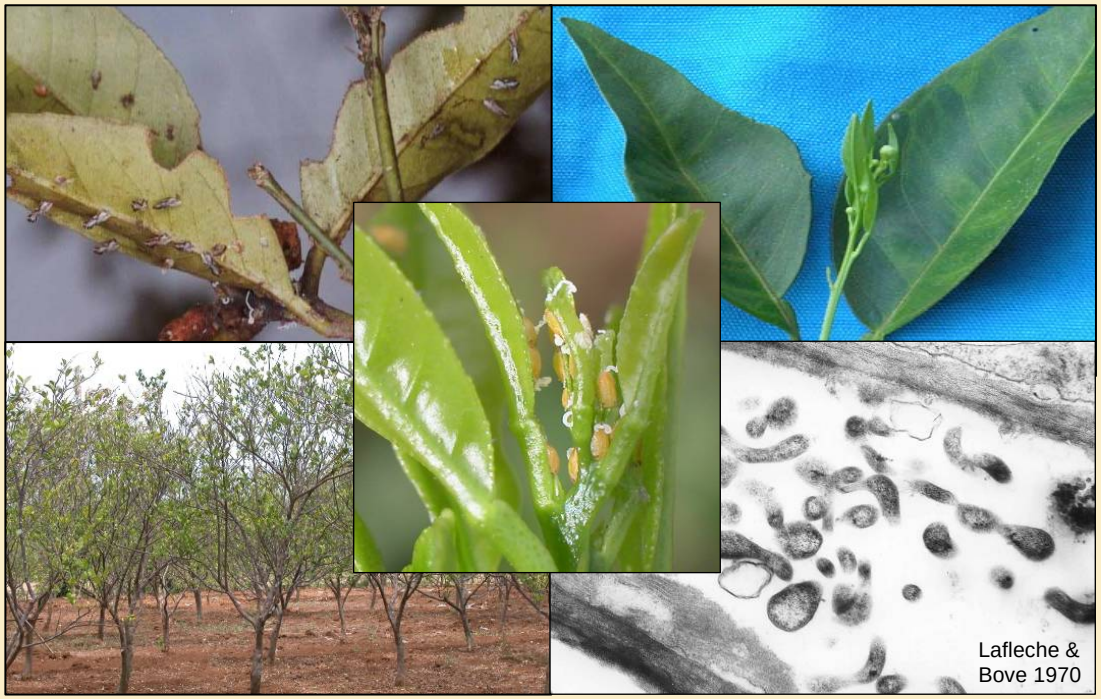
Huanglongbing (citrus greening) and the Asiatic citrus psyllid

Pat Barkley

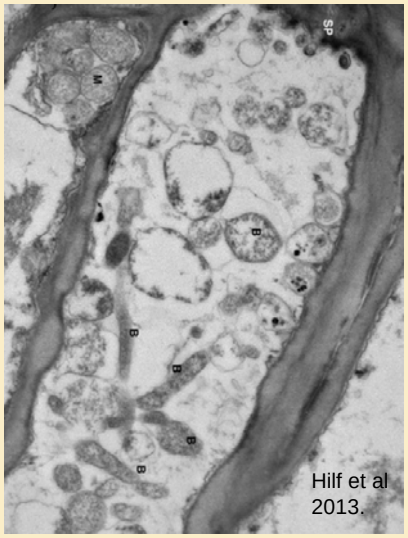
Andrew Beattie
(University of Western Sydney)



‘yellow shoot disease’

HUANGLONGBING (HLB) IS A BACTERIAL DISEASE TRANSMITTED BY GRAFTING AND BY PSYLLIDS

❑ There are 3 putative species of HLB bacteria, called 'liberibacters':



✓ **Asian** ('*Ca*. Liberibacter asiaticus') – causes HLB in Asia, Brazil, Florida

✓**African** ('*Ca*. L. africanus') – cause of citrus greening in Africa

✓**American** (*Ca.* L americanus') – found in Brazil with '*Ca*. L. asiaticus'

❑ There are 3 or 4 vectors:

✓**Asian citrus psyllid** (*Diaphorina citri*)

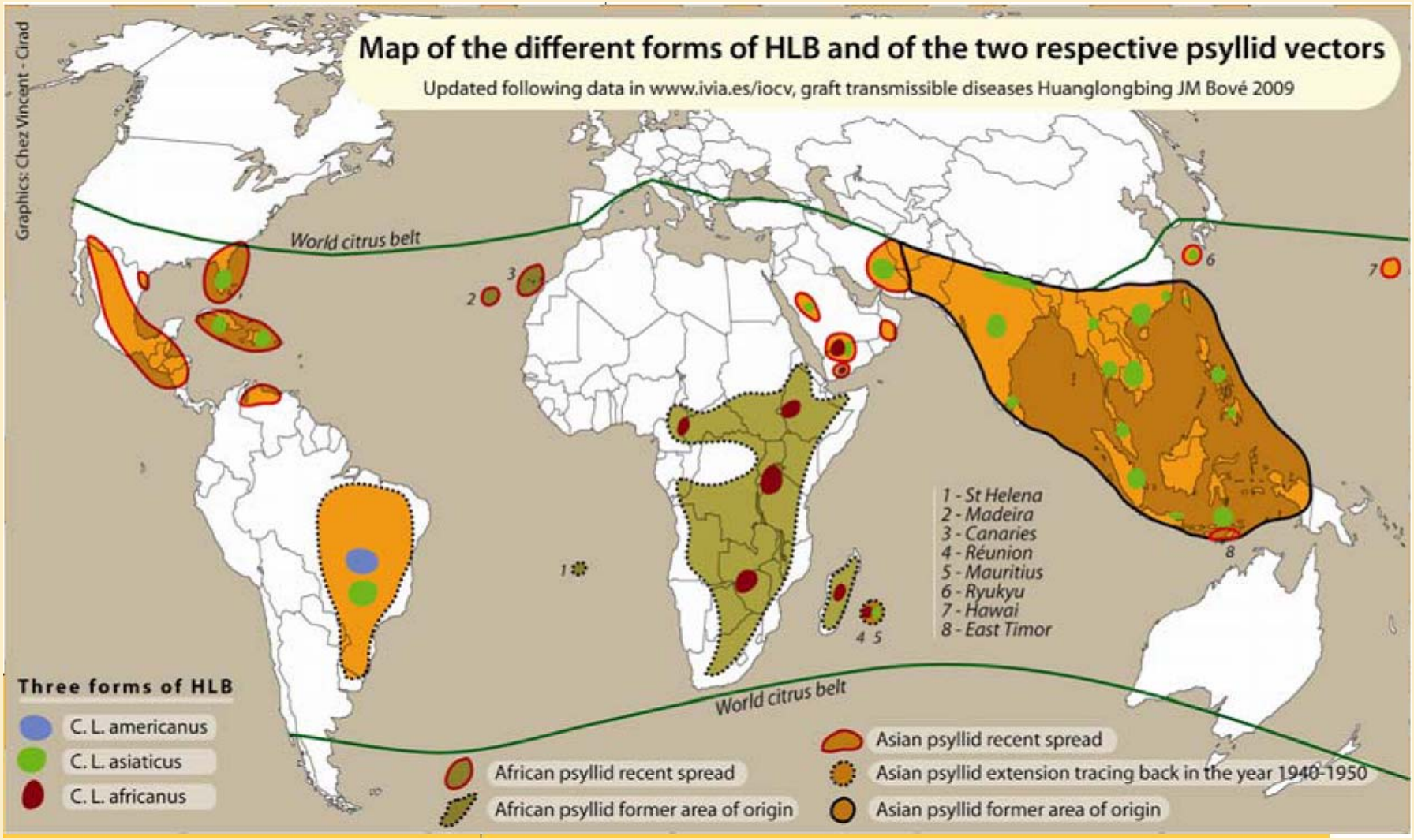
✓**African citrus psyllid** (*Trioza erytreae*)

