

Report of the Asia and Pacific Plant Protection Commission (APPPC) Pest Incursion and Eradication Workshop



Seoul, Republic of Korea
30th August – 3rd September 2010

**Report of the
Asia and Pacific Plant Protection Commission (APPPC)
Pest Incursion and Eradication Workshop**

Seoul, Rep. of Korea
30th August – 3rd September 2010

Summary

The APPPC workshop on pest incursion and eradication was convened from 30 August to 3 September 2010 in Seoul, Republic of Korea. Thirty-six delegates from 23 countries including non-members participated in the workshop, which was co-funded by the Republic of Korea and APPPC. In line with the work plan of the 26th Session of APPPC, the programme of the workshop was developed by Australian experts with collaboration with Rep. of Korea, Japan and New Zealand, which was supported by the working group members.

The principles of ISPM No.9 as well as incursion and eradication with examples from Australia, Rep. of Korea and New Zealand were introduced. The meeting looked at case studies on plum pox virus in Japan, citrus canker in Australia, *Liberibacter* in New Zealand and pine wilt disease in Rep. of Korea.

The participants conducted exercises on South American leaf blight of rubber and Plum pox virus. These studies involved developing contingency plans for these pests. It is hoped that the discussion of these case studies will lead to the development of APPPC regional standards. A plenary discussion examined the draft contingency plan for SALB; it was found that there are some information gaps. The draft plan for the SALB would be reviewed by APPPC standard committee followed by distributed to APPPC member countries for review before submission to the 27th Session of APPPC.

The workshop provided participants an opportunity to improve capacity in development of country's respective contingency plan for specific pests and guidance on the issues to be considered in conducting eradication programmes.

REPORT

Opening ceremony

Thirty-six representatives from 23 countries participated in the workshop (see Annex 2). Dr Yongfan Piao, Executive Secretary of the Asia and Pacific Plant Protection Commission (APPPC) opened the meeting. He stated that this was a special meeting as it was the first meeting part-funded by APPPC funds and that it had a specific technical mission to discuss incursion management and the development of pest eradication plans. He thanked the Vice Minister of the Ministry for Food, Agriculture, Forestry and Fisheries of Rep. of Korea, Mr Seong Jung for providing the welcoming address, the NPQS for contributory financial support for the meeting and the organisation of the meeting, and the government of Australia for technical support.

Mr Seong Jung, the Vice Minister noted the shared financial support for the meeting from the National Plant Quarantine Service of Rep. of Korea and the APPPC. He

discussed the situation of global warming with climate change and the associated changes in the distribution of pests. Mr Jung stressed the need for technical direction in the present situation and the opportunities for international collaboration. He hoped that this meeting would facilitate the exchange of information and allow in-depth discussions for the development of effective phytosanitary measures.

Mr Jung wished the meeting participants a successful meeting.

Dr Kyu Ock Yim dealt with a number of administrative matters

Purpose of the Workshop

In line with the work plan of the 26th Session of APPPC held in New Delhi, India this meeting was developed to study pest incursion control and the use of eradication programmes. A working group was established at the New Delhi APPPC session. The particular aim of this pest incursion and eradication workshop was to develop a base contingency plan to SALB which could be used by rubber producing countries of the APPPC. The programme of the workshop was developed by Australian experts with collaboration with experts from Korea, Japan and New Zealand, who were supported by the working group members.

Overview of Workshop

Mr Rob Schwartz (Australia) provided the meeting with a short overview of the programme. After dealing with the principles of incursion and eradication with examples from Australia, Rep. of Korea and New Zealand, the meeting would look at case studies on plum pox virus in Japan, citrus canker in Australia and pine wilt disease in Republic of Korea (see Annex 1).

The participants would then conduct exercises on South American leaf blight of rubber and Plum pox virus. These studies would involve developing contingency plans for these pests. It is hoped that the discussion of these case studies will lead to the development of APPPC regional standards.

Key Principles of pest eradication

1. Initiation of a response programme

1.1 The identification of the pest and the development of contingency plans

A number of factors were discussed. The rapid detection of pests is essential for the success of an eradication programme. The biology of the pest is critical – particularly if the pest spreads quickly. Where pests have been present for some time, it may be that eradication is not feasible or economic. If the pest has restricted distribution, this can make eradication more feasible.

The systems for supporting the detection of pests include:

- general surveillance programmes
- industry awareness
- facilities and expertise in rapid identification of pests

- good knowledge of the country's or region's pest status.

Some of these systems can be expensive – but they are essential for the development of worthwhile and effective contingency plans and for the implementation of effective pest incursion responses.

Contingency plans should be prepared to deal with pests which have high potential for establishment. The plans should be of a general nature and act as a starting point for response in the case of an occurrence of the pest. The contingency plan is prepared before the pressure of dealing with stakeholders, politicians and the public associated with an outbreak arises. This allows for careful evaluation of the pest, its affects and its eradication or control and for the undertaking of research if needed. Having a contingency plan ready and waiting also minimises the time for reaction to the incursion as many responses have already been agreed to. This is particularly important when a collaborative approach is required. The decisions regarding the funding of action should be made before an outbreak occurs and are essential elements of a contingency plan. The contingency plan is then amended to take the form of a response plan for the specific outbreak that has arisen.

In short, a contingency plan is a summary of the information available. The information provides the basis for decisions. The finding of the pest initiates the development of a response plan – which is specific to the particular outbreak. The response plan is operational and determines the resources that are needed.

1.2 Pest identification and reporting

The matter of having accurate pest identification was stressed. Independent experts may be used. Preserving specimens is most important especially if identifications are challenged. The identification then leads to the determination of the pest status.

Regarding reporting and information sharing, countries have specific obligations under the IPPC. It is important to inform trading partners quickly when new pests are detected. Information should also be supplied to growers, local governments and other interested parties.

The determination of pest pathways, particularly the entry pathway, can be extremely difficult. Trace-backs and trace-forwards are essential components of any investigation. Many of the introductions are from some form of nursery material. Trace-backs can be often be difficult and unsuccessful. Trace-forwards can be most helpful in deciding what actions need to be taken.

1.3 Regulatory action

In discussing regulatory action, the need for existence of legislation or regulations was stressed. NPPOs need to be prepared. Regulations concerning the area around the occurrence, movement controls, the destruction or treatment of host material and the possible compensation for growers affected by regulatory action should be considered.

The consideration of regulatory action should be based on the biology of the pest for example, the plant parts affected, the overwintering method, spore survival, dispersal mechanisms, the reproductive period, and fecundity of the pest.

Participants discussed surveillance and other actions that could be taken in the case of a detection of Queensland fruit fly. These included: the confirmation of the identity of the pest, the establishment of traps, the examination of fruit affected for larval infestation, the spray control for flying insects, the notification, after formal identification, of trading partners and the IPPC, the determination of host range and density of infestation, the application of movement controls, and the undertaking of delimiting surveys. The difficulties of funding were discussed.

The matter of the decision to eradicate the pest was discussed. The decision should be based on a cost-benefit analysis and the feasibility of conducting an eradication programme.

2. The decision whether to eradicate, contain or take no action

The decisions for action include the following options: eradication, control or management, or taking no action.

2.1 Biological and economic information

Factors to consider include: the potential impact of the pest, the presence/absence of physical barriers, the availability of cost effective control, pest population dynamics, the availability of biocontrol agents, the presence of vectors, detections (limited or widespread), secondary spread, weather conditions, and access to the site.

The no action option could be used in cases where factors do not support action. These factors may include: present and potential distribution of the pest, cost and availability of eradication, affect on export markets, affect on the costs of production, affect on the environment, and whether the pest can be lived with.

Factors to consider with the contain option include: where eradication is not feasible or too costly, where the pest can be contained in limited areas, where the benefits of protecting certain production or environmental areas are worth the costs involved.

2.2 Cost-benefit analysis

The cost-benefit analysis (CBA) is undertaken at the same time as the feasibility study. In Australia the CBA is undertaken by ABARE. The CBA takes into account direct and secondary costs, direct and secondary benefits (environmental savings and research and development costs). Direct costs include survey and monitoring teams, research and diagnostics, expert consultation, equipment, chemical, facilities, awareness programmes, salaries, travel, legal fees, data management, contracting or administrative costs, loss of product quality and marketing and processing costs.

Secondary costs can include: cost of detection, likelihood of reintroduction, possible adverse affects of the programmes, costs to affected growers.

Direct benefits include: preventing yield loss, saving growers the cost of additional controls, saving economic losses due to market access restrictions etc. Secondary benefits include prevent losses to associated sectors (environmental damage) preventing risks to human health, saving damage to private gardens, parks etc, saving additional research and development costs.

The estimation of benefits is dependent on the ability to predict the impact. Information on the pest impact overseas must be reassessed to take account of local conditions.

2.3 Case studies

2.3.1 Managing the pest – *Liberibacter* in New Zealand

Mr David Hayes stated that the New Zealand service had some 20 -30 responses at any one time. He discussed the *Liberibacter* response. There was no contingency response for this pest as it had not previously been found as a pest. This response involved a good deal of collaboration and the early notification of the pest to trading partners.

The MAF Biosecurity response. The figure describing the system was shown (rocket ship appearance). The links to the various components including surveillance was noted. The structure showed the basis of the Planning and Intelligence for any response. The operations leader is separated from the governance leadership. The sections relating to communications and liaison were stressed as being essential for the success of the programme.

The generic capability of the programmes allows the development of people capabilities. The framework including the sections for investigation, the response initiation, the planning and reporting, the transition from response, and the learning and closing of the response. The investigate phase allows the determination of the size of the problem. If the problem cannot be solved immediately, a response can be set up. This can be really substantial e.g. for foot and mouth outbreak.

The ‘develop business case/plan and report’ section involves the development of options for the pest before the selection of the one option. These require the CBA and resource requirements. The Business response case is then developed. This is followed by a long term plan to deal with the problem.

Mr Hayes went on to discuss the *Liberibacter* case. The case of the infected tomato with the tomato psyllid was described. The causal agent was similar to *Candidatus Liberibacter asiaticus*. Substantial losses up to 5% were noted in tomato, capsicum, citrus and potato. (This is a different psyllid to that which transfers citrus greening.)

At this time the USA confirmed the presence of a *Liberibacter* associated with Zebra chip on potatoes.

