT	*Marasmius equicrinis* Mull.	Reported from most of the rubber growing countries.
BLACK STRIPE	*Phytophthora meadii* Mc Rae *Phytophthora palmivora* (Butl.) Butl.	Widespread in all rubber growing countries in Asia, Africa and Tropical America.
Root Diseases		
WHITE ROOT DISEASE	*Rigidoporus microporus* (Fr.)Overeem	Widely distributed and it is at present the most serious root disease on rubber in South East Asia (Indonesia, Malaysia, Sri Lanka & Thailand) and Central Africa (Cameroon, Gabon, Ivory Coast & Nigeria). In China, considered as a less important pathogen. Absent or not reported from India, Burma, Vietnam and Tropical American countries.
BROWN ROOT DISEASE	*Phellinus noxius* (Corner) G.H. Cunn.	Widely spread in rubber growing countries and of less significant than white root disease. Reported from South and South East Asia (India, Indonesia, Malaysia, Sri Lanka, Thailand & Vietnam), China and Central Africa (Ivory Coast & Nigeria). Absent in Brazil and Gabon.

Disease name	Causal agent	Present distribution
USTULINA COLLAR ROT (BLACK THREAD ROOT ROT)	*Ustulina deusta* (Hoffm. ex Fr.) Lind	Disease is reported from South and South East Asia (India, Indonesia, Malaysia, Sri Lanka & Thailand), China and Central Africa(Cameroon & Ivory Coast).
PORIA ROOT ROT	*Poria hypobrunnea* Petch	Reported only from few countries viz. China, India, Indonesia, Ivory Coast, Malaysia & Sri Lanka.
BLACK ROOT DISEASE	*Xylaria thwaitesii* Cooke	The disease has been observed only in Ivory Coast, India, Indonesia, Malaysia & Sri Lanka.
FUSARIUM WILT	*Fusarium solani* (Mart.) Sacc.	Reported only from Sri Lanka.
FOOT CANKER AND SUDDEN WILT	*Nattrassia mangiferae* (H.and P.Syd.) Sutton Dyko	Reported only from Sri Lanka
COLLAR & HYPOCOTYL ROT	*Sclerotium rolfsii* Sacc.	Recorded from Brazil, Malaysia and Sri Lanka.
GEOTRICHUM ASSOCIATIONS ON ROOTS	*Geotrichum* sp.	Reported only from Sri Lanka
ROOT-KNOT NEMATODE	*Meloidogyne incognita* (Kofoid & White) Chitwood	Reported from China, South and South East Asia (India, Indonesia, Malaysia, Sri Lanka & Vietnam) and Brazil.

Diagnosis of the Presently Distributed Diseases and Literature Guide for the Authentification, Biology, Pathology and Management of Causative Agents

Leaf Diseases

POWDERY MILDEW [*Oidium heveae* Steinm.]

One of the main causes of secondary leaf fall on mature rubber in Sri Lanka resulting in poor canopies, loss of yield and poor girthing. The severity of the disease varies with the susceptibility of the clone, wintering pattern, elevation planted and weather condition prevailing during refoliation. Copper brown, apple green leaflets and young inflorescence emerging after wintering of the tree are susceptible to infection. The diagnostic character is the appearance of white powdery patches on both surfaces of tender leaves leading to shrivel and fall off leaving petioles for some time giving the appearance of broom stick to the canopies. Semi-mature leaves tolerate the disease, developing only distorted appearance and restricted brown brittle patches.

CMI description on *Oidium heveae*.

Sivanesen, A. and Holliday, P. (1976). CMI Descriptions of Pathogenic Fungi and Bacteria. No. 508. *Oidium heveae*.

A biological study of *Oidium heveae*.

Anon (1982). Journal of Tropical Crops, 3: 63-70.

Biology of *Oidium heveae*, the powdery mildew fungus of *Hevea brasiliensis*.

Liyanage, A.de S.; Peries, O.S. ;Dharmaratne, A.; Fernando, B.; Irugalbandara, Z.E.; Wettasinghe, S. and Wettasinghe, P.C. (1985). Proceedings of the International Rubber Conference, Kuala Lumpur, 3: 291-313.

Sulphur dusting for the control of secondary leaf fall due to *Oidium heveae*.

Leitch, T.A.T. (1971). Planter, 47: 134-138.

Influence of some factors on the pattern of wintering and on the incidence of *Oidium* leaf fall in clone PB 86.

Liyanage, A.de S. (1976). Journal of the Rubber Research Institute of Sri Lanka, 53: 31-39.

The control of *Oidium* leaf disease of *Hevea* on the basis of experimental data.

Peries, O.S. (1973). Planter, 49: 452-455.

Low volume spray of an oil based systemic fungicide for controlling *Oidium* secondary leaf fall.

Lim, T.M. (1976). Proceedings of the Rubber Research Institute of Malaya, Planters Conference: 231-242.

Increased nitrogen manuring for avoiding *Oidium* SLF.

Anon (1976). Planter's Bulletin of the Rubber Research Institute of Malaysia, 146: 120-124.

Diseases of economic importance and their control.

Liyanage, A.de S. (1983). In "A Handbook of Rubber Culture and Processing", edited by O.S. Peries and D.M. Fernando, Caxton Printers, Colombo: 121-158.

Thermal fogging a new method for controlling powdery mildew disease of rubber in India.

Edathil, T.T.; Krishnankutty, V. and Jacob, C.K. (1984). Pesticides, 18: 35-36.

Powdery mildew disease management in *Hevea brasiliensis* using non-sulphur fungicides.

Edathil, T.T.; Krishnankutty, V.; Indicula, S.P. and Jayarathnam, K. (1988). Indian Journal of the Natural Rubber Research, 1: 61-65.

Protection of young rubber plants from powdery mildew disease with systemic fungicides.

Edathil, T.T.; Krishnankutty, V.; Jacob, C.K. and Indicula, S.P. (1988). Rubber Board Bulletin, 24: 22-23.

COLLETOTRICHUM LEAF DISEASE [*Colletotrichum acutatum* Simmonds ex Simmonds/*Colletotrichum gloeosporioides* (penz.) Sacc.]

The epidemiology of the disease resembles that of powdery mildew except that this disease becomes serious towards the latter part of the refoliation and it is a wet weather disease. Disease also occurs in all type of nurseries leading to die-back if not attended. Infection begins at the tips of the immature leaves and disease progresses towards the base causing shrivel and fall off the leaflets leaving the petioles on the stem for some time. If the weather conditions become unfavourable for the pathogen, disease is checked than only the down portion of the leaf affected by the disease drop away leaving the healthy portion of the lamina on the shoot. On semi-mature leaves only the restricted circular lesions are produced and they remain on the leaf as raised spots. A separate symptom produced by the pathogen is the well defined spots or lesions on leaf with concentric zones (anthracnose symptom) and this symptom is commonly seen on seedlings and polybag plants.

CMI description on *Colletotrichum acutatum*.

Dyko, B.J. and Mordue, J.E.M. (1979). CMI descriptions of pathogenic fungi and bacteria No. 630, *Colletotrichum acutatum*.

CMI description on *Glomerella cingulata*.

Mordue, J.E.M. (1953). CMI descriptions of pathogenic fungi and bacteria, No. 315, *Glomerella cingulata*.

Colletotrichum: biology, pathology and control.

Bailey, J.A. and Jegar, M.J. (1992). CAB International Redwood Press Ltd., London, 388 pp.

Diseases of economic importance and their control.

Liyanage, A.de S. (1983). In "A Handbook of rubber culture and processing" edited by O.S. Peries and D.M. Fernando, Caxton Printors, Colombo: 121-158.

Colletotrichum leaf fall.

Anon, (1994). Identification and treatment of diseases of *Hevea brasiliensis*. International Rubber Research and Development Board, Hertford, U.K.

Relationship between the incidence and severity of *Colletotrichum gloeosporioides* leaf disease in *Hevea brasiliensis*.

Samaradeewa, P.K.; Liyanage, A.de S. and Wickramasinghe, W.N. (1985). Journal of the Rubber Research Institute of Sri Lanka, **63**: 1-8.

Pathogenicity of *Colletotrichum acutatum* and *C. gloeosporioides* on leaves of *Hevea* spp.

Brown, A.E. and Soepena, H. (1994). Mycological Research, **98**: 264-266.

Growth at different temperatures and on fungicide amended media: two characteristics to distinguish *Colletotrichum* species pathogenic to rubber.

Jayasinghe, C.K. and Fernando, T.H.P.S. (1998). Mycopathologia, **143**: 93-95.

