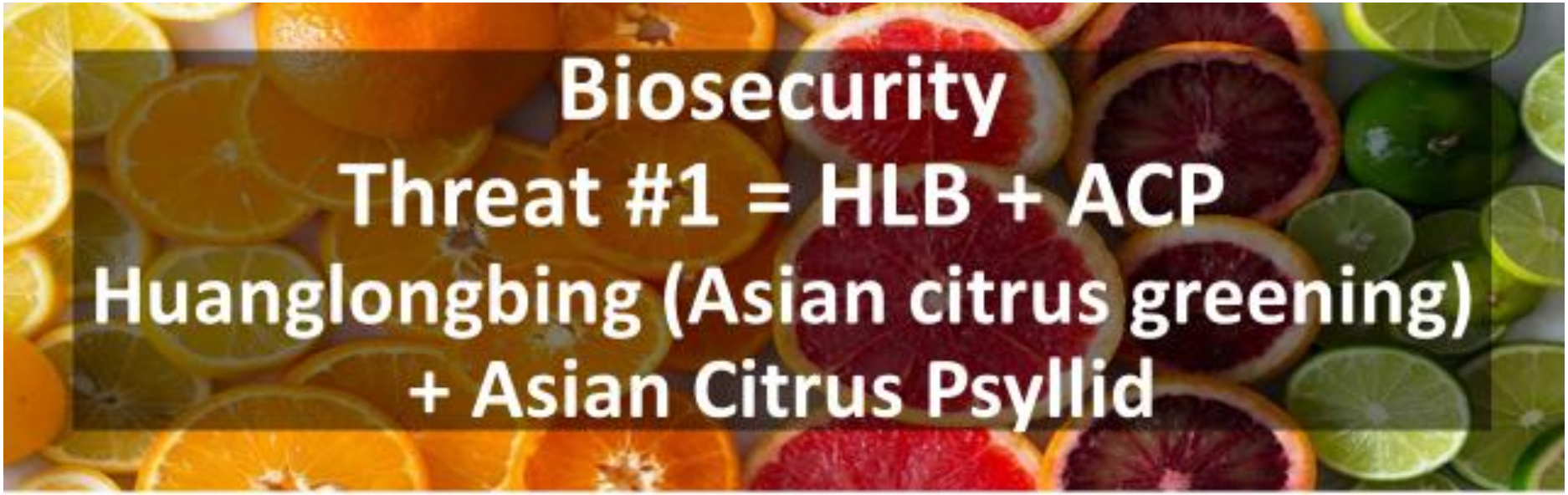

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CONTRIBUTORS

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cri

HLB in southern Africa - a story with two possible ends

The Florida tale = doom and gloom

OR

The Brazil tale = a fighting chance

AN
D

Southern African HLB + ACP Action Plan

HLB: What is it?

- A devastating disease of citrus
- Caused by the bacteria *Candidatus* Liberibacter asiaticus (Las)
- Common names: HLB = Huanglongbing, yellow shoot disease, Asian greening, yellow dragon disease
- First reported in China in 1919. More recently in South and North America.
- Renders fruit unusable, causes severe yield loss and tree death.
- **THE WORST CITRUS DISEASE WORLDWIDE.**

How is HLB different from African Greening Disease

- HLB kills trees / Greening does not
- No cure for HLB / Greening can be managed
- Las (HLB) is heat tolerant / Laf (Greening) is heat sensitive

ACP: What is it?

- *Diaphorina citri* Asian citrus psyllid
- Primary vector of HLB (highly effective)
- Indigenous to China
- Heat tolerant
- Strong flyer
- Minor feeding damage (often undetected at low numbers)
- No highly attractive lure (trap monitoring is not sensitive)
- Presence of ACP precedes the HLB epidemic

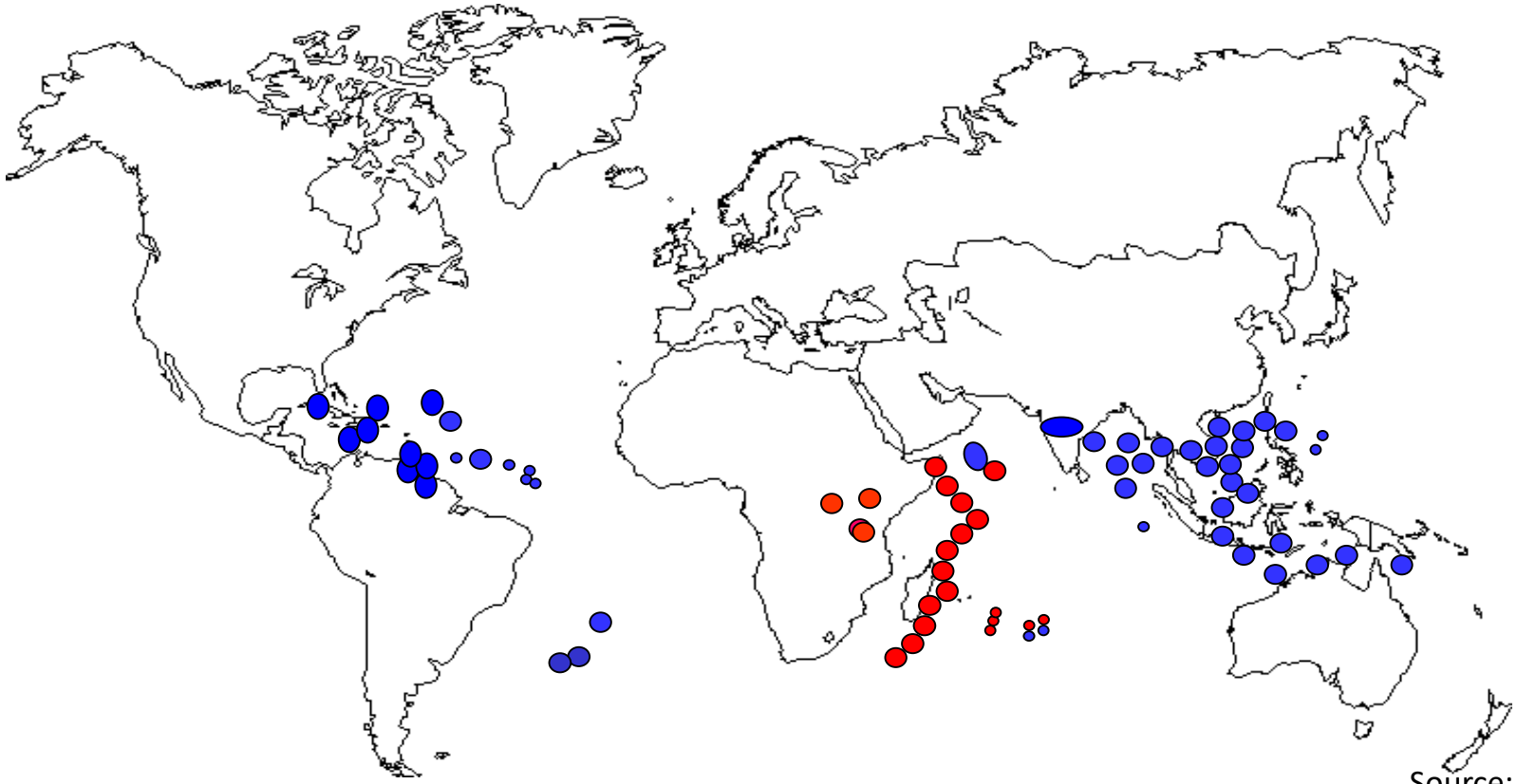
How is ACP different from *Trioza erytreae*