The urgent measure undertaken included – the determination of the distribution, the understanding of the organism, the feasibility of options, the notification of trading partners, develop a compliance programme. The options discussed were eradication,

containment, the baseline scenario, MAF assisted industry led control. These options were discussed at length.

Actions taken included:

- the suspension of export certification
- the application of restrictions by some trading partners
- the identification of key questions regarding technical information.

Surveys were undertaken and research was done to determine the transmission of the pest. The pest was found from the north of the North Island to south of Christchurch.

Transmission studies showed that there was no seed transmission. Psyllids could transmit the pest from plant to plant and from tomato fruit on the truss to plants. From a trade point of view, there was no real risk when there was no psyllid present.

The preferred option was that the baseline option was chosen. It was recognised that eradication was not a feasible option.

The outcomes were that the industry was able to adopt practices and trade was resumed. Domestic production was restored with growers actively managing the pest.

The collaboration with the US scientists in the identification of the organism was noted.

2.3.2 Containment of a significant pest of grapes -*Phylloxera*

The effects of the root aphid *Daktulosphaira vitifoliae* found in Victoria in 1877 were described. With rootstocks and careful management the pest can be managed well.

Machinery is treated, and new material restricted with regulatory control. There is a National *Phylloxera* Management Protocol adopted by all states.

The pest is classified as a quarantine pest – as it is under official control.

This case shows that countries can live with certain pests. This pest does not move easily by itself. and regulatory controls are required to limit its spread.

2.3.3 Detection of Khapra beetle *Trogoderma granarium*

This was a potential issue for the Western Australia grain industry – over 85% of grain is exported. The Khapra beetle was found in a container from Scotland with personal possessions. This was odd because there was no food source in the container, and Khapra beetle is not known to occur in the UK. The goods inside the container were inspected and some items cleaned.

The pest identification was confirmed. As a precaution, the house where the imported goods were unloaded was fumigated with methyl bromide for 48 hrs after being shrink wrapped. The container was treated and sites around the house were baited. 100Kgs of MBr were used. Monitoring was carried on for two years. This programme

was funded 80% by the government and the remainder by industry (\$170,000 total cost).

3. Important aspects of an eradication process

The consideration of an eradication process involves the establishment of a management team. Surveillance to establish the extent of the incursion is necessary. Ongoing surveillance is also an important component.

The quarantine area is determined by the biology of the pest. This must be defined then regulated by legislation. It is more useful to make the area larger rather than smaller initially and then. Movement controls of vectors is necessary to contain the pest. Quick action is needed.

The verification of eradication demands a programme for ongoing surveillance. The duration of intensity is determined by the biology of the pest – ease of detection, habitat, viability of propagules etc. The declaration of eradication follows the eradication programme and needs full documentation to support it and should be communicated to interested parties.

4. Series of case studies

4.1 Case study 1 – plum pox in Japan

The case study was presented by Mr Motoi Sakamura and Mr Norihiko Saito (Yokohama Plant Protection Station). The most recent data was not available to be presented.

Biology and detection

Plum pox virus (PPV) is recognised as an important pest. It is widespread in Europe, found in South and North America and some countries in Asia. The ringspot like symptoms were noted. The virus is transmitted by aphids. The most important factor for spread is the movement of infected material by man.

The first detection in Japan was in 2009 in Ome city Tokyo on apricots. A nationwide survey was undertaken. PPV was limited to areas of Tokyo, Regulated areas were identified and eradication actions begun.

The detection was a natural infection causing abnormalities on Japanese apricots *Prunus mume*. It was the D strain. There is a large concentration of apricots in Ome. The fruit is used for pickling.

There are symptoms on the flowers of infected trees, on the leaves and on the fruit.

Survey and eradication programme

Some 290,000 stone fruit trees were surveyed. Samples were examined by ELISA and RT-PCR in the plant protection stations. Infected trees were found in two botanical gardens in Ibaraki and Kanagawa – arising from material from Ome city. All infected

trees have be destroyed. No infection around the sites were found. Monitoring surveys will be continued for three years.

A delimiting survey was undertaken in Ome area. 1,296 orchards were tested. Analysis has shown the virus to have been in Japan for at least 10 years. Most material is tested on import – but the trees in the Ome area have not been tested in the past.

A cost benefit analysis was undertaken. The eradication programme was undertaken because of a number of factors including that PPV causes severe damage to fruits, Japan exports *Prunus* material, the importance of the amenity value of *Prunus* species the eradication programme was feasible.

A Ministerial ordinance was passed in 2010. A movement prohibition was instituted for all *Prunus* species from regulated areas. This excluded seeds and fruits. Infected trees and suspected trees were eliminated. All orchards and private gardens in regulated areas were inspected. An assessment committee was established and they determined the compensation to be paid. The government financed the whole operation.

An aphid control programme was developed. Pesticide sprays were applied in April, May and October – in orchards and adjacent properties. The same programme has been applied in 2010/ 61 trees found in 5 cities were determined in 2010. All material was from Ome city.

The programmes for the future will involve nationwide surveys, the elimination of infected trees, followed by verification surveys will continue for three years. When no infected trees are found, regulation will be lifted and eradication declared.

Mr Sakumura noted the problems with owners that did not want their trees destroyed. The process involved negotiation. One case involving a 200 year old bonsai plant is causing some difficulty. Wild species have been tested.

Identification methods

A kit using immuno-chromatography has been developed. It is easy to use, takes 15 mins and it has high sensitivity. Another method involves ad TR-LAMP Loop Mediated Isothermal Amplification. It is rapid – 30-60 mins and has high sensitivity. When testing large numbers of samples, ELISA can be recommended as it is not expensive. Malaysia noted that with citrus greening that ELISA has not shown consistency. In Japan, PCR is used for testing citrus greening. Korea noted that the effectiveness of the method depends on the pathogen. Korea uses ELISA for bulk sampling and follow up with PCR.

4.2 Case study 2 – Citrus canker in Emerald, Queensland

Biology of the pest

Citrus canker is one of the most destructive diseases of citrus.

A contingency programme had been prepared. The Minister, growers and trading partners were informed.

The property was locked down and ring-fenced. The pest quarantine area was made quite large and included three shires. No host material was permitted to move in or out of the area.

The response questions included – how widespread is the pest, is it economical to attempt eradication etc. The cost/benefit analysis (CBA) took into account the direct and secondary costs and benefits.

The estimated value of the Australian industry was A\$600 million (2002). Queensland accounts for 20% of the production. The costs of eradication (initial) \$10 million. Final cost was \$18 million.

Emerald is some 300k inland from Rockhampton. The area produces 9% of Queensland citrus. There were only 7 properties growing citrus. This is a very arid area irrigated from the Fairbairn Dam. The area is isolated from other citrus growing areas.

Although only the Emerald area was affected, some (but not all) trading partners imposed bans or measures against citrus canker on citrus fruit exports from other areas of Australia. The removal of these measures had to be negotiated with the relevant trading partners once more information was available on the eradication programme and the measure in place within Australia to ensure freedom from the disease outside of the pest quarantine area established at Emerald.

The programme

A Local Pest Control Centre was established and 250 staff mobilised. 85 surveillance staff were trained. All other facilities were set up in 7 days (labs etc). A communication plan was devised and implemented.

A system involving inspecting 600 trees for a 1000 tree block was established. This gave a 95% chance of detecting a 1% presence of the pest. The 7 properties were examined. One was linked to 40 properties on the coast. The affected property had trees 4 years old. All inspectors had to change clothes when leaving a citrus property. Strict hygiene procedures were applied.

The other Emerald citrus properties and the linked properties were found to be free from the pest. The surveys were initially negative.

There were some 150,000 2-5 yr old trees on the initial affected property. The area of destruction area applied was a 600 metre radius area from each detection site (based

on research from Florida). This was called the “cookie cutter” approach. There were 10 detections over 6 weeks covering most of the tress in the initial property. All the trees in Emerald on the first affected property were destroyed, after being sprayed with copper, by being burnt. The trees were chain-sawed but the rootstock regrew. A non-published paper stated that leaf litter and soil could maintain the pest for two years. All the leaves were raked and burnt. The root stock was sprayed to kill the stock.

The national surveillance programme was completed in January 2005 and confirmed the absence of the disease in the areas outside of the pest quarantine area at Emerald.

Further infested properties

A second infested property was found in October 2004 some 9 kms away. 210,000 trees up to 14 years old. The area between the properties was clean. The infested property had been irrigated by overhead irrigators using river water. The infestation was very light. There were no known mechanical contacts. The participants of the meeting studied the problem. There was no known explanation for this second infestation. The cookie-cutter approach was continued and there were 9 detections (very light infections) covering all 210,000 trees. On this property the roots were ripped out with machines and which also destroyed the irrigation lines.

A third property was found later, a property with 6393 trees. This was clearly a new infection.

A native citrus grows all through this region but no infection was found in the native citrus (*Citrus glauca*).

It was concluded that the infection was so heavy in the first property, that the wind was spreading the disease and that it was likely that all citrus in the area would have had the chance to be affected.

Eradication

A revised eradication strategy was then developed. This would see that all high-risk hosts destroyed. An 18mth host free period would be imposed. The less susceptible native hosts would also be inspected. There would be on-going inspection of the new plantings after the 18mth host free period.

Some 4000 domestic trees were destroyed. Seven commercial properties had the citrus trees destroyed. In all 500,000 trees were destroyed not including the native *Citrus glauca*. The *C. glauca* within 600m of properties were destroyed and those within 1200m of infected areas. This was the result of the consideration of the likely questioning by trade partners of the possible role of the *C. glauca* in the spread of the disease.

After some 18mths of growth of new plantings, no further infections were found so the disease was considered eradicated.

Other points

The research associated with the incursion showed a number of results. It was shown that the leaf litter could contain viable material for up to a month after the tree removal. The testing of surveillance methodology could have been extended if the trees had not been removed in the first affected site.

The replanting of commercial orchards began on July 1, 2007 (344,000 plants). The orchards were inspected every 90 days.

The documentation was produced for trading partners to prove disease freedom. This involved the summarization of many volumes of data from the records of the eradication programme. The identification of properties was not provided because of privacy laws.

The Australian Federal government provided 50% of the funding of the programme. The remainder was provided by the states on a percentage production basis. The citrus industry did not contribute. Some compensation was provided to the growers affected in the 2nd and 3rd properties. In the future, this would probably be a category 2 pest which would involve industry funding 20% costs and government 80%.