In vitro evaluation of fungicides against *Colletotrichum acutatum* and *Colletotrichum gloeosporioides* pathogenic to rubber.

Jayasinghe, C.K. and Fernando, T.H.P.S. (2000) (in press).

Colletotrichum acutatum is the main cause of *Colletotrichum* leaf disease of rubber in Sri Lanka.

Jayasinghe, C.K.; Fernando, T.H.P.S. and Priyanka, U.M.S. (1997). Mycopathologia, **137**: 53-56.

Multivariate analysis of vegetative and reproductive characters to authenticate *Hevea* isolate of *C. acutatum*, the major cause of *Colletotrichum* leaf disease of rubber in Sri lanka.

Jayasinghe, C.K.; Wijesuriya, B.W. and Fernando, T.H.P.S. (1997). International Rubber Research and Development Board Information Quarterly, Hertford, England, 1997 part 4, 17-18.

The significance of the factors affecting spore germination in the spread of *Gloeosporium* leaf disease in *Hevea*.

Wimalajeewa, D.L.S. (1965). Quarterly Journal of the Rubber Research Institute of Ceylon, 41: 63-68.

Growth and pathogenicity of *Colletotrichum gloeosporioides* isolates from cocoa and rubber.

Purwantara, A. (1991). Menara Perkebunan, 59: 12-21.

Susceptibility of rubber clones to *Colletotrichum gloeosporioides* under glasshouse and Ciomas Experimental Garden conditions.

Powirosoemardjo, S.; Hadi, S.; Tantera, D.M. and Wardojo, S. (1982). Menara-Perkebunan, 50: 31-37.

Studies on *Colletotrichum gloeosporioides*: latent infections and artificial defoliation.

Senechal, Y. (1988). Proceedings of the International Rubber Research and Development Board Symposium, Chiang Mai, Thailand, 1987.

Studies on the physiology of spore germination in *Gloeosporium alborubrum*.

Wimalajeewa, D.L.S. (1967). Quarterly Journal of the Rubber Research Institute of Ceylon, 41: 43-69.

The incidence and economic importance of the *Gloeosporium* leaf disease of *Hevea* in Ceylon. Part I. Planters' Assessment.

Wimalajeewa, D.L.S. and Lloyd, J.H. (1963). Quarterly Journal of the Rubber Research Institute of Ceylon, 39: 18-24.

Variability and pathogenicity of isolates of *Colletotrichum gloeosporioides* from *Hevea brasiliensis*.

Wastie, R.L. and Sankar, G. (1970). Transactions of British Mycological Society, 54: 117-121.

Secondary leaf fall of *Hevea brasiliensis*: factors affecting the production, germination and viability of spores of *Colletotrichum gloeosporioides*.

Wastie, R.L. (1972). Annals of Applied Biology, 72: 273-282.

The control of *Gloeosporium* leaf disease of *Hevea* in Ceylon.

Peries, O.S. and Wimlajeewa, D.L.S. (1970). Tropical Agriculture, Trinidad, 47: 221-228.

PHYTOPHTHORA LEAF FALL [*Phytophthora meadii* McRae /*Phytophthora palmivora* (Butl.) Butl. /*Phytophthora citricola* Sawada]

Disease epidemics are dependant on weather conditions in addition to the clonal susceptibility. Prolonged wet weather with cool overcast humid conditions which continue for several days with little or no sunshine are the predisposing factors. The most conspicuous diagnostic character is the presence of dark brown to black lesions with white spots of coagulated latex on the petioles. Affected leaves are shed while they are still green resulting abnormal leaf fall of *Hevea* rubber. In certain clones water soaked lesions develop on the leaf blade, later develop into brown to black patches with tinny white latex globules.

CMI descriptions on *Phytophthora meadii*.

Stamps, D.J. (1985). CMI descriptions of pathogenic fungi and bacteria, No. 834, *Phytophthora meadii*.

CMI descriptions on *Phytophthora palmivora*.

Stamps, D.J. (1985). CMI descriptions of pathogenic fungi and bacteria, No. 831, *Phytophthora palmivora*.

CMI descriptions on *Phytophthora citricola*.

Waterhouse, G.M. and Waterston, J.M. (1966). CMI descriptions of pathogenic fungi and bacteria, No. 114, *Phytophthora citricola*.

Abnormal leaf fall and leaf wither.

Anon (1994). Identification and treatment of diseases of *Hevea brasiliensis*, International Rubber Research and Development Board, Hertford, UK.

Diseases of economic importance and their control.

Liyanage, A.de S. (1983). In "A Handbook of Rubber Culture and Processing" edited by O.S. Peries and D.M. Fernando, Caxton Printers, Colombo: 121-158.

Variation within and between *Phytophthora* species from rubber and citrus trees in China, determined by polymerase chain reaction using RAPDs.

Zheng, F.C. and Ward, E. (1998). Journal of Phytopathology, **146**: 103-109.

The nomenclature of the *Phytophthora* spp. causing bark, leaf, pod and twig diseases of the rubber tree in Ceylon.

Peries, O.S. (1966). Quarterly Journal of the Rubber Research Institute of Ceylon, **42**: 1-7.

Taxonomy of *Phytophthora* species isolated from rubber in Sri Lanka.

Dantanarayana, D.M.; Peries, O.S. and Liyanage, A.de S. (1984). Transactions of British Mycological Society, **82**: 113-126.

Comparative morphology of *Phytophthora* species on rubber.
Liyanage, N.I.S. and Wheeler, B.E.J. (1989). Plant Pathology, 38: 592-597.

Phytophthora citricola on rubber in Sri Lanka.
Liyanage, N.I.S. (1989). Plant Pathology, 38: 438-439.

Production, germination and survival of chlamydospores of *Phytophthora palmivora* from *Hevea brasiliensis*.
Chee, K.H. (1973). Transactions of British Mycological Society, 61: 21-26.

Variability of *Phytophthora* species from *Hevea brasiliensis*.
Chee, K.H. (1969). Transactions of British Mycological Society, 52: 425-436.

Survival of *Phytophthora meadii* in Sri Lankan soils.
Liyanage, N.I.S. and Wheeler, B.E.J. (1991). Plant Pathology, 40: 436-444.

Studies on epidemiology of *Phytophthora* leaf disease of *Hevea brasiliensis* in Ceylon.
Peries, O.S. (1969). Journal of the Rubber Research Institute of Malaya, 21: 73-77.

Physiologic specialization of *Phytophthora meadii* affecting *Hevea* in Sri Lanka.
Peries, O.S. and Dantanarayana, D.M. (1975). Plant Disease Reporter, 59: 252-254.

Studies on the biology of *Phytophthora meadii* (McRae).
Peries, O.S. and Fernando, T.M. (1966). Transactions of British Mycological Society, 49: 311-325.

Phytophthora leaf disease of *Hevea*: its incidence, symptoms and control.
Peries, O.S. (1972). Guide to Tropical Diseases, Tropical Institute, University Geiseen.

Aerial spraying against abnormal leaf fall disease of rubber in India.
Pillai, P.N.R. (1977). Planters' Bulletin of the Rubber Research Institute of Malaysia. No. 148: 10-14.

The control of abnormal leaf fall disease of *Hevea* in Ceylon.
Lloyd, J.H. (1963). Bulletin of the Rubber Research Institute of Ceylon, 57: 1-67.

Phytophthora epidemics-possibility of management using resistant clones.
Jayasinghe, C.K. and Jayaratne, A.H.R. (1996). Journal of the Rubber Research Institute of Sri Lanka, 77: 66-76.

Use of oil dispersible mancozeb as an alternative fungicide for the control of abnormal leaf fall disease of *Hevea*.
Jacob, C.K.; Jayarathnam, K. and Idicula, S.P. (1994). International Rubber Research and Development Board Symposium on Diseases of *Hevea*, Cochin, India, 21-22 November 1994: 39-42.

Crown budding: a method to avoid abnormal leaf fall disease of rubber.
Radhakrishna Pillay, P.N. and Rajalakshmy, V.K. (1980). International Rubber Conference, India, 1980.

CORYNESPORA LEAF FALL [*Corynespora cassiicola* (Berk. & Curt.) Wei]

The most challenging rubber disease in African and Asian continents today. A marked variation in clonal susceptibility is seen. Symptoms appear on immature as well as on mature leaves and symptoms vary depending either on the maturity stage of the plant or type of the clone. The most common symptom on field plants is the production of lesions with railway track appearance or fish bone pattern on leaves. On certain clones (RRIC 110) irregular or polyhedral lesions, surrounded by extended yellow halos are produced. During the juvenile stage of the plant, specially in polybag nurseries the diagnostic feature is the production of circular or irregular lesions of varying sizes delimited by a wavy border. Repeated defoliation occurs on highly susceptible clones resulting the death of the plant.

