



# Managing graft-transmissible citrus diseases in Australia and the importance of high health budwood

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# Citrus Pathology Program

## Prevention

- Reducing the smuggling risk
- Supporting post-entry quarantine
- Supplying high health status germplasm



## Detection

- Improving surveillance and diagnostics



## Eradication

- Supporting responses

## Management

- Improving our understanding of
  - Alternaria black core rot
  - huanglongbing
  - dwarfing viroids





# Graft-transmissible diseases



reduced yield and quality



TREE DEATH



stunting





# Beneficial graft-transmissibles – dwarfing viroids

- Higher returns per hectare for high density plantings
  - compensates for greater establishment cost
- No impact or improved fruit quality
- Advantage over dwarfing rootstocks
  - no effect on canopy development until 4-5 years after inoculation, yield affected 1-2 years later (for trifoliata, longer for citrange)
  - dwarfing rootstocks are typically slow growing in the nursery and vigour is still slow after establishment in the orchard

Ideal management and conditions are required  
Sterilise all cutting tools with sodium hypochlorite  
You MUST know the health status of the tree before inoculation

# Transmission

- infected budwood or seed
- mechanical transmission
- root grafting
- vectors

not all graft-transmissible diseases are vectored

citrus tristeza virus (CTV) is the only one in Australia



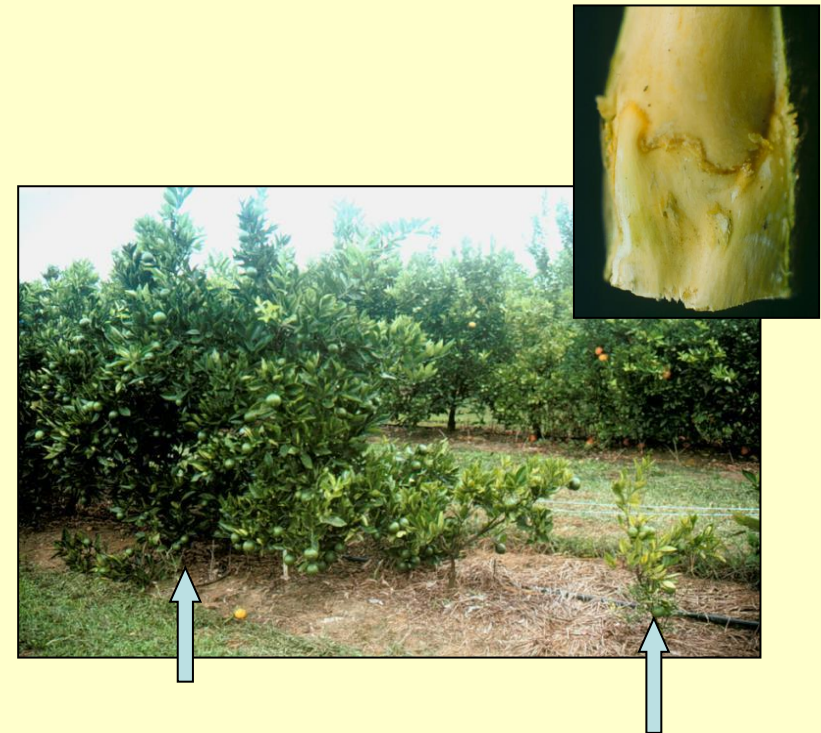
# Graft-transmissibles

Range from no - mild - moderate - severe symptoms

Symptom development may be delayed for years

Symptoms may only be seen in some varieties

BUT symptomless varieties can be carriers



**NO CURE**

# Graft-transmissibles

## Multiple infections

Antagonistic

Mild strain cross protection - inoculate plants with a mild isolate of CTV inhibits severe grapefruit stem pitting isolates



Synergistic

Can be worse in combination

e.g. single infection of CVd-V – mild symptoms

mixed infection CVd-V with dwarfing viroid OR CVd-VII

leads to severe dwarfing



Know what's in  
your budwood

Biosecurity is everyone's responsibility



# Threats to Australian citrus

# Local threats

# citrus exocortis viroid (CEVd)

Field trials over first 9 years showed ↓ yields

- navel on citrange ↓ by ~50%

- navel on trifoliata ↓ by ~65%

Auscitrus bud adds \$0.60 to cost of nursery tree.







