



Texas A&M University-Kingsville, Citrus Center
www.tamuk.edu

Hope for Citrus: Lessons from Texas in the Fight against HLB and a Roadmap for Morocco



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Talking Points

- ❖ **What is HLB or Citrus greening disease?**
 - ❖ **HLB impact on U.S. citrus production (FL & TX)**
 - Decline in production and fruit quality (FL)
 - Increase in production costs
 - Decline in acreage (Abandonment & Removal of groves)
 - ❖ **Multi-tiered approach used in Texas to manage HLB**
 - Enclosed nursery
 - Early detection surveys & removal of infected trees
 - Area-wide management
 - Improving tree health
 - ❖ **Hope and Preparedness for Morocco**
-

What is HLB?

- ❖ Huanglongbing (HLB), aka citrus greening disease, *is one of the most destructive citrus diseases in the world.*



- **Pathogen:** Caused by a bacterium in the *Candidatus Liberibacter* spp. (**CLaf, CLam & CLas**)
- **Vector:** Spread by ACP or AfCP (= ACT)
- **Main Symptoms:** Yellowing or blotchy mottling of leaves; Small fruit; Uneven fruit ripening (color inversion); Stunted growth and twig dieback; Root system decline
- **No Cure:** Management relies on vector control and removing infected trees