4.3 Case study 3 – Incursion of Pine wilt disease and eradication programme in Rep. Korea

Dr Hyerim Han of the Rep. of Korea Forest Research Institute presented the Korean programme on the Pine wilt disease.

It was noted that the *Pinus densiflora*, *P. koraiensis*, and *P. thunbergia* are very susceptible to the disease. The pine sawyer beetle transfers the nematode. The disease cycle begins with the emergence of the insect, it feeds on the host tree, the pupae are formed on the dead trees, the nematodes are attracted to the pupae and contaminate the pupae. There are two insect vectors *Monochamus alternatus* and *M. saltuarius*. The nematode is *Bursaphelenchus xylophilus*. This nematode is difficult to identify and molecular methods are now being used. Restriction enzyme mapping is employed.

Rep. of Korea has some ten species of *Bursaphelenchus*.

It is very difficult to detect the disease in an early stage. The infected trees die quickly. The disease has been in Japan since 1905. It was first found in Rep. of Korea in 1988. By 2004 the disease was spread over much of the country and by 2007 was found in Seoul. By 2008 6,800 ha have been affected.

Work is being undertaken on the mating, hatching and feeding behaviours. Tests are done to test the pathogenicity of the nematodes on the different *Pinus* species. Research on the vector is also carried out along with research on biocontrol. The interaction with microorganisms is studied. There is research done on the development of pesticides for the nematode. Metham sodium is used on the infected wood to kill the insect. Trunk injection has worked to protect trees but the chemicals involved are expensive. The cutting and crushing method is used to remove infected material as well.

Aerial spraying is used to control the adult pine sawyer from May to July with fenitrothion and thiacloprid.

The control of the disease is attempted by an aerial spray with the removal of infested wood. Surveys are carried out.

There are special regulations regarding PWD. Private forest owners have certain obligations. A PWD management team has been set up. There are 543 observation posts, and 1465 observation boxes. There have been 1.36 mill trees removed. \$281 million has been spent on this programme.

The management strategy is an “Adapted control of PWD”. The most effective method is selected for each specific case. This may be clear cut, culling, trunk injection etc. There are now PWD areas declared.

The development of contingency plans by the meeting participants

5. Group exercises for the development of Pest contingency plans

These exercises were undertaken to provide the basic information for the development of contingency plans for SALB and Plum pox virus. The template used in these exercises was that provided by the session leaders entitled Threat specific contingency plans and are based on the template used in Australia.

The participants prepared a plan for each disease. Each contingency plan was divided into three batches of elements – each batch being investigated by a small group of participants.

The small groups reported on the results of their discussions. The material presented was then used by the session leaders to develop a formal draft of an SALB contingency plan.

A plenary discussion examined the draft contingency plan for SALB (Annex 3). Discussion items included:

- the communication strategy was stressed as important. The strategy would have to be developed with stakeholders then passed on to the public.
- distance of the radius of a survey – 3km was suggested. This was described as speculative and would be dependent on the nature of the occurrence (2 days old or 3 weeks). But 3kms was suggested as a reasonable figure to start with.
- the sampling figure was agreed to as satisfactory.
- the use of damp or dry paper for the collection of samples was discussed in detail
- it was suggested that luggage etc can transmit the pathogen (not supported by the PRA)
- the 100m destruction zone around an infection was discussed. The need for research on this area was noted.

The contingency plan for PPV was not discussed.

6. Conclusion

Dr Piao stressed that the workshop provided participants an opportunity to improve capacity in development of country's respective contingency plan for specific pests with country concerns. The draft plan for the SALB would be reviewed by APPPC standards committee followed by distribution to APPPC member countries for review before submission to the 27th Session of APPPC. Dr Yim closed the meeting thanking the session leaders for their efforts and the participants for their contributions.

Program of the workshop

Day 1

Opening

Overview of the Symposium/Workshop

Key Principles (ISPM 9)

- Initiation of program and Identification of pest
- Formal identification
- Determination of pest status (i.e. quarantinable or already present) and potential for spread
- Delimiting surveys – including pathways of the pest
- Surveys (to provide statistical confidence for results to be meaningful for regulatory purposes)
- Decision whether to eradicate, contain or take no action
 - Biological and economic information
 - Cost-Benefit analysis
 - Examples
 - Eradication – PPV in Japan
 - Not to eradicate / Manage – Liberibacter in New Zealand
 - Containment of a significant pest of grapes – Phylloxera
- Eradication process including establishment of a management team
- Conducting the eradication program
 - Surveillance
 - Containment
 - Treatment and/or control measures
- Verification of pest eradication

Day 2

Continue with ISPM 9

Case Study 1

- Plum pox virus eradication (PPV) in Japan

Case Study 2

- Citrus canker eradication in Australia

Case Study 3

- Pine wood nematode in Rep. of Korea

Day 3

Group exercise for development of Pest Contingency Plans

- Plan 1 - SALB
- Plan 2 – PPV

Day 4

Field trip (Pinewood nematode incursion and eradication site)

Day 5

Presentation of results of group exercises on Pest Contingency Plans

List of participants

Australia

1) Ms. Fiona Macbeth
Manager
Emergency Response and Coordination
Office of the Chief Plant Protection Officer
Department of Agriculture, Fisheries and Forestry
Australia
Tel: 02 6272 4650, 0408 292 637
Email: Fiona.Macbeth@daff.gov.au
Web: www.daff.gov.au

2) Mr. Robert Bertrand Schwartz
Senior Manager
Plant Biosecurity
Biosecurity Service Group
7, Civic London Circuit
G.P.O. Box 858, Canberra ACT 2601
Australia
Tel: 61 2 6272 4865
Fax: 61 2 6272 3307
Email: rob.Schwartz@biosecurity.gov.au

Azerbaijan

Mr. Rakhimov Elnur
Agronomist
Rep. Plant Quarantine Expertise Lab
State Phytosanitary Control Service
Ministry of Agriculture
Rep. of Azerbaijan
Mobile: +99450644-35-66
Fax: +99412496-41-58
Email: elnurrahimov@mail.az

Bangladesh

Mr. Nazmul Ahsan
Pesticide Regulation Officer
Plant Protection Wing
Department of Agricultural Extension
Bangladesh
Email: cg_bp22@yahoo.com dppw@dae.gov.bd

Brunei

1) Mr. Jomari bin Haj Ahmad
Senior Agriculture Officer
Department of Agriculture and Agrifood
Ministry of Industry and Primary Resources
Brunei Darussalam
Tel/Fax: 6732670421
Fax: 6732382226
Email: jomari_ahmad@agriculture.gov.bn

2) Mr. Noor Azri bin Haji Mohd Noor
Agriculture Officer
Department of Agriculture and Agrifood
Ministry of Industry and Primary Resources
Brunei Darussalam
Tel: 6732663358
Fax: 6732382226
Email: highlow78@hotmail.com

Cambodia

1) Dr. Hean Vanhan
Deputy Director General
General Directorate of Agriculture
Ministry of Agriculture, Forest and Fisheries (MAFF)
#54, St.656, Sangkat Teuk Laak, Khan Toul Kork, Phnom Penh
Cambodia
Tel: 855-12 818 216
E-mail: heanvanhan@gmail.com

2) Mr. Uch Sothy
Senior GDA Officer in charge of Plant Quarantine
Department of Plant Protection and Phytosanitary
GDA, MAFF
Cambodia
Email: uch.sothy@yahoo.com

China

1) Mr. Jingquan Zhu
Division of Plant Quarantine, National Agro-Tech Extension and Service Center
(NATESC)
Ministry of Agriculture
No.20, Mai Zi Dian Street
Beijing 100125
China
Tel: (8610) 64194524
Email: timzjq@agri.gov.cn

2) Ms. Xingxia Wu
Research Center for International Standard and Technical Regulations
General Administration of Quality Supervision, Inspection and Quarantine
9 floor, Sanyuan Building, No.18 Xiba He Dong Li, Chaoyang District
Beijing 100028
China
Tel: (8610) 84603962
Email: ciqwuxx@sina.com.cn; wuxx@aqsiq.gov.cn

Fiji

Dr. Visoni Timote
P O Box 18360, Suva
Fiji
Tel: 3312512
Fax: 3305043
Email timotev@gmail.com

India

1) Dr. P. Manickam
Deputy Director (Plant Pathology)
Plant Quarantine Station, Bangalore
India
Tel: 080-25225003
Mobile No.: +91-9945038765
Email: manickamblr@gmail.com

2) Dr. Shri K.W. Deshkar
Plant Protection Officer
Plant Quarantine Station
Kochi, India
Tel : 0484-2666145, 2669846
Email : pqfskl12@nic.in kirandeshkar@gmail.com

Indonesia

1) Mr. Hermawan
Head of Sub Division
Technique and Method Development of Plant Quarantine
Indonesia
Mob: +62 813 16766658
Email: hermawan@deptan.go.id

2) Mr. Turhadi Noerachman
Head of Sub Division
Seeds and Other Articles for Export and Domestic of Plant Quarantine
Mob: +62 813 14240700
Email : turhadi_noer@yahoo.co.id

Japan

1) Mr, Motoi Sakamura
Director of Plant Protection Office
Plant Protection Division
MAFF
Address; 1-2-1, Kasumigaseki, Chiyoda-ku,
Tokyo, Japan
Email : motoi_sakamura@nm.maff.go.jp

2) Mr. Norihiko Saito
Principal Officer
Yokohama Plant Protection, MAFF
Address; 1-16-10, Shinyamashita, Naka-ku, Yokohama
Japan
Email: saiton@pps.maff.go.jp

Lao People's Democratic Republic

1) Mr. Souliya Souvandouane
PRA team leader
Plant Quarantine Division
Ministry of Agriculture and Forestry
Department of Agriculture
Lane Xang Avenue
Patuxay Square, P.O. Box 811
Vientiane, Lao PDR
Email : souliya_ss@yahoo.com

2) Dr. Soulaphone Inthavong
Director of Plant Quarantine Division
Ministry of Agriculture and Forestry
Department of Agriculture
Lane Xang Avenue
Patuxay Square, P.O. Box 811
Vientiane, Lao PDR
Email : su-inthavong@hotmail.com

