QUARANTINE MEASURES AGAINST SOUTH AMERICAN LEAF BLIGHT (SALB)

ECONOMIC IMPORTANCE OF SALB

- The most serious disease of rubber
- Destructive, spreads rapidly, difficult and expensive to control
- Infects only rubber plants (*H. brasiliensis, H. benthamiana, H. guianensis, H. spruceana, H. camporum*).

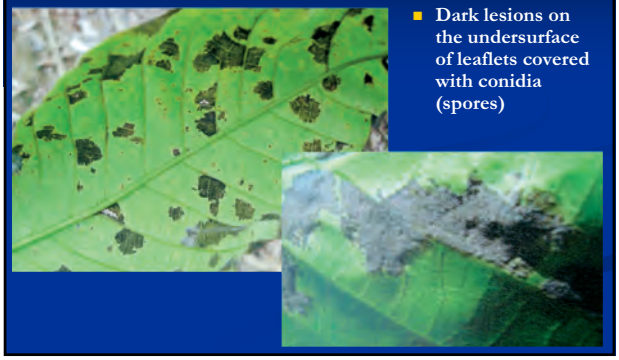
THE PATHOGEN OF SALB

- *Microcylus ulei* – a fungus
- An ascomycete with asexual and sexual stages

SYMPTOMS

- First visible symptoms are the distortion of leaves.
- Visible symptoms occur 2-3 days after inoculation.
- A few days later irregular shaped lesions developed on lower surface of leaves.
- Lesions appear dark or olive green.
- Size of lesions depends on susceptibility of leaves (age & clone).

YOUNG LEAVES

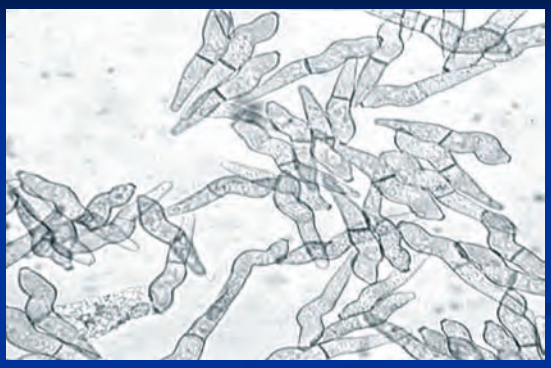


- Dark lesions on the undersurface of leaflets covered with conidia (spores)

Conidial lesions

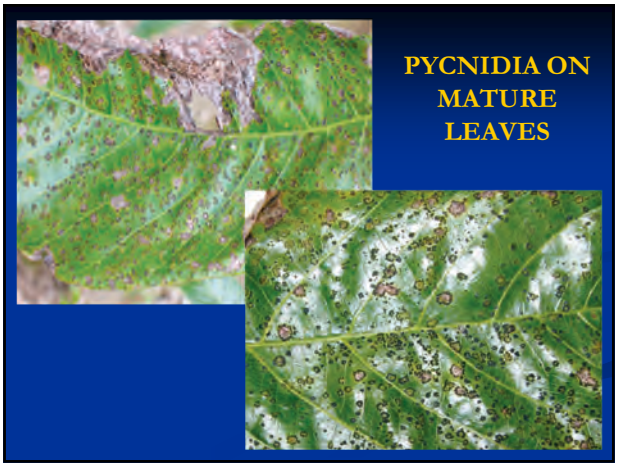
Carlos Mattos

Microcyclus ulei – conidia



CONIDIA

- Mostly septate with two cells with proximal cell broader and tapering distal cell;
- Sometimes single cell depending on weather and growing conditions;
- Characteristic twist;
- Most important for infection and disease spread;
- Present in abundance during wet weather.



PYCNIDIA ON MATURE LEAVES

THE PERITHECIA

- At the site of the pycnidia large (200-400 µm diameter) raised black bodies (perithecia) developed;
- The perithecia produced the ascospores
- Ascospores cause infection and spread SALB;
- Present throughout the year.

Microcyclus ulei – ascospores

PAST DESTRUCTION BY SALB

SURINAM	1911 – 40,000 Tree Planted
	1918 – Plantation Destroyed
PANAMA	1935 – Good year plantation started
	1941 – Plantation destroyed
BRAZIL	1927 – 3,200 ha planted at Fordlandia
	1993 – Plantation abandoned
	1936 – 6,478 ha planted at Belterra
	1943 – Plantation abandoned
	1967 to 1986 – 150,000 ha planted under PROBOR
	1986 – PROBOR Terminated as 100,000 ha were infected with SALB
COSTA RICA	1935 – Goodyear Speedway estate was planted
	1941 – Severely infected by SALB.