Diversity of HLB Symptoms



Sweet orange



Sweet orange



Sweet orange



Sweet orange



Sweet orange



Tangerine



Grapefruit



Grapefruit



Grapefruit

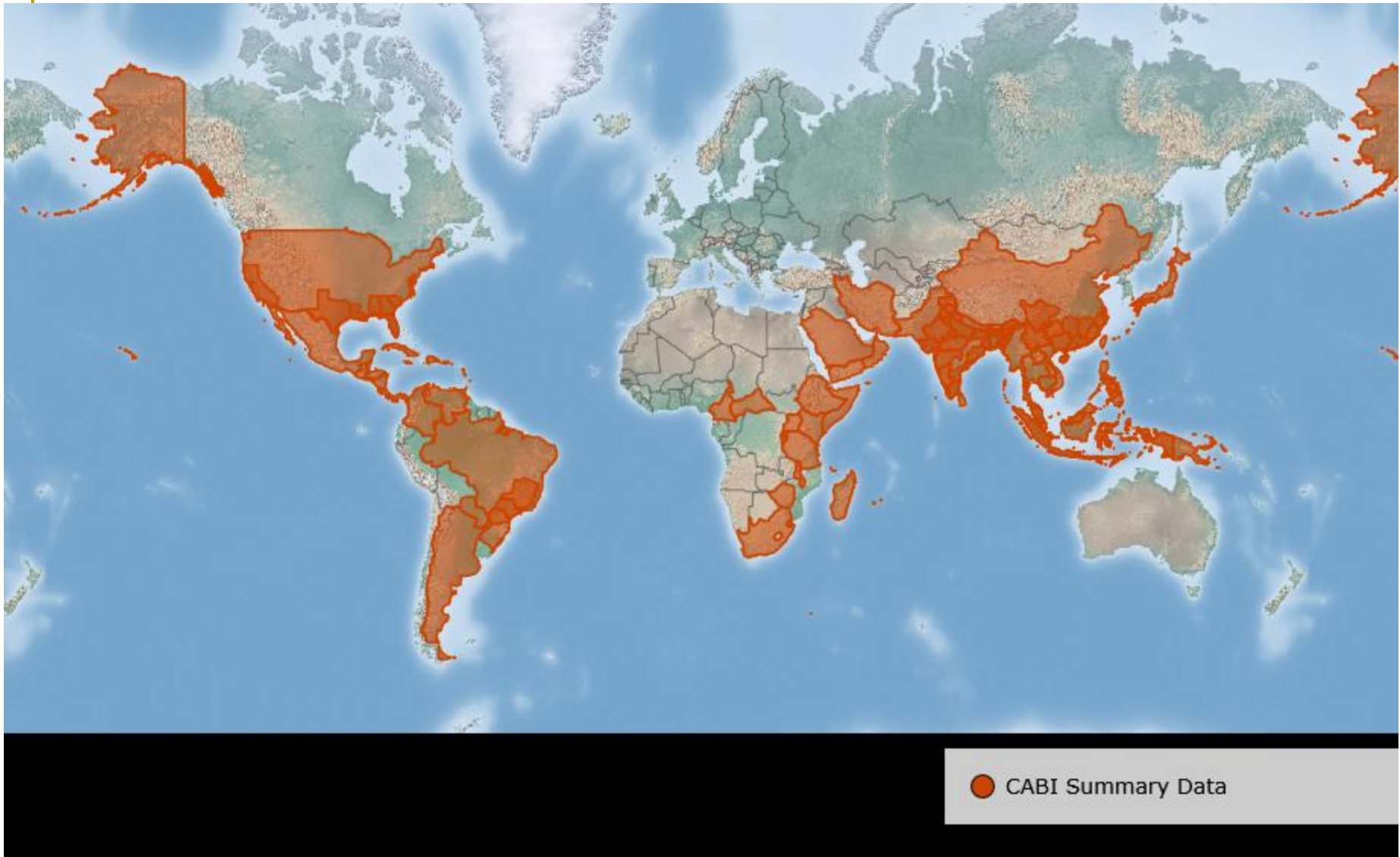


Lime



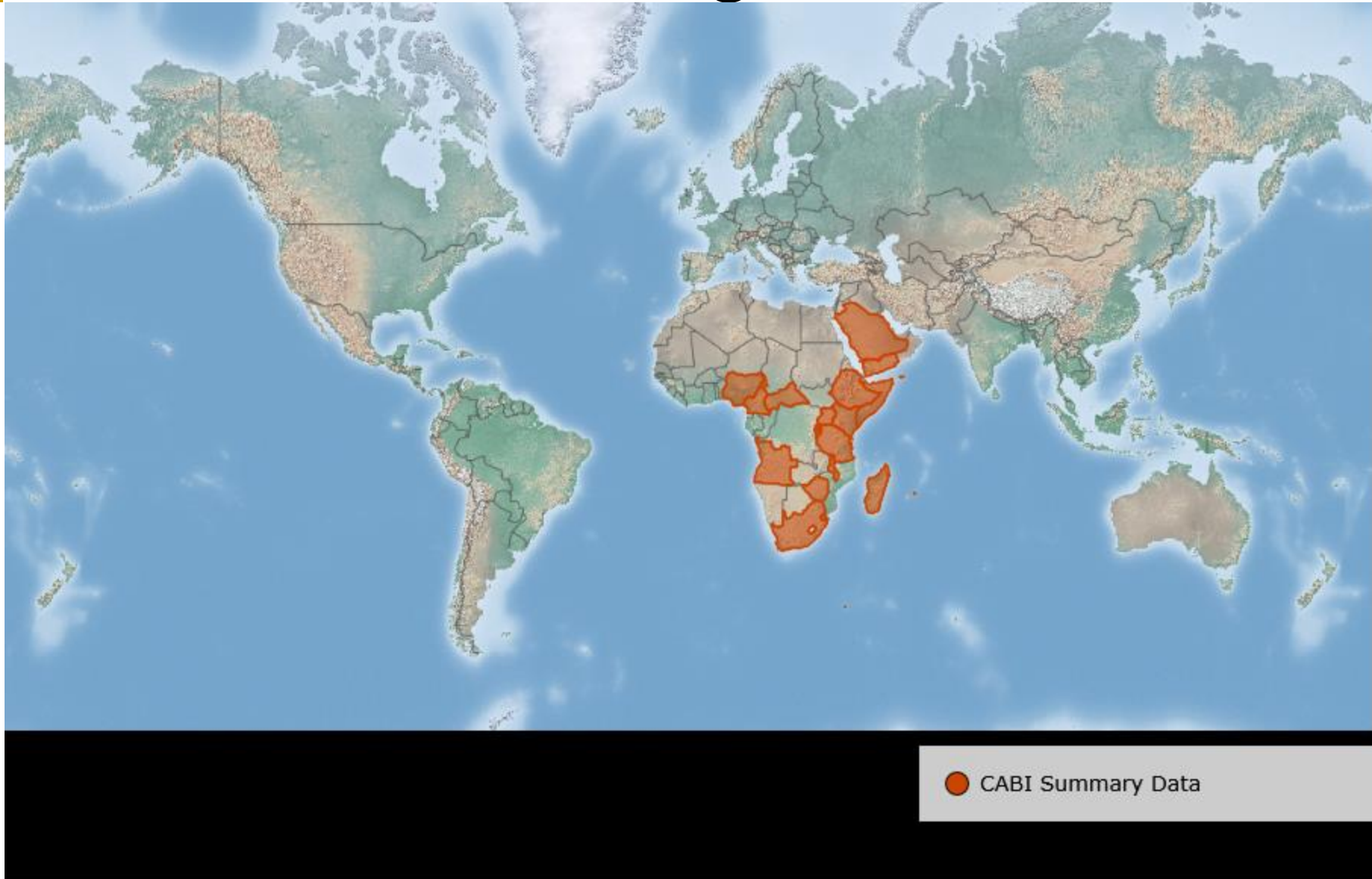
Lemon

HLB Distribution



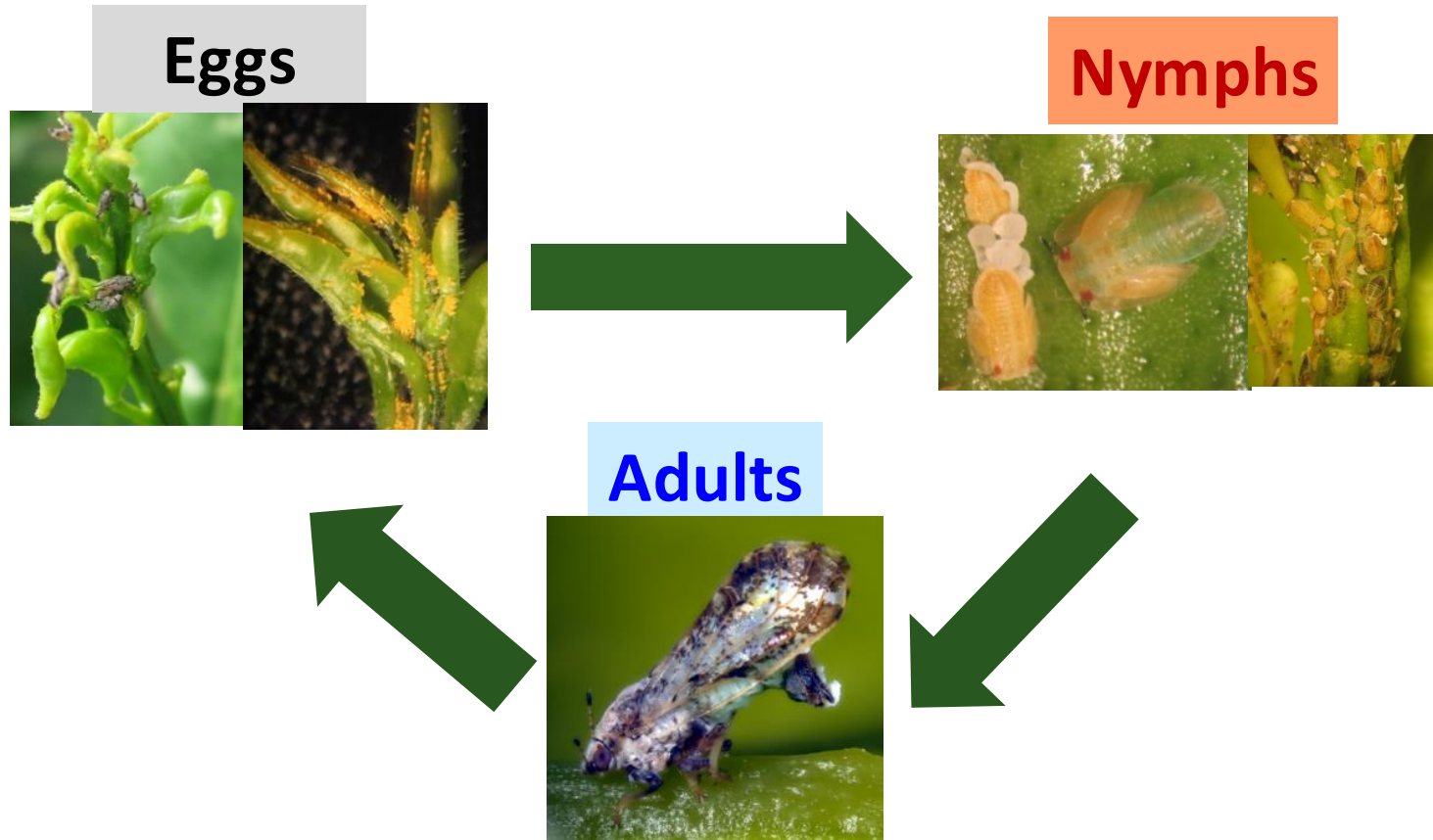
Australia and the Mediterranean area are the only HLB-free citrus areas

African Greening Distribution



Australia and the Mediterranean area are the only HLB-free citrus areas

ACP, Vector of HLB bacteria



- Both nymphs and adults can acquire the bacterium

AfCP, Vector of African Greening

Eggs



Nymphs



Adults



- Both nymphs and adults can acquire the bacterium

Invasiveness of ACP and AfCP

- ❖ Both ACP and AfCP are highly invasive, rapidly spreading throughout the world
- ❖ Commercial citrus and ornamental species such as orange jasmine (*Murraya* spp.) & Curry leaf (*Berberia koenigii*) plants
- ❖ Spread by human commercial activity and natural dispersal
- ❖ **Both ACP (A1) and AfCP (A2) are listed as quarantine pests by EPPO**