Malaysia

1) Mr. Mokhtarud-din Husin
Principal Assistant Director
Enforcement Section
Crop Protection and Plant Quarantine Division
Department of Agriculture
Malaysia
Tel: +603-2030 1403
Fax: +603-2691 3530
Email: mokhtarud@doa.gov.my

2) Mr. Muhamad Zulhisham Jusoh
Assistant Director
Crop Pest Management Section
Crop Protection and Plant Quarantine Division
Department of Agriculture
Malaysia
Tel: +603-2697 7129
Fax: +603-2697 7205
Email: zulhisham@doa.gov.my

Myanmar

1) Mr. Myo Nyunt
Manager, Plant Quarantine, Plant Protection Division
Myanma Agriculture Service
Bayintnaung Road, Gyogon, Insein
P.O 11011, Yangon
Myanmar
Tel: 95-1-644214
Fax:95-1-644019
Email:mnyunt73@yahoo.com;naynyunt940@gmail.com

2) Ms. Myint Nu Thwin
Assistant Manager, Plant Pathology
Plant Protection Division
Myanma Agriculture Service, Bayintnaung Road
Gyogon, Insein P.O 11011, Yangon
Myanmar
Tel: 95-1-644214
Fax:95-1-644019
Email:mnthwin@gmail.com

Nepal

Dr. Yubak Dhoj
G.C. programme Director
Plant Protection Directorate
Ministry of Agriculture and Co-operatives
Singha Durbar
Hariharbhawan
Kathmandu, Nepal
Tel: +977-1-5521597
Mobile: 9841097986
Fax: 4211935
Email: yubakgc@yahoo.com

New Zealand

1) Dr. John Hedley
Principal International Advisor
International Coordination
Ministry of Agriculture and Forestry
ASB Bank House, 101-103 The Terrace
P.O. Box 2526, Wellington
New Zealand
Tel: 644 894 0428
Mobile: 64298940428
Fax: 644 894 0733
Email: john.hedley@maf.govt.nz

2) Mr. David Hayes
Response Manager
MAF Biosecurity New Zealand
PO Box 2526
Wellington , New Zealand
Tel: 64-4-894 0365
Fax: 64-4-894 0728
Email: hayesd@maf.govt.nz
Web: www.maf.govt.nz

Philippines

1) Mr. Gerald Glenn F. Panganiban
Plant Quarantine Officer
Bureau of Plant Industry
692 San Andres Street
Malate, Manila
Philippines
Tel: (+63 2) 404-0409
Email: gerald_glenn97@hotmail.com gfpanganiban@gmail.com

2) Ms. Wilma N. Cuaterno
Chief, Plant Protection Division
Bureau of Plant Industry
692 San Andres Street
Malate Manila
Philippines
Tel : (+63 2) 524-7353
Email : wilmanemesio@yahoo.com

Rep. of Korea

1) Mr. Young-Chul Jeong
Deputy Director
International Quarantine Cooperation Division
National Plant Quarantine Service

Ministry of Agriculture and Forestry (MAF)
433-1, Anyang 6-dong, Manan-Gu
Anyang-Si, Gyeonggi-Do
Rep. of Korea 430-016
Tel: +82-31-420-7664
Fax: +82-31-420-7605
Email: ycjeong@npqs.go.kr

2) Dr. Kyu-Ock Yim
Assistant Director
International Quarantine Cooperation Division
National Plant Quarantine Service
Ministry of Agriculture and Forestry (MAF)
433-1, Anyang 6-dong, Manan-Gu
Anyang-Si, Gyeonggi-Do
Rep. of Korea 430-016
Tel: +82-31-420-7665
Fax: +82-31-420-7605
Email: koyim99@naver.com

Singapore

1. Mr. Keng Ho Ong
Programme Chief (Plant Health) & Deputy Director
Animal Health Laboratory Division and Plant Health Laboratory Division
Laboratory Department
Agri-Food & Veterinary Authority of Singapore
Animal & Plant Health Centre, No. 6 Perahu Road, Singapore 718827
Tel : 065-63165181
Fax: 065-63161090
Email: Ong_Keng_Ho@ava.gov.sg

2. Ms. Mei Lai Yap
Assistant Director, Plant Pathology Section
Agri-Food & Veterinary Authority
Plant Health Laboratory Division
Laboratory Department
Agri-Food & Veterinary Authority of Singapore
Animal & Plant Health Centre, No. 6 Perahu Road, Singapore 718827
Tel: 065-63165142
Fax: 065-63161090
Email: Yap_Mei_Lai@ava.gov.sg

Sri Lanka

Mr. L.C. Wijethilake
Research Officer
Ministry of Agriculture
Govijana Mandiraya, 80/5 Rajamalwatte Avenue, Battaramulla
Sri Lanka

Tel : 01 12253709
Fax : 01 1225228
Email : lcwijetilaka@yahoo.com

Thailand

1) Mr. Surapol Yinasawapun
Chief of Plant Quarantine Research Group
Plant Protection Research and Development Office
Department of Agriculture
Ministry of Agriculture and Cooperative
50 Phaholyothin Rd. Chatuchak, Bangkok 10900
Thailand
Tel: + 662 579 8516
Fax : + 662 561 0744
Email : syinasawapun@yahoo.com

2) Ms. Siriporn Zungsontiporn
Senior Agricultural Scientist
Plant protection Research and Development Office
Department of Agriculture
Ministry of Agriculture and Cooperative
50 Phaholyothin Rd. Chatuchak, Bangkok 10900
Thailand
Tel: + 662 940 7409
Fax : + 662 940 7409 ext.11
Email : siriporn.z@doa.in.th , siriporn.zung@gmail.com

3) Ms. Tasanee Pradyabumrung
Senior Standard Officer
National Bureau of Agricultural Commodity and Food Standards
Ministry of Agriculture and Cooperatives
50 Paholyotin Rd. Chatuchak
Bangkok, 10900 Thailand
Email: tasanee@acfs.go.th

Vietnam

1) Ms. Ha Thanh Huong
Plant Quarantine Officer
Ministry of Agriculture and Rural Development
Vietnam
Email : ppdhuong@yahoo.com

2) Mr. Nguyen Nhat Thanh
Specialist of Post Entry Plant Quarantine Center, PPD
Ministry of Agriculture and Rural Development
Vietnam
Email: thanh04@yahoo.com

Uzbekistan

Mr. Madartov
Inspection of Uzmanestate Quarantine
Tel : 99871 255 62 39 255 2852
Fax: 99871 2553429
Email: glavkaruz@mail.ru

FAO

Mr. Piao Yongfan
Senior Plant Protection Officer
Food and Agriculture Organization of the United Nations
Regional Office for Asia and the Pacific (RAP)
39 Maliwan Mansion
Phra Atit Road
Bangkok 10200
Thailand
Tel: 662 697 4268
Fax: 662 697 4445
Email: yongfan.piao@fao.org

**Contingency plan for South American Leaf Blight (*Microcyclus ulei*)
for the rubber producing countries of the Asia and
Pacific Plant Protection Commission**

Prepared by the APPPC Working Group on Pest Incursion Management
August - September 2010, Seoul, Korea

(NOTE: This version of the SALB contingency plan was prepared in September 2010. Please check with the APPPC website that you have the latest version).

EXECUTIVE SUMMARY

A plant pest contingency plan provides background information on which to base a plant pest response plan. This contingency plan is to prepare for an incursion of South American Leaf Blight (SALB) (*Microcyclus ulei*) of rubber (*Hevea brasiliensis*).

The contingency plan provides a summary of information on the biology of the pest and the available control measures for the disease. It provides guidelines for steps to be undertaken and considered when developing a response plan for this pest. The response plan is operational and determines the resources that are needed.

This version of the contingency plan was prepared in September 2010.

Most of the pest information including that on pest detection, disease symptoms, pathogen identification and lifecycle, affected hosts, information on the entry, establishment and spread, and estimations on the economic and environmental impacts of the disease are reproduced from the Pest risk analysis for South American Leaf Blight (SALB) of rubber (*Hevea*).

It is noted that there is a need for a specific diagnostic protocol on the causal agent of the disease. This should include information on the cultural, morphological, molecular and serological characteristics of *Microcyclus ulei* and methodology for pathogenicity tests.

A response checklist developed at the pest incursion meeting lists the actions that need to be considered in preparing a response plan.

Further pest information is provided on delimiting survey and epidemiology studies with estimations on sampling methods, and the availability of control methods including cultural, chemical, mechanical and biological methods.

The second main section of the contingency plan discusses a destruction strategy and the need for destruction and decontamination protocols and disposal issues. Quarantine and movement controls for people, plant material and machinery are described. Information on the necessary zoning is provided for zones for destruction,

quarantine, buffer, and for restricted and control areas. Lastly in this section, there is information on decontamination and farm clean up and surveillance and tracing.

A list of appendices to be developed is provided including those for diagnostic protocols, experts, resources and facilities, a communications strategy and on market access impacts.

Contents

!Unexpected End of Formula

2	Pest information/status	29
2.1	Pest details	29
2.1.1	General information	29
2.1.2	Life cycle	33
2.2	Affected hosts	34
2.2.1	Host range	34
2.2.2	Geographic distribution	34
2.2.3	Symptoms	34
2.3	Entry, establishment and spread	35
2.3.1	Entry potential.....	35
2.3.2	Establishment potential.....	35
2.3.3	Spread potential	35
2.3.4	Economic impact	36
2.3.5	Environmental impact.....	37
2.3.6	Overall risk.....	37
2.4	Diagnostic information	37
2.4.1	Diagnostic protocol.....	37
2.5	Response checklist	37
2.6	Delimiting survey and epidemiology study	38
2.6.1	Sampling method	38
2.6.2	Epidemiological study	38
2.6.3	Models of spread potential.....	39
2.6.4	Pest Free Area guidelines.....	39
2.7	Availability of control methods	39
2.7.1	General procedures for control	39
2.7.2	Control if small areas are affected	40
2.7.3	Control if large areas are affected.....	40
2.7.4	Cultural control	40
2.7.5	Host plant resistance	40

2.7.6	Chemical control.....	40
2.7.7	Mechanical control.....	41
2.7.8	Biological control.....	41
3	Course of action – eradication methods.....	42
3.1	Destruction strategy	42
3.1.1	Destruction protocols	42
3.1.2	Decontamination protocols	43
3.1.4	Plants, by-products and waste processing.....	43
3.1.5	Disposal issues	43
3.2	Quarantine and movement controls	44
3.2.1	Quarantine priorities	44
3.2.2	Movement control for people, plant material and machinery	44
3.3	Zoning.....	44
3.3.1	Destruction Zone.....	44
3.3.2	Quarantine Zone.....	45
3.3.3	Buffer Zone	45
3.3.4	Restricted Area.....	45
3.3.5	Control Area.....	45
3.4	Decontamination and farm clean up	45
3.4.1	Decontamination procedures	46
3.4.2	Decontamination if pest is identified in a small or large areas	46
3.4.3	General safety precautions	46
3.5	Surveillance and tracing.....	46
3.5.1	Surveillance.....	46
3.5.2	Survey regions	47
3.5.3	Post-eradication surveillance	48
4	References.....	48
5	Appendices.....	48
	Appendix 1. Standard diagnostic protocols	48
	Appendix 2. Experts, resources and facilities	48
	Appendix 3. Communications strategy	49
	Appendix 4. Market access impacts.....	50

1 Purpose of this contingency plan

This contingency plan provides background information on the pest biology and available control measures to assist with preparedness for an incursion of South American Leaf Blight (SALB) (*Microcyclus ulei*) of rubber (*Hevea brasiliensis*). It provides guidelines for steps to be undertaken and considered when developing action against this pest.