History indicated that SALB caused a serious problem within 6-7 years of establishment of a plantation

ECONOMIC IMPORTANCE OF SALB

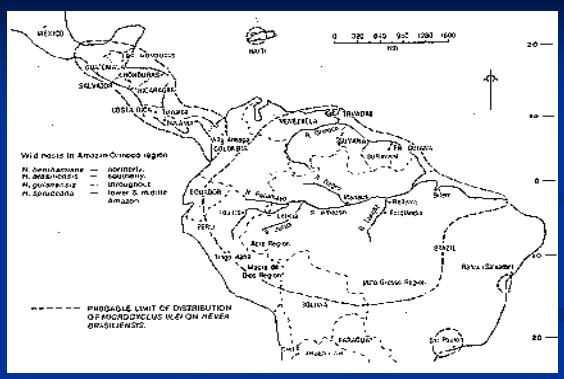
- Reduces tree growth
- Prolongs the immaturity period
- Reduces latex productivity by as much as 70%
  - Productivity of RRIM 600 in Brazil – 11.2 g/t/t and 15.9 g/t/t
  - Productivity of RRIM 600 in Malaysia – more than 60 g/t/t
- Kills the rubber plants and reduce density of stand
- Increases cost of rubber production – extra weeding and disease control

Trees with poor canopy and dead branches

IMPACTS OF SALB ON THE TREE

- Repeated leaf defoliation
- Shoot dieback
- Trees with poor canopy
- Kill the trees

The distribution of SALB (Holliday, 1970)



DISTRIBUTION OF SALB

- Confined to the American tropics and Caribbean islands from Mexico to Brazil
- Present in Brazil, Bolivia, Colombia, Peru, Venezuela, Guyana, Surinam, French Guiana, Trinidad & Tobago, Haiti, Panama, Costa Rica, Nicaragua, Salvador, Honduras, Guatemala, Belize and Mexico
- Asia and Africa are free of SALB

PHYSIOLOGICAL RACES OF *M. ULEI*

- Occurrence of new race causes breakdown of resistance;
- Many races occur;
  - Miller identified four races;
  - Chee identified 9 races in Bahia;
  - Ismail & Almeida confirmed 4 races (2, 3, 4 & 6);
  - Rivano identified 12 races;
  - Large number of strains >50 (Pinheiro);
- Strains also differ in virulence.

SALB IS A THREAT TO RUBBER IN ASIA AND AFRICA

THE THREAT OF SALB IS REAL

- Suitable climatic conditions
- Abundant susceptible clones
- Contiguous rubber plantings
- Rubber plant is mainly planted in smallholdings and hence early disease detection and control difficult.

EFFECT OF CLIMATE ON SALB

- Temperature: Conidia germinate between 8-36 ºC (maximum 24 ºC)
- Humidity: Months with 18+ days with RH exceeding 95% for 10.00 hours – severe SALB

SIMILARITY OF CLIMATE IN MALAYSIA WITH CLIMATE IN SALB REGION

Months	Bahia, Brazil	Trinidad	Malaysia (Negeri Sembilan)
January	22	7	14
February	18	12	21
March	22	17	17
April	26	4	23
May	26	3	25
June	27	14	29
July	24	16	30
August	21	21	30
September	18	23	29
October	22	25	30
November	20	25	29
December	20	17	30

Chee

EFFECT OF RAINFALL ON SEVERITY OF SALB

- High Severity
  - Annual rainfall >250 cm, well distributed with no long dry season
- Intermediate Severity
  - Annual rainfall >200 - <250 cm, well distributed with no long dry season
- Low Severity
  - Annual rainfall, variable with at least four months dry period with <7 cm rain per month

SALB: HOW SEVERE IT WILL BE IF INTRODUCED INTO SOUTH EAST ASIA

- "It is an open secret in the industry that SALB should it crosses the Pacific could wipe out the supply of natural rubber" – Peter Wade in Fortune.
- "SALB would run through the Asian rubber plantations within five years"– Richard Evan Shultes.
- "It moves like a blow torch through the plantings" – Ernie Emle.

