

# Some efforts to control ACP and HLB invasion in California

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# Background

- 1873: First Citrus tree planted in Riverside California
- 1907: Citrus experiment station
- 1959: UC Riverside
- National Citrus and date germplasm collection
- UCR maintains >1000 accessions of Citrus and its relatives



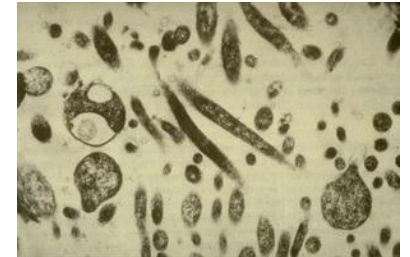
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# ACP and HLB invasion

- FL: ACP 1998, HLB 2005
  - HI: ACP 2006
  - CA: ACP 2008, HLB 2012
  - GA, SC, LA and TX: 2009
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- Needs young/feather flush/bud for oviposition
  - Can acquire and transmit HLB agent



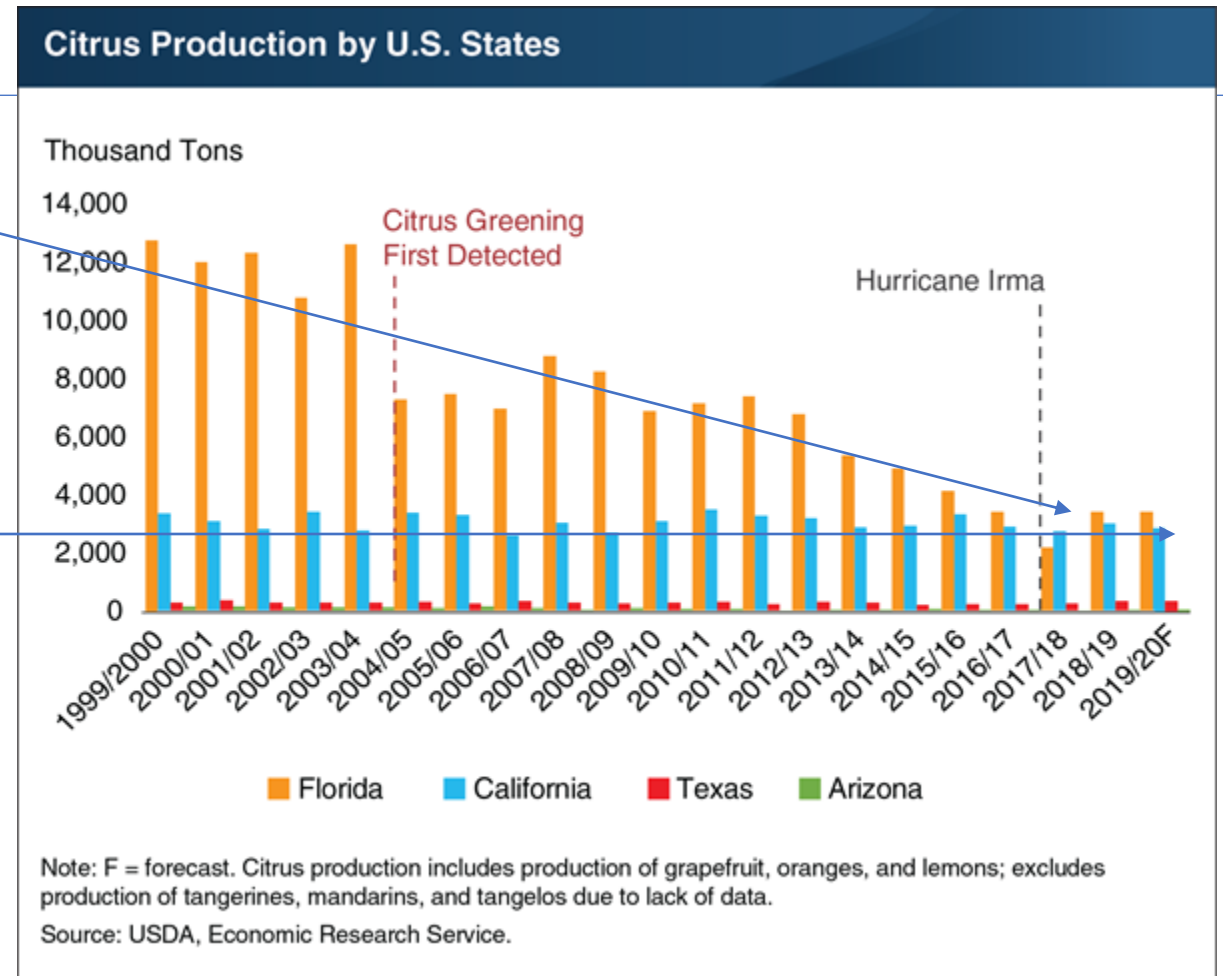
# Impact of HLB

## FLORIDA

- HLB is widely distributed
- Production drastically declined

## CALIFORNIA

- HLB only found in urban backyard citrus in CA,
- 3378 trees removed
- Production is stable