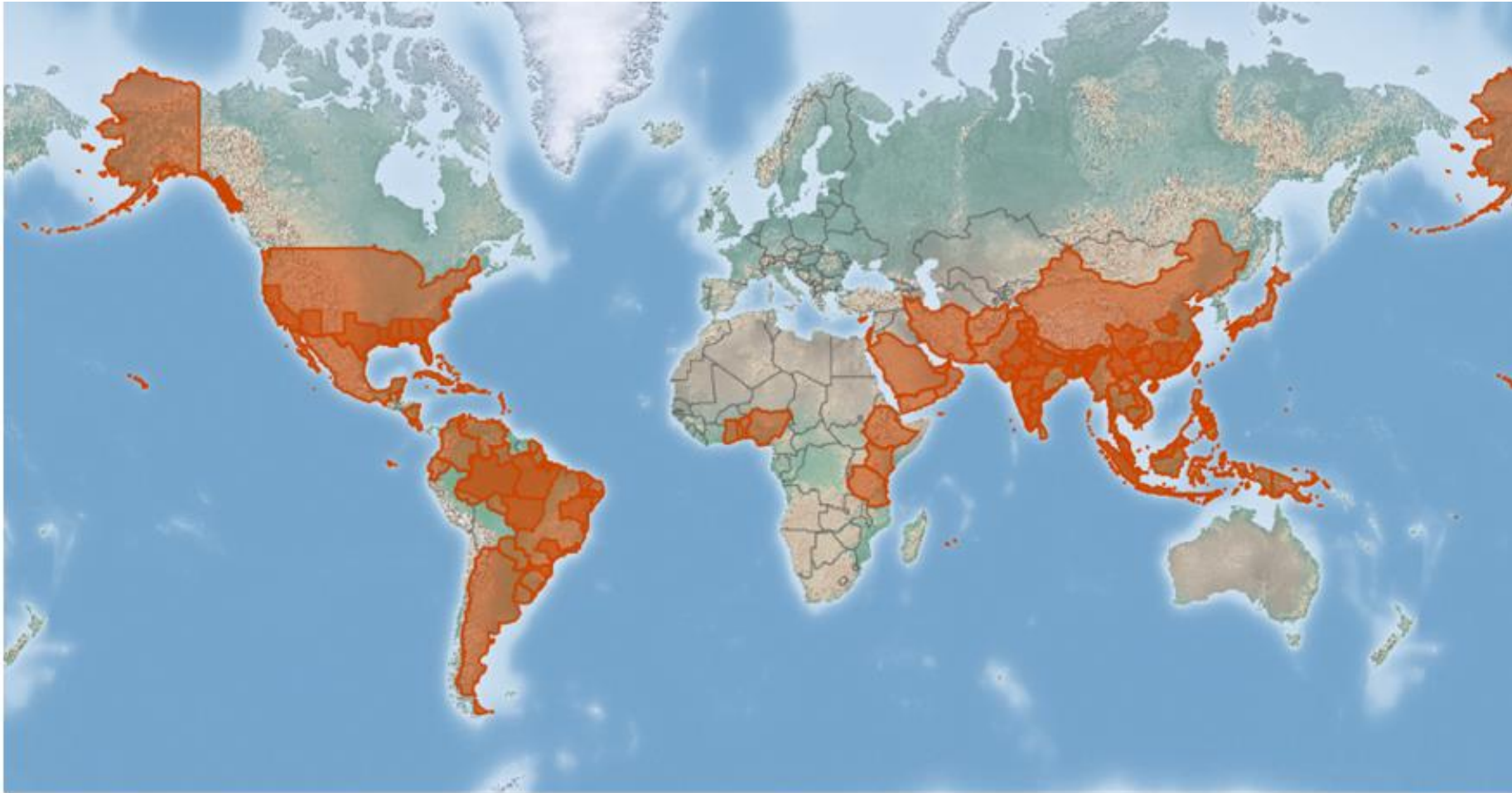


Bois jasmin/Buis de Chine



Kaloupile/Arbre a Curry

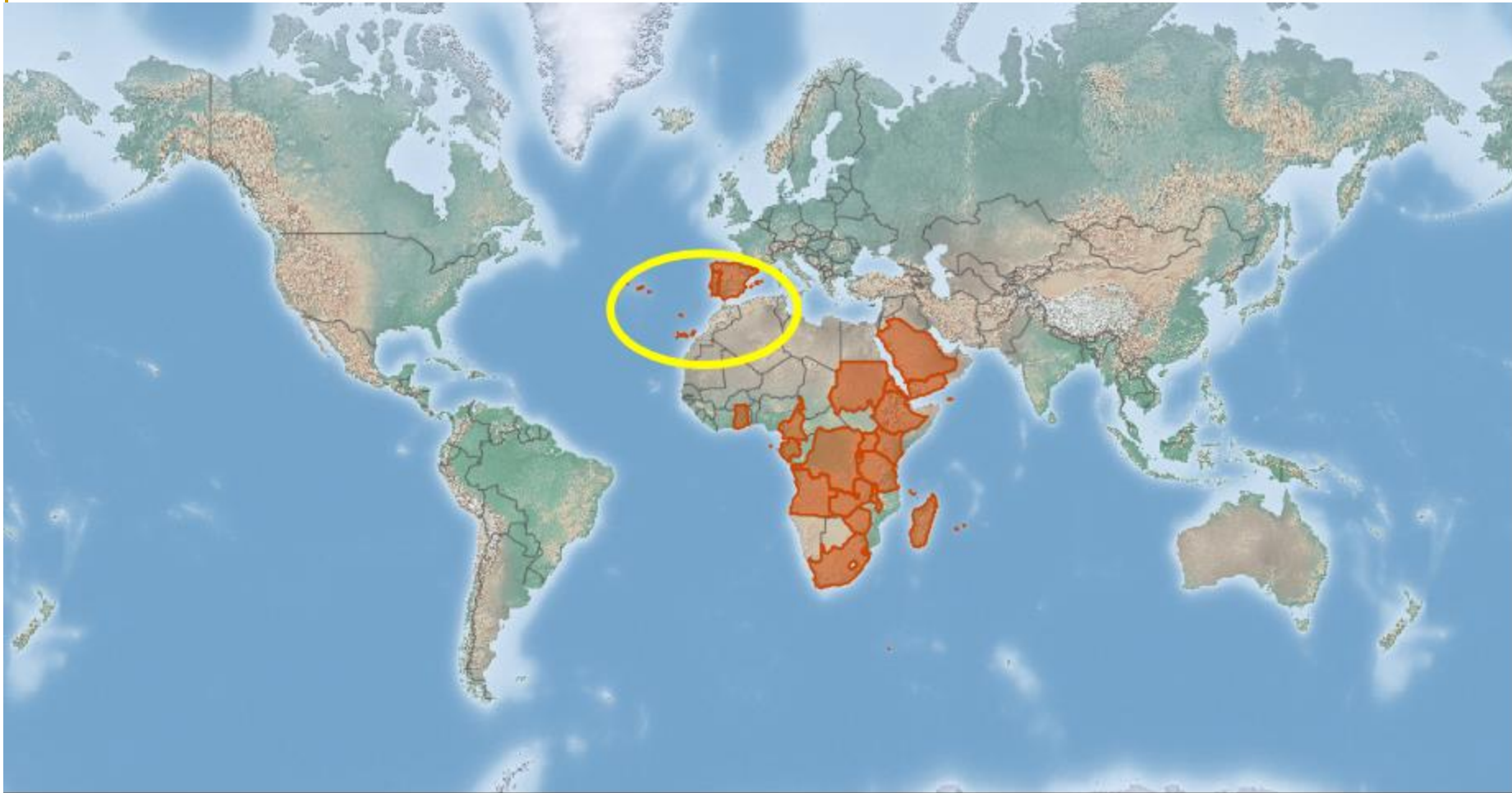
ACP Distribution in the World



CABI, 2025. *Diaphorina citri*. In: CABI Compendium. Wallingford, UK: CAB International.