✓**pomelo psyllid** (*Cacophylla (Psylla) citrisuga)* in Asia

Possibly black psyllid (*Diaphorina communis)* in Asia

IT IS THE ASIAN FORM OF HLB AND THE ASIATIC CITRUS PSYLLID (ACP) WHICH CONCERN US MOST BECAUSE OF THEIR PROXIMITY AND AGGRESSIVENESS

A GLOBAL THREAT!



From Aubert (2009)

ASIATIC CITRUS PSYLLID: THE MOST IMPORTANT VECTOR OF HUANGLONGBING

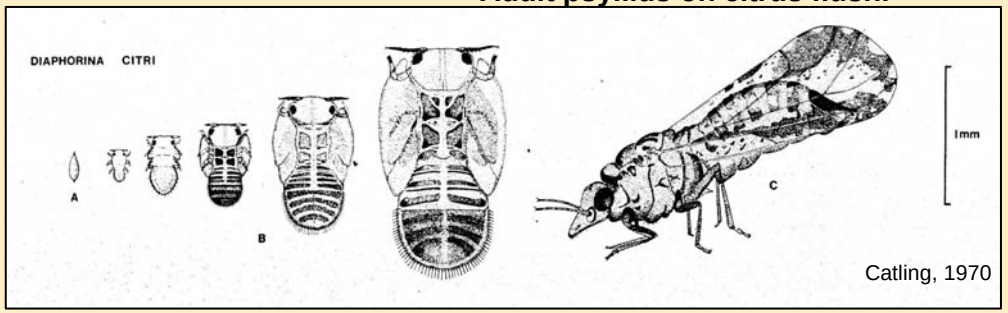
Psyllid nymphs and curling waxy honeydew on citrus flush.

Ovipositing female psyllid.

Adult psyllids on citrus flush.

Copious honeydew produced on orange jasmine, a favoured host of the psyllid.