citrus tristeza virus  
CTV

vectored by aphids



# Exotic threats



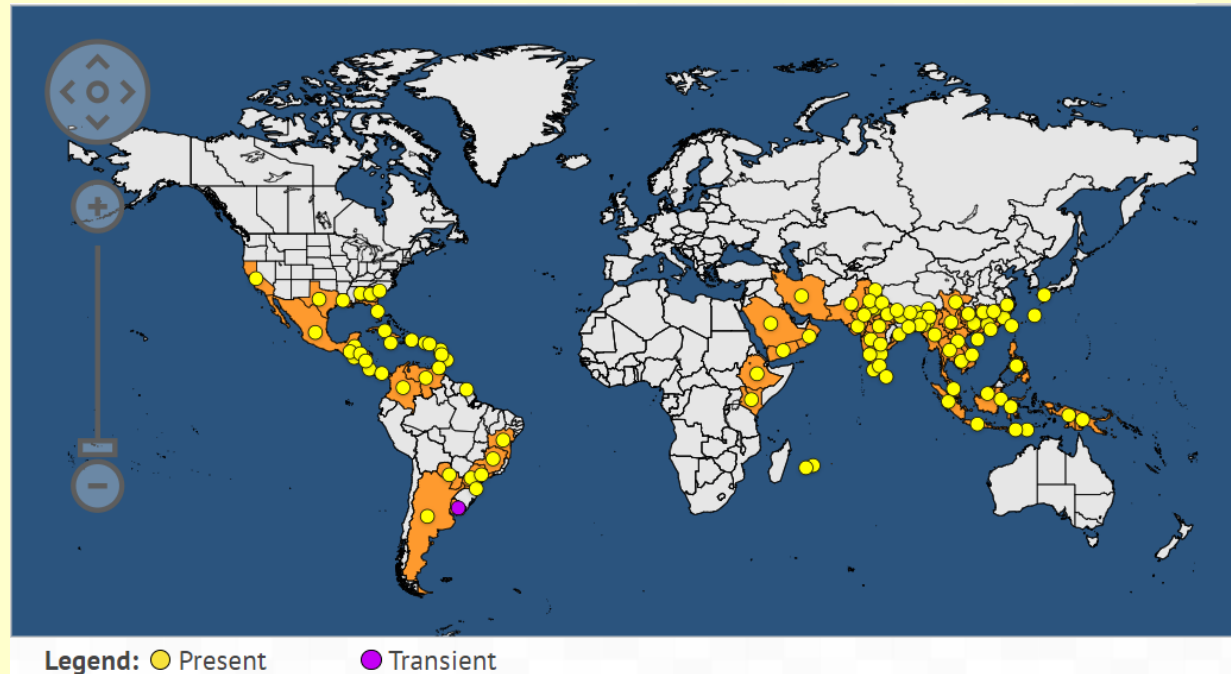
# Huanglongbing HLB



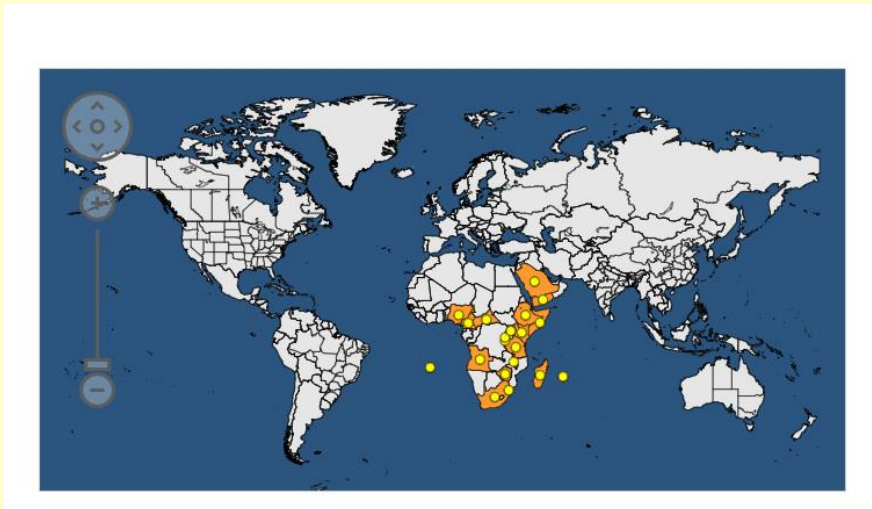


# Asian citrus psyllid ACP

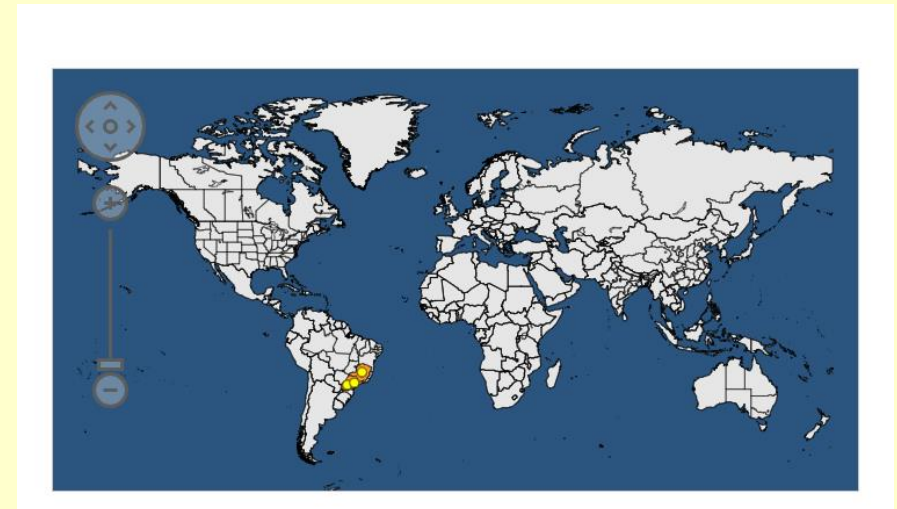




Global distribution: '*Candidatus Liberibacter asiaticus*'