CMI description on *Corynespora cassiicola*.
Ellis, M.B. and Holliday, P. (1971). CMI description on pathogenic fungi and bacteria No. 303, *Corynespora cassiicola*.

Corynespora leaf fall
Anon (1994). Identification and treatment of diseases of *Hevea brasiliensis*, International Rubber Research and Development Board, Hertford, UK.

Leaf fall disease: a threat to world NR industry.
Jayasinghe, C.K. (1997). Rubber Asia, Nov-Dec, 1997, 55-56.

Molecular, physiological and pathological characterization of *Corynespora* leaf spot fungi from rubber plantations in Sri Lanka.
Silva, W.P.K.; Deverall, B.J. and Lyon, B.R. (1998). Plant Pathology, 47: 267-277.

Conclusion of workshop on *Corynespora* leaf fall disease of *Hevea* rubber.
Anon (1996). Proceedings of the workshop on *Corynespora* leaf fall disease of *Hevea* rubber, Medan, Indonesia, IX-XIV.

Scopoletin production and degradation in relation to resistance of *Hevea brasiliensis* to *Corynespora cassiicola*.
Breton, F.; Sanier, C. and D'Auzac, J. (1997). Journal of Plant Physiology, 151: 595-602.

Recent researches on *Corynespora cassiicola/Hevea brasiliensis* interaction.
Breton, F.; Auzac, J.D., Garcia, D., Sanier, C. and Eschbach, J.M. (1996). Proceedings of the workshop on *Corynespora* leaf fall disease of *Hevea* rubber, Medan, Indonesia, 49-78.

Variation among isolates of *Corynespora cassiicola* associated with *Hevea brasiliensis* in Indonesia.
Darmono, T.W.; Darussamin, A. and Pawirosoemardjo, S. (1996). Proceedings of the workshop on *Corynespora* leaf fall disease of *Hevea* rubber, Medan, Indonesia, 79-91.

A study on the production of a toxin in *Corynespora cassiicola.*
Liyanage, N.I.S. and Liyanage, A.de S. (1986). Journal of the Rubber Research Institute of Sri Lanka 65: 51-53.

Management strategies of *Corynespora* leaf fall with fungicides and cultural practices.
Ismail Hashim.; Radziah, N.Z. and Sivanadyan, K. (1996). Proceedings of the workshop on *Corynespora* leaf fall disease of *Hevea* rubber, Medan, Indonesia, 195-214.

Losses due to *Corynespora* leaf fall disease and its eradication.
Liyanage, A.de S.; Jayasinghe, C.K. and Liyanage, N.I.S. (1991). Proceedings of the Plant Growers Conference, Malakka, Malaysia.

Chemical control of *Corynespora* leaf fall.
Soepena, H.; Suwarto and Simulingga, W. (1996). Proceedings of the workshop on *Corynespora* leaf fall disease of *Hevea* rubber, Medan, Indonesia, 215-224.

Effects of fungicides and their combinations with nitrogen manuring and artificial defoliation on control of *Corynespora* leaf fall of *Hevea* rubber.
Ismail Hashim and Chew, B.H. (1998). Journal of the Rubber Research Institute of Malaysia, 1: 111-124.

Toxin production by *Corynespsora cassiicola.*
Onesirosan, P.; Mabuni, C.T.;.Durbin, R.D., Morin, R.B.; Rich, D.H. and Amy, D.C. (1975). Physiological Plant Pathology, 5: 289-295.

Studies on sporulation, pathogenicity and epidemiology of *Corynespora cassiicola* on *Hevea* rubber.
Chee, K.H. (1987). Proceedings of the International Rubber Research and Development Board Symposium, Thailand, 1987: 6-17.

Production of cell wall degrading enzymes of *Corynespora cassiicola* in culture and infected rubber tissue.
Jayasinghe, C.K.; Fernando, T.H.P.S. and Priyanka, U.M.S. (1998). Journal of the Rubber Research Institute of Sri Lanka, 81: 1-13.

A decade of experience with *Corynespora* leaf fall disease in Sri Lanka.
Jayasinghe, C.K.; Silva, W.P.K.; Wettasinghe, D.S.; Wettasinghe, J.L.P.C. and Fernando, T.H.P.S. (1996). Proceedings of the International Rubber Research and Development Board, Annual Meeting, Beruwala, Sri Lanka, 1996: 94-96.

Current status of *Corynespora* leaf fall in Sri Lanka.
Jayasinghe, C.K. and Silva, W.P.K. (1996). Proceedings of the workshop on *Corynespora* leaf fall disease of *Hevea* rubber, Medan, Indonesia, 15-19.

Corynespora cassiicola: a fungal pathogen with diverse symptoms of *Hevea* rubber.
Jayasinghe, C.K.; Silva, W.P.K. and Wettasinghe, D.S. (1999). Bulletin of the Rubber Research Institute of Sri Lanka, **39**: 1-5.

Corynespora leaf spot disease of rubber (*Hevea brasiliensis*) – A new record.
Liyanage, A.de S.; Jayasinghe, C.K.; Liyanage, N.I.S. and Jayaratne, R. (1986). Journal of the Rubber Research Institute of Sri Lanka, **65**: 47-50.

Biology, epidemiology and pathogenicity of *Corynespora cassiicola*.
Liyanage, A.de S.; Jayasinghe, C.K. and Liyanage, N.I.S. (1988). Country paper presented at the International workshop on *Corynespora* leaf fall disease at Bogor Research Institute, Indonesia.

BIRD'S EYE SPOTS [*Bipolaris heveae* (Petch) Von Arx]

Disease is restricted to nursery plants. Lesions are circular with a reddish brown margin, central area is silvery white but later falls-off giving a shot-hole appearance, hence the name bird's eye spot.

CMI descriptions on *Drechslera heveae*.
Ellis, M.B. and Holliday, P. (1972). CMI descriptions of pathogenic fungi and bacteria, No. 343, *Drechslera heveae*.

Diseases of economic importance and their control.
Liyanage, A.de S. (1983). In "A Handbook of Rubber Culture and Processing" edited by O.S. Peries and D.M. Fernando, Caxton Printers, Colombo: 121-158.

Bird's eye leaf spot, a severe disease of mature rubber trees.
Blazquez, C.H. (1963). Phytopathology, **53**: 24.

Bird's eye spot.
Anon (1967). Planters' Bulletin of the Rubber Research Institute of Malaya, **93**: 281-283.

Fogging as a method of controlling Bird's eye spot.
Radziah Nom Zainuddin and Lim, T.M. (1979). Planters' Bulletin of the Rubber Research Institute of Malaysia.

Evaluation of fungicides for the control of *Helminthosporium heveae* on *Hevea* rubber in Malaysia. II. Field tests.
Wastie, R.L. (1969). Experiment Agriculture, 5: 41-46.

TARGET LEAF SPOT [*Thanatephorus cucumeris* (Frank) Donk]

A disease declared as quarantine importance to Asia and Africa. However, recently detected in rubber nurseries and immature clearings in Sri Lanka. Initially,symptoms appear on young leaves during prolonged humid weather as small circular spots, which later develop into irregular water soaked patches. Whitish latex exudates appear as tiny globules on new infection points which turn to brownish black. With the maturity of the leaves, lesions become dry and brown surrounded by a chlorotic yellow layer. Leaflets with lesions on their basal part and close to the main vein start to fall. Simultaneously light tan hyphae develop and net work of silvery mycelium appear covering the young stems, petioles and sometimes leaf blade. At many instances detached leaves could be seen hanging down from the mycelial strands.

CMI descriptions on *Thanatephorus cucumeris*.
Mordue, J.E.M. (1974). CMI description of pathogenic fungi and bacteria, No. 406, *Thanatephorus cucumeris*.

Target leaf spot.
Anon (1994). Identification and treatment of diseases of *Hevea brasiliensis*, International Rubber Research and Development Board, Hertford, UK.

The natural occurrence of *Thanatephorus cucumeris* leaf spot on *Hevea brasiliensis* in Sri Lanka.
Jayasinghe, C.K. (1993). Plant Pathology, 42: 473-474.

Rhizoctonia foliage disease of *Hevea brasiliensis*.
Kotiala, J.E. (1945). Phytopathology, 35: 739-741.

