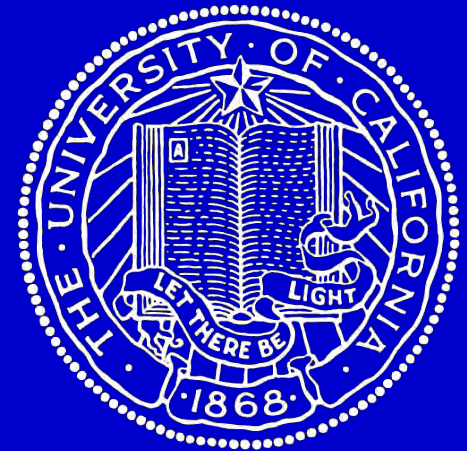


US Congressional Briefing Citrus Huanglongbing (HLB)

Georgios Vidalakis, Ph.D.
Director, Citrus Clonal Protection Program
Dept. of Plant Pathology & Microbiology



University of California
Agriculture and Natural Resources

Washington DC, B-340 Rayburn Building
07/23/2015

Acknowledgements

Mark Hoddle, UC Riverside

Victoria Hornbaker, CDFA

Mike Irey, US Sugar/Southern Gardens

Fernando Tersi, Cambuhy Farm, Brazil

MaryLou Polek, Citrus Research Board

Elizabeth Grafton-Cardwell, UC Riverside

My Background

- Born and raised in the island of Crete in southern Greece
- 1992-1998: BS & MSc, Agricultural Univ. of Athens, Greece
- 2000-2004: PhD, University of California, Riverside
- 2005-Present: UC Riverside
Dept. of Plant Pathology & Microbiology
Plant Pathologist & Extension Specialist
Director, Citrus Clonal Protection Program (CCPP)

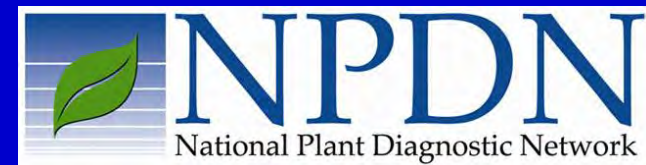
- 2007-Present: Secretary of the International Organization of Citrus Virologists (IOCV)



- 2009-Present: Founding member and Chairman of the Citrus Clean Plant Network of the National Clean Plant Network (NCPN)



- 2015: National Plant Diagnostic Network (NPDN) - STAR-D Board



G. Vidalakis - Research & Extension

- Developed a diverse research & extension program with emphasis on citrus diseases that transmit during tree propagation, such as HLB
- Working directly with the citrus industry, growers and nurseries, as well as citrus enthusiasts, at a state and national level
- Over 50 technical, semi-technical, and extension publications

HAVE YOU SEEN THIS INSECT?
Asian Citrus Psyllid



Eggs tucked inside new citrus flush
Adult psyllid - 1/8 inch in size
Young stages with waxy tubules
Psyllids infesting a leaf
Twisted flush

The Asian citrus psyllid, *Diuraphis citri*, is a small, aphid-like insect. It feeds on the new flush of citrus and very closely related plants such as orange jasmine (*Murraya paniculata*). Psyllid feeding causes burned tips and twisting of the new leaves. More importantly, it can spread the bacterium that causes Huanglongbing (HLB) disease.

HAVE YOU SEEN THIS CITRUS DISEASE?
Huanglongbing or Citrus Greening Disease



Lopsided bitter, hard fruit with small, dark aborted seeds
Asymmetrical blotchy mottling of leaves
Yellow shoots

Huanglongbing (HLB), also known as citrus greening disease or yellow shoot disease, is a very destructive bacterial disease of citrus and closely related plants. It is spread by psyllids and through grafting with infected budwood. Symptoms include yellow shoots, blotchy leaf mottle, small lopsided fruit and juice with bitter flavor. Diseased trees stop producing fruit and must be removed and destroyed to prevent further spread of the disease. HLB is a serious threat to all citrus in California.