- ACP is heat tolerant / *T. erytreae* is heat sensitive
- Las persists at high levels in ACP host / *T. eyrtreae* is a less effective vector
- ACP presence may not be obvious due to limited damage / *T. erytreae* feeding damage is obvious.

Why should the southern African citrus industry be concerned – *very concerned*

- Currently no effective remedy or sustainable management strategy for HLB, and none on the near horizon
- South Africa shares biosecurity risk with Africa. ACP and HLB occurs in close geographic proximity to southern Africa.
- South African ports of entry are NOT SECURE.
- Citrus hosts are widely present throughout eastern and southern Africa.
- No effective means to stop ACP spread.
- HLB difficult to detect at early stages of infection.
- Not IF, rather WHEN

DISTRIBUTION of Candidatus *Liberibacter africanus* (●) and *asiaticus* (●)



Source: T Gottwald

Transmission

Adult positive psyllid feeds on new shoot

Shoot is infected, but infection is transient

Nymphs are infected as they develop. They can repeat the process when they mature.

Symptoms develop months to years later.

Photos: Jeff Lotz & Susan Halbert

Symptoms

Photos: Susan Halbert

HLB epidemic

Photos: Susan Halbert

THE FLORIDA STORY

Original 1998 distribution of *D. citri* (delimiting survey)

Photo: Jeff Lotz & David Ziesk

First find of *D. citri*, June, 1998

Original distribution of *D. citri*

Source: S Halbert

Long range dispersal

- Nursery stock (*Murraya* spp. plants and citrus plants)
- Fruit trucks (plant debris)

Source: S Halbert

HLB in Florida: 7 years after first ACP find

Palmetto Bay *Citrus* sp.

August 2005

Florida City *Citrus maxima*

First find locations

Photos: Xiao-an Sun and Susan Halbert

Positive psyllids were found to precede positive plants

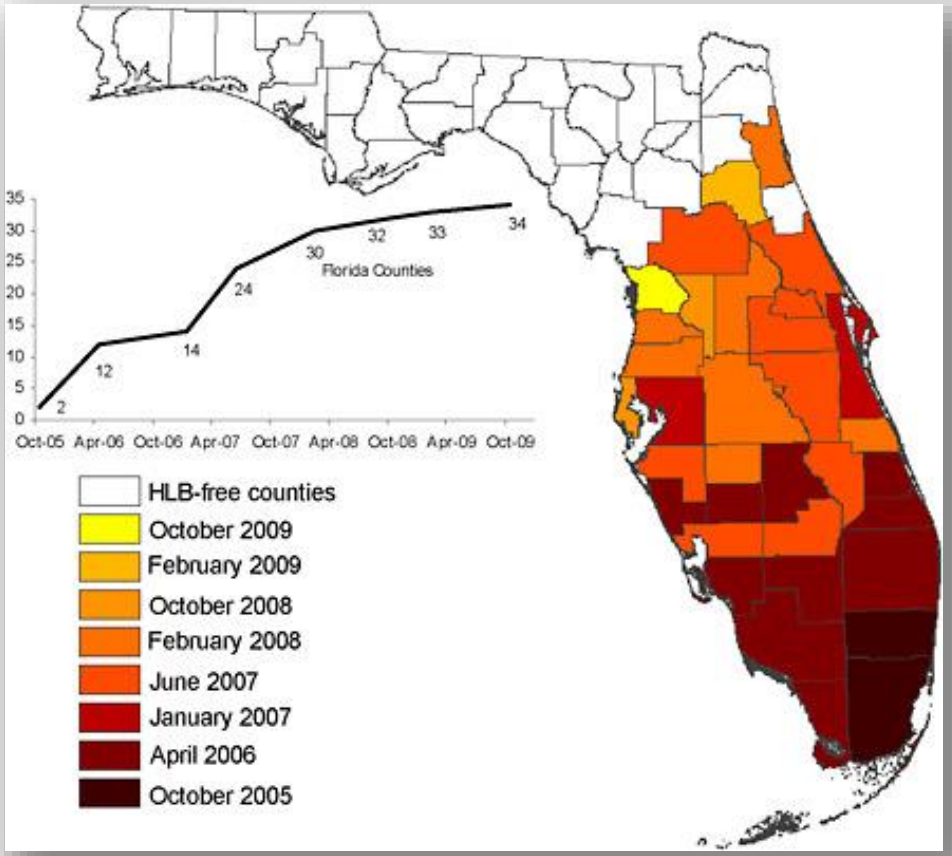
- Positive psyllids detected 6 years prior to plant positive detection in two groves
- Average 9 months between positive psyllid detection and plant positive detection in retail venues

http://journals.fcla.edu/flaent/article/view/80375/77616

http://apsjournals.apsnet.org/doi/pdfplus/10.1094/PHYTO-98-4-0387

Source: S Halbert

Spread of HLB in Florida



- 100% of Florida orchards infected
- 15 million trees lost
- 15 of the 20 juicing plants closed
- Citrus production 2017 < 1942
- Decrease in production: 225m 40lb boxes to 45m in 2017-18.
- $8.6 billion (USA) economic impact
- Cumulative decline in 10 seasons of 34 000 jobs