The technical information contained within this plan has been taken from the pest risk analysis (PRA) published in the report of the 25th Session of the APPPC that was prepared for the rubber growing member countries of the Asia and Pacific Plant Protection Commission (APPPC) namely Thailand, Indonesia, Malaysia, India, China, Viet Nam and Sri Lanka and adopted by the APPPC session of 27-31 August 2007 held in Beijing China (Pest risk analysis for South American Leaf Blight (SALB) of rubber (*Hevea*). The PRA was developed to provide the scientific justification for standards that will be developed by the APPPC member countries to manage the trade-related phytosanitary risks of South American Leaf Blight (SALB). Associated standards on diagnostics, surveillance, import regulation, control and eradication to be prepared in the future will provide guidelines to further assist countries efforts to safeguard against the incursion of SALB into the PRA area.

2 Pest information/status

Pest details

Source:

Microcyclus ulei (Boddie, 1850)

General information

Pest identity and taxonomy

Pathogen: *Microcyclus ulei* (P. Henn.) v. Arx

Order: Ascomycetes

Family: Dothideales

Synonyms: *Dothidella ulei* (Henn. 1904)

Melanopsammopsis ulei (Henn.) Stahel 1917

Aposphaeria ulei Henn 1904

(conidial state: *Fusicladium macrosporum* Kuyper 1912)

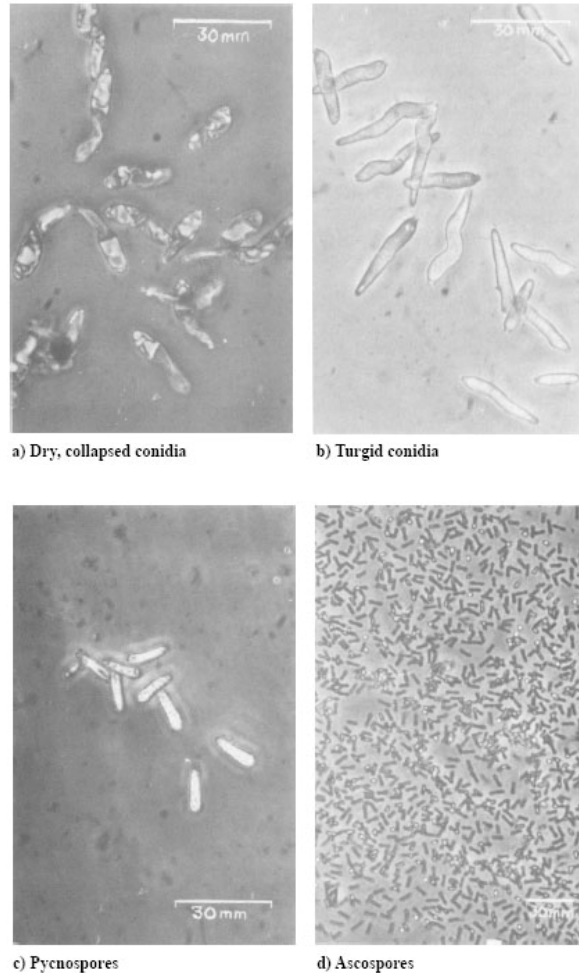
Common name: South American Leaf Blight (SALB)

Microcyclus ulei is a major pathogen of rubber.

Spore production, germination and infection

The causal pathogen *Microcyclus ulei* is known to only infect species within the genus *Hevea*. It produces three types of spores; conidia on immature leaves; pycnosporangia on newly matured leaves; and ascospores on fully matured leaves. The main propagules are conidia and ascospores (Plate 1b, d). Pycnosporangia do not appear to germinate and do not therefore constitute an effective agent of disease dissemination (Plate 1c).

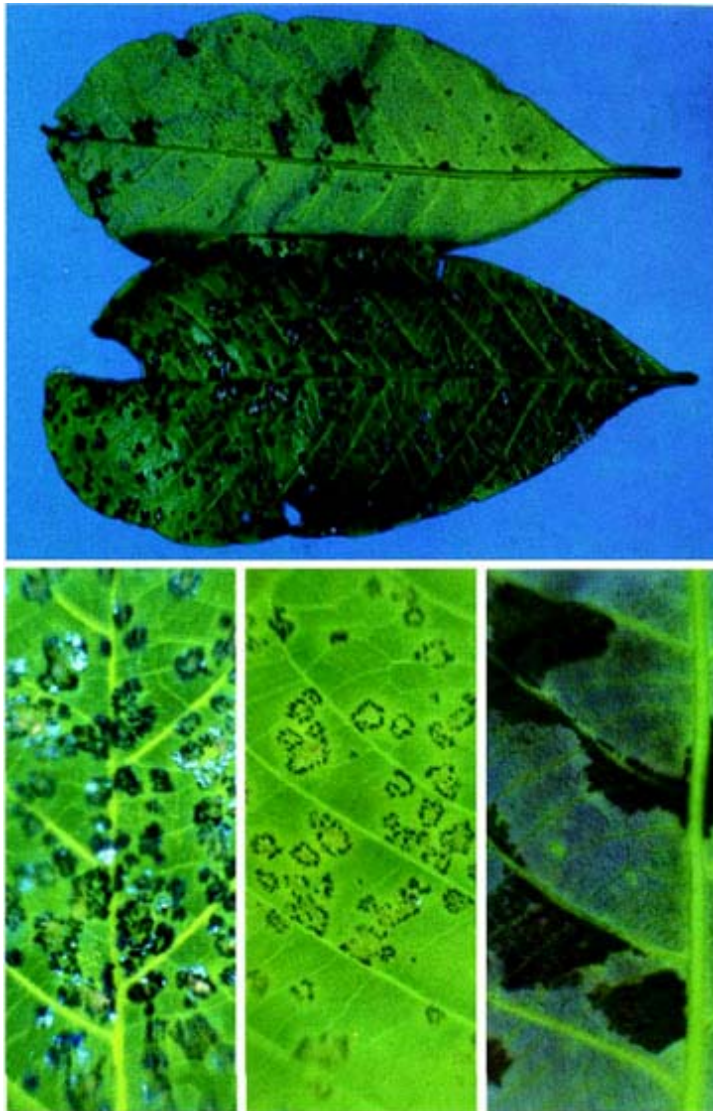
Plate 1. Conidia, pycnospores and ascospores (from Chee & Holliday 1986)



The conidia and ascospores infect the young developing leaves causing distortion followed by necrosis of the lamina (Plate 2). Affected leaves will abscise if infection is severe. Repeated defoliations and twig dieback weaken the tree and may sometimes cause its death (Plate 3) (Chee and Holliday 1986).

The primary stage of the disease on young leaves is characterized by the appearance of lesions covered by dark grey powdery masses of conidia on the abaxial leaf surface. Sporulation lasts for 2 to 3 weeks, later it becomes sparse and eventually no more conidia are produced. The conidia are disseminated by wind, vectors and water.

Plate 2. Foliar signs of SALB (from Chee & Holliday 1986)



Clockwise: a) Conidial lesions and ascostromata on leaf surfaces; b) close up of conidial lesions; c) and d) pycnidia and ascostromata on mature and old leaves respectively.

The ascospores play an important role in the survival of the fungus from one season to the next. The viability of detached conidia and ascospores is affected by moisture and temperature. The optimum temperature for growth, sporulation and infection is 24°C. Conidia and ascospores germinate in 3-4 hours at 24°C. The optimum temperature range for ascospore germination is 19°C to 25°C, but none germinate at 26-32°C. Water, in the form of dew or rain for about 8 hours, is considered necessary for germination, the formation of an aspersorium, infection hypha and penetration. Penetration is direct and through the leaf cuticle. Conidia begin to form within a week of infection and the perfect state mature about 8-9 weeks later. In infected rubber plantations ascospores are present throughout the year with peak concentrations

occurring during the wet seasons. The wet season also marks the period of maximum production and dispersal of conidia (Chee 1976a, c).

Plate 3. Plants infected with SALB



Immature rubber plant infected with SALB

Matured rubber trees infected with SALB

The optimum temperature for germination of conidia is about 24°C (Holliday 1970; Chee 1976a; Kajornchaiyakul et al. 1984; Gasparotto et al. 1989a). Sporulation was found by Kajornchaiyakul et al. (1984) to be totally inhibited at 20°C. However, some isolates of *M. ulei* are able to infect and produce spores at 16°C (Gasparotto and Junqueira 1994). These differences seem to reflect physiological differences between isolates from different ecological regions.