IF YOU SUSPECT YOU HAVE SEEN THIS INSECT OR DISEASE CALL THE CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE: 1-800-491-1899
For more information: www.CaliforniaCitrusThreat.org
E. Grafton-Cardwe and G. Vidalakis, University of California Riverside
Photos by M. Rogers and M. Karamanos

UCRIVERSIDE



细菌引起的
柑橘黄龙病或称青果病
Huanglongbing or citrus greening disease
其病症为叶片斑驳、黄化、嫩枝坏死、果实苦涩。可通过病的枝条传播。

如果您怀疑曾经见到过此种昆虫或病症，请拨打品与农业部热线电话：1-800-491-1899

ANR UNIVERSITY OF CALIFORNIA
Agriculture & Natural Resources
G. Vidalakis and E. Grafton-Cardwe
加州大学食品与农业学院
照片由 M. Rogers 和 M. Ke 翻译：高岗

Psílido asiático de los cítricos
Asian Citrus Psyllid
Diuraphina citris un insecto (vector) de la enfermedad "Huanglongbing" de los cítricos. Los daños que causan estos insectos psílidos cuando se alimentan incluyen: que las hojas se tuerzan y se vean quemadas en las puntas.



Si ve esta plaga, por favor llame a la línea del CDFCA: 1-800-491-1899



G. Vidalakis - Research & Extension - Funding

- University of California



- California Citrus Research Board (CRB)



- California Citrus Nursery Board



- California Department of Food and Agriculture



- US Department of Agriculture



1. National Clean Plant Network
2. HLB Multi-Agency Coordination (MAC)
3. NIFA/SCRI/Citrus Disease Research & Extension

Invited to submit full proposals for three collaborative HLB projects: Citrus Phytobiome, Bacteria culturing, & Bacterial secreted proteins

Citrus Phytobiome ?

The Escaped Tree Phenomenon

HLB +



California - Plant Pathology 101

1. Exclusion

2. Eradication

3. Management

Citrus Clonal Protection Program-Short History

1937: Psorosis Free Program

- Directors: Dr. Fawcett & Wallace

1957: Citrus Variety Improvement Program

- Directors: Dr. Calavan & Reuther

1977: Rename to Citrus Clonal Protection Program

- Director: Dr. Gumpf

2005: Citrus Clonal Protection Program

- Director: Dr. Vidalakis

2009: National Clean Plant Network (NCPN)

- Citrus Clean Plant Network Administration at CCPP with Dr. Vidalakis as Chair

CCPP-Collaboration, Collaboration, Collaboration

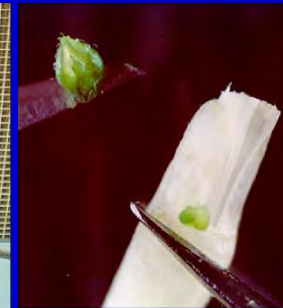
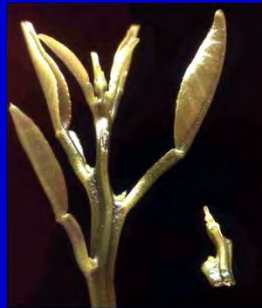
- **Citrus Research Board**
- **California Citrus Nurserymen Board**
- **University of California**
- **California Department of Food & Agriculture**
- **United States Department of Agriculture**
- **National Clean Plant Network**

Citrus Clonal Protection Program-CCPP

Purpose:

- **To provide a safe mechanism of introduction of citrus germplasm into California**
- **To maintain primary sources of disease tested & true to type citrus trees**

CCPP Introduction-Quarantine Diagnostics & Therapy



Maintenance & Distribution

U.C. Lindcove Research & Extension Center

~350 COMMERCIALY IMPORTANT VARIETIES
DISEASE RETESTING & TRUENESS-TO-TYPE EVALUATION

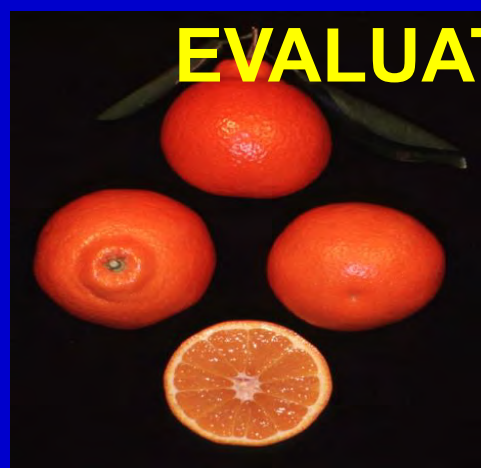


80,000 ft²
PROTECTED

~2000 TREES
FOUNDATION &



FOUNDATION BLOCK



EVALUATION BLOCK



G. Vidalakis - Research & Extension – Impact Citrus Varieties Distribution

Five years period:

- 581 orders
- 149,095 buds
- 290 different varieties
- 614 registered budwood users
- ~40 commercial citrus nurseries in California



149,095 buds x 200 nursery trees = 29,819,000 Trees

Wall Street Journal: The Big War Over a Small Fruit, August 14, 2014



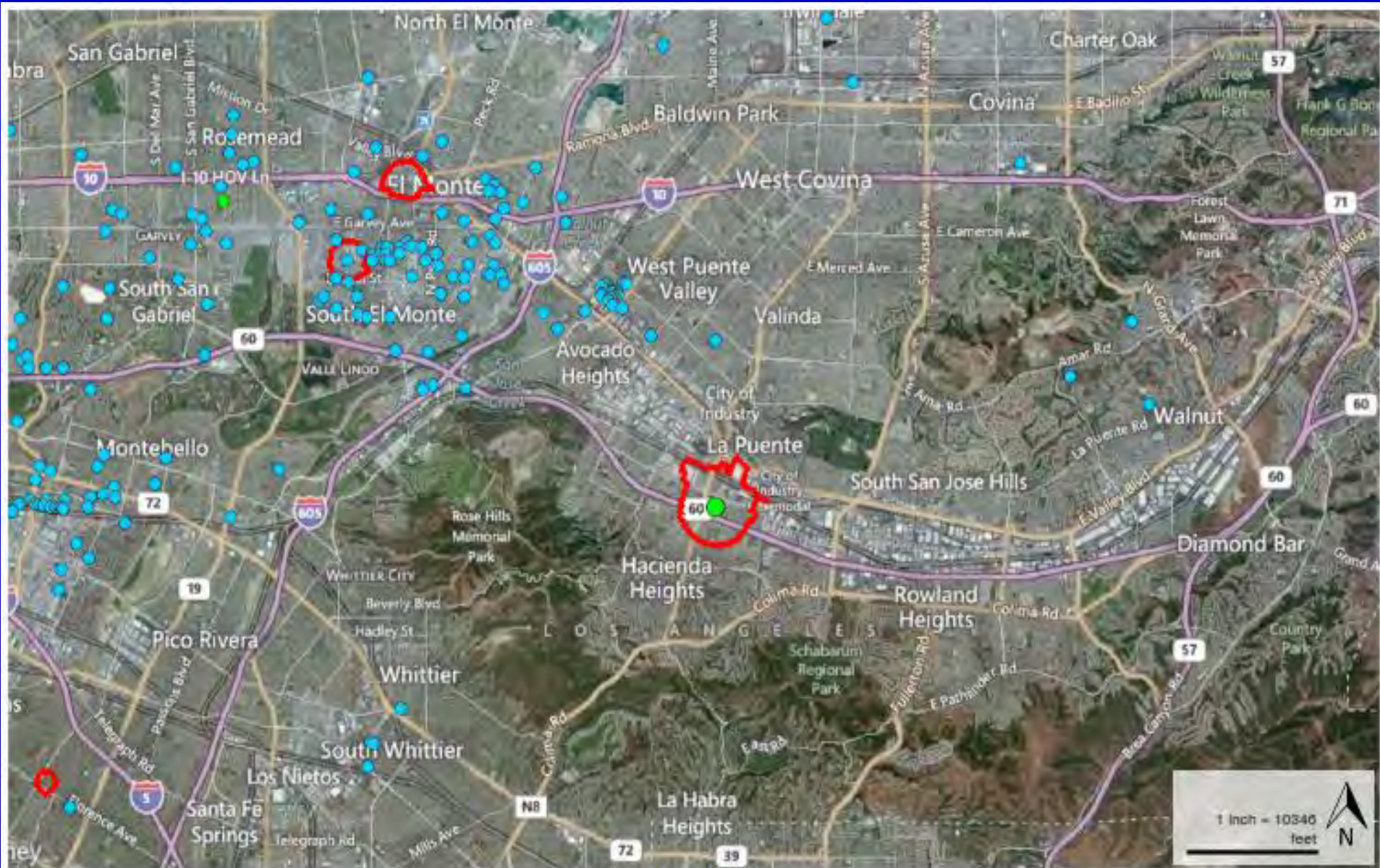
2012, 1st HLB Tree

Hacienda Heights, Los Angeles, California

A lemon tree with 19 grafts of unknown origin that could not be traced back to a California citrus nursery or a CCPP source plant