Source: T Gottwald

Source: S Halbert

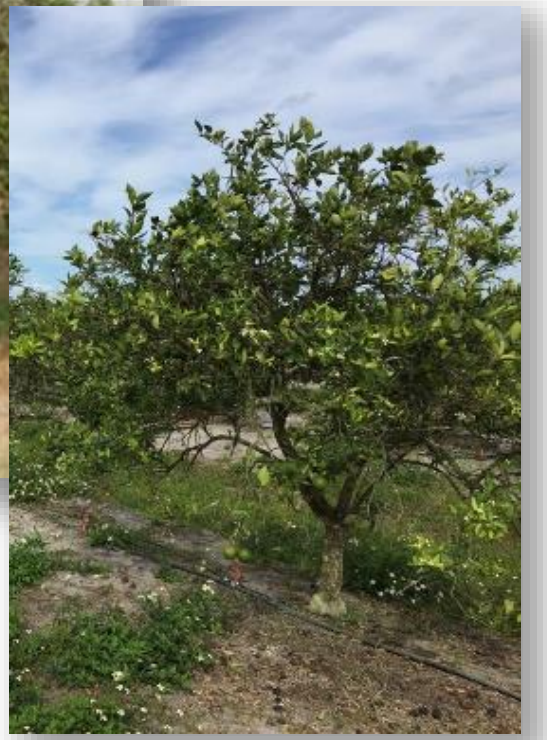
Snapshots in time……

Source: T Gottwald

HLB in Florida

2007: Healthy

2016: HLB
Varies from sparse but nonproductive to dead



Source: T Gottwald

Photos: Susan Halbert

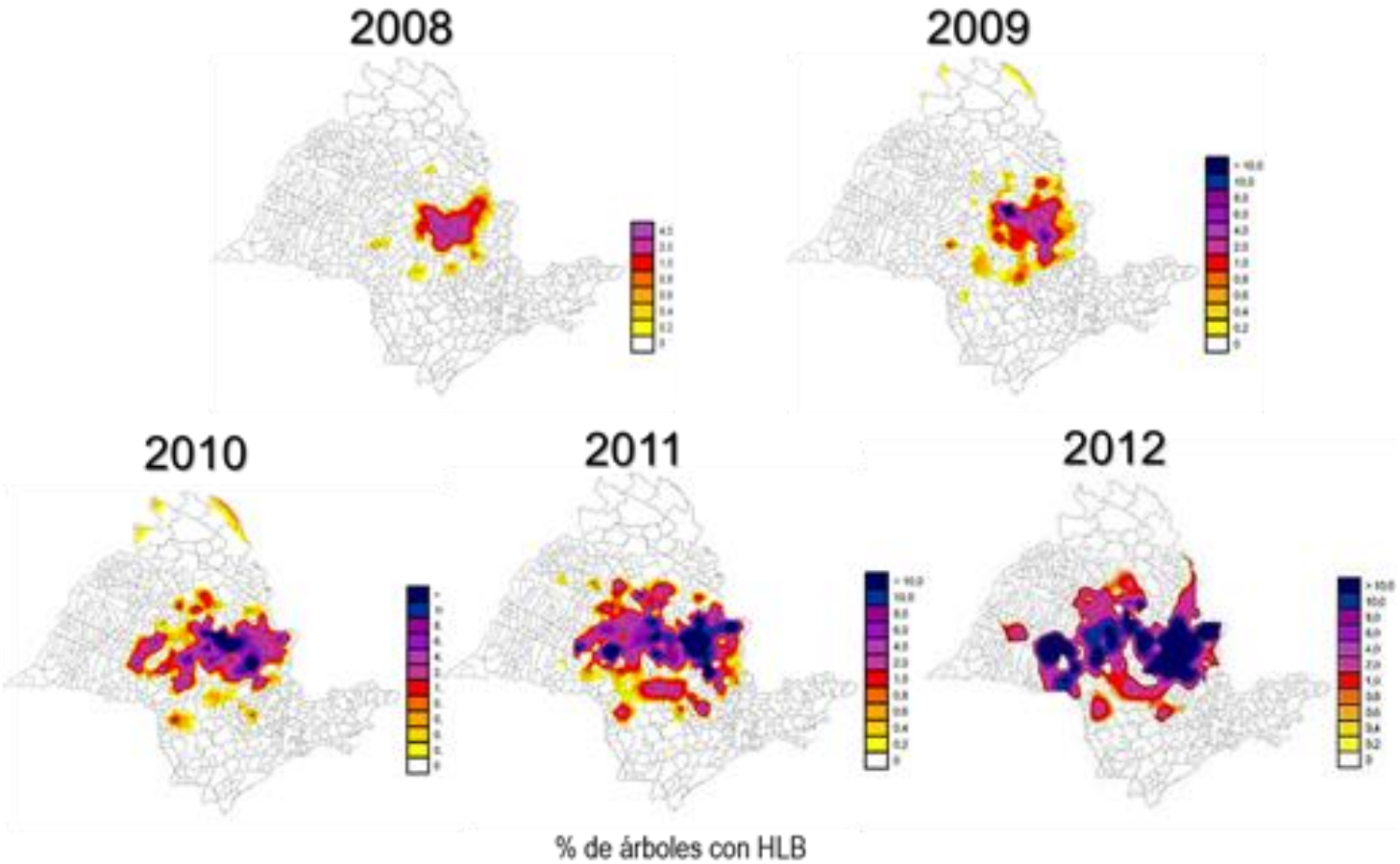
Source: S Halbert

Source: S Halbert

The Brazil story – signs of hope, despite major impact

- **ACP in Brazil since 1942, spread throughout Brazil over time especially with *Murraya* spp.**
- **HLB first detected 2004**
- **HLB spread with ACP and *Murraya* spp. plants (not citrus since all nurseries were already enclosed for CVC)**