'*Candidatus Liberibacter africanus*'

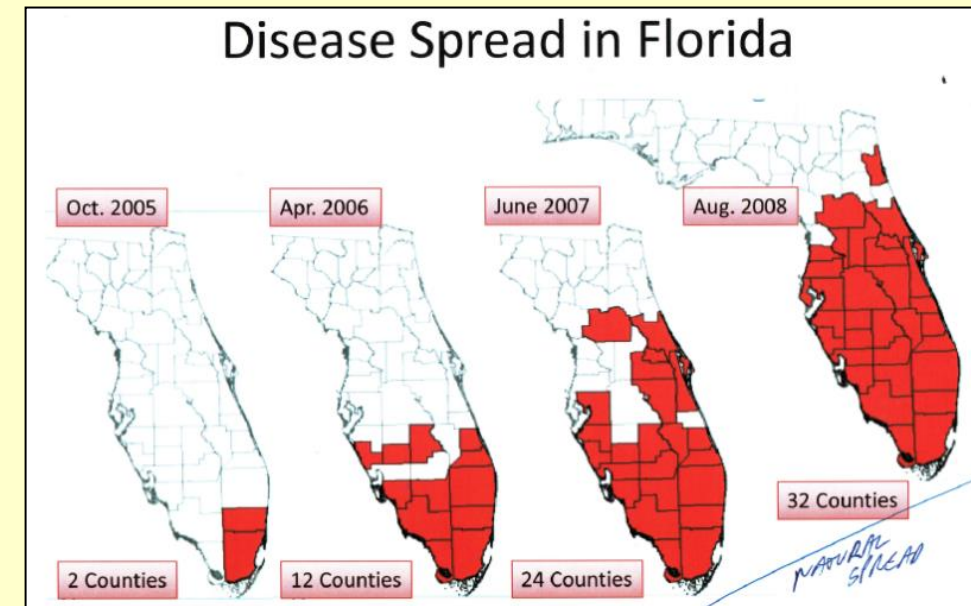


'*Candidatus Liberibacter americanus*'



# Case study: HLB in the USA

- HLB detected in Florida in 2005
  - also in Texas, South Carolina, Louisiana, Georgia, California
- Production ↓ ~ 75%
- Cost of production ~ doubled