A system of evaluating the incidence of target spot [*Thanatephorus cucumeris* (Frank Donk)] on rubber (*Hevea* spp.).
Gasparotto, L.; Trindade, D.R. and Lieberei, R. (1982). Fitopatologia Brasiliera, 7: 347-357.

Production and discharge of basidiospores by *Pellicularia filamentosa* (PAT) rogers on *Hevea* rubber.

Carpenter, J.B. (1949). Phytopathology, 39: 980-985.

In vitro evaluation of fungicides against rubber isolate of *Thanatephorus cucumeris* and management of foot rot of *Hevea* seedlings.

Jayasinghe, C.K.; Fernando, E.B. and Tennakoon, B.I. (1997). Journal of the Rubber Research Institute of Sri Lanka, 80: 45-52.

Pueraria phaseoloides and *Mikania cordata*: two alternate hosts for *Thanatephorus cucumeris* in rubber plantations of Sri Lanka.

Jayasinghe, C.K. and Fernando, E.B. (1998). International Journal of Tropical Plant Diseases, 15: 247-250.

The adoption of correct cultural practices prevents collar rot and target leaf spot in *Hevea* rubber.

Jayasinghe, C.K. (1998). International Rubber Research and Development Board Information Quarterly, Hertford, England, part 2: 6-7.

NODULES ON LEAVES [*Aschersonia* sp.]

Not an economically important disease, knoblike growths (warts) up to five millimeters in diameter appear on leaves and young shoots of rubber plants. The colour varies from pale yellow or brownish orange when young, to black when old. Associated with scale insect infestations.

Aschersonia

Hawksworth, D.L.; Kirk, P.M.; Sutton, B.C. and Pegler, D.N. (1995) Ainsworth & Bisby's dictionary of the fungi, CAB International: 20.

Nodules on leaves

Petch, T. (1921). The diseases and pests of the rubber tree. Macmillon, London: 95-96.

Orange gall of *Hevea*

Young, H.E. (1954). Advisory circular. No. 50, Rubber Research Institute of Ceylon.

SOOTY MOULD [*Meliola* sp.]

Do not consider as a significant disease of rubber. Disease appears as a dense black covering, generally on the upper surface. The fungus develops on the secretions of scale insects and this black film scales off when dry.

The Meliolineae
Hansford, C.G. (1962). Sydowia Beiheft, II: 75.

Studies on meliolaceae of India.
Patil, M.S. and Pawar, A.B. (1986, publ. 1987). Indian Phytopathology, 39: 361-367.

Monograph of tree diseases in the Philippines with taxonomic notes on their associated micro-organisms.
Kobayashi, T. and Guzman, E.D. de (1988). Bulletin of the Forestry and Forest Products Research Institute Ibaraki, 351: 99-200.

Sooty moulds.
Petch, T. (1921). The diseases and pests of the rubber tree. Macmillon, London: 94-95.

Report on the work of the Botanical and Mycological Division.
Bryce, G. (1921). Report of the Department of Agriculture Ceylon for 1920: 13-15.

ALGAL SPOT [*Cephaleuros parasiticus* Karst.]

Not an economically significant disease in Sri Lanka. Disease symptoms appear as small translucent spots which later develop into dark purplish red circular or irregular patches on the leaf surface. If the midrib or the veins are infected, elongated lesions are produced.

Algal spots of *Hevea* leaves in Ceylon.
Munasinghe, H.L. (1961). Quarterly Journal of the Rubber Research Institute of Ceylon, 37: 49-50.

Red rust of tea and its control.
Anon (1972). Advisory Circular No. D3, Tea Research Institute of Sri Lanka, Sri Lanka.

Algal spot.
Rao, B.S. (1975). Maladies of *Hevea* in Malaysia, Rubber Research Institute of Malaysia, Kuala Lumpur: 68-69.

Stem and Branch Diseases

PINK DISEASE [*Corticium salmonicolor* Berk. & Br.]

Not considered as a significant disease in rubber plantations of Sri Lanka. Occurs mostly on young trees (3-7 years old) of susceptible clones. The most common site of infection is the fork of the tree and then the branches. The initial indication is the exudation of drops of latex from the infection sites which drip or run along the stem. Later white, silky cob-web like mycelium develops on the branches producing masses of salmon pink spores giving the characteristic pink colour.

CMI descriptions on *Corticium salmonicolor*.

Mordue, J.E.M. and Gibson, I.A.S. (1976). CMI descriptions of pathogenic fungi and bacteria, No. 511, *Corticium salmonicolor*.

Pink disease

Anon (1994). Identification and treatment of diseases of *Hevea brasiliensis*, International Rubber Research and Development Board, Hertford, UK.

Diseases of economic importance and their control.

Liyanage, A.de S. (1983). In "A Handbook of Rubber Culture and Processing" edited by O.S. Peries and D.M. Fernando, Caxton Printers, Colombo: 121-158.

Pink disease of rubber caused by *Pellicularia salmonicolor* (Berk. & Br.) Dastur (*Corticium salmonicolor* Berk. and Brit.)

Ramakrishnan, T.S. and Radhakrishna Pillay, P.N. (1962). Rubber Board Bulletin, **5**: 120-126.

Pink disease of rubber.

Radhakrishna Pillay, P.N. and George, M.K. (1980). Rubber Board Bulletin, **16**: 8-10.

Control of pink disease of *Hevea* rubber.

Wastie, R.L. (1976). Pesticides, **10**: 55-56.

Efficacy of some fungicides against *Corticium salmonicolor*.

Soepadmo, B. (1978). Menara-Perkebunan, **46**: 171-174.

Control of pink disease of *Hevea* using tridemorph in ammoniated latex.

Edathil, T.T. and Jacob, C.K. (1983). Pesticides, **17**: 25-26.

New approaches of Pink disease management in *Hevea*.

Jacob, C.K. and Edathil, T.T. (1986). Planter, **62**: 465-467.

Pink disease of rubber caused by *Pellicularia salmonicolor* (Berk. & Br.) Dastur (*Corticium salmonicolor* Berk. and Brit.)

Ramakrishnan, T.S. and Radhakrishna Pillay, P.N. (1962). Rubber Board Bulletin, 5: 120-126.

PATCH CANKER [*Phytophthora* spp.]

Though the disease out breaks are limited, sporadic reports of disease occurrence during rainy overcast weather on highly susceptible clones are available. Disease begins as a discolouration of bark with exudation of latex. At the later stages coagulated latex pads of evil-smelling are formed under the bark resulting splitting of the bark.

See *Phytophthora* leaf disease for the literature on the causative agents.

Patch canker of *Hevea brasiliensis* caused by *Phytophthora palmivora*.

Chee, K.H. (1968). Plant Disease Reporter, 52: 132-133.

Stem canker.

Anon (1969). Planters' Bulletin of the Rubber Research Institute of Malaya, 102: 103-104.

USTULINA STEM ROT [*Ustulina deusta* (Hoffm. ex Fr.) Lind]

Infection occurs through wound or on trees predisposed by mechanical or chemical means. Disease initiates as bleeding along the trunk or branches and forming foul smelling latex pads underneath the bark. The most characteristic features are the appearance of grey-black or charcoal plates like fructifications on the affected bark and network of double black lines running through the wood.

CMI descriptions on *Ustulina deusta*.

Hawksworth, D.L. (1972). CMI descriptions of pathogenic fungi and bacteria, No. 360, *Ustulina deusta*.

Diseases of economic importance and their control.

Liyanage, A.de S. (1983). In "A Handbook of Rubber Culture and Processing" edited by O.S. Peries and D.M. Fernando, Caxton Printers, Colombo: 121-158.

Ustulina stem rot.

Rao, B.S. (1975). Meladies of *Hevea* in Malaysia, Rubber Research Institute of Malaysia, Kuala Lumpur, pp. 40-41.

STEM ROT [*Phellinus noxius* (Corner) G.H. Cunn.]

Occurs sporadically. Infection occurs on mechanically damaged trees. Pathogen commonly enters through exposed end of branches and proceeds towards the trunk and finally ends up reaching collar and root system. The affected wood becomes dry and pathogen invades the interior, giving it a honeycomb like appearance.

CMI descriptions on *Phellinus noxius*

Pegler, D.N. and Waterston, J.M. (1968). CMI descriptions of pathogenic fungi and bacteria, No. 195, *Phellinus noxius*.

Phellinus stem rot.