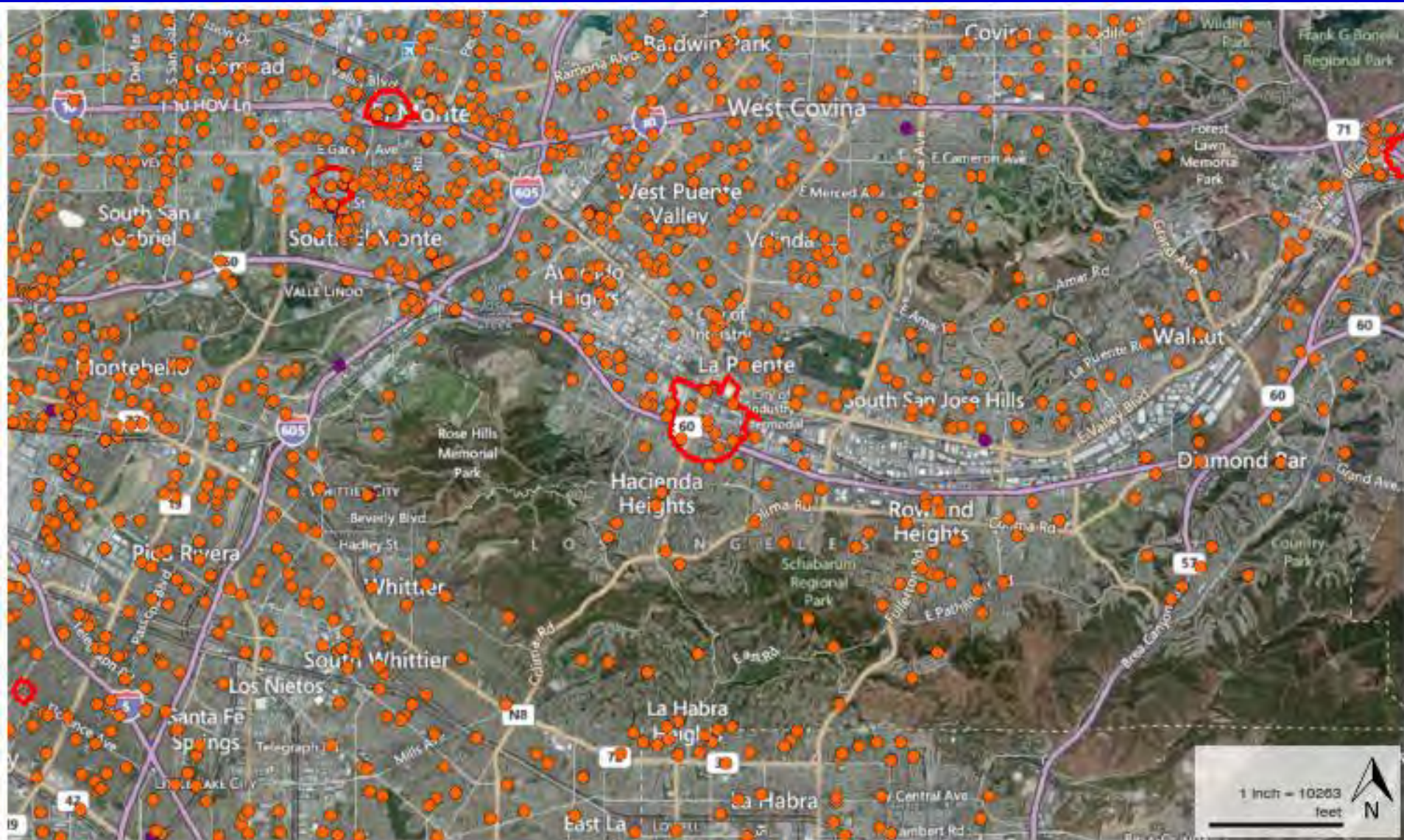


2010 ACP Detections Near Hacienda Heights, Los Angeles



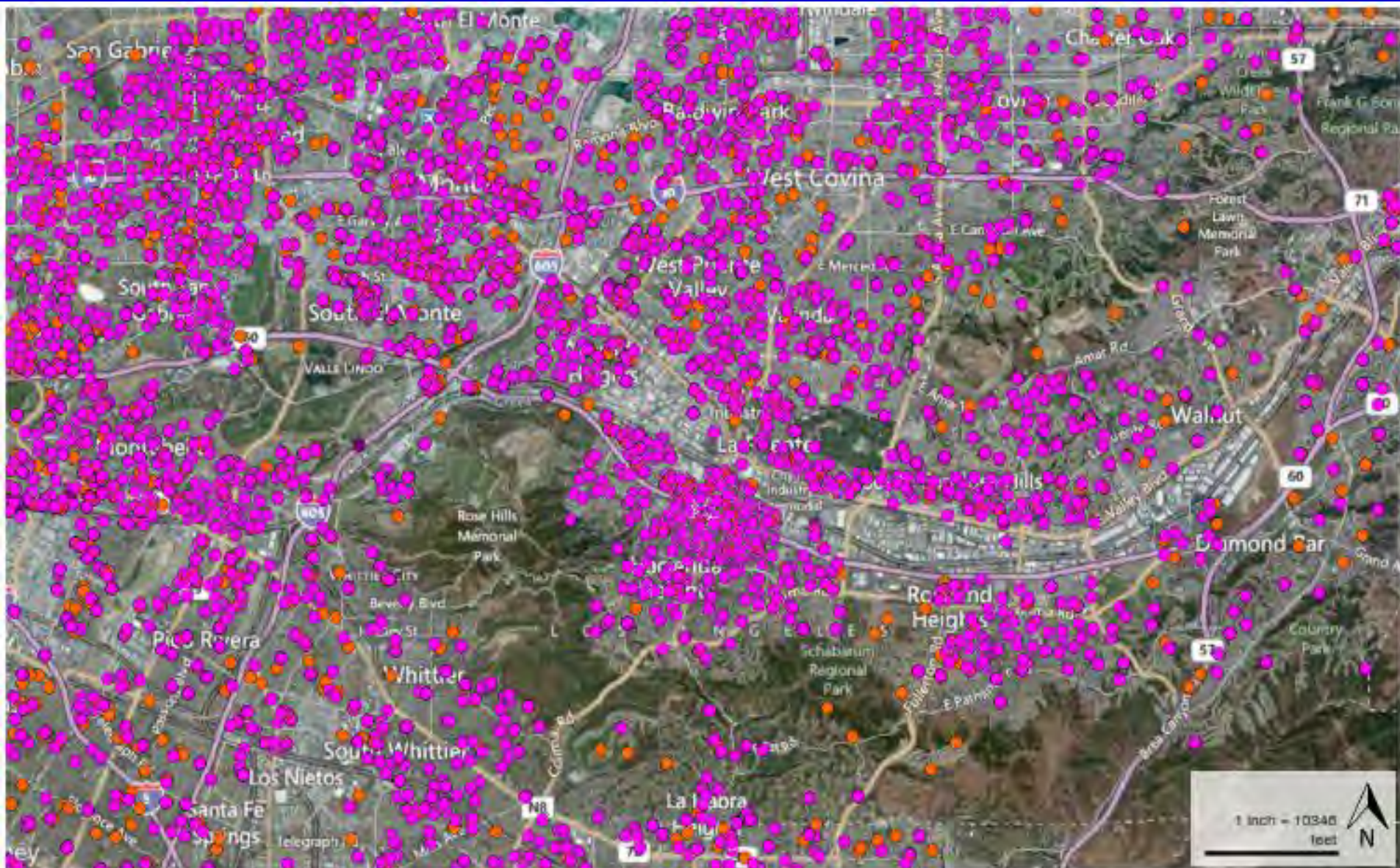
ACP Detections 2010

2011 ACP Detections Near Hacienda Heights, Los Angeles



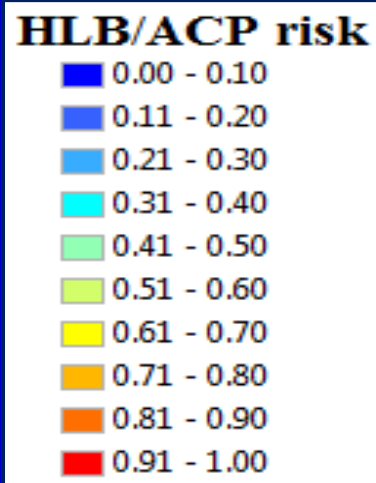
ACP Detections 2011

2012 ACP Detections Near Hacienda Heights, Los Angeles



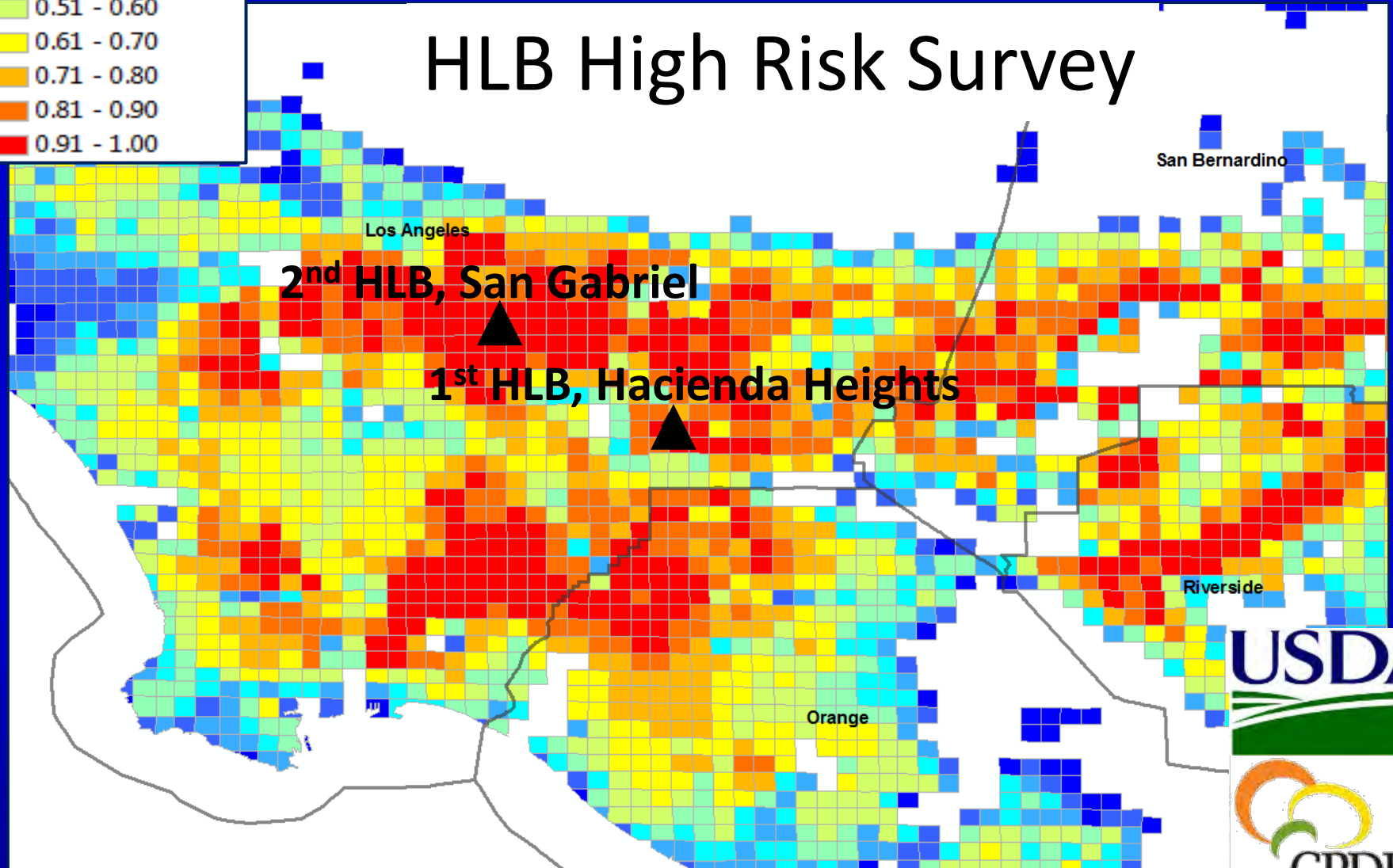
ACP Detections 2012

2nd HLB detection in Los Angeles, CA



Census travel (Asian)	ACP density	Weather suitability	Total Risk
1	1	1	0.944