Dry conidia need to be wetted and require 6-8 hours of high relative humidity after deposition for infection. Gasparotto and Junqueira (1994) found that one isolate of the pathogen did not need more than 3 hours of leaf wetness for infection and other isolates could infect within 4 hours. It is assumed that the different periods of leaf wetness required for infection are related to the virulence of the isolates and the susceptibility of the clones used. Optimum temperature for infection ranges from 19-25°C, but little infection occur at 26-29°C and none at 30-32°C. After inoculation high disease intensity was observed on plants incubated at 19-22°C or 23-25°C. Lesions developed best at 23-25°C. Conidial sporulation occurred at 19-28°C and was increased by high humidity especially at 23-25°C (Kajornchaiyakul et al. 1984). Ascospores are released in rapid succession when leaves are wetted at sub-ambient temperature (14°C). Leaves which fall during wintering discharge ascospores readily after rain (Chee 1976a, b). During wet weather secondary infections from leaf diseases such as *Collectotrichum* and *Oidium* can occur causing secondary leaf fall (Chee 1990).

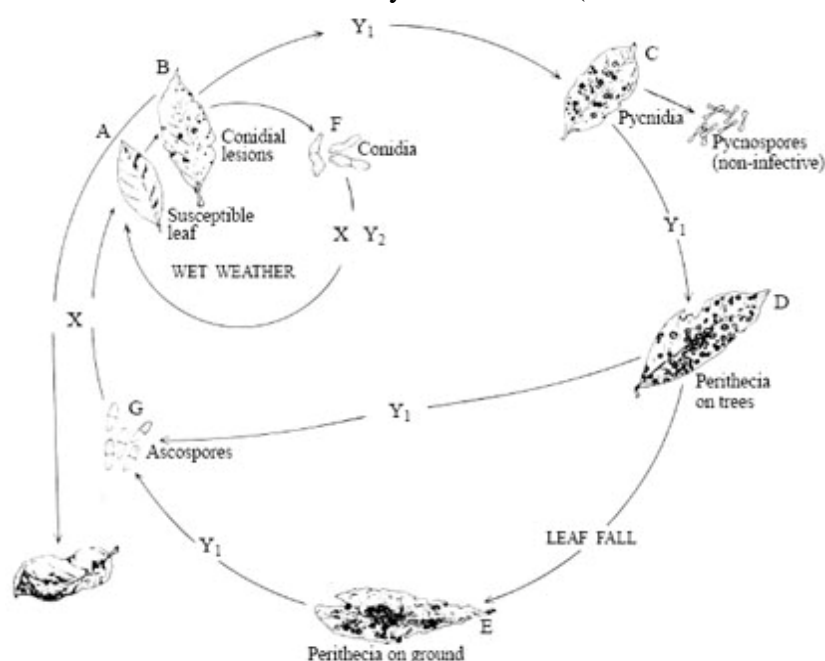
Ascospores are released from dark green leaves throughout the dry season (Chee 1976c; 1980a). Under moist conditions at 24°C, perithecia on green leaves lose their viability after 12 days and after 9 days for perithecia on fallen brown leaves. In Brazil, epidemics of the disease occur when daily temperatures are under 22°C for longer than 13 hours, relative humidity is over 85 percent for a period of over 10 hours, and rainfall exceeds 1 mm per day the preceding 7 days (Rocha and Vasconcelos 1978).

Spore survival and adaptability

The detached conidia stored at 24°C between 65-85 percent relative humidity remained viable after 3 weeks. The conidia still attached on leaf lesions when stored under desiccation, 9 percent of the conidia still germinated after 16 weeks. Fresh conidia produced under optimum conditions can survive over a week on leaves, clothes, polyethylene, artificial leather, glass, mature Hevea leaves, metal, paper as well as soil (Zhang et al. 1986). Conidia recovered from these materials were tested for viability by their ability to germinate. These recovered single conidia were transferred to leaf discs in laboratory infection tests to determine their ability to infect host material. No infection occurred (Darmono and Chee 1985; Chee pers. com. 2007).

Life cycle

Plate 4. Disease cycle of SALB (from Chee & Holliday 1986)



Plant infection requirements

Junqueira et al. (1986) determined that the optimum inoculum concentration was 2×10^5 conidia/ml, with higher concentrations inhibiting conidial germination and reducing the diameter of lesions. Outdoor (natural) light reduced viability more quickly than reduced-light (indoor) or no-light conditions. It is expected that for successful infection, with an inoculum concentration similar to that noted above, a spore loading equivalent to that generated from perithecia on a leaf segment at least 1 cm² would be required. This in effect means that for the purposes of this risk analysis it will be assumed that leaf segments of less than 1 cm² would not lead to successful infection under normal circumstances. This technical estimation is supported by the general experience of a number of workers (Chee, pers. comm.).

Population variation

Isolates of *M. ulei* grown on agar culture exhibit morphological differences and also differ in the rate of sporulation. Numerous strains have been observed. Over the years clones resistant to SALB succumbed to infection one after another and this was found

to be due to evolution of new physiological races breaking down the resistance. Eight races were found initially (Chee et al. 1986), and four more have been added (Rivano 1997). Additionally geographical strains have been noted in Brazil (Chee pers. com. 2007).

Affected hosts

Source:

Host range

Host species: *Hevea brasiliensis* Muell. Arg. (Commercial species)

Hevea benthamiana Muell. Arg.

Hevea guianensis Aubl.

Hevea spruceana (Benth.) Muell. Arg.

Geographic distribution

SALB is present in all countries in Central and South America where rubber IS present, whether cultivated or wild. In 2003 Brazil's total rubber planted area was 108 373 ha, of which Sao Paulo state had 33 477 ha, Bahia 29 314 ha and Mato Grosso 25 536 ha. The area under production was 103 586 ha; dry rubber production was 156 318 tonnes. Brazils own production for 2003 was 94 000 tonnes; and in 2004 was 100 000 tonnes. In the second largest rubber planting state Bahia, despite ravages by SALB and low rubber yield (estate: 1 000-1 200 kg/ha/yr; smallholder: 500-600 kg/ha/yr), rubber cultivation is still being attempted. Commercial rubber area in the northern states is negligible. Although indigenous wild populations exist, Amazonas' 540 ha of rubber in 1995 has dwindled to 28 ha today.

Symptoms

Part of plants affected: Young leaves severely affected. The young tissue of petioles, stems, inflorescences and fruit pods is less affected.

The disease is only seen on young leaves of the plant (less than 10-15 days old) and can be a risk to mature plants that have begun to shed leaves annually. The first signs are discoloured green masses on the leaves that become a dark grey powdery mass as the fungus starts to produce conidia. These spots can grow together, consuming the leaf causing it to die and fall

Entry, establishment and spread

Source:

Entry potential

Table 3. Summary of the assessment of entry

Vector	Probability of association	Probability of transit by Sea/Air	Probability of transfer to a suitable host	Conclusion of probability of entry
Host material (<i>Hevea</i> species)				
Budded stumps or budwood	High	High/High	High	High
Foliage (stem and leaf material not for planting)	High	High/High	Low (<1 cm ²)	Low (<1 cm ²)
Flowers, fruit and seeds	Moderate	Low/Moderate	Low	Low
Plants <i>in-vitro</i>	Negligible	N/A/N/A	N/A	Negligible
Wood	Negligible	Negligible/Negligible	Negligible	Negligible
Non-host material				
Inanimate goods or non-host organic material	Low	Negligible/Negligible	N/A	Negligible
Inanimate goods or non-host organic material contaminated by host plant material	Moderate	Low/Moderate	Low (<1 cm ²)	Low (<1 cm ²)

Establishment potential

Rating: High

The establishment potential is high once infected budded material has been moved into an area and planted.

Spread potential

Rating: High

Infection and establishment of SALB requires the presence of susceptible young foliage, wet weather and suitable temperature (22oC-28oC). Depending on the local climatic conditions, after the annual wintering, rubber trees refoliate from February to April. There are abundant rubber plantations throughout the PRA area, and host plants (Hevea species) can be found in urban plantings and forest areas.

In South American countries the initial spread is believed to have originated from wild rubber trees, but spread to Trinidad and Central American and to Bahia and Sao Paulo areas of Brazil was presumably through infected material when attempts were made to grow rubber in these regions. The spread of disease to Haiti is speculated to be through the spores brought over by wind and rain from Guyana or Trinidad and Tobago. Spread of the disease from Amazon basin to the surrounding areas was possibly caused by long distance dissemination by wind and rain and deposition of spores from infected plants in the field (Holliday, 1970).

Climatic conditions especially rainfall in Asian countries are similar with SALB endemic regions of the Amazon. SALB occurs in epidemic proportions in the months which have 18 days of high relative humidity (exceeding 85%) for 10 hours. The climatic condition in many parts of Asian countries is similar to SALB endemic region in Brazil (Chee 1980b). Lin (2006), using Geographic Information System (GIS) analysis to compare the climatic records of 12 rubber growing countries in the PRA area, including Thailand, Indonesia and Malaysia, with SALB endemic regions, confirmed the climatic suitability of SALB to these countries. The criteria used in the analysis were:

- Average temperature of March, April and May (refoliation in Northern Hemisphere) is higher than 18.5oC; the average temperature of September, October and November (refoliation in Southern Hemisphere) is higher than 18.5oC.
- Annual rainfall is higher than 760 mm.
- There is no more than 6 consecutive months with less than 42 mm per month of rainfall.

Economic impact

Rating: High (only for rubber producing countries)

Natural rubber is one of the most important commercial commodities in Asia, particularly Southeast Asia. Presently, the rubber areas in Asia are free from SALB. If SALB were to establish and spread in the PRA areas the potential consequences would be expected to include:

1. Increased cost of production with lower productivity

- additional disease and weed control costs
- shortage of raw material for rubber and rubber wood based industries
- poor stand and wood quality when infected trees suffer dieback

2. Adverse financial effects

- reduction in country's revenue from rubber and rubber wood exports including effects on growers and rubber manufacturing sectors
- loss of income due to unemployment of rubber smallholders
- escalating rubber wood prices because of low supply.

Environmental impact

Rating: Unknown (depending on nature of the response)

Given the limited range of hosts for this pathogen it is likely that the environmental impact would be low if untreated. If treated, chemical contamination may occur and soil disturbance may cause environmental impact.