CYVCV



CVC – Xylella

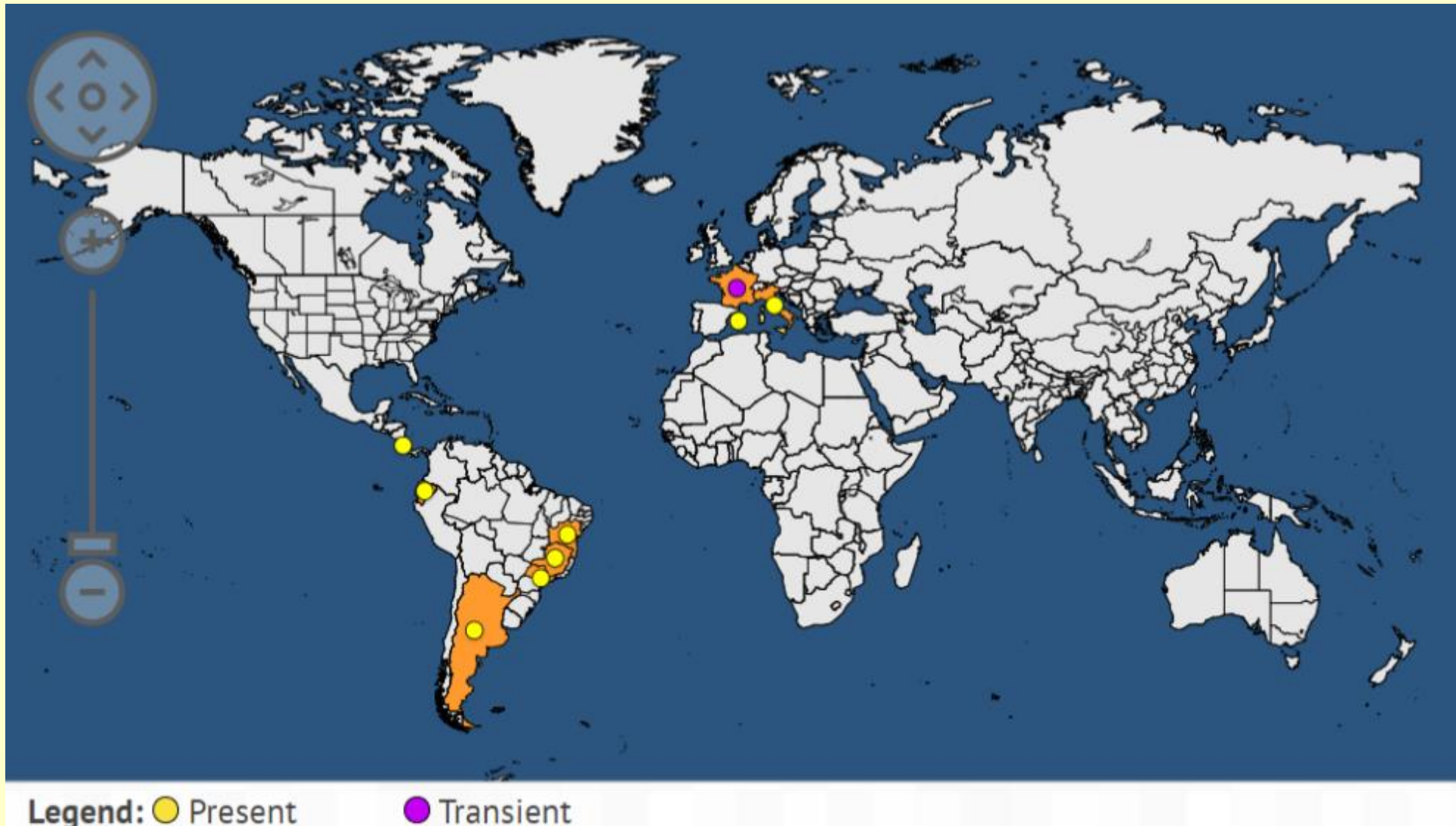


© Andrew Miles





Global distribution: *Xylella fastidiosa* subsp. *pauca*



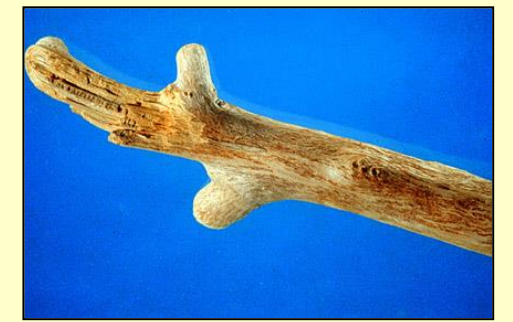
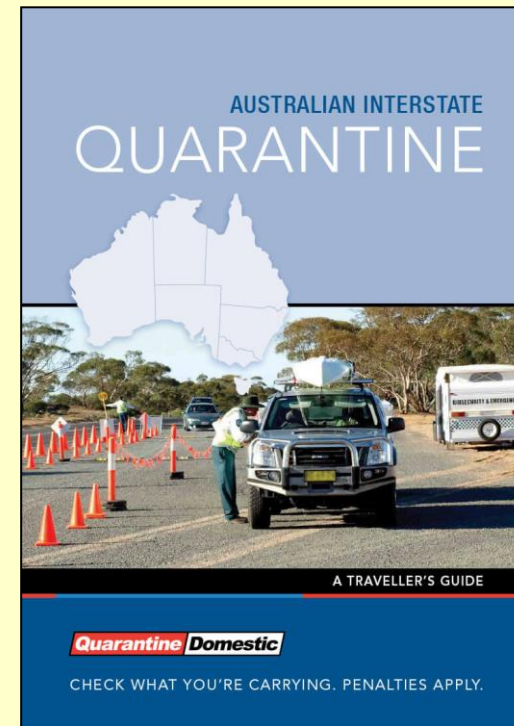
# How do we manage graft-transmissible diseases?

- Border protection
- Post-entry quarantine for imported varieties
- Interstate or regional quarantine
- National Citrus Repository Programme
- Auscitrus Propagation Scheme
- Vector management





# Quarantine



Legal importation of new citrus varieties through post-entry quarantine (PEQ)



SBS FILIPINO

### Australia avoids potential citrus outbreak



00:00 08:53

(Supplied by C.Macintosh)

A Brisbane airport passenger has been caught trying to smuggle an infected citrus budwood in the country.