Rao, B.S. (1975). Maladies of *Hevea* in Malaysia, Rubber Research Institute of Malaysia, Kuala Lumpur: 42-43.

DIE-BACK [Pathogenic die-back: *Colletotrichum* spp.; *Bipolaris* sp.; *Phytophthora* spp.; and *Corynespora* sp.]/[Secondary die-back: *Botryodiplodia* sp. and *Phomopsis* sp.]

Generally the term "die-back" is used to describe gradual death of twigs, branches and even the entire tree from top to downward. Varying extents of die-back in polybag plants and seedlings in nurseries are common in all rubber growing localities. Die-back may occur due to variety of causes; common pathogens attacking tender leaves extend infection to buds resulting destruction of green shoots specially under high humid overcast weather, on the other hand mechanical damages (pruning, wind break, lightning strike, sun scorch and fire) predispose the plants to weak wound parasites.

See *Colletotrichum* leaf disease, Bird's eye spots, *Phytophthora* leaf disease and *Corynespora* leaf disease for the literature on *Colletotrichum, Bipolaris, Phytophthora* and *Corynespora* respectively.

CMI descriptions on *Botryodiplodia theobromae*.

Punithalingam, E. (1976). CMI descriptions of pathogenic fungi and bacteria, No. 519, *Botryodiplodia theobromae*.

Diseases of economic importance and their control.

Liyanage, A.de S. (1983). In "A Handbook of Rubber Culture and Processing" edited by O.S. Peries and D.M. Fernando, Caxton Printers, Colombo: 121-158.

The coelomycetes. Fungi Imperfecti with Pycnidia, Acervuli and Stromata.
Sutton, B.C. (1980). Commonwealth Mycological Institute, Kew, Surrey, England: 696 pp.

Pathogenic die-back.
Rao, B.S. (1975). Maladies of *Hevea* in Malaysia, Rubber Research Institute of Malaysia, Kuala Lumpur: 50-51.

Secondary die-back.
Rao, B.S. (1975). Maladies of *Hevea* in Malaysia, Rubber Research Institute of Malaysia, Kuala Lumpur: 48-49.

Die-back.
Anon (1967). Planters' Bulletin of the Rubber Research Institute of Malaya, 90: 107-111.

A new disease of *Hevea brasiliensis* caused by *Fusarium solani* and *Botryodiplodia theobromae.*
Chee, K.H. (1971). Plant Disease Reporter, 55: 152-153.

THREAD BLIGHT [*Marasmius rotula* Berk. & Br. /*Marasmius* spp.]

Not considered, as a significant disease but can become significant in over crowded moist canopies bordering jungles. Fungus attacks branches, twigs and leaves and mycelial strands could be seen as white threads all over the infected parts. When the fungal threads approach the leaf surface it produces a profuse network of hyphae on the leaf leading to wither and abscise. Mycelial network binds dead leaves resulting hanging down.

Marasmieae (basidiomycetes – Tricholomataceae) (key to over 200 *Marasmius* spp.; descriptions and illustrations).
Singer, R. (1976). Flora Neotropica, Monograph 17, New York Botanical Garden, Bronx, 347 pp.

Leaf blight of *Ficus pumila* caused by a basidiomycetes. (describes *Marasmius* sp. and the disease, similar to thread blight of rubber).
Ikediugwu, F.E.O. (1984). Transactions of British Mycological Society, 83: 501-505.

Thread blight.
Rao, B.S. (1975). Maladies of *Hevea* in Malaysia, Rubber Research Institute of Malaysia, Kuala Lumpur: 46-47.

HORSE HAIR BLIGHT [*Marasmius equicrinis* Mull.]

The most conspicuous symptom is the presence of black threads composed of fungal tissue resembling horse hair in size and appearance. On rubber its common position is on dead bark at the base of the tree. But occasionally it invades over crowded canopies under moist and shaded conditions. Dead leaves become matted together by the threads and hang down from the diseased twigs in characteristic chains. Not considered as a significant problem.

Marasmieae (basidiomycetes – Tricholomataceae) (Key to over 200 *Marasmius* spp.; descriptions and illustrations).

Singer, R. (1976). Flora Neotropica, Monograph 17, New York Botanical Garden, Bornx, 347 pp.

Horse-hair blight

Petch, T. (1921). The diseases and pests of the rubber tree, Macmillon, London: 160.

Thread blight.

Rao, B.S. (1975). Maladies of *Hevea* in Malaysia, Kuala Lumpur: 46-47.

BLACK STRIPE [*Phytophthora meadii* McRae and *Phytophthora palmivora* (Butl.) Butl.]

The disease causes serious damage to the tapping panel of the susceptible clones if prophylactic measures are not employed during *Phytophthora* leaf fall season. Diagnostic character is the series of depressed, black, vertically parallel lines on the tapping panel just above the tapping cut on the renewed bark. If this area of the bark is removed, a series of black parallel lines can be seen on the wood. If conducive weather conditions persist, these lines coalesce resulting "canker" condition.

See *Phytophthora* leaf fall for the literature on *Phytophthora meadii* and *Phytophthora palmivora.*

Balck stripe.

Anon (1994). Identification and treatment of diseases of *Hevea brasiliensis*, International Rubber Research and Development Board, Hertford, U.K.

Diseases of economic importance and their control.

Liyanage, A.de S. (1983). In "A handbook of Rubber Culture and Processing" edited by O.S. Peries and D.M. Fernando, Caxton Printers, Colombo: 121-158.

Black stripe.
Chee, K.H. (1970). Planters' Bulletin of the Rubber Research Institute of Malaya, **109**: 105-110.

Factors influencing the spread of bark rot in *Hevea* caused by *Phytophthora meadii*.
Liyanage, A.de S.; Liyanage, I.; Fernando, E.B. and Dharmaratne, A. (1984). In proceedings of the International Rubber Conference, 75 years of Rubber Research in Sri Lanka, 1984, Colombo, Sri Lanka: 325-343.

Susceptibility of *Hevea* clones to black stripe disease.
Jayasinghe, C.K. and Wettasinghe, D.S. (1997). Journal of the Rubber Research Institute of Sri Lanka, **80**: 30-36.

Recent investigations in the control of black stripe.
Chee, K.H. (1972). Proceedings of the International Rubber Conference, Kuala Lumpur: 155-162.

Management of black stripe disease of *Hevea*.
Jacob, C.K.; Edathil, T.T. and Idicula S.P. (1995). Indian Journal of Natural Rubber Research, **8**: 21-24.

New recommendations for the control of black stripe.
Tan, A.M. (1990). Planters' Bulletin Rubber Research Institute of Malaysia, No. **202**: 14-17.

A new fungicide for the control of black stripe.
Tan, A.M. (1983). Planters' Bulletin of the Rubber Research Institute of Malaysia: 13-16.

Incidence and control of bark rot in *Hevea brasiliensis*.
Peries, O.S. (1975). Planter, Malaysia, **51**: 491-498.

Factors affecting infection of *Hevea* bark by *Phytophthora* species with special reference to disease control.
Peries, O.S. (1976). Proceedings of the International Rubber Conference, Kuala Lumpur, **3**: 199-212.

Investigations on new fungicidal systems for control of bark rot on *Hevea brasiliensis*.
Liyanage, A.de S.; Nadarajah, M.; Liyanage, G.W. and Dantanarayana, D.M. (1977). Journal of the Rubber Research Institute of Sri Lanka, **54**: 316-328.

Field evaluation of fungicides to identify a substitute for organo mercurials in the control of black stripe disease of rubber in India.
Edathil, T.T.; Indicula, S.P. and Jacob, C.K. (1988). Indian Journal of Natural Rubber Research, **1**: 42-47.

Fungicides in the control of *Phytophthora* disease of rubber in Sri Lanka.
Jayatissa, H.G.; Liyanage, N.I.S. and Wijesundera R.L.C. (1994). Journal of the National Science Council of Sri Lanka, 22: 7-13.

Root Diseases

WHITE ROOT DISEASE [*Rigidoporus microporus* (Fr.) Overeem]

The most devastating root disease of *Hevea* rubber tree. The pathogen effects both mature and immature clearings killing the tree as well as many other cultivated and jungle hosts. Fast spreading nature of the fungus through root contact and probably by colonization of spores on dead stumps account for the wide spread of the disease in rubber clearings causing bare patches. The most characteristic symptom is the presence of white strands of mycelia (rhizomorphs) on the affected roots. During the advanced stages of infection yellowish orange semi circular bracket shaped fructifications are produced in tiers at the collar of the affected trees. The rim of the fructifications are whitish and bearing numerous pores at the lower surface.