HLB High Risk Survey



Early Detection

USDA-APHIS MAC PLAN K9 Detection Team



TINA

AGE: 12 Months
BREED: GSD
DISCIPLINE: HLB
STAGE OF TRAINING:
1st Stage Odor Training



FOREST

AGE: 15 Months
BREED: Mal
DISCIPLINE: HLB
STAGE OF TRAINING:
1st Stage Odor Training



AKIM

AGE: 15 Months
BREED: GSD
DISCIPLINE: HLB
STAGE OF TRAINING:
1st Stage Odor Training



SZABOLES

AGE: 18 Months
BREED: Mal
DISCIPLINE: HLB
STAGE OF TRAINING:
1st Stage Odor Training



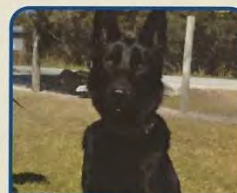
ZSEMIR

AGE: 15 Months
BREED: Mal
DISCIPLINE: HLB
STAGE OF TRAINING:
1st Stage Odor Training



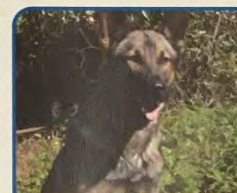
AMOR

AGE: 15 Months
BREED: Mal
DISCIPLINE: HLB
STAGE OF TRAINING:
1st Stage Odor Training



VERA

AGE: 23 Months
BREED: GSD
DISCIPLINE: HLB
STAGE OF TRAINING:
1st Stage Odor Training



MIRA

AGE: 19 Months
BREED: GSD/Mal
DISCIPLINE: HLB
STAGE OF TRAINING:
Fully Trained on Odor



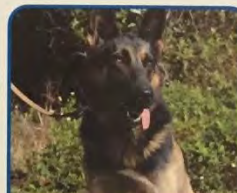
BOBBY

AGE: 19 Months
BREED: GSD
DISCIPLINE: HLB
STAGE OF TRAINING:
Fully Trained on Odor



BELLO

AGE: 22 Months
BREED: Springer
DISCIPLINE: HLB
STAGE OF TRAINING:
Fully Trained on Odor



MAXI

AGE: 21 Months
BREED: GSD
DISCIPLINE: Citrus Canker
STAGE OF TRAINING:
Fully Trained on Odor



BODY

AGE: 25 Months
BREED: GSD
DISCIPLINE: Citrus Canker
STAGE OF TRAINING:
Fully Trained on Odor

Huanglongbing (HLB)

The Pandemic of our Times

- **2002-2012: Florida lost almost half of the citrus acreage. From ~800.000 to ~500.000 acres: HLB and Citrus Canker (USDA, National Agricultural Statistics Service, 2012)**