Rate of HLB spread in Brazil
ACP already present throughout before HLB first detected in 2004



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HLB: impact in São Paulo

- Increase of production costs (15-25%)
- Elimination of 52.6 million orange trees
- Reduction in orchard number (23% from 2015 to 2018), mainly small and medium-sized growers
- Reduction of citrus area (25% from 2005 to 2018)

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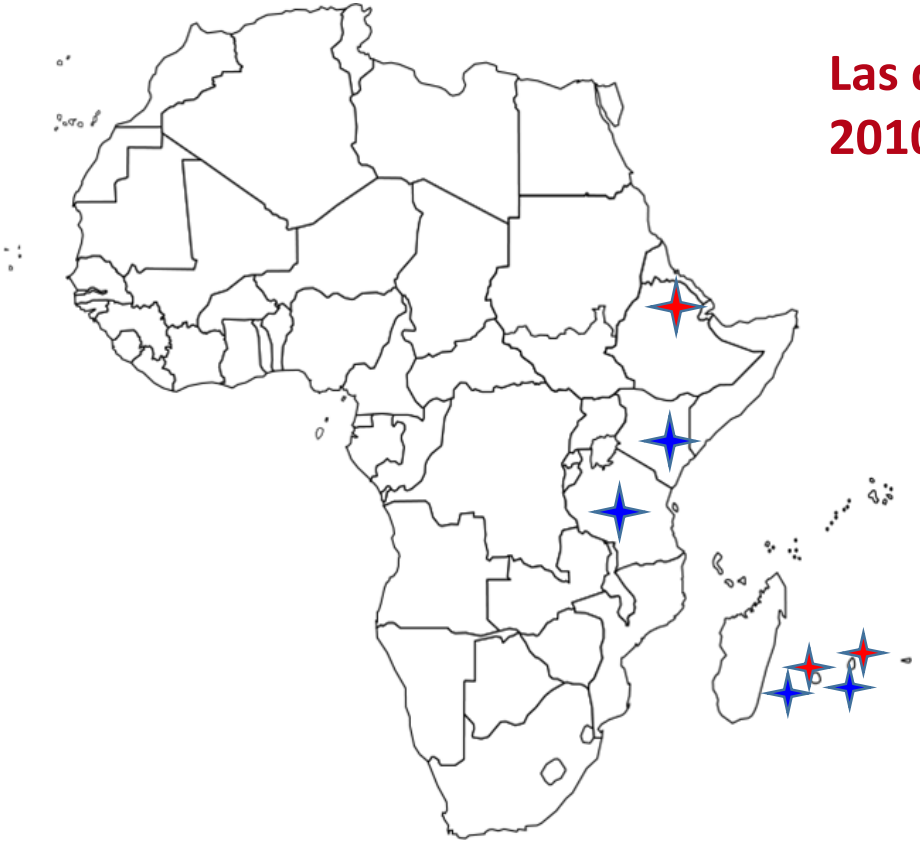
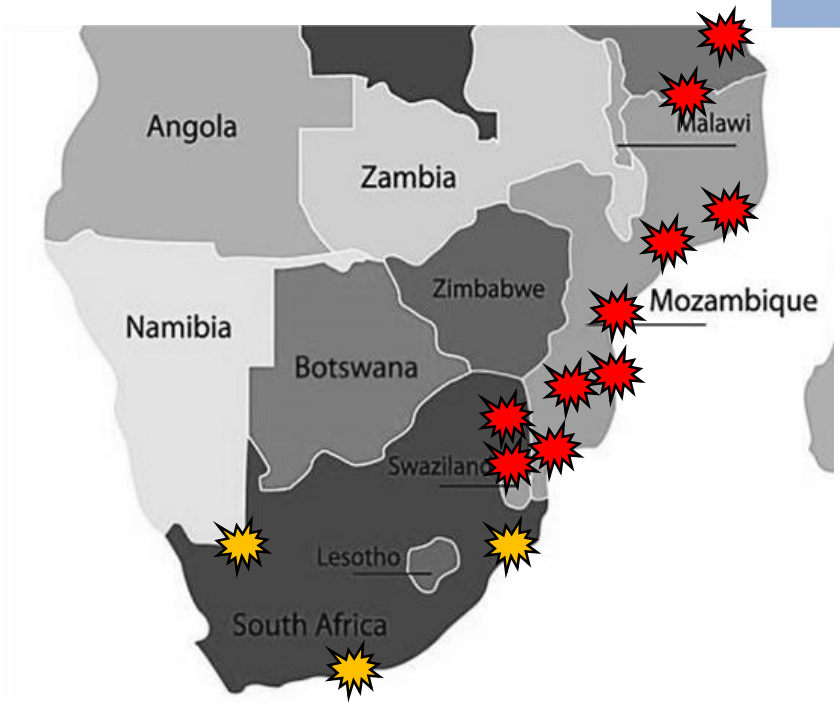
How much time do we have?