CMI descriptions on *Rigidoporus lignosus.*
Pegler, D.N. and Waterston, J.M. (1968). CMI descriptions of pathogenic fungi and bacteria, No. 198, *Rigidoporus lignosus.*

White root disease.
Anon (1994). Identification and Treatment of Diseases of *Hevea brasiliensis*, International Rubber Research and Development Board, Hertford, UK.

Diseases of economic importance and their control.
Liyanage, A.de S. (1983). In "A Handbook of Rubber Culture and Processing" edited by O.S. Peries and D.M. Fernando, Caxton Printers, Colombo: 121-158.

Studies on the spread of white root disease caused by *Rigidoporus lignosus* in Sri Lanka.
Liyanage, N.I.S.; Peries, O.S.; Liyanage, A.de S. and Warnapura, S.S. (1980). Journal of the Rubber Research Institute of Sri Lanka, 57: 26-36.

The role of the basidiospore of *Rigidoporus lignosus* in the spread of white root disease of *Hevea.*
Liyanage, N.I.S.; Peries, O.S. and Liyanage, A.de S. (1980). Journal of the Rubber Research Institute of Sri Lanka, 57: 37-40.

Penetration and degradation of suberized cells of *Hevea brasiliensis* infected with root rot fungi.

Nicole, M.; Geiger, J.P. and Nandris, D. (1986). Physiological and molecular plant pathology, **28**: 181-185.

Infection of *Hevea brasiliensis* by *Rigidoporus lignosus*.

Nicole, M.; Nandris, D. and Geiger, J.P. (1983). Canadian Journal of Forest Research, **13**: 359-364.

The effect of triadimefon and triadimenol for controlling white root disease of rubber.

Ng, K.T. and Yap, T.H. (1990). Proceedings of 3rd International Conference on Plant Protection in the Tropics, Malaysia, **2**: 31-35.

The control of white root disease in Sri Lanka.

Liyanage, G.W. and Peries, O.S. (1973). Quarterly Journal of the Rubber Research Institute of Ceylon, **50**: 201-207.

An integrated approach to control of white root disease in Sri Lanka.

Liyanage, A.de S.; Perics, O.S.; Warnapura, S.S.; Senadheera, E.A.T. and Amaratunga, W. (1984). Proceedings of the International Rubber Conference. 75 Years of Rubber Research in Sri Lanka, 1984, Colombo, **1**: 499-520.

Hexaconazole (Anvil 5SC), a cost effective fungicide for controlling white root disease in immature rubber.

Lam, C.H. and Chiu, S.B. (1993). Planter, **69**: 465-474.

Pentachlorophenol effective and economical fungicide for the management of white root disease caused by *Rigidoporus lignosus* in Sri Lanka.

Jayasinghe, C.K.; Jayasuriya, K.E. and Fernando, T.H.P.S. (1995). Journal of the Rubber Research Institute of Sri Lanka, **75**: 61-70.

Economical and less hazardous fungicide for management of white root disease.

Jayaratne, R.; Jayasinghe, C.K. and Wettasinghe, P.C. (1997). Journal of the Rubber Research Institute of Sri Lanka, **80**: 20-29.

Possible integration of *Trichoderma* with fungicides for the control of white root disease of rubber.

Ismail Hashim (1990). Proceedings of the International Rubber Research and Development Board Symposium, Kunming, China, 1990: 1-8.

New developments in chemical control of white root disease of *Hevea brasiliensis* in Africa.

Gohet, E.; Canh, T. Van; Louanchi, M. and Despreaux, D. (1991). Crop Protection, **10**: 234-238.

A new method of direct control of *Fomes lignosus*, causing agent of white root of *Hevea*.
Canh, T.V. (1984). Proceedings of the International Rubber Conference. 75 Years of Rubber Research in Sri Lanka, 1984, Colombo, 1: 473-491.

Field evaluation of methods for the control of white root disease (*Fomes lignosus*) of *Hevea*.
Peries, O.S.; Fernando, T.M. and Samaraweera, S.K. (1963). Quarterly Journal of the Rubber Research Institute of Ceylon, 39: 9-15.

Fungicide drenching for white root disease control.
Tan, A.M. and Hashim, I. (1992). Planters' Bulletin Rubber Research Institute of Malaysia, 212: 87-101.

Control of white root disease (*Fomes*) of *Hevea*.
Canh, T.Van (1996). Plantaitons Recherche Development, 3: 245-250.

Economics of white root disease control.
Liyanage, A.de S. (1977). Bulletin of the Rubber Research Institute of Sri Lanka, 12: 51-57.

In vitro interactions between *Rigidoporus lignosus*, the cause of white root disease of rubber and some potentially antagonistic fungi.
Jayasuriya, K.E. and Deacon, J.W. (1995). Journal of the Rubber Research Institute of Sri Lanka, 76: 36-54.

Economics of control of the white root disease (*Fomes lignosus*) of *Hevea brasiliensis* in Ceylon.
Peries, O.S. (1970). In Root Diseases and Soil Borne Pathogens, University of California, Berkeley Press.

BROWN ROOT DISEASE [*Phellinus noxius* (Corner) G.H. Cunn.]

Characteristics of the disease are similar to white root disease. However, the fungus grows slower resulting the death of few trees only in replantings. Tawny brown gummy rhizomorphs firmly fixed to the affected roots with an encrustration of sand and stones is the diagnostic character of the disease. Few bracket sporocarps, uniformly dark brown are produced at later stages in the collar of the affected trees. In advanced stages, honey comb appearance develops inside the affected roots.

See stem rot for the literature on *Phellinus noxius*.

Brown root disease.
Anon (1994). Identification and treatment of diseases of *Hevea brasiliensis*, International Rubber Research and Development Board, Hertford, UK.

Diseases of economic importance and their control.

Liyanage, A.de S. (1983). In "A Handbook of Rubber Culture and Processing" edited by O.S. Peries and D.M. Fernando, Caxton Printers, Colombo, 121-158.

Host-parasite interaction between *Hevea brasiliensis* and the root rotting pathogens *Phellinus noxius* and *Rigidoporus lignosus*. Comparative physiopathological study (in French).

Nicole, M.; Geiger, J.P. and Nandris, D. (1982). Phytopathologische Zeitschrift, 105: 311-326.

Brown root disease in nurseries.

Ramakrishnan, T.S. and Radhakrishna Pillay, P.N. (1964). Rubber Board Bulletin, 7: 67-69.

Effect of fungal antagonists on *Phellinus noxius* causing brown root disease of *Hevea*.

Jacob, C.K.; Annajutty, Joseph.; Jayarathnam, K. and Joseph, A. (1991). Indian Journal of Natural Rubber Research, 4: 142-145.

In vitro screening of selected fungicides against *Phellinus noxius* and *Poria vincta*.

Rajalakshmy, V.K.; Sheba, Arthassery and Arthassery, S. (1994). Indian Journal of Natural Rubber Research, 7: 63-64.

Actinomycete population in the rhizosphere of *Hevea* and its inhibitory effect on *Phellinus noxius*.

Kothandaraman, R.; Kochuthresiamma, Joseph; Mathew, J. and Rajalakshmi, V.K. (1991). Indian Journal of Natural Rubber Research, 4: 150-152.

USTULINA COLLAR ROT [*Ustulina deusta* (Hoffm.) Lind.]

No reports are available as a serious pathogen on rubber. Progress of the disease is very slow and causes the death of the trees several years after first infection. Causes a dry rot mostly on the collar and laterals of the poorly maintained trees. The unique symptom on root/collar is the production of thick black double lines on the outer layer of the wood. The fructifications are flat plates attached to bark surface and gray in colour.

See *Ustulina* stem rot for the literature on *Ustulina deusta*.

Ustulina root rot.

Rao, B.S. (1975). Maladies of *Hevea* in Malaysia, Rubber Research Institute of Malaysia, Kuala Lumpur: 20-21.

PORIA ROOT ROT [*Poria hypobrunnea* Petch]

By no means economical threat to rubber plantations. Fungus forms stout, smooth red strands of mycelium, sometimes joining into a continuous red sheet. The basidiocarp of the fungus is a flat plate like structure on the collar or the exposed portions of the affected roots. The colour of the fructification is reddish-brown to gray and covered with small pores.

CMI descriptions on *Poria hypbrunnea*.

Pegler, D.N. and Gibson, I.A.S. (1972). CMI descriptions of pathogenic fungi and bacteria, No. 322, *Poria hypobrunnea*.

Poria root rot.