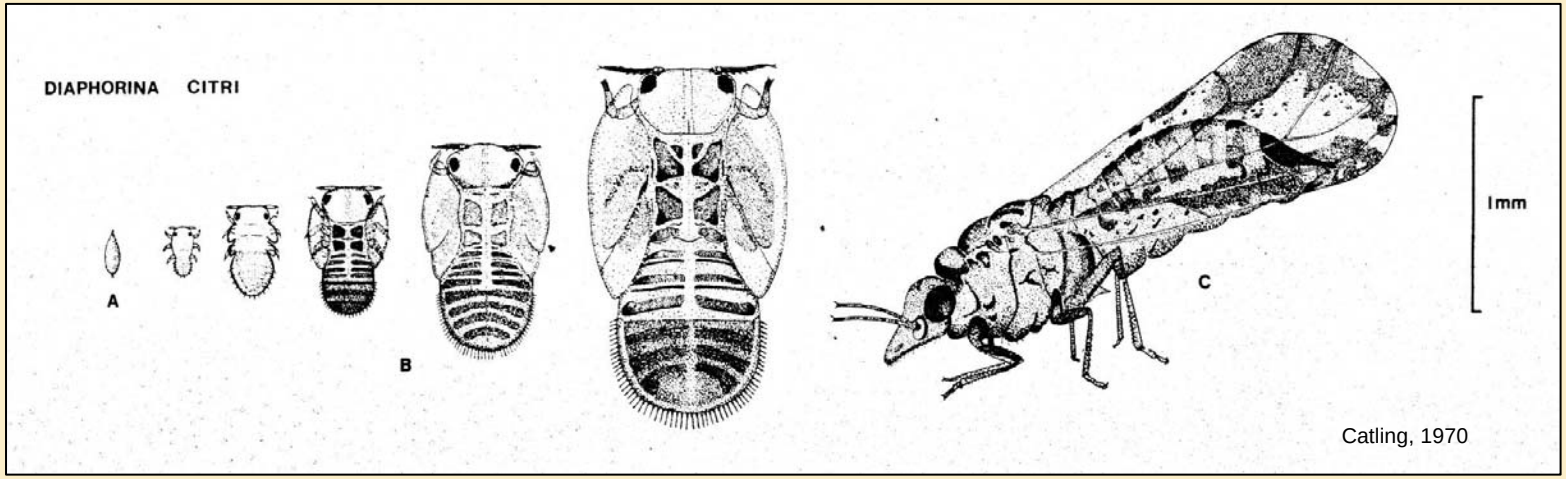
Photos: GAC Beattie



Catling, 1970

ASIATIC CITRUS PSYLLID

Adult psyllids on <u>underside</u> of mature leaves



eggs on tips of growing shoots, on and between unfurling orange leaves

psyllid nymphs and honeydew on young stem and petiole of orange jasmine

adult *D. citri* on orange jasmine

Photos: GAC Beattie

SYMPTOMS OF HUANGLONGBING

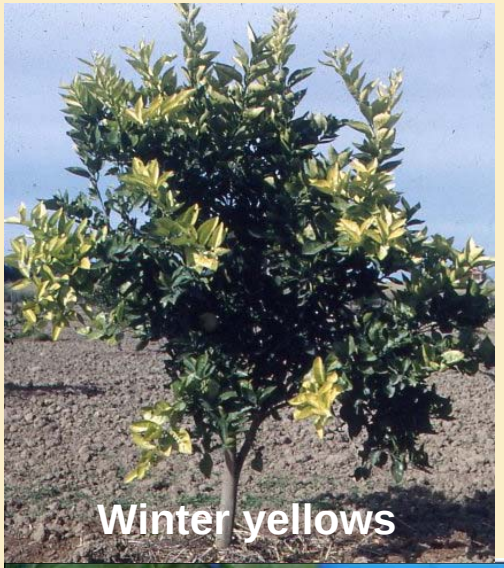
SYMPTOMS OF HLB

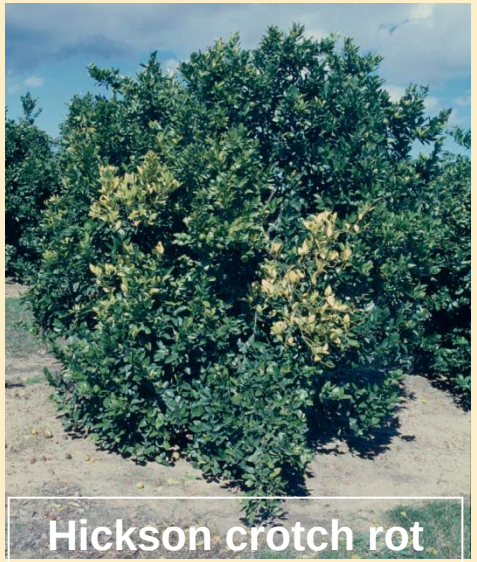
Leaves with asymmetric, sometimes dull, blotchy mottling across leaf veins.

Yellow shoots

Small, lopsided, bitter tasting sometimes green fruit with small, dark aborted seeds. Fruit drop.

Photos: Pat Barkley

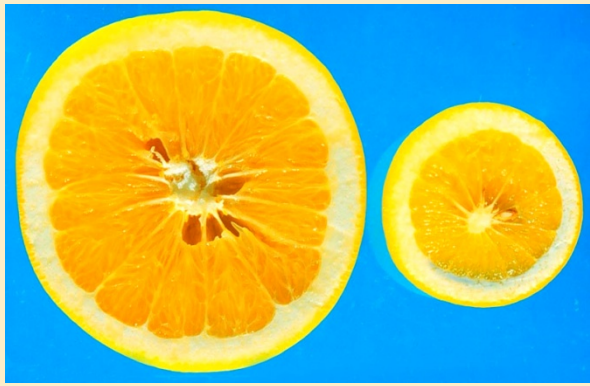





Nutrient deficiency

CONDITIONS CAUSING SYMPTOMS SIMILAR TO HUANGLONGBING

AUSTRALIAN CITRUS DIEBACK (ACD) – SYMPTOMS SIMILAR TO HLB



Photos: Pat Barkley

If we have a HLB incursion, the widespread occurrence of ACD <u>with symptoms similar to HLB</u> will cause field identification problems.

Nutritional Deficiencies and HLB/Citrus Greening

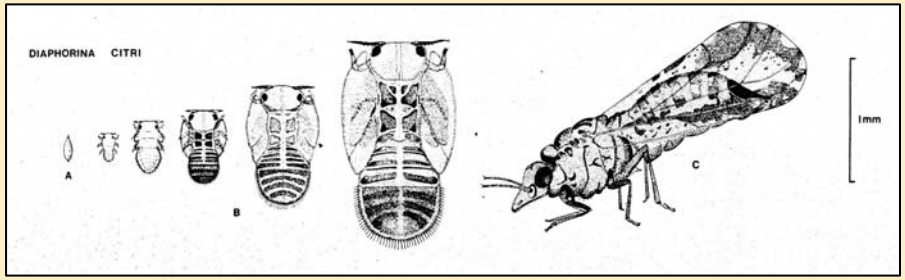
1 Iron chlorosis
2 Magnesium deficiency
3 Manganese deficiency
4 Zinc deficiency
5 HLB lopsided fruit
6/7 HLB blotchy mottle

*Nutritional deficiencies have a symmetrical pattern on opposite sides of the mid-vein on leaves; HLB has *NO* symmetry or pattern

UNIVERSITY OF FLORIDA
IFAS EXTENSION

HOW DO PSYLLIDS ACQUIRE THE BACTERIA?

When psyllids feed they take up the bacteria into their mouth parts and pass them on when feeding on the next citrus or orange jasmine tree.



The HLB bacterium can be acquired by 2nd, 3rd, 4th and 5th instar stages and transmitted by adult psyllids.

Once a psyllid takes up the bacteria, it carries it in its body for the rest of its life (weeks to months), spreading the disease as it moves from tree to tree.