# Research Priority

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- Early detection: ACP and HLB
- Eradication: ACP and HLB
- Quarantine and containment
- Management practices

# Early Detection

- Extensive trapping of ACP
- Intensive sampling in high risk areas
- Canine
- PCR



## Total Detections of ACP in South SJV

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022 YTD
Madera	0	0	1	2	2	0	0	0	1	0	0
Fresno	0	0	0	2	28	11	3	1	0	1	0
Tulare	3	12	12	13	74	34	10	2	3	2	10
Kings	0	0	0	0	28	2	0	0	1	0	0
Kern	0	1	4	113	247	78	18	1	113	18	2
<b>TOTAL</b>	<b>3</b>	<b>13</b>	<b>17</b>	<b>130</b>	<b>379</b>	<b>125</b>	<b>31</b>	<b>4</b>	<b>118</b>	<b>21</b>	<b>12</b>

# Quarantine

- Restricted/regulated Seedling movement
- Restricted Fruit movement
- Fruit cleaning/treatment
- Tarping



## CITRUS PLANT QUARANTINE IN PLACE TO SAVE CALIFORNIA CITRUS

A fatal plant disease called Huanglongbing (HLB) is threatening backyard citrus trees throughout California.

HLB can be spread by a dangerous pest called the Asian citrus psyllid (ACP) as it feeds on the leaves of citrus trees. HLB has been found in Los Angeles, Orange, Riverside, San Bernardino and San Diego counties, but ACP populations have increasingly been found across the state. There are a handful of rules and regulations in place to help protect the California citrus we love, including an HLB quarantine which places limits on the transport and movement of citrus plants and material to prevent the spread of the deadly disease.

To help California residents understand what the HLB quarantine means, the Citrus Pest & Disease Prevention Program answers commonly asked questions to best explain how we all need to work together to protect California's citrus:

### WHAT IS THE HLB QUARANTINE AND WHAT DOES IT MEAN?

- To limit the spread of the deadly citrus plant disease HLB, **an HLB citrus quarantine** is in place throughout portions of Los Angeles, Orange, Riverside, San Bernardino and San Diego counties in response to HLB detections in surrounding areas.
- An area is put under the HLB quarantine when an HLB infection is present in a citrus tree or other host plant material nearby. Citrus plant material is routinely collected by California Department of Food and Agriculture (CDFA) officials to be tested for the disease.
- Once an HLB detection is confirmed, a quarantine is established within a 5-mile radius surrounding the site where the confirmed HLB positive tree is located.
- To further limit the spread of the ACP and HLB, there are additional quarantines in place that make it illegal to bring citrus fruit or plant material into California from other states or countries.


[Citrus-Plant-Quarantine-in-Place-to-Save-California-Citrus.pdf](#)  
([californiacitrusthreat.org](http://californiacitrusthreat.org))








# Breeding for resistance

- Development of Resistant rootstock varieties
- Development of resistant scion varieties
- Australian finger lime

**Delicious and disease-free: scientists attempting new citrus varieties**  
\$4.67 million helps put new fruits to the test


 **JULES BERNSTEIN**  
December 22, 2020

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**U**C Riverside scientists are betting an ancient solution will solve citrus growers' biggest problem by breeding new fruits with natural resistance to a deadly tree disease.

The hybrid fruits will ideally share the best of their parents' attributes: the tastiness of the best citrus, and the resistance to [Huanglongbing](#), or HLB, displayed by some Australian relatives of citrus.