● CABI Summary Data

AfCP Distribution in the World



● CABI Summary Data

Impact of ACP/HLB Invasion

HLB Affected World Areas

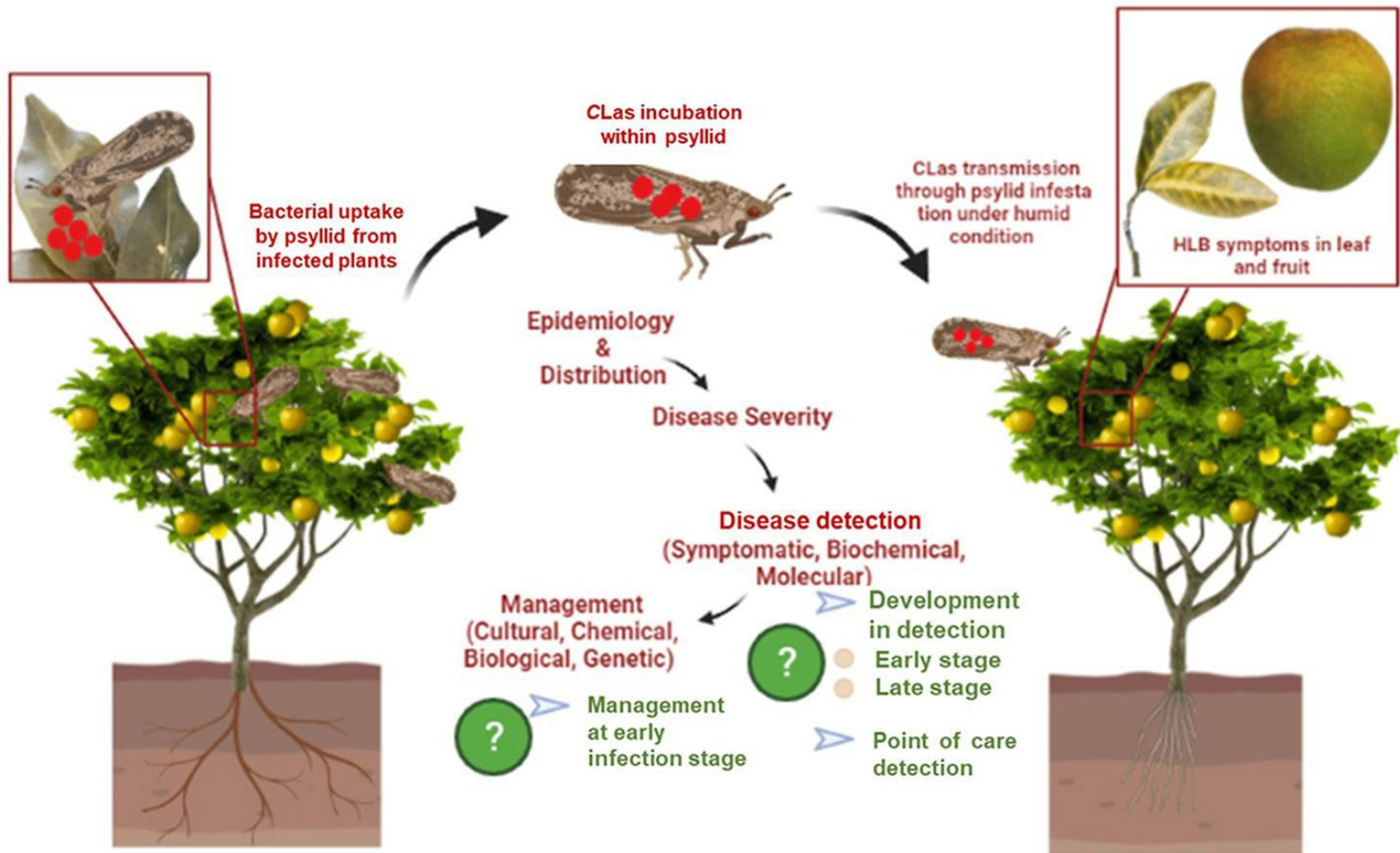


ACP Infested World Areas

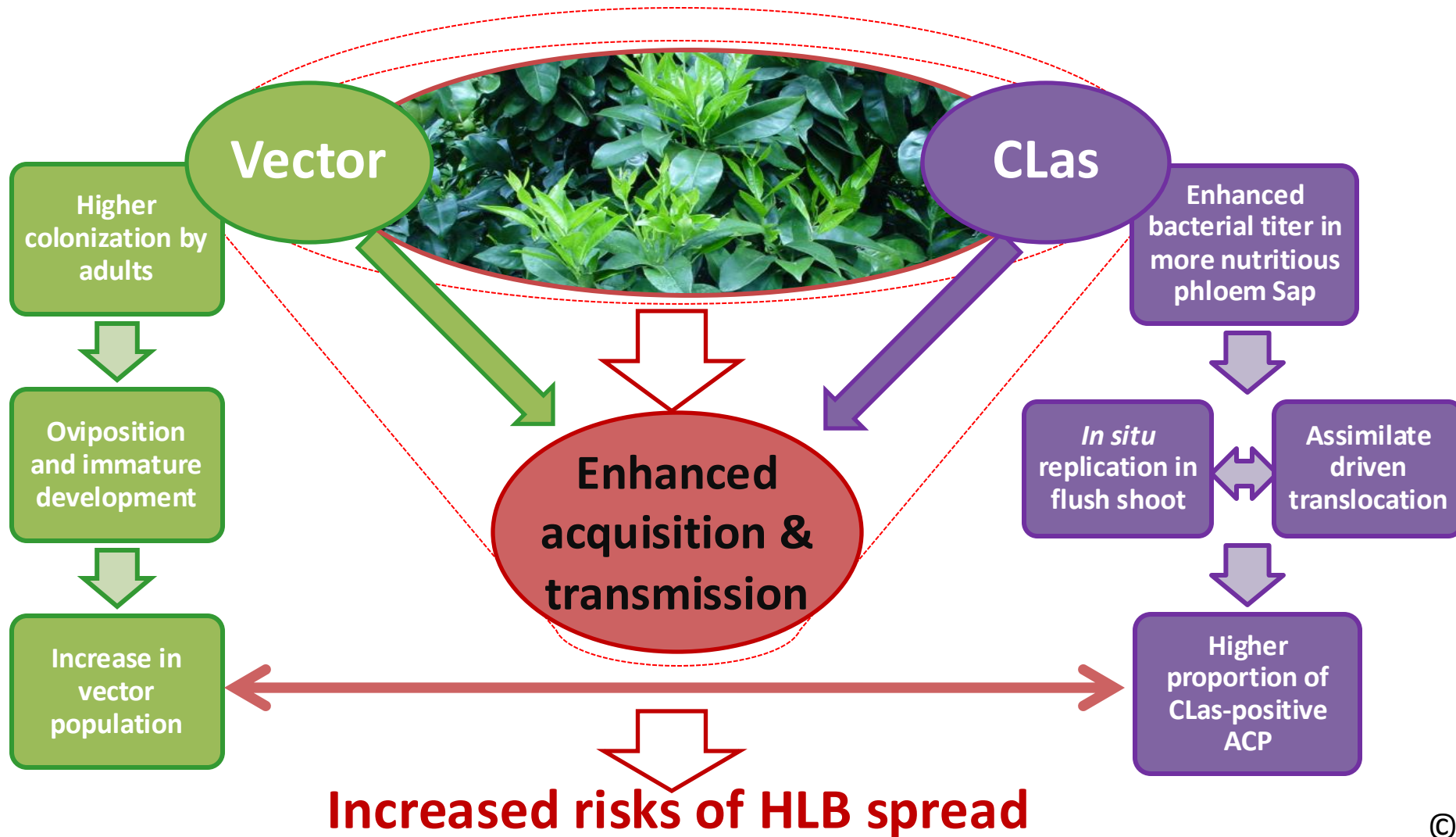


- ❖ Both ACP and HLB invaded the U.S. in the last 2-3 decades; **HLB tends to always follow ACP**

Disease Cycle of Citrus HLB



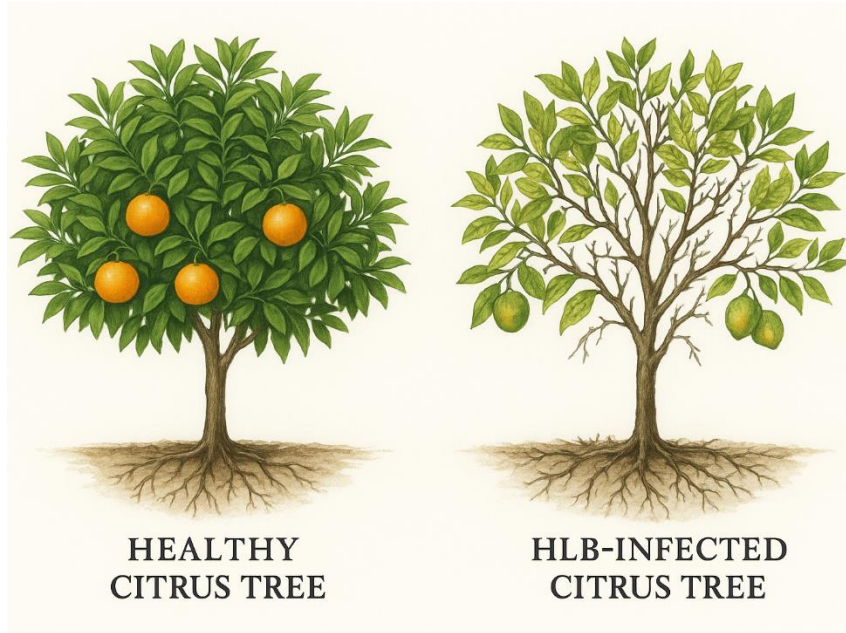
Flush Shoots are Key to HLB Dynamics in Environment



Effect of HLB on Citrus Tree

Healthy Citrus Tree

- Green leaves
- Round, well-colored fruit
- Normal root system
- Even canopy



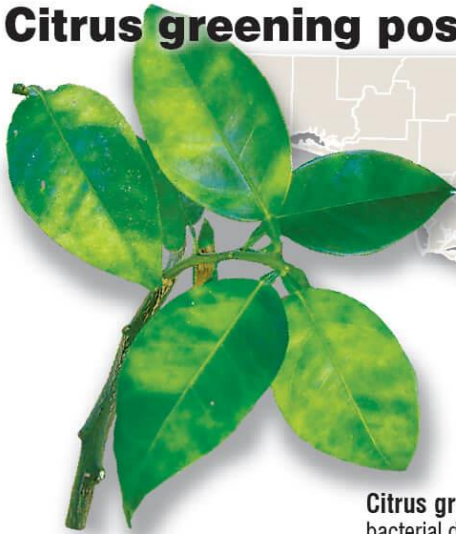
HLB-Affected Citrus Tree

- Yellow mottled leaves (asymmetrical blotching)
- **Leaf nutrient imbalance** (\downarrow N, Mg, Ca, S, Fe, Mn B; \uparrow Na)
- Small, misshapen & bitter fruit with color inversion
- Sparse canopy
- Dieback in branches
- **Root decline** (fibrous root loss)

