

MANAGEMENT OF SOUTH AMERICAN LEAF BLIGHT (SALB)

STRATEGIES TO MANAGE SALB

- Resistant Clones;
- Chemical Control;
- Crown Budding With Resistant Clones;
- Disease Escape Areas;
- Biological Control.

RESISTANT CLONES



BREEDING FOR RESISTANCE TO SALB

- After the Fordlandia and Belterra plantations were ravaged, the Ford Motor Co. started breeding clones resistant to SALB in Brazil using some clones that escaped the disease in their plantations;
- Initially immune or highly resistant clones were used as parents. *H. benthamiana* (F 4542) was also used as parents;
- The better primary clones (F, FA and FB) were crossed with introduced oriental clones producing Fx clones;
- The Instituto Agronomico do Norte continued the breeding programme to produce IAN clones;
- Firestones also carried out breeding programmes for SALB resistance in Costa Rica and Liberia;

BREEDING FOR SALB RESISTANCE

- Malaysia attempted breeding for SALB resistance in late 1950s using some introduced primary and secondary clones (Fx and IAN clones);
- The resultant progenies were assessed for SALB resistance at the RRIM SALB Unit in Trinidad and Tobago which has since ceased operation.
- Similar attempts were made in Sri Lanka.

DISEASE RESISTANT CLONES

- Pathogen – Physiological races
- Host resistance – Horizontal vs vertical resistance

RESISTANT CLONES

- High yielding resistant clones are lacking;
- Breakdown of resistance of a clone happens e.g. IAN 717 when a new race (Race 2) of *M. ulei* occurs;
- Some tolerant clones (Fx 3864) have been planted;
- Immune *Hevea* species e.g. *H. pauciflora* (PA 31) has been utilized as source of resistance.

HEVEA RESISTANCE TO SALB

- Vertical or monogenic resistance (hypersensitive cell collapse) :
 - Is associated with single or few gene;
 - Resistant to only few fungal races;
 - Resistance breaks down when a new race occurs.
- Horizontal or field or polygenic resistance:
 - Infected but tolerate disease;
 - Most desired as the clone are resistant to many races;
 - More durable;
 - Harder to breed.
- Earlier, breeding for vertical resistance was adopted but currently breeding for horizontal resistance is being emphasized.

MECHANISM OF RESISTANCE

- Passive resistant factors are not important;
- Resistance contributed by active resistant factors:
 - Increase in certain enzyme activities;
 - Accumulation of polyphenols (scopoletin);
 - Associated with HCN liberation.

PHYSIOLOGICAL RACES OF M. ULEI

- Occurrence of new races caused breakdown of resistance;
- Many races and strains of *M. ulei* occur;
- Occurrence of a new race has caused breakdown of resistance of earlier bred clones.
- Lack of high yielding horizontal clones to be used as parents.

COMPONENTS OF HORIZONTAL RESISTANCE

- Longer Incubation period;
- Longer latent period;
- Reduced number of lesions;
- Smaller lesions;
- Reduced sporulation;
- Shorter susceptible leaf period
- Shorter fungal pathogen generation period
- Reduced number of fungal generation period within a leaf flush.

Breeding for horizontal resistance

- Select for desired parental clones (horizontal resistance and high yielding);
- Screen clones for resistance to all known races of *M. ulei*.
 - Preparation of inoculum of a race by culturing the fungus in vitro;
 - Inoculating the *Hevea* progenies under controlled conditions;
 - Assess the various components of resistance .
- Assessing resistance of the progenies by planting the progenies in a field that are exposed to as many races of *M. ulei* as possible.

COMPONENTS OF RESISTANCE OF HEVEA TO M. ULEI RACE 2

Clone	Infection Type	Latent Period (days)	No. Lesions/cm	Lesion size (mm)	Spore/cm ² (x 10 ⁴)	Spores/lesion (x10 ⁴)
FX2804	HS	5.25	6.27	2.2	12.53	2.63
FX3925	HS	5.33	11.41	1.77	11.69	1.04
IAN717	HS	5.23	9.48	2.30	10.56	1.10
IAN710	S	5.00	8.25	2.08	2.43	0.30
SIAL263	S	5.25	7.32	2.63	4.22	0.76
FX3864	MR	8.00	5.42	1.34	0.15	0.04
FX25	MR	7.75	8.47	1.00	0.12	0.03
FX4098	MR	7.25	6.90	2.11	0.21	0.04

BREEDING TECHNIQUES

- Traditional breeding techniques are mostly adopted;
- Molecular techniques improve rubber breeding
 - QTLs for SALB resistance have been identified recently.

PRODUCTION OF HEVEA CLONES WITH HORIZONTAL RESISTANCE



C. Mattos

- Michelin has produced 13 clones with horizontal resistance and good latex yield;
- These clones are being evaluated in several Asian countries (Malaysia and Cambodia).

CHEMICAL CONTROL

CHEMICAL CONTROL OF SALB



- Chemical control is commonly practised in nurseries and immature rubber;
- Multiple rounds of weekly spraying is needed making chemical control not cost effective during low rubber price;
- Many fungicides (protective and systemic) are effective on M. ulei.