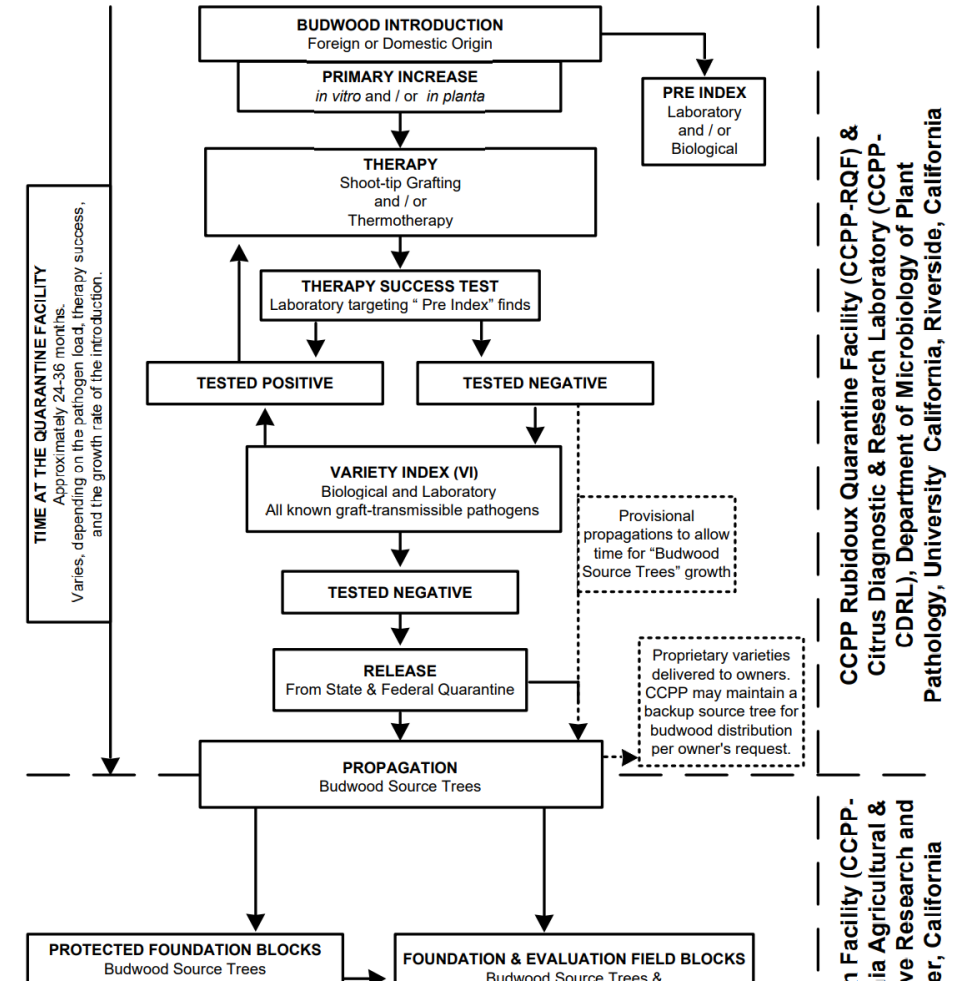
There is no truly effective commercial treatment for HLB, also called citrus greening disease, which has destroyed orchards worldwide. The disease has already been detected in California, where 80 percent of the country's fresh



[Delicious and disease-free: scientists attempting new citrus varieties | News \(ucr.edu\)](#)

# New variety introduction

- All new varieties introduced through Citrus clonal protection program
- Under screenhouse
- Disease free buds
- Strict quality control



[CCPP Flow chart \(ucr.edu\)](http://ucr.edu)

# ACP in Commercial orchard

- Pesticide application
- Mode of action rotation
- Dormant spray, coordinated spray, border spray, perimeter spray, cover spray, trap crop spray etc.

## Asian Citrus Psyllid - UC Statewide IPM Program

<https://www2.ipm.ucanr.edu/agriculture/citrus/asian-citrus-psyllid> ▼

260 rows · The Asian citrus **psyllid** (ACP; Hemiptera: Psyllidae) is a tiny (0.125 inch, 3 mm, in length) mottled brown insect that is about the size of an aphid. The adult **psyllid** feeds with its...

COMMON NAME	AMOUNT TO USE	REI‡	PHI‡
(Danitol 2.4 EC)	16–21.33 fl oz/acre (OC)	24	1
(Baythroid XL)	2.4–6.4 fl oz/acre (OC)	12	0
(Tombstone)	2.0–3.2 fl oz/acre (OC)	12	0
(Mustang)	4.3 fl oz/acre (OC)	12	1

[See all 260 rows on www2.ipm.ucanr.edu](https://www2.ipm.ucanr.edu)

[Asian Citrus Psyllid / Citrus / Agriculture: Pest Management Guidelines / UC Statewide IPM Program \(UC IPM\) \(ucanr.edu\)](#)

### Stepping in as citrus IPM Advisor

As of July 2021, I joined the UC Agriculture and Natural Resources as a Cooperative Extension Area Citrus IPM Advisor at Lindcove Research and Extension Center. I am very excited in my new role and for the opportunity to serve San Joaquin Valley that...