By Celeste Macintosh File size 16.29 MB [Tweet](#)  
Published on Tuesday, September 4, 2018 - 15:39 Duration 8 min 54 sec


# Domestic quarantine

- legislation prohibits the movement of citrus plant material from Qld
- orange stem pitting isolates of CTV – only reported in Qld
- no symptoms observed outside of Qld – no recent survey data
- mandarins – symptomless carriers
- If spread, it would destroy our southern orange industry

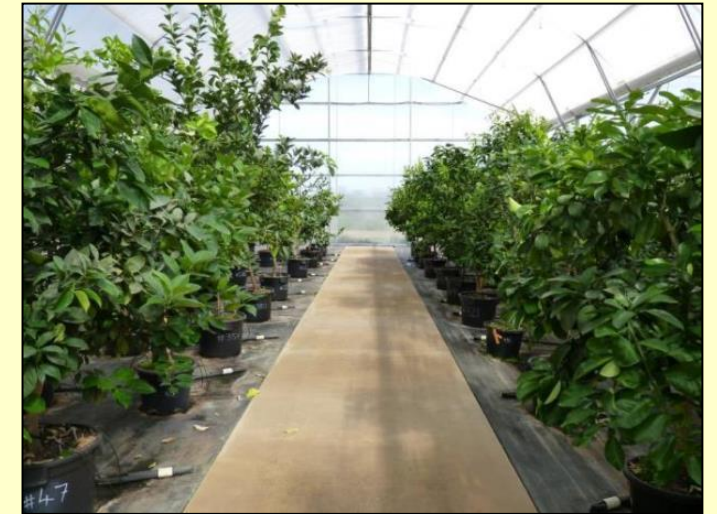
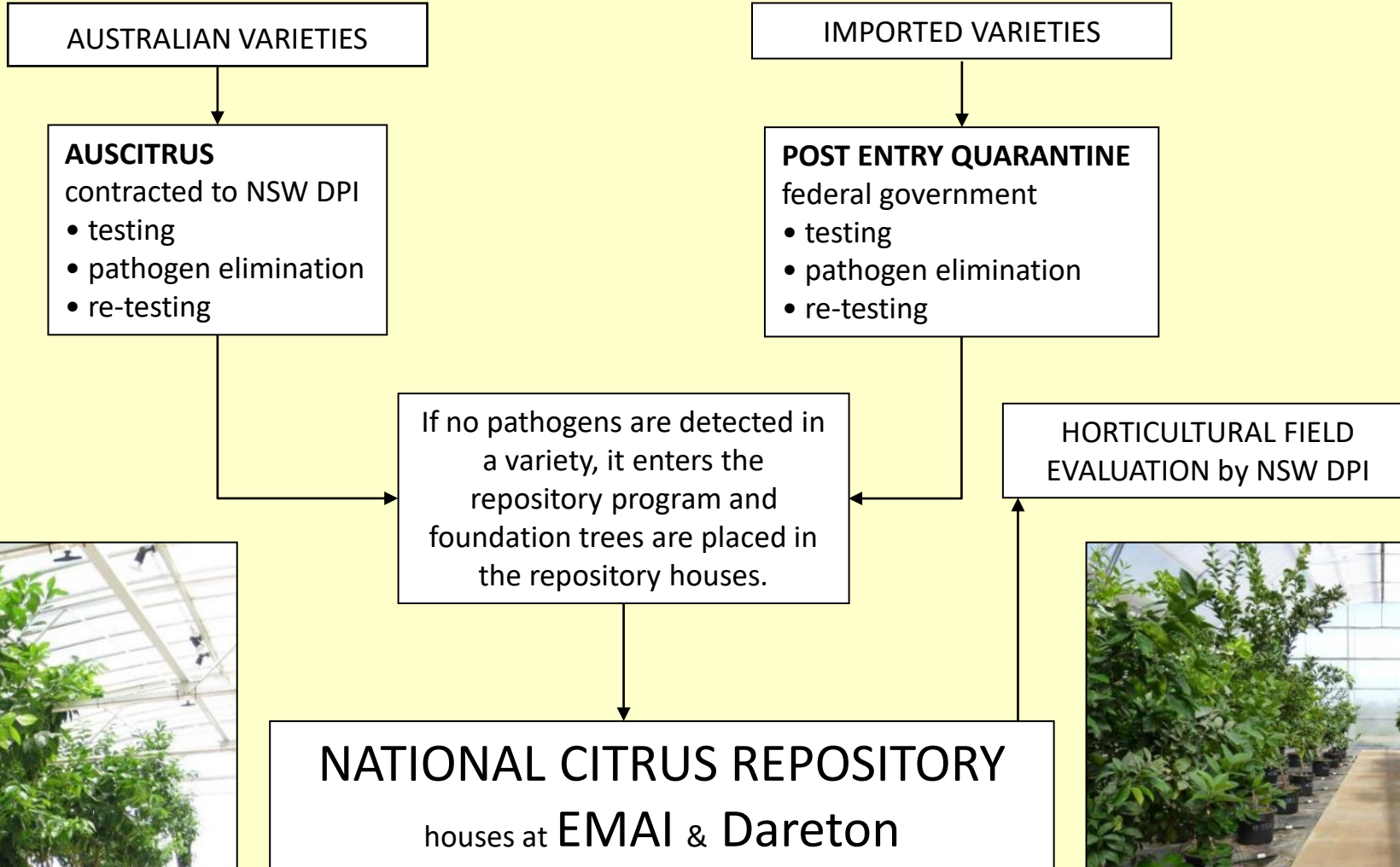
**REDUCE SPREAD TO REDUCE IMPACT**