Overall risk

Rating:

Diagnostic information (there is gap for specific diagnostic protocol)

Source: APPPC Working Group on Pest Incursion Management meeting

Diagnostic protocol

Is not limited to but should include:

- Cultural characteristics
- Morphological characteristics (EM optical microscopes)
- Molecular characteristics
- Serological characteristics (ELISA)
- Pathogenicity test

Response checklist

Source: APPPC Working Group on Pest Incursion Management meeting

These are guidelines only as every situation will be different. The following checklist provides a summary of generic requirements to be identified and implemented within a Response Plan:

- Inform stakeholders, Minister, industry and householders
- Contact trading partners
- Confirm identity of pest with second expert
- Destruction methods for plant material and disposable items

- Disposal procedures
- Quarantine restrictions and movement controls
- Decontamination and farm cleanup procedures
- Diagnostic protocols and laboratories
- Identifying research lab
- Trace back and trace forward procedures
- Protocols for delimiting, intensive and ongoing surveillance
- Zoning
- Reporting and communication strategy

Delimiting survey and epidemiology study

Source: APPPC Working Group on Pest Incursion Management meeting

Delimiting surveys should comprise local surveys around the area of initial detection concentrating on areas of obvious damage. Delimiting surveys are critical to determine the extent of spread of the pest and provide information for review and further development of the Response Plan. Size of survey should be 3 km radius (speculative) around known infected sites and should include any trace forward and linked sites.

Sampling method

Sampling of 600 trees per 10 ha blocks. Trees to be chosen randomly and closely inspected especially new growth and young leaves.

2.1.1.1 NUMBER OF SPECIMENS TO BE COLLECTED

Collect symptomatic material only.

2.1.1.2 HOW TO COLLECT PLANT SAMPLES (WILL BE INCLUDED IN DIAGNOSTIC PROTOCOL)

Plant material with suspect infection should be picked and placed between sheets of dry paper to prevent rapid drying

2.1.1.3 HOW TO PRESERVE PLANT SAMPLES

For discussion as above

2.1.1.4 HOW TO TRANSPORT PLANT MATERIAL

Secure and safe packaging should aim to ensure safe transport and handling. IATA 650 provides a guide.

Legal permits to move material may be needed.

Epidemiological study

Any epidemiological study of South American Leaf Blight will need to consider damage to the host plant, links between affected sites such as mechanical transmission

via machinery or harvesters. These factors would need to be considered against the biology of the organism (including survival potential, rate of reproduction and methods/rates of dispersal) along with biotic and abiotic factors of its environment (including host plant availability, climate, geographical features, predators, parasites and pathogens).

Models of spread potential

Spread is by plant material or by wind borne rain and splash dispersal. Potential is for great distances as demonstrated by movement through central and south America. Pathogen may be carried on baggage, shoes and clothes. Climatic conditions are important, especially rainfall humidity and temperature. The presence of natural barriers such as deserts, mountain range and seas will inhibit long range spread. Spread is also by transporting plant material although seeds may carry surface contamination but can be cleaned with bleach.

Pest Free Area guidelines

The establishment and maintenance of Pest Free Areas (PFAs) can be a resource-intensive process. Prior to development of a PFA due consideration should be given to alternative methods (e.g. treatments, enclosed quarantine) that achieve an equivalent biosecurity outcome to a PFA. A benefit-cost analysis is useful for this purpose.

Where an evaluation justifies the establishment and maintenance of a PFA the requirements of ISPM No. 4 (IPPC, 1995) should be met. In defining and establishing the pest free area due consideration of the biological characteristics of South American Leaf Blight along with the climatic and geographic features of the area, will need to be given.

Additional information is provided by the IPPC (1995) in Requirements for the Establishment of Pest Free Areas. This standard describes the requirements for the establishment and use of pest free areas as a risk management option for phytosanitary certification of plants and plant products. Establishment and maintenance of a PFA can vary according to the biology of the pest, pest survival potential, means of dispersal, availability of host plants, restrictions on movement of produce, as well as PFA characteristics (size, degree of isolation and ecological conditions).

Availability of control methods

Source: APPPC Working Group on Pest Incursion Management meeting

General procedures for control

- Keep traffic out of affected areas and minimize movement in adjacent areas
- Adopt best-practice farm hygiene procedures to retard the spread of the pathogen between fields and adjacent farms
- After surveys are completed, destruction of the infested crop is an effective control

- Quarantine areas quickly put in place to restrict and control the movement of regulated articles (e.g. host plant material and machinery) within and out of the affected area
- On-going surveillance of affected plantations to ensure *M. ulei* is eradicated

Control if small areas are affected

Where the incursion is restricted to a small area the likelihood of eradication is generally greater than for a large area. Initial control efforts should presume eradication is the aim. If area is small the infected material may be burned after felling and spraying.

Control if large areas are affected

Where the incursion has spread extensively control efforts may be targeted towards containment rather than eradication. The decision to eradicate or contain will need to be made on a case-by-case basis. Aerial application of fungicide may be required to suppress disease. Alternate option to destroying trees may be defoliation.

Cultural control

Cultural control techniques for SALB are used in South America where the disease is prevalent. South American literature should be referenced. *Selection for resistant varieties (Sri Lanka)*.

Host plant resistance

Historically breeding for disease resistance was continuously frustrated by the concurrent evolution of new physiological races of the pathogen that are capable of breaking down the resistance. No rubber clones can therefore escape infection over the long term. The rubber in Southeast Asia and the PRA area was introduced from South America and it was perhaps fortunate that SALB did not establish during this introduction period.

Chemical control

As with other control methods the use of chemicals should form part of an integrated approach to pest management, thereby ensuring resistance does not build up in the target pest.

Prevention and Treatment The fungus can be controlled by a number of fungicides depending on each countries' legislation, including:

Contact
Systemic
(Benomyl
biteranol
carbendazim

chlorothalonil
fenarimol
fenbuconazole
mancozeb
myclobutinol
propiconazole
thiophanate methyl
triadimenol
triadimephon
triforin)

In southern Bahia (Brazil), no satisfactory control level was reached using benomyl, carbendazim or thiophanate-methyl (Santos and Periera,1985), probably because of fungicide-resistant strains.

In seed gardens, clonal gardens and young developing plantations, terrestrial sprayers, tractor-mounted pneumatic sprayers or atomisers can be used. Chemical control is difficult. However, in productive rubber plantations: the trees are up to 25 m high and conventional spraying equipment does not reach the canopy. Aerial spraying, used in south east Bahia, is extremely expensive and not economically feasible for smallholding and medium sized plantations especially when the plantations are dispersed and at far distances from one another.

The time and equipment used for fungicide application depends on the developmental stage of the plants and the plantations. In seed gardens and clonal gardens in areas of high disease occurrence, spraying must be done weekly in the rainy season and at fortnightly intervals during the dry season. In adult plantations spraying must be done during the refoiliation period at weekly intervals until the leaves reach their mature state. It is difficult to reach the canopy using normal spraying equipment.

Mechanical control

Cultural practice has little value in control measures. Fungicide spraying is effective to certain extent, but the cost of chemical control is high and method of application is difficult because of uneven terrain and tree height.

M. ulei is no respecter of reputation or money. When Henry Ford tried to establish the ill-conceived Fordlandia rubber plantations in the Amazon Basin in the 1920s South American Leaf Blight devastated the seedlings. The plan was not helped by attempting to apply North American farming methods to the complex ecosystems of the Amazon.

Biological control

There is no record of effective biological controls of SALB. There is no known natural enemy or other biological control agent for SALB. Work with *Dicyma pulvinata* does not appear to have produced successful results (Chee pers. com.). However, *D. pulvinata* may serve as an important component of integrated pest management and has been developed for potential commercial use (Bettiol, 1996).

3 Course of action – eradication methods

Source: APPPC Working Group on Pest Incursion Management meeting

Additional information is provided by the IPPC (1998) in Guidelines for Pest Eradication Programmes. This standard describes the components of a pest eradication programme which can lead to the establishment or re-establishment of pest absence in an area. A pest eradication programme may be developed as an emergency measure to prevent establishment and/or spread of a pest following its recent entry (re-establish a pest free area) or a measure to eliminate an established pest (establish a pest free area). The eradication process involves three main activities: surveillance, containment, and treatment and/or control measures.

Specific priorities for eradication include:

- Confirm the presence of the pest
- Prevent the movement of plant within and out of the area
- Prevent movement of vehicles and equipment through affected areas
- Priority of eradication/decontamination of infected host material

Destruction strategy

Destruction protocols

- Disposable equipment, infested plant material should be disposed of by autoclaving, high temperature incineration or deep burial
- Any equipment removed from the site for disposal should be double-bagged

Trees should be sprayed with fungicide if small enough. All trees should be felled and larger trees sprayed with fungicide when on the ground.

Material should be left to gain exposure to UV radiation and allowed to desiccate. Material should be windrowed when dry enough to burn, in the intervening period all material should be sprayed with an appropriate fungicide at fortnightly intervals. Alternately material may be buried if space allows.

The fungicide application is to prevent viable ascospores becoming air borne on hot currents.

Area of destruction around a single known infected tree to be 100 metre (speculation; research needed) radius.

Trash Management

Trash (leaf and plant material) should be raked and burned soon after trees are windrowed and burned.

Inspection of regrowth

Inspection for regrowth material should take place every fortnight and regrowth treated with herbicide. Regrowth should be sampled and tested at a rate of 600 samples per 10 ha block. Negative results will support a case for replanting host material in the future and underpin a case for declaration of area freedom.

Decontamination protocols

Machinery, equipment and vehicles in contact with infested plant material or present within the Quarantine Area should be washed (or alternatively steam cleaned) to remove plant material using high pressure water or scrubbing with products such as a farm degreaser or a 1% bleach (available chlorine) solution in a designated wash down. General guidelines for wash down areas are as follows:

- Located away from crops or sensitive vegetation
- Readily accessible with clear signage
- Access to fresh water and power
- Mud free, including entry and exit points (e.g. gravel, concrete or rubber matting)
- Gently sloped to drain effluent away
- Effluent must not enter water courses or water bodies
- Allow adequate space to move larger vehicles
- Away from hazards such as power lines
- Waste water, soil or plant residues should be contained (see Appendix 18 of Plant Health Australia (2008))
- Disposable overalls and rubber boots should be worn when handling infested plant material in the field. Boots, clothes and shoes in contact with infested plant material should be disinfested at the site with an appropriate fungicide or double-bagged to remove for cleaning

Plants, by-products and waste processing

- Material should be destroyed as above except smaller Infested plant material which can be destroyed by (enclosed) high temperature incineration, autoclaving or deep burial

Disposal issues

In plantations, the pathogen survives on old leaves by producing the secondary stage of stromata. The stromata are alive on the leaves that are on the trees or have fallen to the ground, and will continue to eject ascospores from the perithecia contained in the stromata. Therefore all trash must be raked and destroyed as described previously.