# ACP in Urban backyard

- Biological control
  - Conservation of resident predators
  - Repeated releases of parasitoids



# Parasitoid production



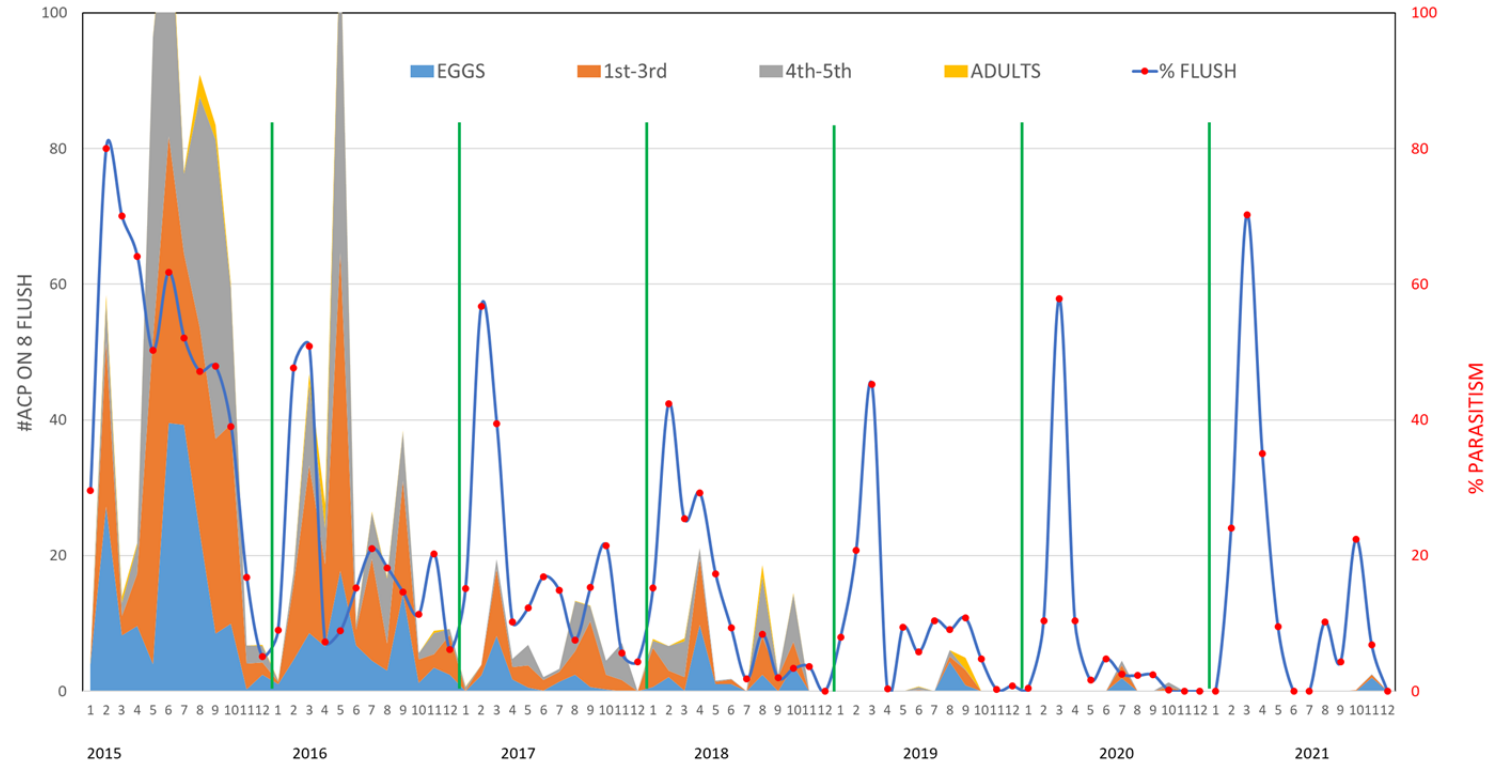
**Greenhouse production**



**Field cage production**

# Current ACP status

- *Tamarixia* is well established
- *Diaphorencyrtus* did not establish
- ACP population has declined
- No HLB in commercial orchard