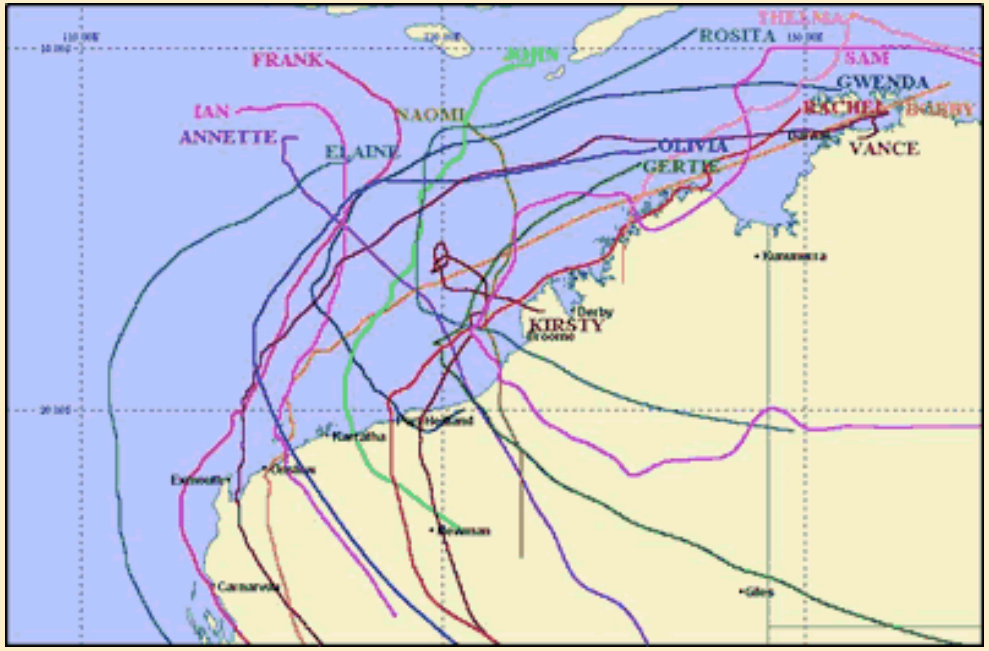
VULNERABILITY OF AUSTRALIAN CITRUS INDUSTRY

Australia's proximity to the islands of the Indonesian Archipelago and East Timor and to the island of New Guinea, where both HLB and ACP are endemic.

Map: R. Davis

PATHWAYS OF ENTRY OF HLB AND ITS VECTORS

Air movements (e.g. cyclonic and jet streams) carrying psyllids from the Indonesian Archipelago and New Guinea



Tracks of severe tropical cyclones - northwest coastline - 1986-87 to 1995-96 (www.bom.gov.au)

Evidence: The leucaena psyllid was possibly carried from East Timor to the Northern Territory on air currents associated with a severe tropical cyclone.

PATHWAYS OF ENTRY OF HLB AND ITS VECTORS

Photo:
R. Davis

Looking across from Australian Territory to Papua New Guinea

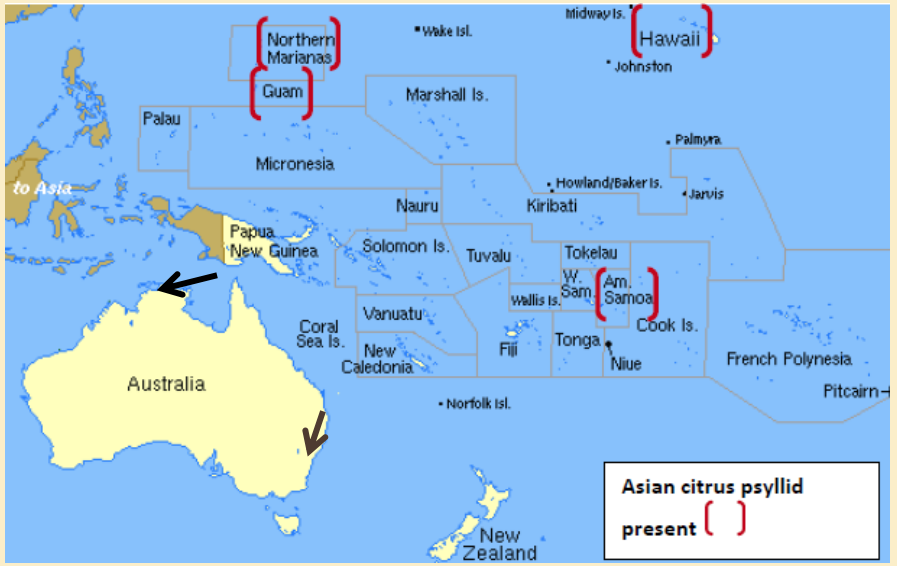
Movement of people carrying citrus fruits and other plant material across the Torres Strait from Papua New Guinea, principally by sea.

Unregulated landings of boats carrying citrus from other areas to the north of Australia.

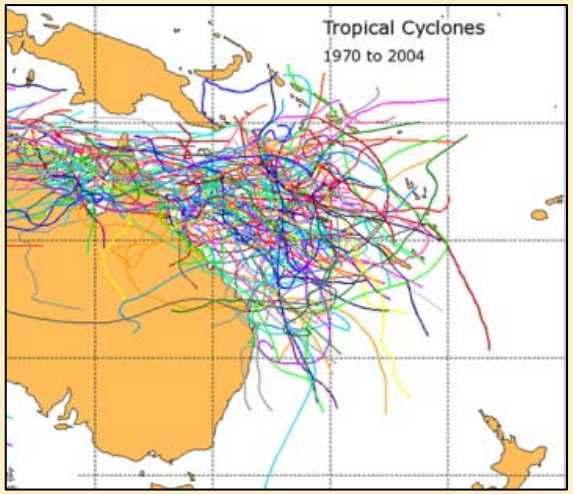
PATHWAYS OF ENTRY OF HLB AND ITS VECTORS

❑ **Passive transport of adult psyllids, which are strongly attracted to light e.g. in commercial and <u>military</u> aircraft**

?