# Australian citrus industry

Problem	Solution
<p>Early 1900's – budwood source trees not checked for disease (CTV, CPsV) or trueness to type</p>	<p>Cooperative Bud Selection Society est. 1928</p>
<p>1940's – Phytophthora on sweet orange / rough lemon rootstock</p>	<p>trifoliata rootstock</p>
<p>Citrus exocortis viroid on trifoliata</p>	<p>1953 - Parent tree registration scheme evolved with help from NSW DPI to form</p> 

# National Citrus Repository Program







Auscitrus property, Dareton



# Pathogen tested budwood and seed

Viroids	Viruses
citrus exocortis viroid	citrus psorosis virus (CPsV)
citrus bent leaf viroid	citrus virus A (CiVA)
hop stunt viroid (HSVd) incl. cachexia	citrus concave gum associated virus (CCGaV)
citrus dwarfing viroid (CDVd)	apple stem grooving virus (ASGV) – tatterleaf
citrus bark cracking viroid (CBCVd)	
citrus viroid V (CVd-V)	citrus tristeza virus (CTV) – grapefruit stem pitting isolates
citrus viroid VI (CVd-VI)	grapefruit budwood inoculated with a mild isolate of CTV
citrus viroid VII (CVd-VII)	to protect against severe stem pitting CTV



# Pathogen elimination

Heat treatment and shoot tip grafting can be used to remove graft-transmissible pathogens from citrus varieties

Shoot tip graft from 0.1 mm bud

Sterile rootstock (5 cm)



# Reducing the risk of illegally imported citrus budwood

Review the demand for culturally significant varieties

expert panel and wider stakeholder engagement

cultural significance

risk of online sales

Identify and source varieties

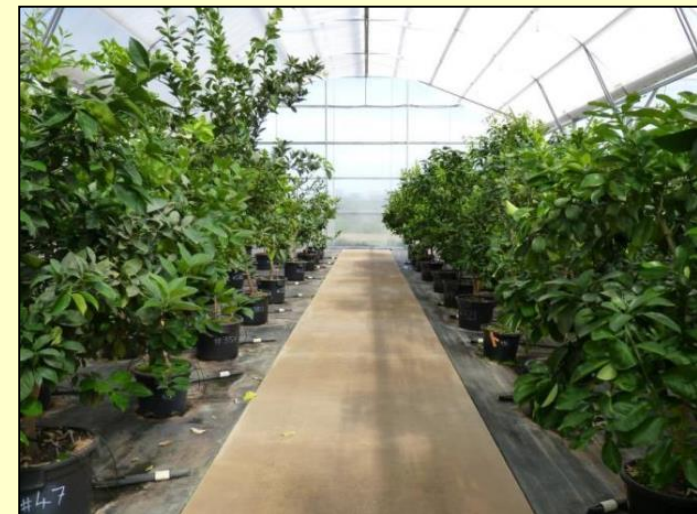
may involve imported or local sources

Make high health status propagation material available

Australian Citrus Variety Testing Program

National Citrus Repository Program

Support awareness of variety availability





# Improving Australia's ability to respond to graft-transmissible citrus diseases

## Detection methods

evaluate published methods

develop new methods to detect Australian strains

develop improved methods using new technologies

## New pathogens

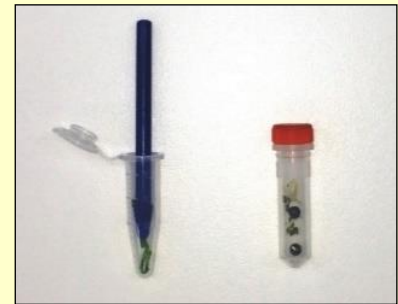
assess biological and economic impact

## National capability

expand through diagnostic hubs

## Awareness

## Surveillance



# 53 graft-transmissible citrus threats

(not including strains, variants)