Quarantine and movement controls

Quarantine priorities

- Plant material at the site of infestation to be subject to movement restrictions
- Machinery, equipment, vehicles and disposable equipment in contact with infested plant material to be subject to movement restrictions

Movement control for people, plant material and machinery

Movement controls need to be put in place to minimise the potential for translocation of the pest as a contaminant of plant material or other articles.

Fresh conidia can survive for 1 week on clothes, polythene, artificial leather, glass, mature leaves, metal paperl. Therefore movement of people, vehicle and machinery, from and to affected plantations must be controlled to ensure that infested or plant debris is not moved off-farm on clothing, footwear, vehicles or machinery. The following measures can be used to effect controls on movement:

- Signage to indicate quarantine area and/or restricted movement in these zones
- Fenced, barricaded or locked entry to quarantine areas
- Movement of equipment, machinery, plant material or soil by permit only
- Clothing and footwear worn at the infested site should either be double-bagged prior to removal for decontamination or should not leave the farm until thoroughly disinfested, washed and cleaned
- All machinery and equipment should be thoroughly cleaned down with a pressure cleaner prior to leaving the affected farm. The clean down procedure should be carried out on a hard surface, preferably a designated wash-down area, to avoid mud being re-collected from the affected site onto the machine

Zoning

The size of each quarantine area will be determined by a number of factors, including the location of the incursion.

Destruction Zone

A destruction zone of 100 metres radius is recommended if windborne movement is not suspected. Surveillance and sampling should commence on the outside of the zone at the same time as destruction commences at the centres, the closest point to known infection. Destruction should encompass residential (non-commercial) properties if these fall within the 100 metres radius and have SALB hosts.

Legislation is an important consideration when undertaking destruction of both commercial and on commercial host material.

A smaller zone may be considered if the initial infection can be directly linked to a single point of entry within a short timeframe (ie not windborne). Factors relevant to

this consideration are weather in the intervening period and life stage of the host and pathogen.

Quarantine Zone

The Quarantine Zone is defined as the area where voluntary or compulsory restraints are in place for the affected property(ies). These restraints may include restrictions or movement control for removal of plants, people or contaminated equipment from an infested property. The quarantine zone should contain adequate signage.

The Quarantine Zone should be 3 km radius from the infected site. Three km radius represents 2,826 ha. This should be mapped and monitored regardless of the disease status. Intensive monitoring should be carried out within the area and fungicide should be applied.

Buffer Zone

A Buffer Zone may or may not be required depending on the incident. It is defined as the area in which the pest does not occur but where movement controls or restrictions for removal of plants, people or equipment from this area are still deemed necessary. The Buffer Zone may enclose an infested area (and is therefore part of the Control Area) or may be adjacent to an infested area. The buffer zone must be subject to intensive surveillance to ensure the destruction area is adequate in size.

Restricted Area

The Restricted Area is defined as the zone immediately around the infected premises and suspected infected premises. The Restricted Area is established following initial surveys that confirm the presence of the pest. The Restricted Area will be subject to intense surveillance and movement control with movement out of the Restricted Area to be prohibited and movement into the Restricted Area to occur by permit only. Multiple Restricted Areas may be required within a Control Area.

Control Area

Encompasses all other zones and is usually defined in legal terms, shires, counties, states, provinces or prefectures. The Control Area is defined as all areas affected within the incursion. The Control Area comprises the Restricted Area, all infested premises and all suspected infested premises and will be defined as the minimum area necessary to prevent spread of the pest from the Quarantine Zone. The Control Area will also be used to regulate movement of all susceptible plant species to allow trace back, trace forward and epidemiological studies to be completed.

Decontamination and farm clean up

Decontamination practices are aimed at eliminating the pest thus preventing its spread to other areas.

Collect plant material and burn or destroy if small holding.

Decontamination procedures

General guidelines for decontamination and clean up:

- Fungicide application until burning can take place
- Raking trash and leaf litter to be burned
- Inspection and herbicide treatment of regrowth
- Keep traffic out of affected area and minimize it in adjacent areas
- Adopt best-practice farm hygiene procedures to retard the spread of the pest between fields and adjacent farms
- Machinery, equipment, vehicles in contact with infested plant material or soil or present within the Quarantine Area, should be washed to remove plant material using high pressure water or scrubbing with products such as detergent, a farm degreaser or a 1% bleach (available chlorine) solution in a designated wash down area as described in 0

Decontamination if pest is identified in a small or large areas

Where the infestation appears recent and linked to a specific pathway then procedure will be as before but the 3 km radius will be assessed and may be smaller or larger.

General safety precautions

For any chemicals used in the decontamination, follow all safety procedures listed by the chemical manufacturers. Personal protective clothing must be used. Environmental impacts should be considered.

Surveillance and tracing

Surveillance

Detection and delimiting surveys are required to delimit the extent of the outbreak, ensuring areas free of the pest retain market access and appropriate quarantine zones are established.

Initial surveillance priorities include the following:

- Surveying all host growing properties in the pest quarantine area
- Surveying all properties identified in trace forward or trace back analyses as being at risk
- Surveying all host growing properties that are reliant on trade with interstate or international markets which may be sensitive to *SALB* presence
- Surveying commercial nurseries selling at risk host plants
- Surveying other host growing properties, backyards and abandoned commercial plantings
- Consider use of spore traps

Trace forward and trace back should take priority and include all material that has left the property since and before the incursion was detected. Trace forward properties should be sampled at the same rate ie 600 trees per 10 ha block.

Survey regions

Establish survey regions around the surveillance priorities identified above (Section 0). These regions will be generated based on the zoning requirements (see Section 3.3), and prioritised based on their potential likelihood to currently have or receive an incursion of this pest. Surveillance activities within these regions will either allow for the area to be declared pest free and maintain market access requirements or establish the impact and spread of the incursion to allow for effective control and containment measures to be carried out.

Steps outlined in Table 1 form a basis for a survey plan. Although categorised in stages, some stages may be undertaken concurrently based on available skill sets, resources and priorities.

Table 1. Phases to be covered in a survey plan

Phase 1	<ul style="list-style-type: none"> • Identify properties that fall within the buffer zone around the infested premise • Complete preliminary surveillance to determine ownership, property details, production dynamics and tracings information (this may be an ongoing action)
Phase 2	<ul style="list-style-type: none"> • Preliminary survey of host crops in properties in buffer zone establishing points of pest detection
Phase 3	<ul style="list-style-type: none"> • Surveillance of an intensive nature, to support control and containment activities around points of pest detection
Phase 4	<ul style="list-style-type: none"> • Surveillance of contact premises. A contact premise is a property containing susceptible host plants, which are known to have been in direct or indirect contact with an infested premises or infested plants. Contact premises may be determined through tracking movement of materials from the property that may provide a viable pathway for spread of the pest. Pathways to be considered are: <ul style="list-style-type: none"> ○ Items of equipment and machinery which have been shared between properties including bins, containers, irrigation lines, vehicles and equipment ○ The producer and retailer of infested material if this is suspected to be the source of the outbreak ○ Labour and other personnel that have moved from infested, contact and suspect premises to unaffected properties (other growers, tradesmen, visitors, salesmen, crop scouts and harvesters) ○ Movement of plant material from controlled and restricted areas ○ Storm and rain events and the direction of prevailing winds that result in air-borne dispersal of the pest during these weather events
Phase 5	<ul style="list-style-type: none"> • Surveillance of gardens and public land where plants known to be hosts of SALB are being grown
Phase 6	<ul style="list-style-type: none"> • Agreed area freedom maintenance, pest control and containment

Post-eradication surveillance

The inspection of regrowth should continue for a length of time calculated by weather and likely breakdown of spores and spore viability – 19 weeks being the longest demonstrated so far.

Planting of sentinels on site should be consider using the same criteria as pest entry quarantine inspection to prove absence of disease (6 new leaf cycles).

Surveillance of the buffer zone should continue for the same period of time also allowing for weather to provide optimum growth conditions and enhance the visibility of disease if present. The period of pest freedom sufficient to indicate that eradication of the pest has been achieved will be determined by a number of factors, including the life cycle duration of the pest in the prevailing climatic conditions of the area, the previous level of infestation and the control measures applied. As a guide, the period of pest freedom required to confirm eradication should be no less than two generations of the pest where all conditions are taken into account.

- Establishment of sentinel plants at the site of infestation
- Maintain good sanitation and hygiene practices throughout the year
- The monitoring traps or sentinel plants should remain in place and be inspected on a fortnightly basis for a further 6 weeks and then on a monthly basis
- Surveys comprising plant sampling for SALB to be undertaken for a minimum of 12 months after eradication has been achieved or in accordance with IPPC PFA guidelines.

4 References

Pest Risk Analysis for South American Leaf Blight (SALB) of Rubber (*Hevea*) prepared by the APPPC <http://www.fao.org/docrep/010/ai003e/AI003E25.htm>

5 Appendices

Appendix 1. Standard diagnostic protocols

Appendix 2. Experts, resources and facilities

The following tables provide lists of experts (Table 2) and diagnostic facilities (Table 3) for use in professional diagnosis and advisory services in the case of an incursion.

Table 2. Experts who can be contacted for professional diagnostic and advisory services

Expert	Place	Details
Plant Pathologists	Rubber Research Institute of Malaysia, KL & Sungei Buloh	
Plant Pathologists	Department of Agriculture, Malaysia	
Surveillance team	DOA, Malaysia	

Table 3. Diagnostic service facilities

Facility	Place	Details
Diagnostic Lab	KL	

Appendix 3. Communications strategy

A communication strategy is the use of a combination of communication facets (frequency, direction, modality, and content).

Internal Communication Plan

Ensure that all parties involved are aware of the latest contingency plan and are briefed accordingly.

2. External Communication Plan

Informative leaflets/ pamphlets on the regulated pest should be produced and distributed in all ports of entry.

Communication should include related agencies that will be involved in an incursion e.g, Military agencies, export agencies or Foreign Affairs and Trade agencies.

Appendix 4. Market access impacts

Restrictions on export on agricultural products to rubber growing countries can be expected for nursery stock, budwood and budded stumps, however processed rubber or latex products will not carry the disease and their markets should not be affected.