POSSIBLE METHODS OF INTRODUCTION OF SALB

- Infected *Hevea* plant parts
- Viable spores contaminating travelers, their belongings and imported commodities
- Spores of *M. ulei* could survive for a reasonably long time

VIABILITY OF SPORES OF *M. ULEI*

SPORES	CONDITIONS	VIABILITY
Conidia (detached)	24 °C, 65-85% RH	3-4 weeks
	24 °C, 85-100% RH	2 weeks
Conidia (intact)	24 °C, desiccation	16 weeks
Ascospores	24 °C, 85-100% RH	9 days
	31 °C, 0-100% RH	3 days
Perithecia	24 °C, 65% RH	3 weeks
	24 °C, 100% RH	12 days

Survival Of Conidia Of *M. ulei* After 7 Days On Different Materials

Material	Germination (%)
Infected Leaves	53.3
Cloth	31.6
Polyethylene	29.3
Leather	26.5
Glass	26.0
Hevea Leaves	21.0
Metal	6.3
Paper	5.8
Dry Soil	50.0

Zhang, 1986

QUARANTINE MEASURES

FAO ESTABLISHED THE PLANT PROTECTION AGREEMENT FOR THE SOUTH EAST ASIA AND PACIFIC REGION IN 1955

PLANT PROTECTION AGREEMENT FOR THE SOUTH EAST ASIA AND PACIFIC REGION

- Article IV

MEASURES TO EXCLUDE SALB OF HEVEA FROM THE REGION

In view of the importance of the *Hevea* rubber industry in the Region, and the danger of introducing the South American leaf blight of *Hevea* rubber tree, the Contracting Governments shall take the measures specified in Appendix B to this Agreement. Appendix B to this Agreement may be modified by a decision of the Committee taken unanimously.

PLANT PROTECTION AGREEMENT FOR THE SOUTH EAST ASIA AND PACIFIC REGION

- Appendix B: MEASURES TO EXCLUDE SALB
  - Prohibit the importation of any plant or plants of the Genus *Hevea* from outside the region unless ….(certain conditions are met);
  - Prohibit the importation of any plant or plants of the Genus *Hevea* capable of further growth (excluding seeds) from American Tropics or SALB country;
  - Prohibit the importation of any seed of any plant of the Genus *Hevea* unless …. (specific requirements are met);
  - Prohibit the importation of any plant or plant parts of the Genus *Hevea* not capable of further growth or propagation unless ….(specific requirements are met);
  - Prohibit the importation of any plant or plants other than the Genus *Hevea* capable of further growth or propagation from American Tropics or SALB country unless ….(specific requirements are met);
  - The Competent Authority must ensure that any importation of *Hevea* plants for propagation must be grown under control and release only after they are free of any pests and diseases.

AMENDMENTS OF THE AGREEMENT

- **The Plant Protection Agreement for Asia and Pacific region had been revised to update and align the Agreement with the International Plant Protection Convention (IPPC, 1997) and the WTO Application of Sanitary and Phytosanitary (SPS) Measure;**
- **The Amendments were adopted at the 21st Session of the APPPC in Yogyakarta in 1999.**

PEST RISK ANALYSIS (PRA)

- PRA is the process of evaluating biological or other scientific and economic evidence to determine whether a pest should be regulated and the strength of any phytosanitary measures to be taken against it;
- PRA of SALB was done.

PRA OF SALB

(1) Examine and evaluate risks of SALB being associated with the relevant commodities/ pathways from the SALB endemic countries into the Asia and Pacific region;

(2) Evaluate risks of introduction and spread of SALB into region;

(3) Evaluate the economic consequences resulting from the occurrences of SALB and;

(4) Evaluate various management options to mitigate these risks.

VECTORS (PATHWAYS) OF SALB INTRODUCTION

(1) Host material (*Hevea* species):

- Budded stumps or budwood
- Foliage (stem and leaf material not for planting)
- Flowers, fruits and seeds
- Plants *in vitro*
- Wood

(2) Non-host materials:

- Inanimate goods or non-host organic materials
- Inanimate goods or non-host organic material contaminated by host plant materials.