Rao, B.S. (1975). Maladies of *Hevea* in Malaysia, Rubber Research Institute of Malaysia, Kuala Lumpur, 22-23.

Poria root disease of rubber in India.

Rajalakshmy, V.K. and Radhakarishna Pillay, P.N. (1979). Indian Phytopathology, **31**: 199-202.

BLACK ROOT DISEASE [*Xylaria thwaitesii* Cooke]

A disease of minor importance. Slow growing fungus showing the symptoms on the tree only at very late stages. Diagnostic characters are the unique colour of the rhizomorphs and shape of the fruit bodies. The fungal mycelium initiates as a whitish mat which rapidly turns black. The fruit bodies are staghorn like and formed on the soil surface at the base of the affected trees. They are white when young and turn to black with the maturity.

Diseases of economic importance and their control.

Liyanage, A.de S. (1983). In "A Handbook of Rubber Culture and Processing" edited by O.S. Peries and D.M. Fernando, Caxton Printers, Colombo: 121-158.

Black root disease of *Hevea* caused by *Xylaria thwaitesii*.

Munasinghe, H.L. (1971). Quarterly Journal of the Rubber Research Institute of Ceylon, **48**: 92-99.

Some Xylarias of Tropical America. (Describes and illustrates 51 species).

Dennis, R.W.G. (1956). Kew Bulletin, **3**: 401-444.

FUSARIUM WILT [*Fusarium solani* (Mart.) Sacc.]

A disease of minor importance. Above ground symptoms resemble that of white root disease. No superficial fungal strands are produced on roots or collar as most of the other root diseases. The most reliable diagnostic feature is the presence of a discolouration on the vascular tissue when longitudinally split the roots of affected plants.

CMI descriptions on *Fusarium solani*.

Booth, C. and Waterston, J.M. (1964). CMI descriptions of pathogenic fungi and bacteria, No. 29, *Fusarium solani*.

Diseases of economic importance and their control.

Liyanage, A.de S. (1983). In "A Handbook of Rubber Culture and Processing" edited by O.S. Peries and D.M. Fernando, Caxton Printers, Colombo: 121-158.

Association of *Fusarium solani* with root lesions of rubber (*Hevea brasiliensis*) showing leaf wilt in Sri Lanka.

Liyanage, A.de S. and Dantanarayana, D.M. (1983). Transactions of British Mycological Society, **80**: 565-567.

FOOT CANKER AND SUDDEN WILT [*Nattrassia mangiferae* (H. and P. Syd.) Sutton Dyko]

Fungus was reported to cause mortality of seedlings resulting in bare patches in nurseries specially during the dry months of the year. The most conspicuous symptom is the development of cankers at the collar region of seedlings. Longitudinal cracks appear on the bark at the collar and a brownish rot of the pith develops in severe cases. Sooty layer of arthrospores of the fungus also could be seen covering the entire surface of the affected bark in severely affected plants.

CMI descriptions on *Hendersonula toruloidea*.

Punithalingam, E. and Waterston, J.M. (1970). CMI descriptions of pathogenic fungi and bacteria, No. 274, *Hendersonula toruloidea*.

Revision of *Hendersonula*.

Sutton, B.C. and Dyko, B.J. (1989). Mycological Research, **93**: 466-488.

Foot canker and sudden wilt of *Hevea brasiliensis* associated with *Nattrassia mangiferae*.

Jayasinghe, C.K. and Silva, W.P.K. (1994). Plant Pathology, **43**: 938-940.

Nattrassia mangiferae: Cultural characteristics and reproductive morphology of the *Hevea* isolate.

Jayasinghe, C.K.; Fernando, T.H.P.S. and Priyanka, U. (1997). Indian Phytopathology, **50**: 95-98.

COLLAR & HYPOCOTYL ROT [*Sclerotium rolfsii* Sacc.]

Seems to be a problem in seed germination beds. Seedlings affected by this disease show typical rotting of the stem at the collar region and the presence of net work of whitish mycelium with tiny sclerotia along the affected stems. Hypocotyls of the germinated seeds are also reported to be affected resulting in poor emergence.

CMI descriptions on *Corticium rolfsii.*

Mordue, J.E.M. (1974). CMI descriptions of pathogenic fungi and bacteria, No. 410, *Corticium rolfsii*.

Outbreaks and new records. Collar rot of rubber seedlings caused by *Sclerotium rolfsii.*

Jayasinghe, C.K.; Liyanage, A.de S. and Warnapura, S.S. (1988). FAO Plant Protection Bulletin, **36**: 189.

Management of collar rot of *Hevea* seedlings: A new record on *Hevea* in Sri Lanka.

Jayasinghe, C.K. and Warnapura, S.S. (1992). Proceedings of the International Natural Rubber Conference, Bangalore, India, B4. 04.

Sclerotium collar rot of *Hevea* seedlings and management of the disease.

Jayasinghe, C.K.; Warnapura, S.S. and Fernando, I. (1993). Indian Journal of Natural Rubber Research, **6**: 5-9.

The adoption of correct cultural practices prevents collar rot and target leaf spot in *Hevea* rubber.

Jayasinghe, C.K. (1998). International Rubber Research and Development Board Information Quarterly, Hertford, England part 2: 6-7.

GEOTRICHUM ASSOCIATIONS ON ROOTS [*Geotrichum* sp.]

Found on the collar and the roots of seedlings raised in nurseries where the soil is heavily contaminated with leaf litter and decaying roots. The most conspicuous symptom of this condition is the presence of a network of whitish mycelium on the root system. The mycelium is superficial and could be easily removed if swabbed with wet cotton wool. This condition is merely a saprophytic colonization and no collar or root rot is caused due to the fungal growth.

A revision of the genus *Geotrichum* and its telemorphs.
Hoog, G.S.; Smith, M.T.H. and Gueho, E. (1986). Studies in Mycology, No. 29, 131 pp.

Saprophytic colonization of *Geotrichum* sp. on *Hevea brasiliensis* roots. A condition that resembles white root disease
Jayasinghe, C.K. and Wettasinghe, J.L.P.C. (1966). Journal of the Rubber Research Institute of Sri Lanka, 78: 102-105.

Culture characteristics and reproductive morphology of *Geotrichum* sp.: Guide to distinguish *Geotrichum* from *Rigidoporus*.
Jayasinghe, C.K. and Wettasinghe, J.L.P.C. (1998). Journal of the Rubber Research Institute of Sri Lanka, 81: 23-28.

ROOT KNOT NEMATODE INFESTATION [*Meloidogyne incognita* (Kofoid & White) Chitwood]

Present incidence are not serious on rubber and limited only to nurseries resulting stunted seedlings showing symptoms that of nutrient deficient plants. Conspicuous swellings on the lateral roots or root-lets are characteristic to plants infested with root-knot nematodes. Pear shaped females could be dissected from the galled tissue of the roots.

Identification of *Meloidogyne* species from Sri Lanka.
Ekanayake, H.M.R.K. and Di Vito, M. (1984). Crop Nematode Research and Control Project (CNRCP) International Nematology Network Newsletter, 1: 13-14.

Frequency of occurrence and distribution of plant parasitic nematodes in rubber nursery soils.
Thankamony, S.; Nehru, C.R. and Jayarathnam, K. (1996). Indian Journal of Natural Rubber Research, 9: 60-62.

Outbreaks and new records. *Meloidogyne incognita*, pathogen of *Hevea brasiliensis* in Sri Lanka.
Jayasinghe, C.K. and Wettasinghe, D.S. (1993). FAO Plant Protection Bulletin, 41: 36.

GENERAL REFERENCES

Anon (1960). Host list of plant diseases recorded in the South East Asia and Pacific region. *Hevea brasiliensis* – Rubber. Plant Protection Committee for the South East Asia and Pacific Region. Food and Agriculture Organization Document No. 7 (2nd ed.), Bangkok, Thailand, 3pp.

Anon (1988). Pathology of *Hevea brasiliensis*. International Rubber Research and Development Board Bibliography, IRRDB Secretariat, Herford, U.K, 59 pp.

Brown, A.E. and Soepena, H. (1994). Pathogenicity of *Colletotrichum acutatum* and *C. gloeosporioides* on leaves of *Hevea* spp. Mycological Research, **98**: 264-266.

Bryce, G. (1921). Report on the work of the Botanical and Mycological Division. Report of the Department of Agriculture Ceylon, 1920: 13-15.

Carruthers, J.B. (1903). The canker fungus in rubber. Tropical Agriculturist, **23**: 372-373.