31 viruses

8 viroids

14 bacterial and bacterial-like

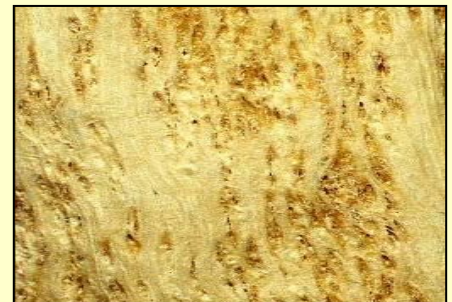
# 36 exotic



# Understanding cross-protection of diseases in horticulture crops – a case study of citrus tristeza virus

To strengthen Australia's ability to combat (CTV) by

- improving our understanding of the diversity of CTV in Australia
- developing methods to identify and diagnose severe strains of CTV
- developing pipelines to select or generate mild strains of CTV for use in cross-protection



Government surveillance  
National Border Surveillance Program  
Northern Australia Quarantine Strategy (NAQS)  
National Plant Health Surveillance Program



NAQS / state government / citrus industry  
joint surveillance activities



Hort  
Innovation CITRUS  
FUND

Industry-driven  
citrus surveillance







An exotic citrus pest & disease surveillance and education program. Industry funded. Run throughout Australia across citrus orchards and urban areas. Largely relies on an extensive volunteer-based Early Detector Network across Australia.

Team:



Major partner:




African citrus psyllid  
*Trioza erytreae*



Citrus variegated chlorosis  
*Xylella fastidiosa*

Surveillance targets

- Priority exotic citrus pests identified in the Aust Citrus Industry Biosecurity Plan
- Over 20 species identified with threat levels of HIGH or EXTREME
- Six are key targets of the program activities



The Asian citrus psyllid  
*Diaphorina citri*



Huanglongbing disease  
*Candidatus liberibacter asiaticus / africanus*



Citrus canker disease  
*Xanthomonas citri*



Glassy-winged sharpshooter  
*Homalodisca vitripennis*

The Early Detector Network includes...





# Building knowledge and awareness

**CITRUSWATCH**

Spotted something UNUSUAL???

**REPORT EXOTIC CITRUS PESTS: What are we most worried about?**

Please call the Exotic Pests Hotline on 1800 084 881 or...

Submit a report with MyPests@dpi.nsw.gov.au

Report your observation

**Asian citrus psyllid (ACP)**

**What is it?** A sap-sucking insect that can spread the disease, Huanglongbing (HLB; also known as 'citrus greening') by feeding on plants' leaves and stems (refer to Page 2).

**What does it look like?** Adults are small (3-4 mm), brownish with mottled brown patches on forewings. Nymphs are dull orange with red eyes, and eggs are yellow-orange and almond shaped.

**Which plants are affected?** All commercial citrus: native and ornamental mock orange (Murraya spp.), and curry tree.

**African citrus psyllid (AACP)**

**What is it?** Like the ACP, it is also a sap-sucking insect that can spread the disease, Huanglongbing (HLB; also known as 'citrus greening') by feeding on plants' leaves and stems (refer to Page 2).

**What does it look like?** The adults are small (4 mm) with large, transparent forewings that have distinct veins. Nymphs vary from yellow, olive-green to dark grey and are flat with distinct marginal fringes of white, waxy filaments. Eggs are yellowish orange, cylindrical with sharp points.

**Which plants are affected?** All commercial citrus: native and ornamental mock orange (Murraya spp.), and curry tree.

**Glassy-winged sharpshooter (GWS)**

**What is it?** Large leafhopper that causes direct damage through its feeding activities, and excrement "showers". It is also highly efficient at spreading a bacteria which causes citrus variegated chlorosis (refer to Page 2).

**What does it look like?** Adults are 12-14 mm long with a large flat head that have yellow dots, prominent eyes, and translucent wings with reddish veins. Nymphs are dark grey to grey, and eggs are 'sausage' shaped.

**Which plants are affected?** Over 100 plant species including commercial hosts like citrus.

AUSTRALIAN

## Citrus News

Biosecurity begins with best practice

2022-2023

TECH FORUM REVIEW

13-23

Citrus Australia

5 Exports rise in value

9 Air-fuel safety ready

26 Controlling Citrus Gull Virus

**CITRUSWATCH**

### Common hosts of the exotic Asian citrus psyllid

Orange (Citrus sinensis)

Common lime (Citrus latifolia)

Carrotwood (Carpenteria acronotata)

Curry leaf plant (Murraya koenigii)

Guavaquat (Eugenia jambolana)

Pomelo (Citrus grandis)

Carriway (Citrus aurantium)

Wax myrtle (Callitris glauca)

Mandarin (Citrus reticulata)

Lime (Citrus aurantifolia)