# Novel methods

- **SAMP (Stable anti microbial peptide) from Australian finger lime**
- CUPS (Citrus under protective screen)
- Heat treatment
- Genetic modifications: Gene from spinach
- RNAi

## A stable antimicrobial peptide with dual functions of treating and preventing citrus Huanglongbing (PNAS)

February 12, 2021 / in Plant Science Research Weekly / by Toluwase Olukayode


Citrus Huanglongbing (HLB) caused by the bacterium *Candidatus Liberibacter asiaticus* (CLAs) is the most destructive disease of citrus and currently has no cure. Current management practices are also not effective. Huang et al. used comparative analysis of small RNAs and mRNAs between HLB-sensitive and HLB-tolerant hybrids to identify genes mediating HLB tolerance. One of these genes encodes a 67 amino acid peptide that has an Arabidopsis homolog with antimicrobial properties. This candidate gene was subsequently named SAMP; stable antimicrobial peptide. To functionally characterize this candidate gene, *SAMP* genes were cloned from HLB tolerant citrus relatives. Tolerant citrus relatives have both a long (109-aa) and short (67-aa) version of the peptide, while the susceptible varieties have only the long version (LSAMP). SAMP mRNA expression was significantly higher in tolerant varieties than LSAMP expression in



[Plantae | A stable antimicrobial peptide with dual functions of treating and preventing citrus Huanglongbing \(PNAS\) | Plantae](#)

# Final thoughts

- No alternative to clean planting material
- Interplanting guava did not work
- Spraying nutritional cocktail provided partial relief
- Conserve biological control agents
- Inarching or side grafting Australian finger lime help?
- How about grafting on bel patra, *Aegle marmelos*?



## Pummelo interstocks could improve performance of HLB trees

By Manjul Dutt, Ethan Nielsen, Lamias Mahmoud, Maria Quirico and Jude Grosser

**A**ll commercially cultivated citrus scion varieties are grafted onto rootstocks before being planted in the field. The rootstocks are selected based on specific desirable qualities (abiotic/biotic stress resistance) and the ability to produce a good crop in a specific location. The ideal rootstock confers disease resistance, hardiness, tolerance of environmental stresses, enhanced nutritional uptake, soil adaptation and improved yield.

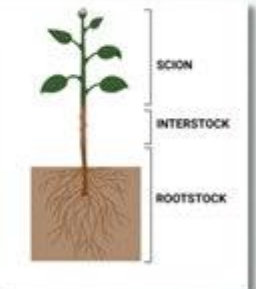
### ROOTSTOCKS AND INTERSTOCKS

Rootstocks can influence fruit quality, affect the Brix and soluble solids in the fruit, or affect the texture of the rind in some cases. In Florida, prior to the advent of HLB, many popular rootstocks, including Swingle or Kuharske/Carrius, have been used in most locales and have resulted in supporting successful citrus culture. Rootstocks support the scion, and there is a constant rootstock-scion interaction. Imparting HLB tolerance to the aboveground scion has become

the primary trait of interest, and newer cultivars like US-942 and X-639 have gained in popularity.

The interstock, as the name suggests, is a bridge between the rootstock and the scion and is grafted in between the rootstock and scion (Figure 1). Interstocks are widely used in apple cultivation, where they have been used to regulate tree size and improve production and fruit quality. Interstocks can be used to compensate for scion/rootstock incompatibility, preventing decline of the tree, or to regulate the growth when one grafted element is more vigorous than the other. The interstock may prevent a bulge that can slow sap and stunt the growth of the tree.

Additionally, interstocks may increase the lifespan of the tree while improving production and fruit quality. Using interstocks that are tolerant to Huanglongbing (HLB) may be able to confer this tolerance to the scion and the rootstock. Using an interstock may allow citrus growers to topwork a grove with a new interstock/scion combination, perhaps saving a grove that would otherwise be destroyed.



**Figure 1.** Schematic representation of the interstock grafting process

### RESEARCH: THEN AND NOW

In the citrus breeding program, somatic fusion techniques have been used to generate new hybrids with the main goal of producing disease-resistant rootstocks or seedless triploid scions. In 1999, the University of Florida Institute of Food and Agricultural Sciences (UF/IFAS) initiated a project

10 Citrus Industry December 2021



# Acknowledgements

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## Collaborative work

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