Chee, K.H. (1976). Micro-organisms Associated with Rubber (*Hevea brasiliensis* Mull Arg.) Rubber Research Institute of Malaysia, Kuala Lumpur, Malaysia, 78 pp.

Chee, K.H. (1987). International collaboration in research on *Hevea* diseases. Proceedings of the International Rubber Research and Development Board Symposium, Chiang Mai, Thailand, 1987: 24-39.

Gadd, C.H. (1925). *Hevea mildew*. Year Book of Department of Agriculture Ceylon, 1926: 22-23.

Hawksworth, D.L.; Kirk, P.M.; Sutton, B.C. and Pegler, D.N. (1995). Ainsworth and Bisby's Dictionary of the Fungi. Eighth Edition, Commonwealth Agricultural Bureaux International, Oxon, U.K, 616 pp.

Jayasinghe, C.K. (1992). South American leaf blight – likelihood behaviour in Sri Lanka and strategies in management. Bulletin of the Rubber Research Institute of Sri Lanka, **29**: 21-26.

Jayasinghe, C.K. (1993). The natural occurrence of *Thanatephorus cucumeris* leaf spot on *Hevea brasiliensis* in Sri Lanka. Plant Pathology, **42**: 473-474.

Jayasinghe, C.K. (1997). Leaf fall disease: a threat to world NR industry. Rubber Asia, Nov-Dec.: 55-56.

Jayasinghe, C.K. (1998). The adoption of correct cultural practices prevents collar rot and target leaf spot in *Hevea* rubber. International Rubber Research and Development Board Information Quarterly, Hertford, England part 2: 6-7.

Jayasinghe, C.K. (1999a). Disease scenario of the *Hevea* rubber tree: Current status and prospects in prevention and control of the most challenging diseases. (In press)

Jayasinghe, C.K. (1999b) Pests and Diseases of Quarantine Importance to Rubber Cultivation in South East Asia. Bulletin of the Rubber Research Institute, Sri Lanka, **39**: 45-50.

Jayasinghe, C.K.; Fernando, T.H.P.S. and Priyanka, U.M.S. (1997). *Colletotrichum acutatum* is the main cause of *Colletotrichum* leaf disease of *Hevea* in Sri Lanka. Mycopathologia, **137**: 53-56.

Jayasinghe, C.K. and Jayaratne, A.H.R. (1996). *Phytophthora* epidemics – possibility of management using resistant clones. Journal of the Rubber Research Institute of Sri Lanka, 77: 66-76.

Jayasinghe, C.K.; Liyanage, A.de S. and Warnapura, S.S. (1988). Out breaks and new records: Collar rot of rubber seedlings caused by *Sclerotium rolfsii*. Food and Agriculture Organization Plant Protection Bulletin, **36**: 189.

Jayasinghe, C.K. and Silva, W.P.K. (1994). Foot canker and sudden wilt of *Hevea brasiliensis* associated with *Nattrassia mangiferae*. Plant Pathologoy, **43**: 938-940.

Jayasinghe, C.K. and Wettasinghe, D.S. (1993). Outbreaks and new records: *Meloidogyne incognita*, pathogen of *Hevea brasiliensis* in Sri Lanka. Food and Agriculture Organization Plant Protection Bulletin, **41**: 36.

Jayasinghe, C.K. and Wettasinghe, J.L.P.C. (1996). Saprophytic colonization of *Geotrichum* sp. on *Hevea brasiliensis* roots, a condition that resembles white root disease. Journal of the Rubber Research Institute of Sri Lanka, **78**: 102-105.

Liyanage, A.de S. (1983). Diseases of economic importance and their control. In "A Handbook of Rubber Culture and Processing" edited by O.S. Peries and D.M. Fernando, Caxton Printers, Colombo: 121-158.

Liyanage, A.de S. (1983). Diseases of rubber absent or uncommon in Sri Lanka. In "A Handbook of Rubber Culture and Processing" edited by O.S. Peries and D.M. Fernando, Caxton Printers, Colombo: 183-189.

Liyanage, A.de S. and Dantanarayana, D.M. (1983). Association of *Fusarium solani* with root lesions of rubber (*Hevea brasiliensis*) showing leaf wilt in Sri Lanka. Transactions of British Mycological Society, **80**: 565-567.

Liyanage, A.de S. and Jacob, C.K. (1992). Diseases of economic importance in rubber. "In Natural Rubber: Biology, Cultivation and Technology" edited by M.R. Sethuraj and N.M. Mathew, Elsevier Science Publishers B.V., Amsterdam: 324-359.

Liyanage, A.de S.; Jayasinghe, C.K.; Liyanage, N.I.S and Jayaratne, A.H.R. (1986). *Corynespora* leaf spot disease of rubber (*Hevea brasiliensis*) – A new record. Journal of the Rubber Research Institute of Sri Lanka, **65**: 47-50.

Liyanage, N.I.S. (1989). *Phytophthora citricola* on rubber in Sri Lanka. Plant Pathologoy, **38**: 438-439.

Munasinghe, H.L. (1961). Algal spot of *Hevea* leaves in Ceylon. Quarterly Journal of the Rubber Research Institute of Ceylon, **37**: 49-50.

Murray, R.K.S. (1929). A preliminary note on a disease of young rubber buddings. Tropical Agriculturist, **73**: 235-238.

Murray, R.K.S. (1930). Diseases of rubber in Ceylon. Rubber Research Scheme (Ceylon), 38 pp.

Murray, R.K.S. (1938). Root disease with special reference to replanting. Quarterly Circular of the Rubber Research Scheme (Ceylon), 15: 24-31.

Park, M. (1937). Report on the work of the mycological division. Ceylon Administration Reports, 1936, Department of Agriculture: D28-D35.

Peries, O.S. (1965). Recent developments in the control of the diseases of the *Hevea* rubber tree. Quarterly Journal of the Rubber Research Institute of Ceylon, **41**: 33-43.

Peries, O.S. (1966a). The economics of disease control in *Hevea*. Bulletin of the Rubber Research Institute of Ceylon, **1**: 27-33.

Peries, O.S. (1966b). Present status and methods of control of leaf and panel diseases of *Hevea* in South East Asian and African countries. Quarterly Journal of the Rubber Research Institute of Ceylon, **1**: 27-33.

Peries, O.S. and Brohier, Y.E.M. (1965). A virus as the causal agent of bark cracking in *Hevea brasiliensis*. Nature, **205**: 624-625.

Peries, O.S. and Liyanage, A.de S. (1985). *Hevea* diseases of economic importance and integrated method of control. Proceedings of the International Rubber Conference, Kuala Lumpur, **3**: 255-269.

Peries, O.S. and Liyanage, A.de S. (1987). Diseases of economic importance of *Hevea brasiliensis* and their control. Review of Tropical Plant Pathology, **4**: 149-198.

Petch, T. (1905). Diseases of *Hevea brasiliensis* – Peradeniya Annual Report for 1905. Agriculture Bulletin of the Straits and Federal Malaya States, **5**: 396-398.

Petch, T. (1906). Report of the mycologist for 1906. Cited from Petch, 1909; A bark Disease of *Hevea*, tea and etc. Circulars and Agricultural Journal of the Royal Botanic Gardens, Ceylon Vol. IV, No 21, 1909.

Petch, T. (1907). Report of the Mycologist (Ceylon) for 1907. Cited from Petch, 1910; A root disease of *Hevea*. Circulars and Agricultural Journal of the Royal Botanic Gardens, Ceylon, V: 65-71.

Petch, T. (1910). Cocoa and *Hevea* canker. Circulars and Agricultlural Journal of the Royal Botanic Gardens, Ceylon, **5**: 143-180.

Petch, T. (1911). The Physiology and Diseases of *Hevea brasiliensis*. Dulau and Co. Limited, London, 268 pp.

Petch, T. (1921). The Diseases and Pests of the Rubber Tree. Macmillan, London, 278 pp.

Petch, T. (1923). A root disease of *Hevea* (*Xylaria thwaitesii* Cooke). Tropical Agriculturist, **60**: 100-101.

Small, W. (1927). Further notes on *Rhizoctonia bataticola* Taub. Tropical Agriculturist, **69**: 9-12.

Weir, J.R. (1926). A pathological survey of the para rubber tree (*Hevea brasiliensis*) in the Amazon Valley. United States Department of Agriculture Bulletin, **1380**, pp129.

Young, H.E. (1955). Bark rot and canker of the rubber tree. Advisory Circular No. 54, Rubber Research Institute of Ceylon, 1955.