HLB progressively reduces tree vigor and productivity. The decline can lead to tree death!!!

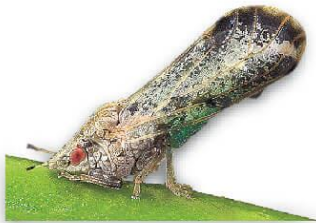
Impact of HLB in Florida

Citrus greening poses threat to Florida groves



Leaves yellowed from the veins out are a symptom of citrus greening. The tree will produce smaller, misshapen and bitter fruit, and the tree itself could die.

PHOTO | USDA



The Asian citrus psyllid is about 1/8 inch long. The psyllid lays eggs in the foliage and spreads the HLB bacteria.

PHOTO | UNIVERSITY OF CALIFORNIA INTEGRATED PEST CONTROL

Citrus greening in Florida

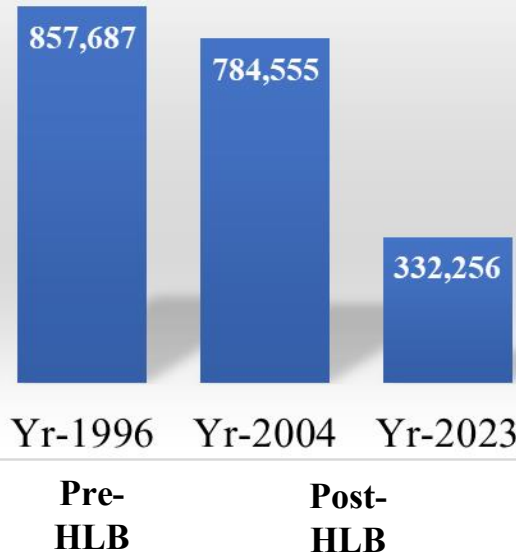
- 37 counties with HLB
- Reported areas of HLB

Citrus greening is an insect-borne bacterial disease called huanglongbing (HLB) which attacks the vascular system of plants. HLB spread across Asia and Africa beginning in the 1940s, and first appeared in the U.S. in Miami-Dade County in 2005. It has since spread to 37 Florida counties and 9 other states.