Trifoliate orange (Poncirus trifoliata)

## Biosecurity Manual for Citrus Producers

Reducing the risk of new pests impacting your orchard

Version 2.0 December 2014

Plant Health AUSTRALIA

Horticulture Innovation Australia

Citrus Australia

NSW Department of Primary Industries

### Exotic Plant Pests and Diseases of Citrus

www.dpi.nsw.gov.au

Plant Biosecurity Research Symposium 11-12 May 2022

Advancing our greater research impact

PLANT BIOSECURITY RESEARCH INITIATIVE

PLANT BIOSECURITY RESEARCH SYMPOSIUM 2022

PLANT BIOSECURITY RESEARCH INITIATIVE

Department of Primary Industries  
Department of Regional NSW

NSW GOVERNMENT

## Citrus plant protection guide 2023-24

NSW DPI MANAGEMENT GUIDE

www.dpi.nsw.gov.au



Department of Primary Industries and Regional Development

### Agriculture and Food

search citrus website

Go to whole of WA Government search

Climate, land & water

Crops

Livestock & animals

Pests, weeds & diseases

Agribusiness Food & Trade

Biosecurity & quarantine

About us

Tools & support

Home > Biosecurity & quarantine > Biosecurity > Plant biosecurity > Citrus biosecurity and quarantine

#### Biosecurity & quarantine

Biosecurity

Invasive species

European house boer

Livestock biosecurity

Livestock movement & identification

Wildlife biosecurity

#### Citrus biosecurity and quarantine

Page last updated: Wednesday, 19 January 2017 - 10:27am

Protecting Western Australian citrus orchards from pests and diseases that could significantly affect their production and therefore the availability of citrus is an important activity of growers, industry and the government.

Author: Bronwyn Walsh

See Also:

- 1 Frequently asked questions about the DM Act and HSC.
- 1 Citrus orchard management

External Links

15 Citrus Australia quarantine and biosecurity



# Preparedness and management of huanglongbing (HLB) to safeguard the future of the citrus industry in Australia, China and Indonesia

## HLB and ACP not found in Australia

- HLB and ACP management practices
- HLB tolerant rootstocks
- High density plantings
- Asian citrus psyllid (ACP) repellents
- ACP trapping
- Intercropping
- Extension

Indonesia – improve understanding

Australia – awareness and preparedness



Project Leader  
Dr Jianhua Mo



# National Tree Crop Intensification in Horticulture

## Dwarfing viroids for high density citrus plantings

Field trials single / mixed infections:

- commercial dwarfing viroid
- potential dwarfing viroid
- newly discovered or detected viroids
- pathogenic viroids

Project Leader  
Dr David Monks



ORDER OF INOCULATION



Know what's in  
your budwood

Biosecurity is everyone's responsibility



Ask your nursery if they used Auscitrus buds





Use clean cutting  
tools

Biosecurity is everyone's responsibility

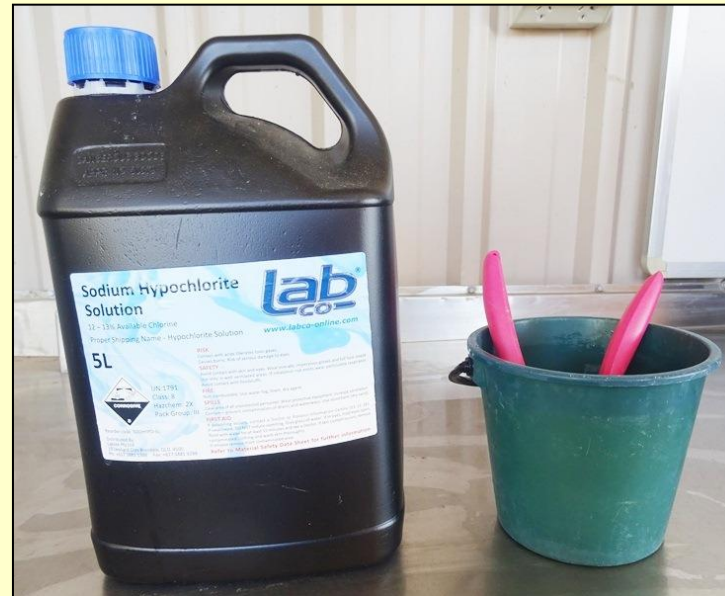
# Sterilise cutting tools

Disinfect cutting tools between each tree

Use 1.25% or 12,500 ppm sodium hypochlorite solution

sodium hypochlorite = chlorine bleach

Use a fresh solution every few hours





**Report unusual  
symptoms**

Biosecurity is everyone's responsibility

**EXOTIC PLANT PEST HOTLINE**

**1800 084 881**





Biosecurity is **EVERYONE'S**  
responsibility