❑ **Cyclones?**



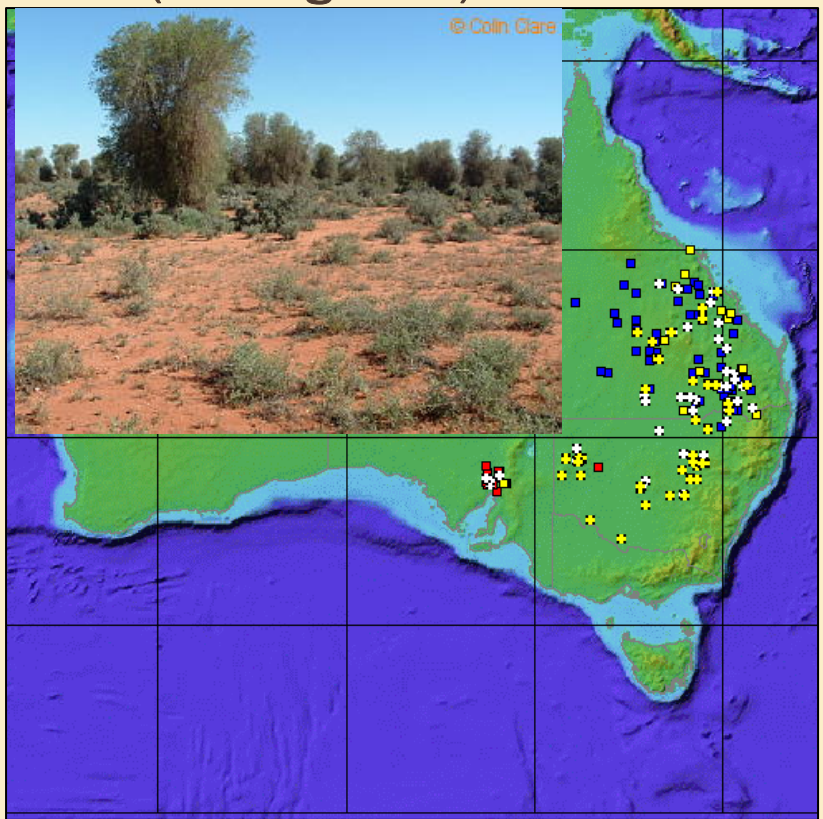
Eastern region tropical cyclone tracks for cyclones from 1970-2004 (www.bom.gov.au)

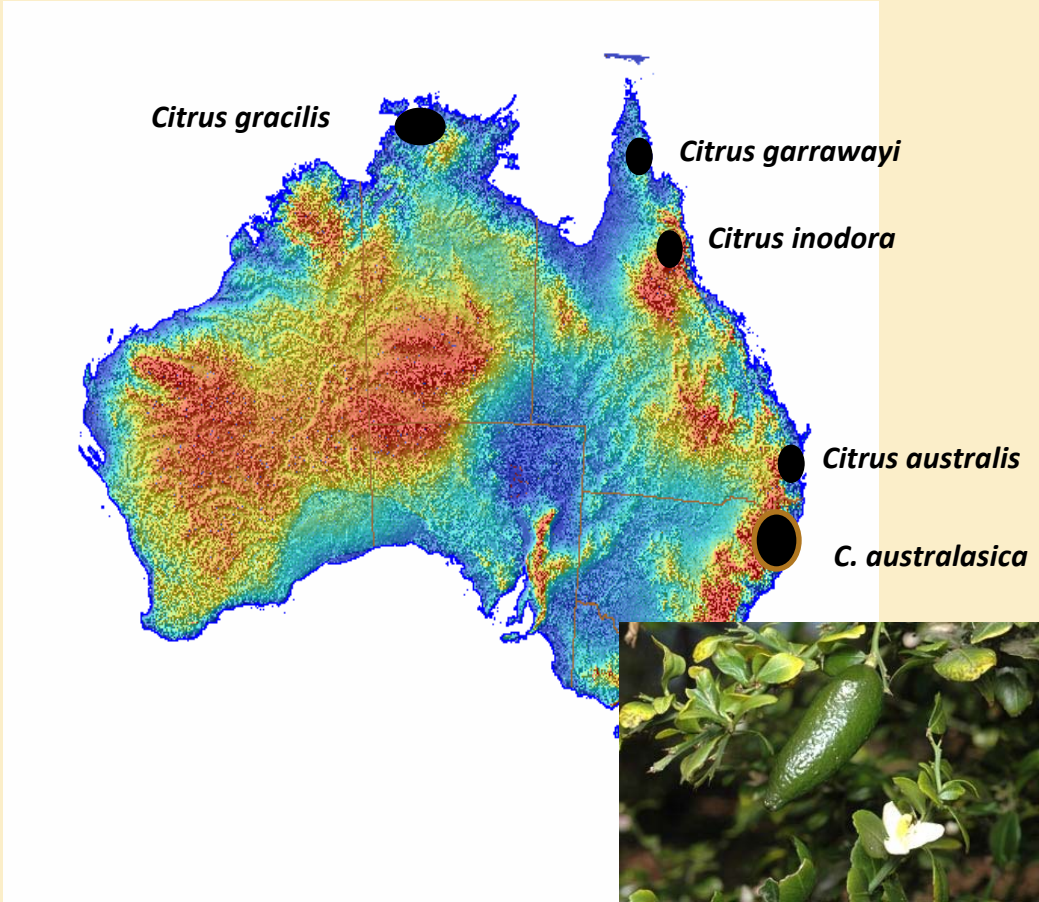
<u>Evidence:</u> The leucaena psyllid was carried from the Western Pacific to northeast Queensland on air currents associated with a severe tropical cyclone.

VULNERABILITY OF THE AUSTRALIAN CITRUS INDUSTRY

The distribution of indigenous citrus (potential hosts of psyllids and HLB) around the Australian coastline and inland