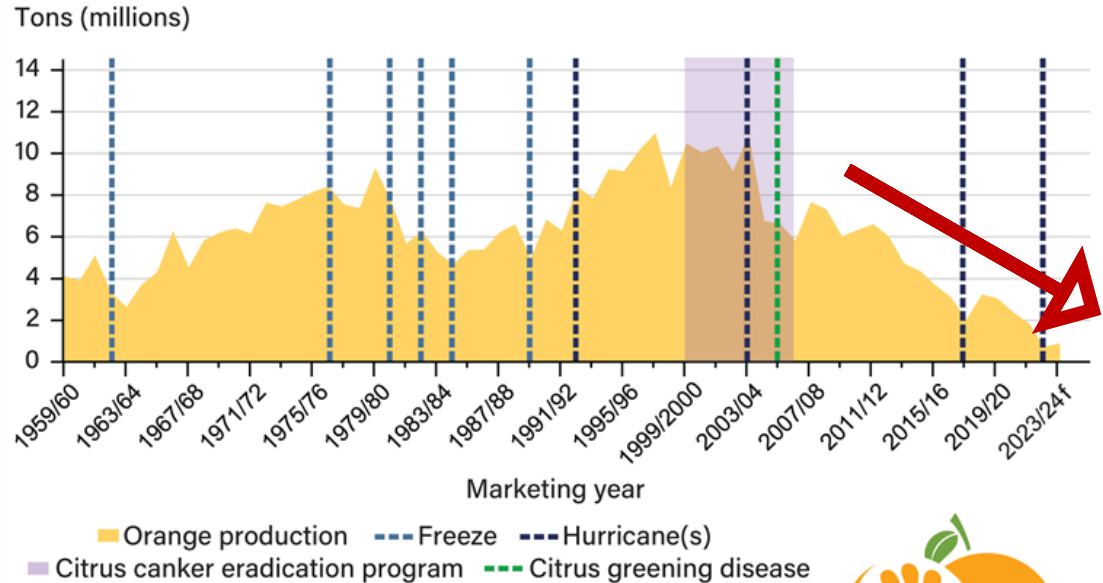
Impact of HLB in Florida

Florida Citrus Harvested Acreage



Florida's orange production, 1959/60–2023/24f

USDA Economic Research Service
U.S. DEPARTMENT OF AGRICULTURE



Note: f = forecast. The marketing season for Florida oranges begins in October and November of the preceding year and ends in September or October of the current year. Citrus canker has appeared multiple times in Florida's citrus groves since the 1900s. Between 2000 and 2006, the State implemented a mandatory eradication program to respond to the disease.

Source: USDA, Economic Research Service based on data from Florida Department of Agriculture, Florida Agricultural Statistics Service.




CHARTS of NOTE

Impact of ACP/HLB in Florida, U.S.

- ❖ Direct impact on citrus production in FL
 - 90% drop from 150 M boxes in 2003 to 16 M in 2024
- ❖ Drastic reduction in citrus acreage (>60%) and loss of jobs
 - 74% drop in yield; poor juice quality
 - Decline in # of citrus growers from 7,389 to 2,775 (62%)
 - Drop in juice processing plants (41 to 14)
- ❖ \$1.61 B in labor income loss and \$7 B loss in output to the economy for the 2020-21 year alone
- ❖ Increase in production costs post-invasion due to vector control, tree removal and tree health improvement (260% for oranges and 164% for grapefruit)

The Texas Citrus Industry



~25,000 acres
65% grapefruit
30% oranges
5% other spp.

Implementation of multi-tiered HLB Management in Texas

- Propagation of clean nursery stocks
- Rouging of infected trees
- Control of the Asian citrus psyllid
- Maintaining and improving tree health

Three-pronged approach recommended by NAS (2010)

TPA1. Clean Nursery Stock

■ Florida:

- switch to enclosed nursery fully implemented **two years after first HLB find**
- no subsequent documentation of HLB spread via nursery stock post-implementation

■ Texas:

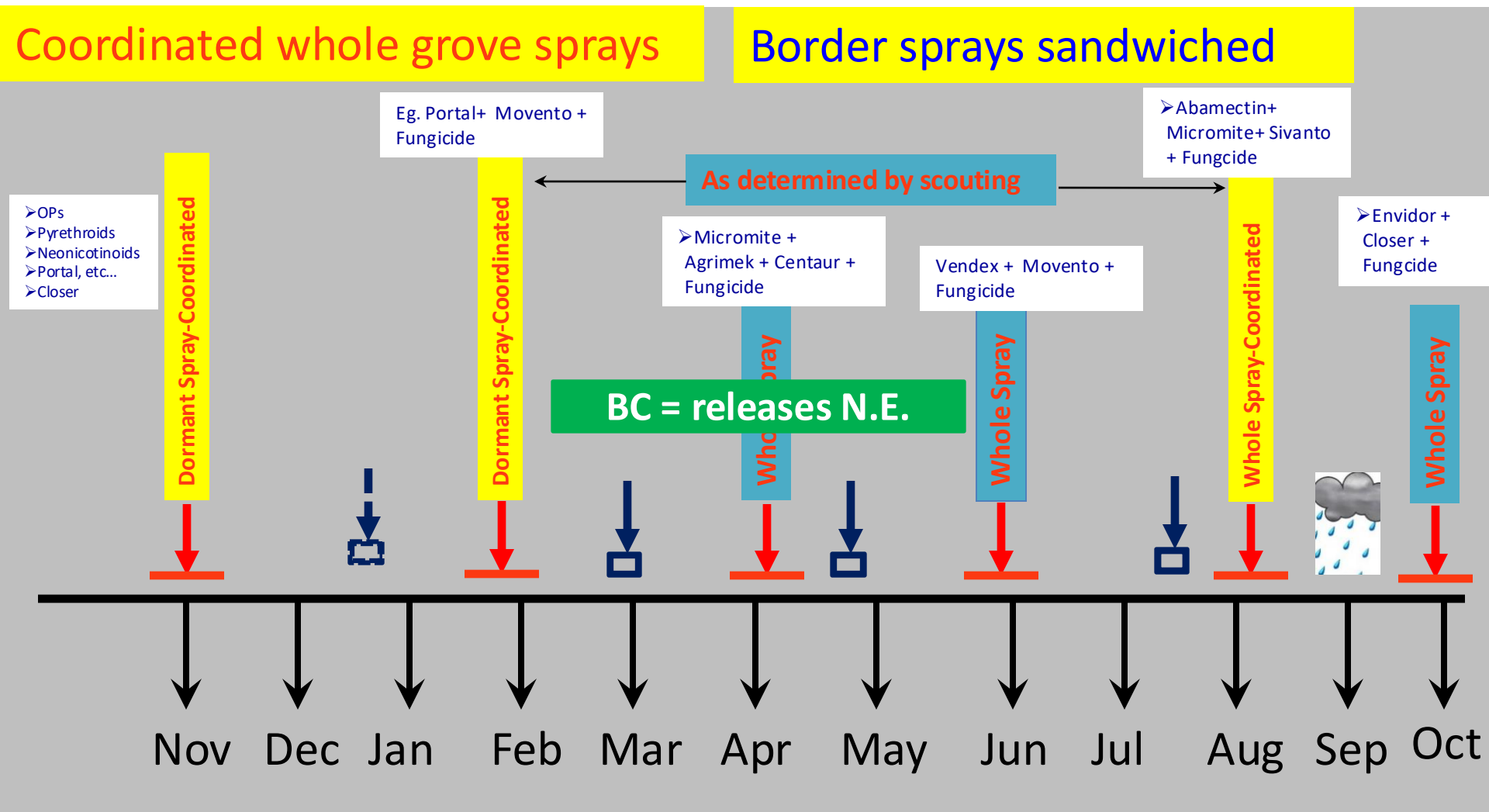
- open-field nursery implicated in statewide HLB spread
- switch to enclosed nursery fully implemented **two years after first HLB find**
- no subsequent documentation of HLB spread via nursery stock post-implementation