Fungicides Effective Against *M. ulei*

- Dithane M-45 (mancozeb)
- Benlate (benomyl)
- Cercobin M (thiophanate methyl)
- Daconil/Bravonil (chlorothalonil)
- Bayleton (triadimefon)
- Saprool (triforine)
- Bayfidan (triadimenol)
- Tilt (propiconazole)
- Folicur (tebuconazole)
- Sportak (prochloraz)
- Score (difeconazole)
- Amistar (strobil)

CHEMICAL CONTROL

- Commence spraying when young leaves are emerging after annual leaf change;
- Repeat weekly spraying until leaves mature;
- Numerous rounds are required;
- Tractor mounted mist blowers, helicopters and aero planes are more suitable for mature trees or large areas;
- Fogging machines were tried but are not very suitable due to poor deposition ;
- Chemical control had increased latex when properly employed.

SPRAYING OF FUNGICIDES



- Portable mist blowers can be used for young trees and smaller areas;
- Tractor mounted larger sprayers, airplanes or helicopters are more suitable for older trees and large areas.



INTEGRATED CONTROL

- Integrating herbicide spraying with chemical control to rehabilitate an area;
- Integrating chemical control with disease tolerant clones;
- Integrating chemical control with biological control.

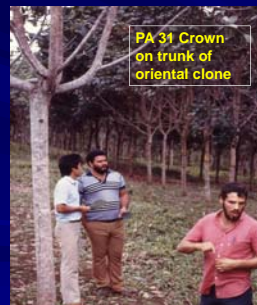
CROWN BUDDING

CROWN BUDDING



- Three part tree: disease resistant crown; High latex yielding trunk and good rootstock.
- Immune species (*H. pauciflora*) had been used as crown

CROWN BUDDING



- Crown budding with immune or tolerant crown;
- Immune species *H. pauciflora* (PA 31), *H. guianensis* var. *marginata* and *H. rigidifolia* have been commercially used;
- Other tolerant clones (FX3899, FX3810, FX3925, IAN 7388) were used as crown.

CROWN BUDDING AT MICHELIN PLANTATION, BAHIA



Source: C. Mattos

Performance of Crown budded clones

Clone combination	No of trees	Year of Tapping	Yield (dry rubber (g)/tree)
PB235/TP875	249	4	3920
PB235/Fx2784	190	1	2976
PB235/TP1003	210	2	2380
PB235/MDF180	349	5	2380
PB235/F4512	412	5	2604
PB235/PA31	387	6	2459
PB235/Fx3864	177	1	1838

Source: C. Mattos

CROWN BUDDING: PROBLEMS

- High cost to establish a crown budded plant;
- There is a problem of incompatibility: different growth rates between crown and trunk;
- Crown clones depressing latex yield of trunk clones
- Breakdown of resistance of crown clone eg. Fx 3925, Fx 25.

CROWN BUDDING: PROBLEMS



- Major Problems:**
- Uneven scion-trunk growth;
 - Scion depresses trunk yield;
 - Breakdown of resistance of scion canopy

Adapted from C. Mattos

CROWN BUDDED PLANTS



Fx 25 crown on RRIM 600
(Source: Rivano)



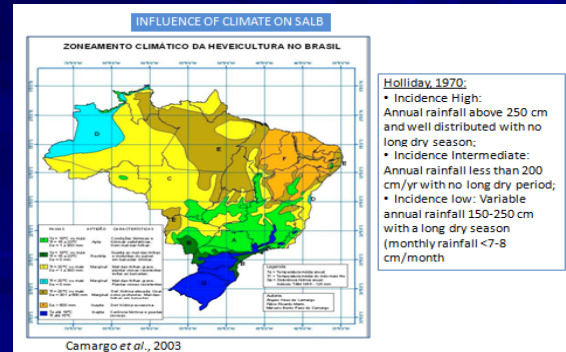
PA 31 crown (Source: Moraes)

PLANTING IN SALB ESCAPE AREAS

SALB ESCAPED AREAS

- SALB escaped areas are areas with climatic conditions not suitable for serious disease development;
- Areas with low rainfall and long dry periods (4-5 months);
- Annual defoliation and refoliation occurs during the dry period;
- Escaped areas - Sao Paulo and Matto Grosso;

SALB ESCAPE AREAS IN BRAZIL



SALB ESCAPE AREAS



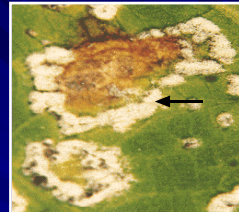
Common oriental clones such as Gt 1, RRIM 600 and PB 260, PB 235 were successfully planted.



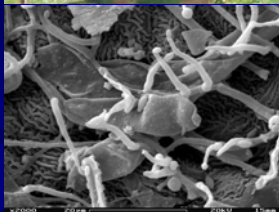
BIOLOGICAL CONTROL



- *Hansfordia pulvinata* (*Dicyma pulvinata*) is antagonistic to *M. ulei*;
- It controls SALB in glasshouses and small scale field trials.
- *Periconia manihoticola* also antagonizes *M. ulei*.



Microcyclus ulei, being colonized by *Dicyma pulvinata* (Source: S. Mello).



INDUCED RESISTANCE



- Prior inoculation of leaves with an incompatible race induces resistance to a compatible race;
- Can be adopted by planting a mixture of clones;
- Resistance is also induced by VA mycorrhiza.

POLYPLOIDY

- Polyploid plants ($3n$ or $4n$) were produced by colchicine or X-ray treatments;
- Polyploid plants show variable resistance to SALB and some polyploid plants ($4n$) plants are resistant to SALB;
- Polyploid plants are not commercially planted due to other inherent properties.

THANK YOU