PROBABILITY OF ENTRY THROUGH HOST MATERIALS (*Hevea* Species)

Vector	Probability of association	Probability of transit by Sea/Air	Probability of transfer to a suitable host	Conclusion of Probability of Entry
Budded stumps or budwood	High	High	High	High
Foliage (stem and leaf material not for planting)	High	High	Low (< 1cm^2)	Low (< 1cm^2)
Flowers, fruits and seeds	Moderate	Low (sea) to Moderate (Air)	Low	Low
Plants *in-vitro*	Negligible	N/A	N/A	Negligible
Wood	Negligible	Negligible	Negligible	Negligible

PROBABLY OF ENTRY THROUGH NON-HOST MATERIALS

Vector	Probability of association	Probability of transit by Sea/Air	Probability of transfer to a suitable host	Conclusion of Probability of Entry
Inanimate goods or non host organic material	Low	Negligible	N/A	Negligible
Inanimate goods or non-host organic material contaminated by host plant material	Moderate	Low (Sea), Moderate (Air)	Low (< 1 cm^2)	Low (< 1 cm^2)

PROBABILITY OF INTRODUCTION, SPREAD AND CONSEQUENCES THROUGH HOST MATERIALS

VECTOR	ENTRY	ESTABLISHMENT	SPREAD	IMPACT	RISK
Budded stumps or budwood	High	High	High	High	High
Foliage (leaf and stems not for planting)	Low	High	High	High	Moderate
Flowers, fruits and seeds	Low	High	High	High	Low
Plants *in vitro*	Negligible	Not applicable	Not applicable	Not applicable	Negligible

PROBABILITY OF INTRODUCTION, SPREAD AND CONSEQUENCES THROUGH NON-HOST MATERIALS

VECTOR	ENTRY	ESTABLISHMENT	SPREAD	IMPACT	RISK
Inanimate goods or non-host organic materials	Negligible	N/A	N/A	N/A	Negligible
Inanimate goods or non-host organic materials contaminated by host plant materials	Low (if <1 cm)	High	High	High	Low (if <1 cm)

PROBABILITY OF ESTABLISHMENT AND SPREAD

- The probability of establishment within the rubber growing areas of the PRA area should be considered high if SALB is introduced into a suitable environment on appropriate host material.
- The probability of spread within the rubber growing areas of the PRA area should be considered high if SALB is introduced into a suitable environment and an area where sufficient host material is available.

STANDARD ON SALB

- A Standard on SALB was established;
- Aims to assist APPPC member countries to protect the Region against SALB;
- The Standard provides guidelines to improve or develop phytosanitary measures including prevention, eradication and control against SALB.

STANDARD ON SALB – MAJOR AREAS

- The prevention of the introduction of SALB;
- The establishment of eradication or control programmes in the case of entry of SALB;
- The development of training programmes on inspection and diagnostic methods, surveillance, eradication and control programmes;
- The description of minimum requirement for personnel and facilities;
- The establishment of co-ordination and co-operation activities for SALB programme.

RISK MANAGEMENT

A. Viable host material:

- Plants for planting: Whole plants and cuttings, and plants *in-vitro*;
- Seeds, flowers and fruit.

B. Non-viable (inanimate) host material:

- Cargo pathway (including sea freight, airfreight and mail);
- Passenger pathway (including accompanied luggage).

STANDARD ON SALB – RELEVANT POINTS

- The Outline of Requirements in the standard is specific to APPPC rubber growing countries;
- The PRA and Standard apply only to FAO member countries in the Asia and Pacific region. Non member countries in the Region are not compelled to adopt measures in the Agreement;
- Similar quarantine measures should be taken for Africa;
- The risk of SALB establishing in Africa is real due to close proximity, existence of direct flights.

ANRPC SALB COMMITTEE

- National SALB Committee was established in some member countries
- National SALB Contingency plan
- Advise returning passengers from SALB areas to break journey
- Announcement on SALB in plane
- Establish plant quarantine declaration card
- Undertake treatment measures on baggage of passengers from SALB areas – UV irradiation, air tunnel, floor mats soaked with disinfectant etc.
- Increase awareness through workshops and courses.

IRRDB: ACTIVITIES OF IRRDB ON SALB

- IRRDB SALB fellowship – produced trained diagnosticians
- Widening of genetic base of rubber for breeding
- 1984 Workshop on SALB in Brazil
- Workshop on SALB in Ivory Coast (1988) and Brazil (May 2004)
- Promotes research on SALB