Las detected in Ethiopia: 2010, 2014

***D. citri* detected in Tanzania 2015**
Kenya 2016

Expectation for spread of ACP along the East coast corridor



What can be done to prepare for the storm of HLB + ACP

- Monitor spread in Africa (surveys and collaboration): cannot prevent, but can indicate time
- Collaborate internationally on research and pest management
- Lessons from US and Brazil
  - Roll out HLB + ACP Action Plan
  - Nurseries prepare
  - Growers prepare

California and Texas have learned from the Florida Experience

- California probably bought a decade by proactive measures

Source: S Halbert

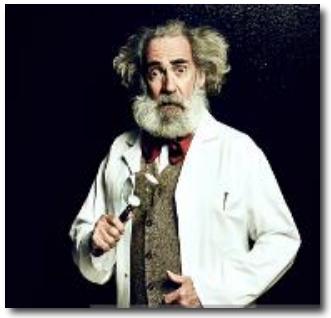
Pillars of HLB Control

Psyllid (ACP) Control

Nursery Sanitation

Positive Tree Removal

Early Detection

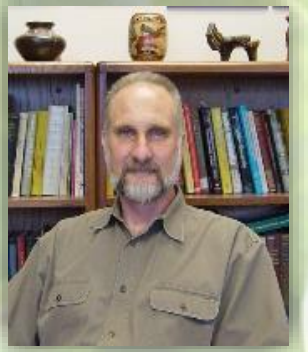


Source: T Gottwald

Nursery Sanitation

Source: T Gottwald

Citrus Health Management Area (CHMA) Design: A Risk-based Optimization for California, Texas, and Arizona



Tim Gottwald

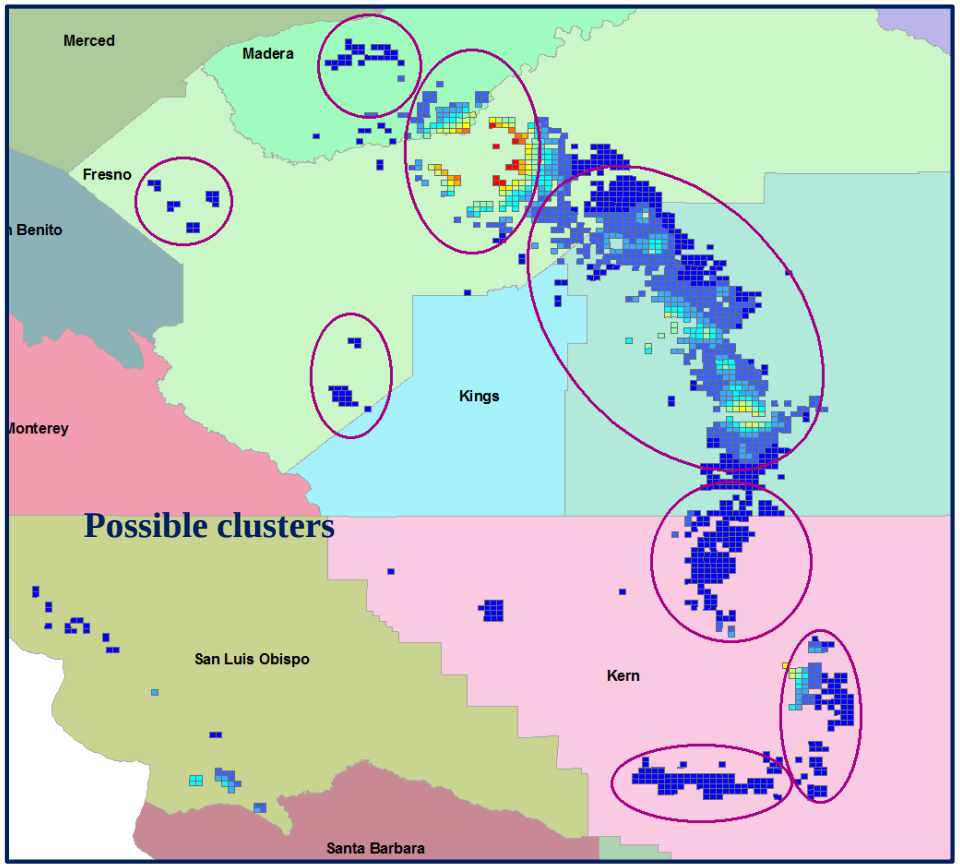
Weiqi Luo

Risk aggregation for CHMA

- Construct CHMA as homogenous as possible for risk
- Optimize CHMA size and location for cost-effective management
- Interact with citrus producers in areas of concern

So, what scale appropriate?

- County
- **Cluster area**



Source: T Gottwald

Management of HLB in Brazil: learning from the research and from the mistakes and successes of citrus growers

Renato Beozzo Bassanezi
renato.bassanezi@fundecitrus.com.br

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The citrus growers that sought a cure and opted to keep the diseased plants had severe damage in a few years (Brazil)

The prevention of new infections must be pursued until more sustainable solutions become available

"If citrus growers accomplish the three-pronged system to manage HLB they will have a chance.
If not, they will be out of citrus business"

J.M. Bové (2004)

Search for resistant or tolerant or repellent citrus

Biotechnology: long term results

- Repellent citrus to *Diaphorina citri*
- *Murraya exotica* or *M. koenigii* with lethal genes to *D. citri*
- Gene selection with CTV vector