TPA2. Rouging of Infected Trees

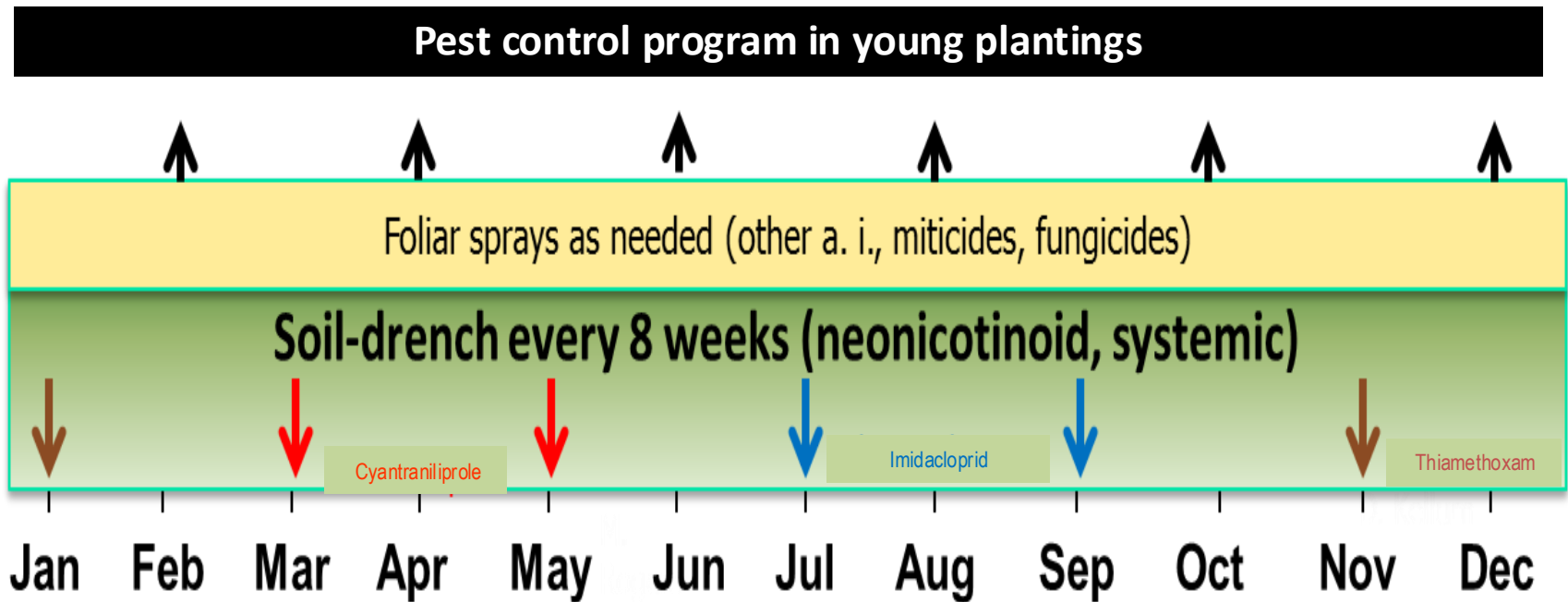
- Impacted by reliance on symptoms-based tree sampling
 - HLB is characterized by a long incubation period: months to years
 - ACP can acquire/spread CLAs from infected, but non-symptomatic trees (Psyllids can be early detection tool!!!)
 - Florida:
 - Voluntary implementation by large citrus operations
 - Little appetite for mandates due to canker experience
 - Texas:
 - Implemented for the first 3 year post first HLB detection
 - Dooryards as continued sources of inoculum
 - Residents incentivized to remove infected trees
 - Relatively small grove size makes it unpalatable for growers
-