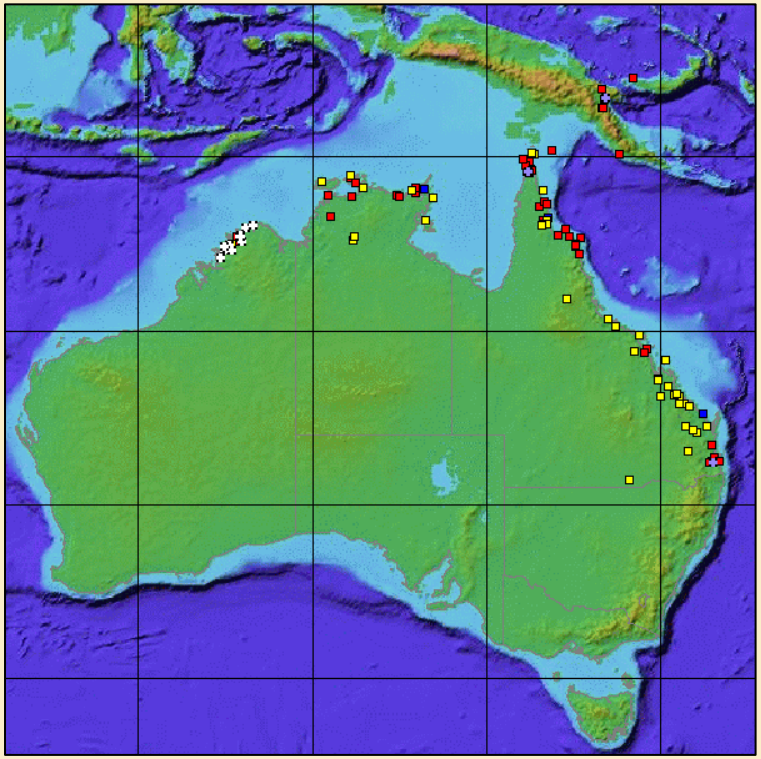
Herbarium records for desert lime (*Citrus glauca*):





VULNERABILITY OF THE AUSTRALIAN CITRUS INDUSTRY

Another host of the Asiatic citrus psyllid, the wild orange jasmine, (*Murraya ovatifoliolata* L. var. *ovatifoliolata*), occurs in coastal and sub-coastal areas of Western Australia, Northern Territory and Queensland.

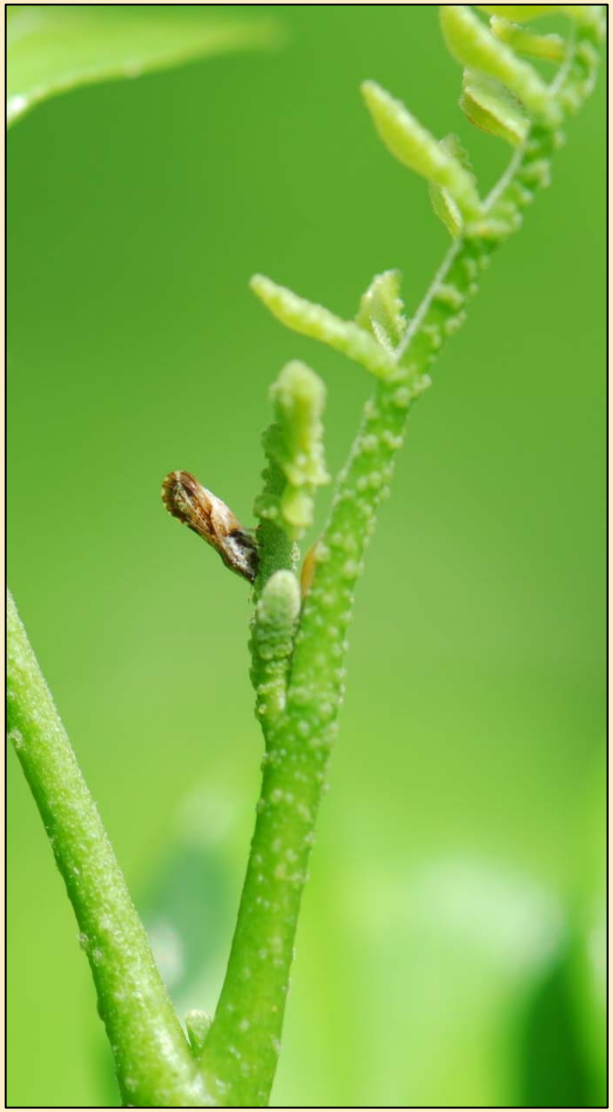


http://www.rbg.vic.gov.au/cgi-bin/avhpublic/avh.cgi

VULNERABILITY OF CITRUS

Suitability of citrus, orange jasmine etc. as hosts of the Asiatic citrus psyllid varies with the extent and frequency of leaf flushing and leaf hardness.

Gravid females & eggs at 47°C in Pakistan



Photos: GAC Beattie

PATHWAYS OF ENTRY OF HLB AND ITS VECTORS

June 2009 to March 2011 (Sydney International Airport):

- Citrus fruits, peel and leaves in amnesty bins: **13.05%** of the total content of the bins; 8557 citrus items from passengers i.e. **142 items per week!**
- Of these 2067 items were undeclared i.e. 34 items per week.

From January 2010 to April 2011 (Melbourne International Airport):

- Quarantine officers seized 4892 citrus items or **81 per week.** Passengers did not declare 1162 of these items.

≈ 25% undeclared!

Last year 3 adult Asiatic citrus psyllids were found on leaflets of curry leaf intercepted at Melbourne Airport.

PSYLLIDS INTERCEPTED BY USDA

- Asiatic citrus psyllids routinely found on citrus and curry leaf in baggage from Sri Lanka, Singapore, Philippines, Pakistan, India, Indonesia, Malaysia.
- Asiatic citrus psyllids found on other (non-hosts?):
  - Mint *(Mentha* sp.) from India, myrtle (*Myrtus* sp.) from Mexico in **baggage**,
  - **Permit cargo** of malungai (*Moringa oleifera*), sweet basil leaf (*Ocimum basilicum*) from Hawaii and coriander (*Coriandrum sativum*) *and* choko (*Sechium edule*) from Mexico.

INTERCEPTION DATA FOR CITRUS PSYLLIDS BY AQIS?

PATHWAYS OF ENTRY OF HLB AND ITS VECTORS

ILLEGAL INTRODUCTIONS OF BUDWOOD
e.g. From Asia, South Africa or Florida

US surveys for HLB have focused on neighbourhoods with predominant demographics linked to the regions where HLB is endemic.

- First find of HLB in Florida was in a tree behind a Thai restaurant
- First find of HLB in California was in a lemon/pummelo tree at a Chinese residence in Los Angeles .

It is highly probable that a HLB-infected tree(s) occurs in Australia, but spread is unlikely without the psyllid vector.

VULNERABILITY OF AUSTRALIAN CITRUS INDUSTRY

The widespread occurrence of orange jasmine (*Murraya exotica*) in gardens, especially in suburban areas.

Orange jasmine is a favoured host of the Asiatic citrus psyllid and can become infected with the HLB organism.