USP ESALQ

CSIC Spanish Council of Research

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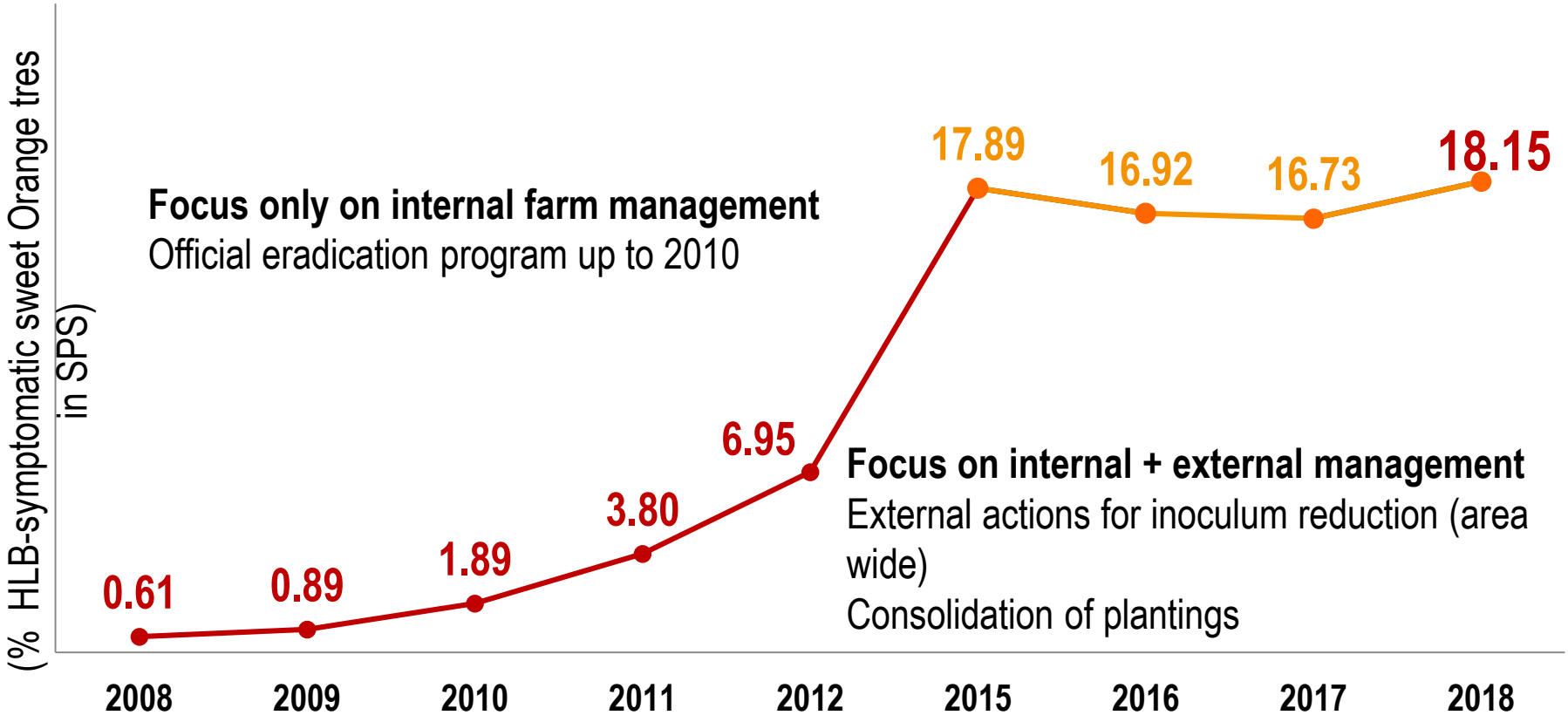
Learning curve of HLB management in São Paulo



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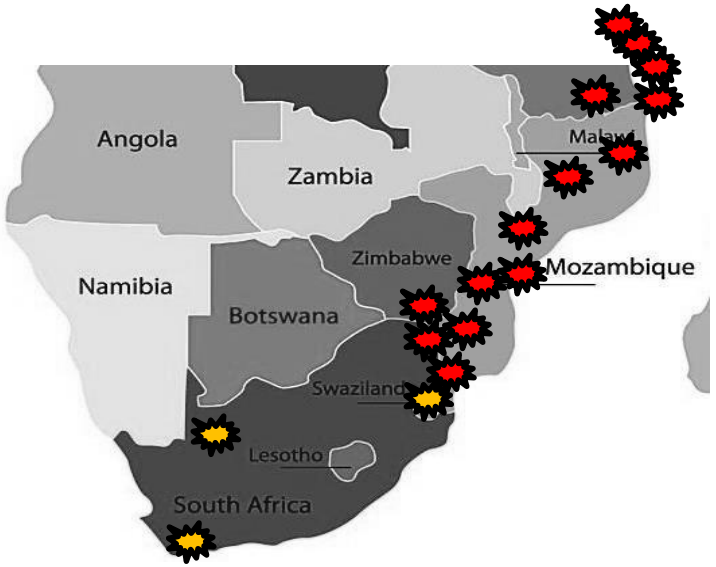
Draft ACTION PLAN
Huanglongbing + Asian Citrus Psyllid

Citrus Biosecurity Advisory Committee

citrus research international

The dreaded first detection…!

- **Las, ACP (*Diaphorina*), ACT (*Trioza*)… "hot or not"?**
- **Point incursion *vs.* range expansion**
- **Scenarios**
  - **A. Las incursion**
    - A-1: Las point incursion but no vector activity
    - A-2: Las point incursion, ACT present and active
    - A-3: Las point incursion, ACP present and active
    - A-4: Las + ACP range expansion
  - **B. ACP incursion**
    - B-1: ACP point incursion
    - B-2: ACP range expansion



South African Action Plan for Huanglongbing and Asian Citrus Psyllid – preparedness, early detection and rapid response

Compiled by Citrus Research International and HLB Steering Committee

Content layout

A. Background
B. Oversight and coordination (HLB Steering Committee)
C. Preparedness
D. Awareness and training
E. Surveillance
    I. Incursion detection surveys
    II. Sample analysis and reporting
F. Rapid response to incursions into pest-free areas
    I. Delimiting surveys
    II. Record keeping
    III. Quarantine and official orders
G. Permitted movement of plant material from quarantine zones
H. Containment and control measures
    I. HLB-infected tree removal
    II. Vector control
    III. Record keeping
    IV. Declaration of eradication of point incursions
I. Resources
J. Communication

HLB Safe System for the production of citrus tree in nurseries

Compiled by Citrus Research International and HLB Steering Committee

Content layout

A. Background
B. Nursery qualification
C. Nursery location
D. Security and access control
E. Physical infrastructure and maintenance
F. Nursery operations
    I. Sanitation
    II. Scouting and monitoring
    III. Production practices
    IV. Vector control programme
    V. Loading and movement protocol
G. Declaration of Compliance
    I. Responsibility of participating nurseries
    II. Responsibility of the relevant authority
    III. Non-compliance and reinstatement of compliance