TPA3. Area-Wide Psyllid Management

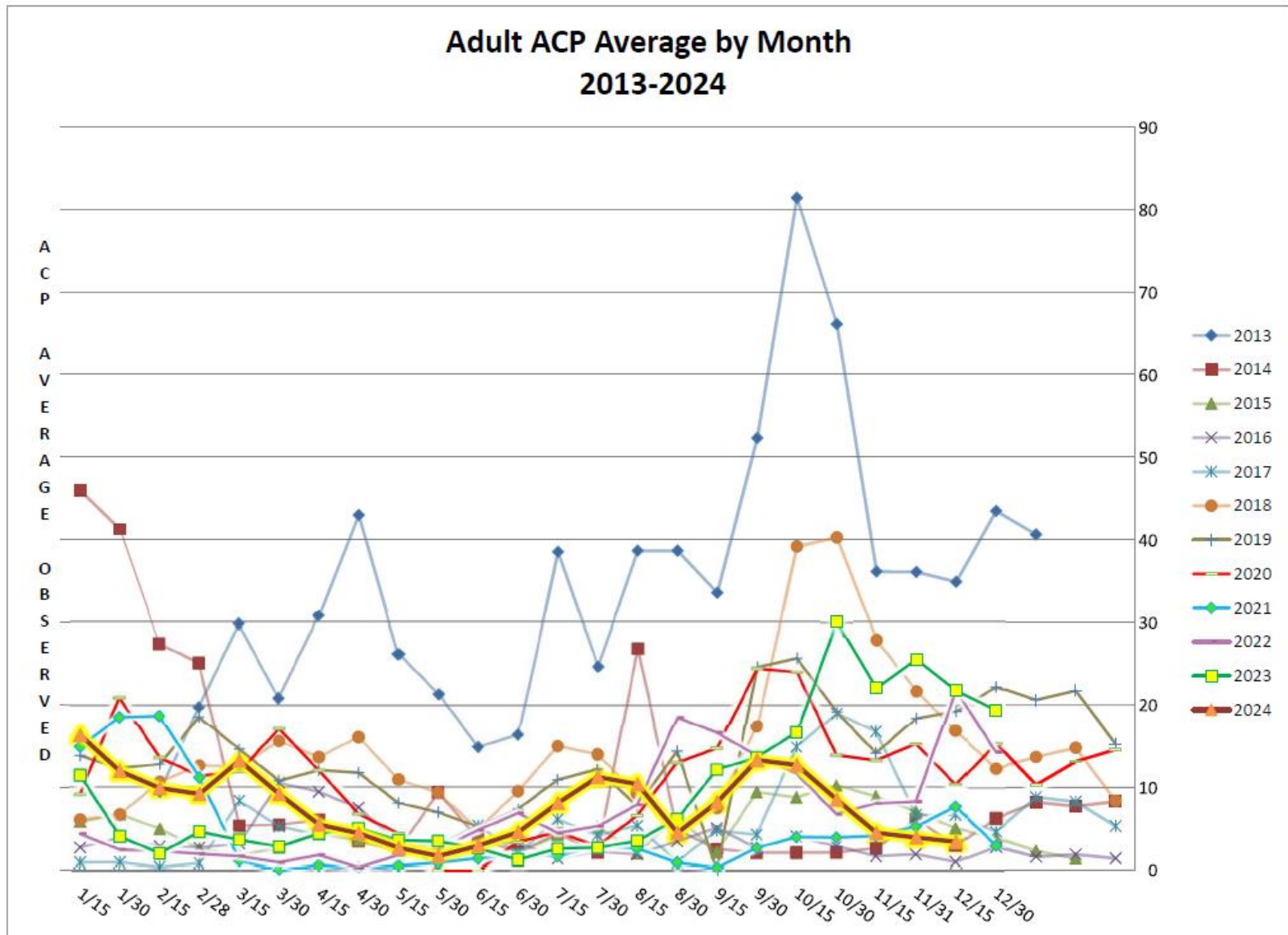


➤ Whole grove sprays are generally multipest

TPA3: Mandatory ACP control program in young plantings (0-4 yr.-old)



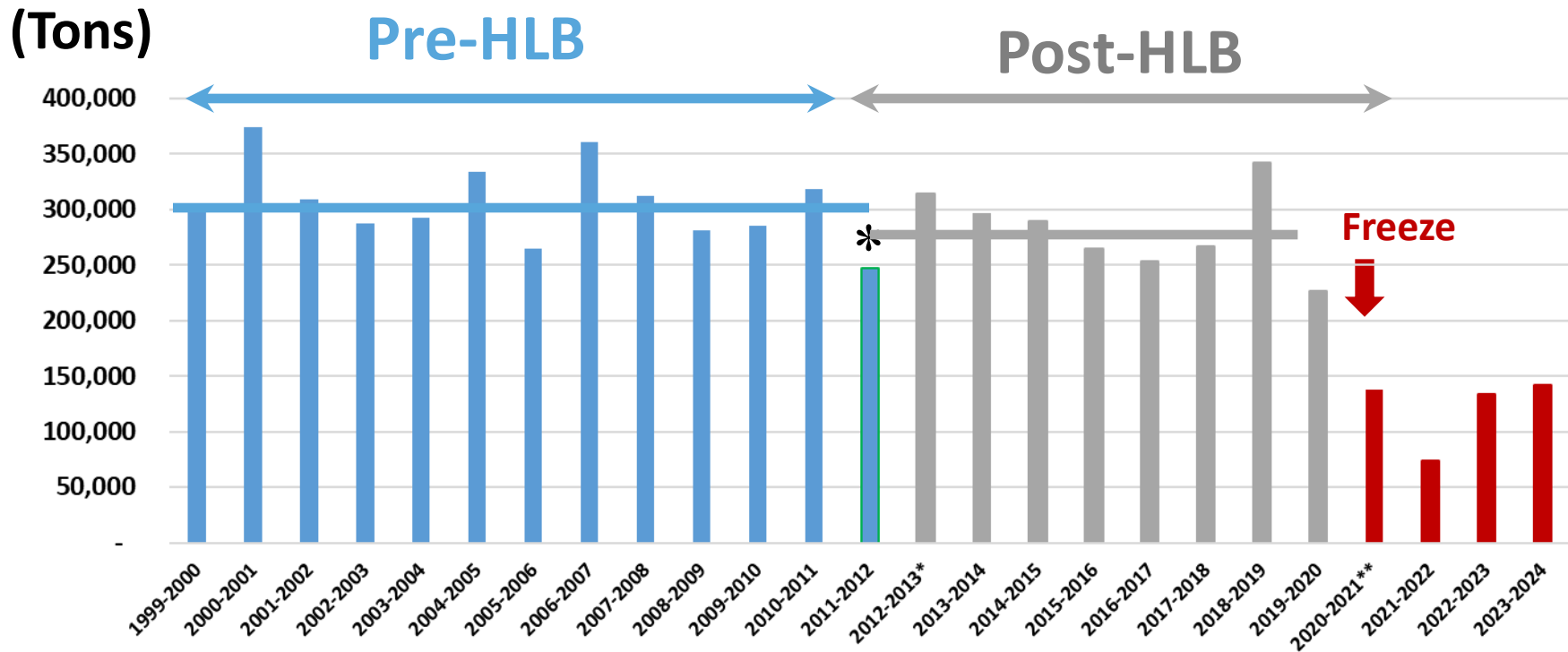
TPA3: Successful AWM of ACP in Texas



TPA3. ACP-AWM

- Strongly recommended (mandatory??) program for psyllid control
 - Although HLB is largely spread, significantly reduced rate of tree re-infection
 - Participation rate >90%
 - Young groves have very low incidence of HLB; <1% up to 4 years-old (due to use of IPC and effective ACP control)
 - Program mainly funded by growers (\$25-45/ac assessment for ACP-AWM and HLB mitigation)
-

Citrus Production Output in Texas



About 6.7% drop in production due to HLB

Promoting Tree Health

- **HLB is mainly a root disease, thus promote root health** (proper land preparation, soil amendments, better irrigation and fertilization)
- **New planting design:** Combination of raised bed, ground cover, soil amendments such as compost or biochar, hydrogels in planting holes to improve water use and promote root growth)



Preparedness for Morocco

- The Mediterranean Basin and Australia are the two main citrus-growing regions free of ACP (AfCP) and HLB
 - Joint occurrence of drought and HLB will be a **disaster** for the citrus industry in Morocco
 - Morocco has a unique opportunity to successfully prevent the entry and/or to effectively mitigate the ACP/HLB complex
 - Already there is an effective organization (Maroc Citrus) bringing stakeholders of the citrus sector together
 - Stakeholders understand the urgency of the threat of HLB and in addressing it
-

Preparedness for Morocco

- What is needed?
 1. Form an independent multidisciplinary group under the leadership of Maroc Citrus that will solely focus on “Invasive pests and diseases ”
 2. This group will comprise representatives of Maroc Citrus, INRA, ONSSA, Ag. Universities, Producers (technicians)
 3. Define a roadmap for a proactive psyllid/HLB prevention and mitigation
 - Develop a budwood program & citrus nursery regulations
 - Put in place CLas-Claf-CLam/HLB testing diagnostic lab(s)
 - Initiate citrus commodity surveys for early detection (twice/year)
-

Preparedness for Morocco

- What is needed?
4. Develop a contingency/rapid response plan to implement in case of detection of either psyllid and/or HLB. Early detection will facilitate eradication

Preparedness for Morocco

- Food for Thought:

“In invasive pest and disease management, absence of proof is not a proof of absence. Proof of absence only resides in intensive surveillance”

Acknowledgments



THANK YOU!