VULNERABILITY OF AUSTRALIAN CITRUS INDUSTRY

All species and varieties of *Citrus* are hosts of the Asiatic citrus psyllid and susceptible to HLB.

There is some variability in sensitivity of mandarin and pomelo varieties, but in general sweet oranges, mandarin and grapefruit are highly sensitive, with lemon, rough lemon and trifoliate orange and its hybrids tolerant and limes highly tolerant.

CONSEQUENCES OF HLB AND ACP

80-90% of Florida's groves have some HLB infection, many in southern counties with 100% infection rates.

28% symptomatic trees corresponds to 100% of trees infected in an orchard!

- Tree death; reduction in acreage;
- Reductions in yield (fruit drop, more culls, infected fruit are smaller, infected fruit may have a bitter taste, fruit do not colour properly);
- Increased production costs (rogueing, scouting, spraying)
- Changes to management practices
- Disruption of IPM

BRAZIL

FLORIDA

Increasing Grove Care Costs for Managing Diseases

(Cultural Care Costs Only)

2010-2011 (US$/Acre)		Total Costs (including spray costs)	% Increase	Spray Costs	% Increase
WITH HLB-GREENING					
Valencia (Central)	**(7)**	1,567.68	37%	389.32	93%
Hamlin (SW FL)	**(8)**	1,571.82	35%	346.26	94%
GFT (Indian River)	**(11)**	1,770.04	29%	685.08	74%

Source: Ronald P. Muraro, UF/IFAS CREC, Lake Alfred, FL.

ABANDONED CITRUS ORCHARDS

- 136,533 acres of citrus abandoned in Florida in 2012.
- Abandoned citrus groves are a significant source of HLB as dispersing psyllids move the HLB pathogen into nearby managed groves.
- In Florida, an abandoned orchard is defined as an orchard where there has been:
  - no commercial fruit harvest during the last two seasons; and
  - no production care during the past two years, including weed control and mowing; and
  - where orchard use has been transferred to other uses (e.g., livestock)

Australia needs:

- **Uniform definition of an abandoned orchard**
- **Uniform legislation for the removal of abandoned orchards**

ECONOMICS OF HLB

2006 -2012, HLB cost Florida's economy an estimated $3.63 billion in lost revenues and 6,611 jobs by reduced orange juice production.

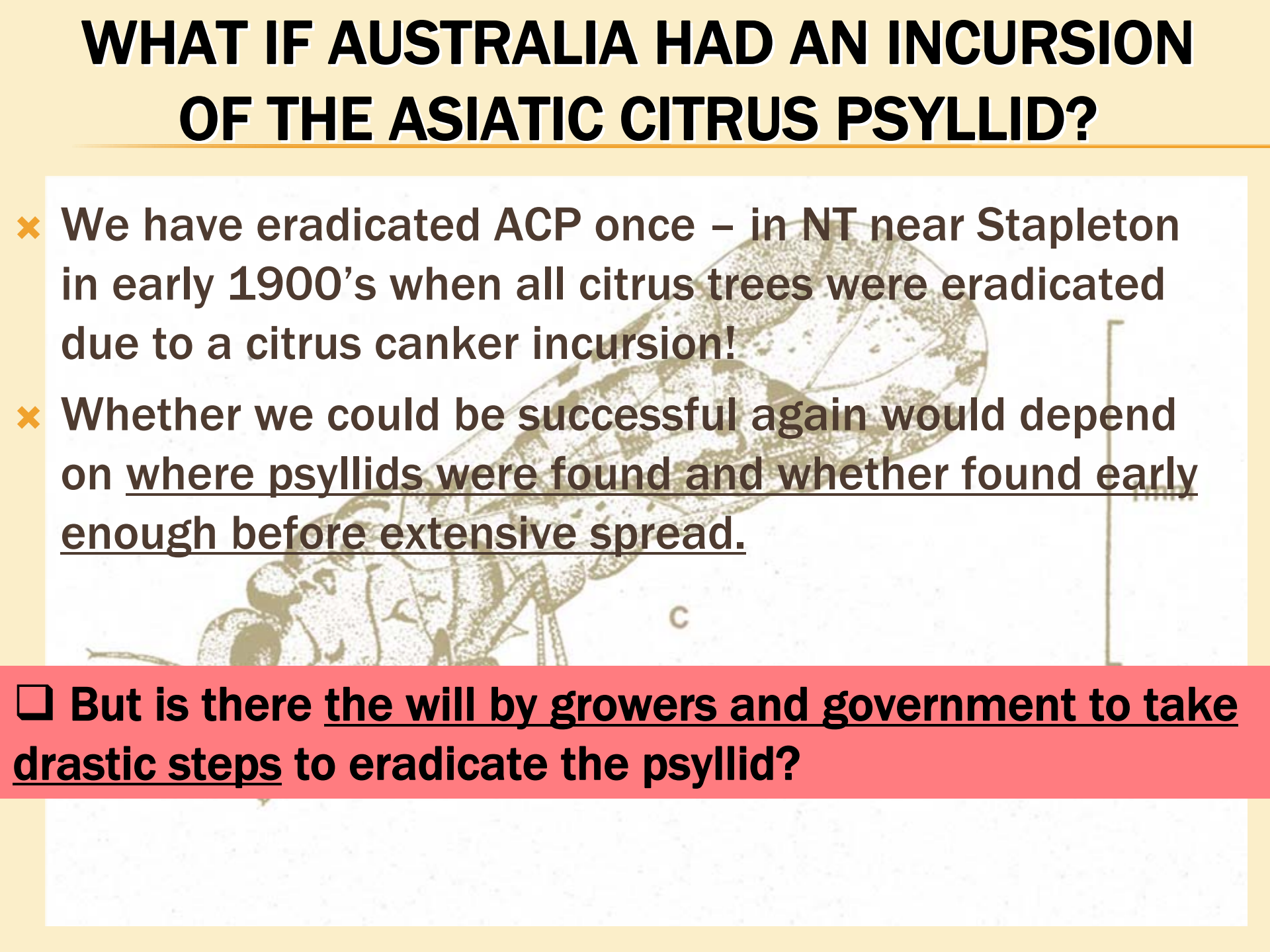
Eight years ago, Florida produced 240 million boxes of fruit. Today – 138 million!