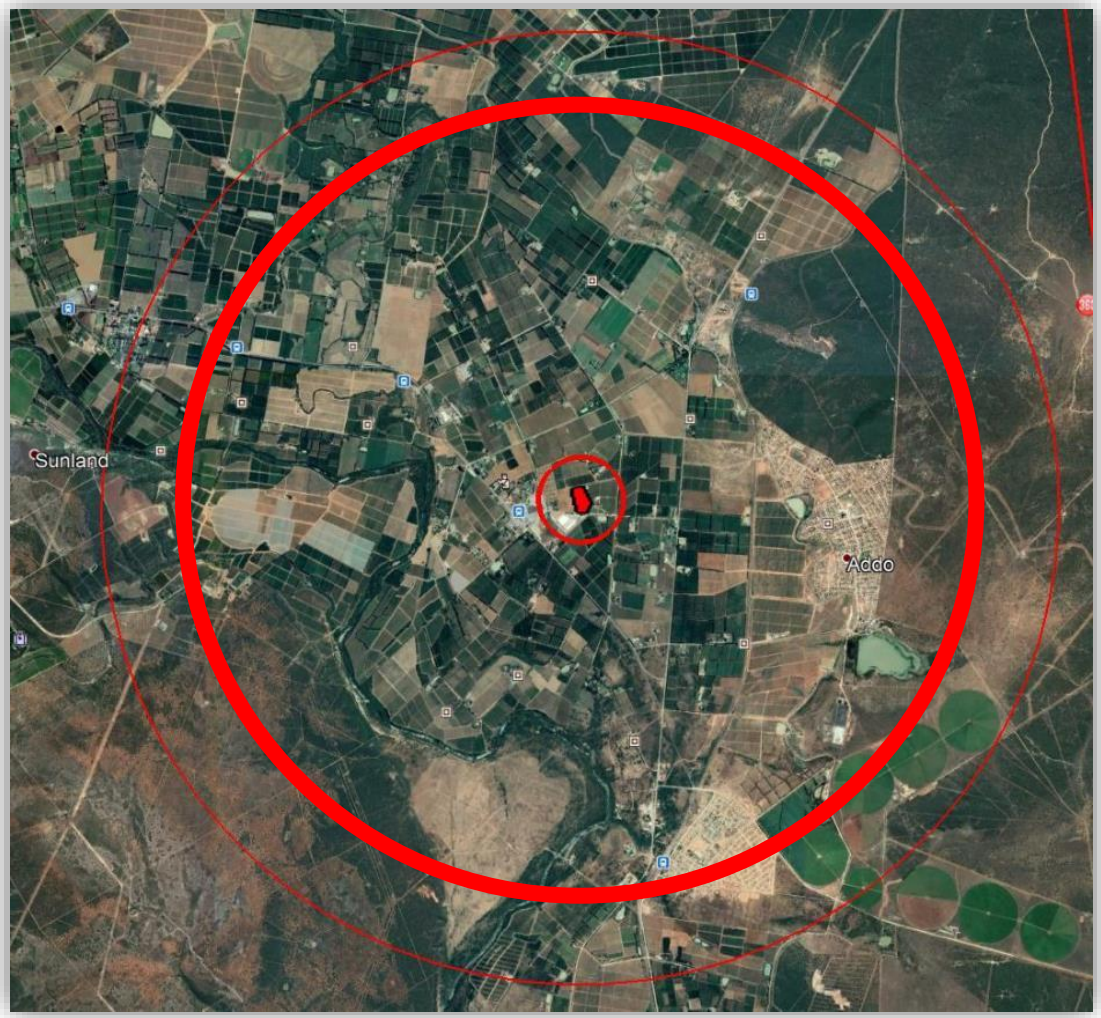
HLB/ACP Action Plan:
G. Permitted movement… Propagation material

Citrus trees from CIS-certified citrus nurseries… Movement restrictions

Scenario	Regional movement ONLY	Unrestricted movement (subject to R.110's CBS regulations)
A-1: Las detected but no vector activity	HLB Safe System	HLB Safe System 50-m no host buffer zone
A-2: Las point incursion, ACT (Trioza) present	HLB Safe System	HLB Safe System 50-m no host buffer zone 800-m vector-free treatment and monitoring zone
A-3: Las point incursion, ACP (*Diaphorina*) present	HLB Safe System	HLB Safe System 800-m no-host buffer zone
A-4: Las + ACP range expansion	HLB Safe System	HLB Safe System 800-m no-host buffer zone
B-1: ACP point incursion	HLB Safe System	HLB Safe System 800-m no-host buffer zone
B-2: ACP range expansion	HLB Safe System	HLB Safe System 800-m no-host buffer zone