Employment in related industries also affected.

In Australia, a full economic assessment of the potential impact of HLB/ACP on citrus, nursery and allied industries, and on regional economies should be completed before an incursion occurs, to inform industry leaders and decision makers in government of the economic importance of HLB and the need to eradicate the psyllid and the disease.

WHAT IF AUSTRALIA HAD AN INCURSION OF THE ASIATIC CITRUS PSYLLID?

- We have eradicated ACP once – in NT near Stapleton in early 1900's when all citrus trees were eradicated due to a citrus canker incursion!
- Whether we could be successful again would depend on <u>where psyllids were found and whether found early enough before extensive spread.</u>



❑ **But is there <u>the will by growers and government to take drastic steps</u> to eradicate the psyllid?**

RESPONSE PLAN IF WE HAVE AN INCURSION

From Plant Health Australia's PLANTPLAN:

Members are eligible for owner reimbursement costs, but they may also be required to contribute to the costs of the implementation of the response plan. The cost sharing arrangements are based on the category of the emergency plant pest.

Category	Funding	Example
Category 1	100% government	Sudden oak death
Category 2	80% government | 20% industry	HLB
Category 3	50% government | 50% industry	ACP
Category 4	20% government | 80% industry	Army worm

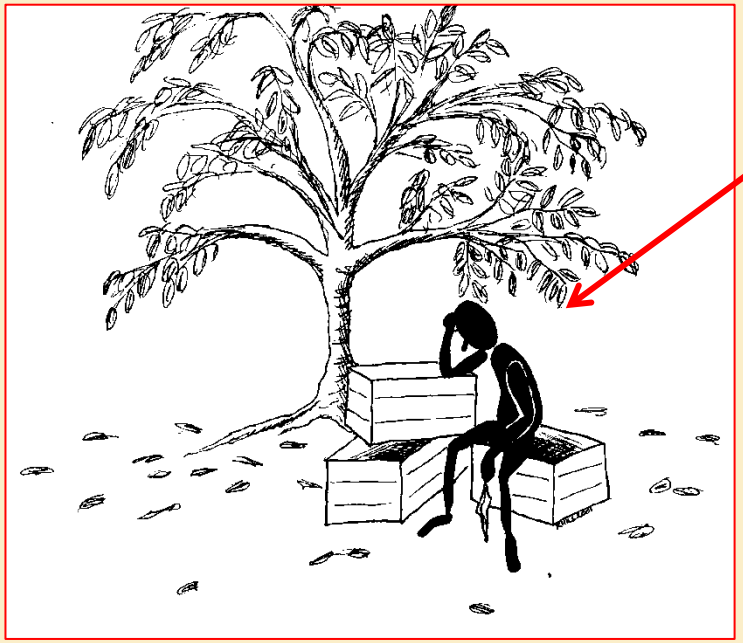
- **Citrus Australia requested PHA re-categorise ACP to a Category 2 – rejected by some state departments**

- **Owner Reimbursement Costs framework for citrus must be established as per Australian Citrus Strategic R&D Plan 2012–17:**

b.9 Provide more clarity around owner reimbursement costs for biosecurity incursions.

WHAT ELSE IS NEEDED?

- A National Scientific Task Force to address issues related to pre-incursion preparedness for an incursion needs to be reformed;
- Surveillance for ACP incursions, including maintenance of current NAQS and QDAFF activities in northern Australia, and establishment of surveillance programs in other states for nurseries, orchards, urban areas and areas where native or naturalised hosts occur and around air force bases and ports;
- Awareness plan in place to be rolled out when an incursion of ACP and/or HLB occurs;
- Updating of the HLB/ACP Pest Specific Contingency Plan based on the experiences of California, Florida and Brazil in dealing with incursions of ACP and HLB and on the scientific knowledge gained since 2009. **It must not be generic!**



Will this be an Australian citrus grower if psyllids and HLB arrive?

Will government and industry be (a)prepared for an incursion of ACP/HLB and
(b) willing to take drastic steps to prevent the establishment of the Asian citrus psyllid?

Will the nursery industry, including propagators of orange jasmine as well as citrus, support eradication efforts?

"Citrus canker is like a cold. It is unpleasant, but you can live with it. Huanglongbing is more like a cancer : you have to deal with it in a more serious manner" (M. Irey, Southern Gardens Citrus, Florida).

ESSENTIAL FOR CONTROL OF ENDEMIC HLB AND ITS VECTORS

- **Mandatory area-wide management practices e.g. psyllid sprays**; (this will be difficult where orchard sizes are small).
- **Legislation** for **mandatory removal** of infected plants and abandoned orchards.
- **Mandatory and immediate destruction of HLB-infected trees** by cutting each trunk and applying glyphosate to the stump to kill the roots (this must be done without waiting to harvest any mature fruit);
- **Mandatory and immediate destruction of** all trees in a block **should the % HLB-infected trees reach 10% within 1 year**

Healthy young trees from covered, insect-free nurseries

Elimination of symptomatic trees

HLB Management

Insecticide treatments

HLB/ACP RISK ANALYSIS BY AUSCITRUS

- **All imported citrus varieties are tested for HLB in post-entry quarantine by AQIS**
- **Auscitrus is working towards:**
  - **Maintenance of budwood sources in insect-proof screenhouses**
  - **Registration of all nurseries propagating HLB hosts, particularly *Citrus* and *Murraya***
  - **A legally mandated certification or accreditation scheme for use of pathogen-tested citrus budwood**

ALL ESSENTIAL IF WE ARE TO BE PREPARED FOR A PSYLLID INCURSION

YOU CAN HELP!

- Buy only trees from a reputable nursery using pathogen-tested Auscitrus budwood
- **Don't bring plant material into Australia from other countries illegally**
- Learn to recognize psyllids and HLB symptoms
- Check flush foliage of citrus and orange jasmine - wherever you go for citrus psyllids
- Call your Department of Agriculture office immediately, if you suspect you have either the pest or the disease OR call

EXOTIC PLANT PEST HOTLINE
1800 084 881