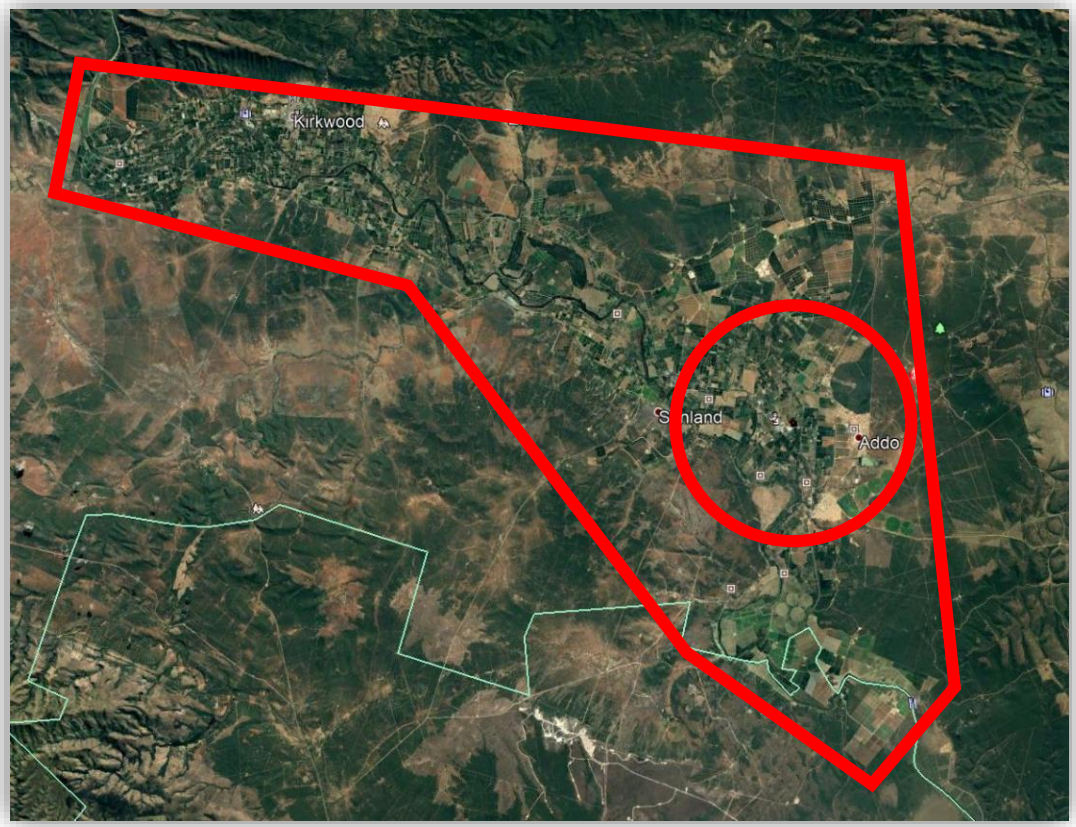
A-2: Las point incursion, ACT (*Trioza*) present

- Quarantine zone: 5 km around detection site



A-4: Las + ACP range expansion

- Quarantine zone: 5 km around detection site *or regional quarantine*

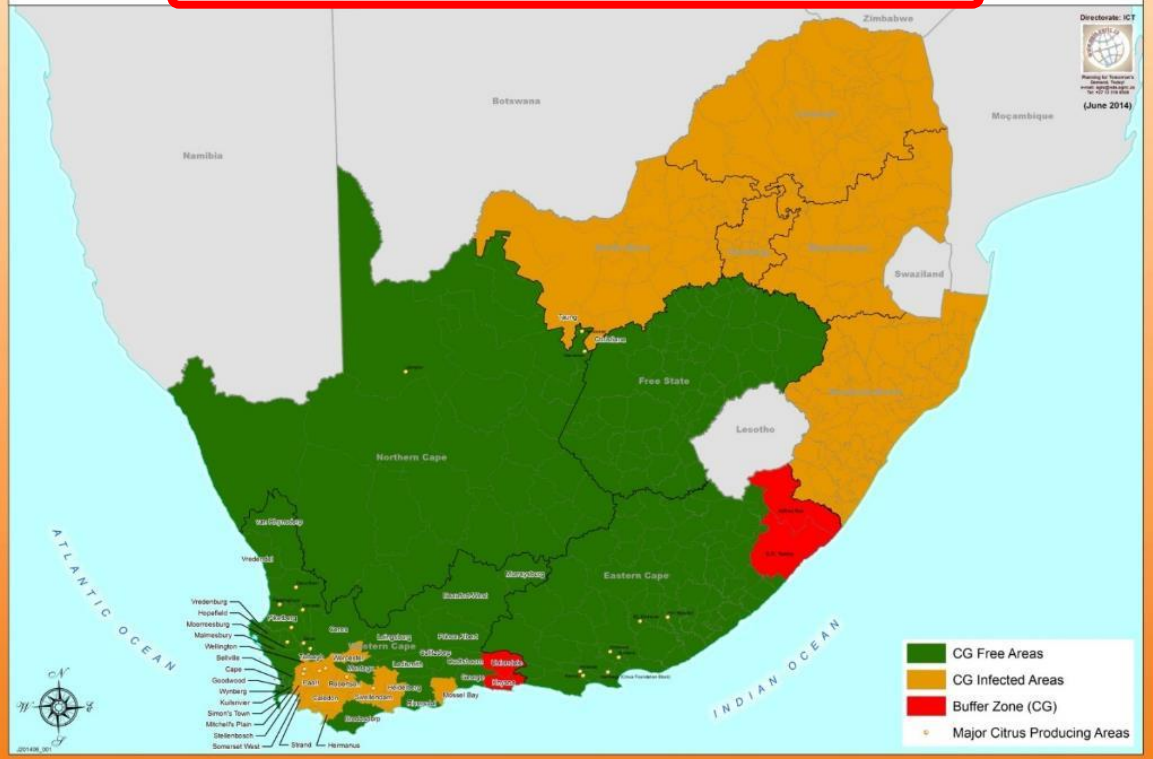


Regulated movement of Citrus (R.110)

ARE YOU MOVING CITRUS AND/OR RELATED PLANTS?

In terms of Agricultural Pests Act, 1983 (Act No. 36 of 1983), movement of citrus and/or related plant propagation material is prohibited from one area to another within the Republic of South Africa, unless the movement is authorised by the means of a permit, or the material is certified as pest free.

Prohibited National Movement: Citrus Greening (CG)



Host plants for Citrus Greening

Citrus and species of the genera *Aegle, Aeglopsis, Afraegle, Atalantia, (Severinia synonymous), Balsamocitrus,Calodendrum, Citropsis, Clausena, Cuscuta, Eremocitrus, Fagaropsis, Feronia, Fortunella, Hesperethusa, Limonia, Microcitrus, Murraya, Oricia, Pleiospermium, Poncirus, Swinglea, Teclea, Toddalia, Toddaliopsus, Triphasia, Vepris, Zanthozylum* and any cross thereof.

For further information please contact:
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agriculture, forestry & fisheries

Thank you

citrus research international