April 19, 2007



December 16, 2008

April 19, 2007



Southern Gardens-Florida

Fruit Drop

Victor Williams & Mike Irey



UNITED STATES
SUGAR
CORPORATION

SOUTHERN
GARDENS
CITRUS

Healthy



HLB



Fruit Drop

Healthy



HLB



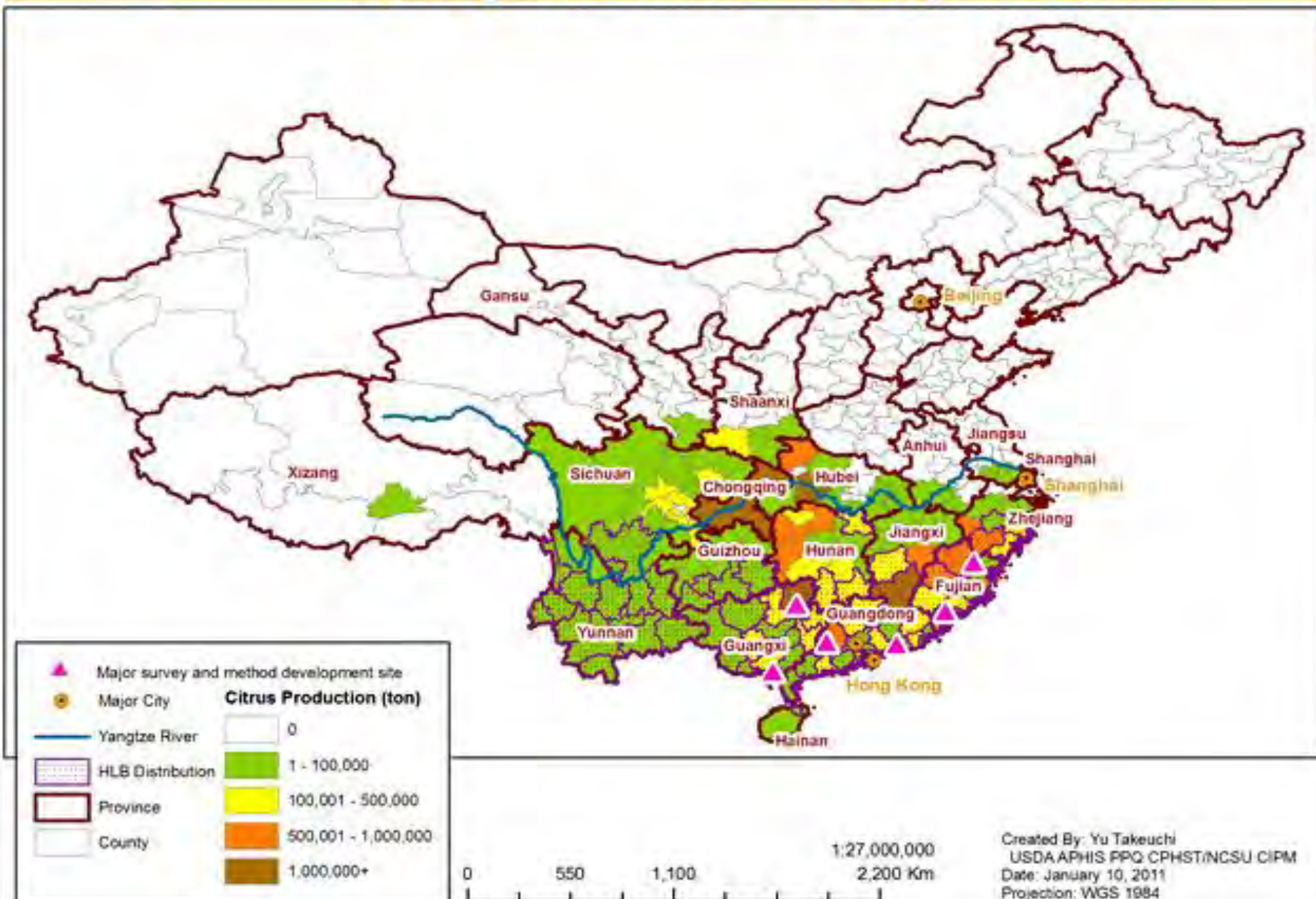
Unusable Fruit – Taste & Quality

	Fruto de Ramo Normal	Fruto de Ramo Doente	Diferença (%)
Altura (cm)	7,95 a	6,54 b	- 18
Diâmetro (cm)	7,72 a	6,20 b	- 20
Peso (g)	246 a	136 b	- 45
Brix %	9,15 a	7,31 b	- 20
Acidez	0,95 b	1,44 a	+52
Ratio	9,67 a	5,15 b	- 47
% suco	47,5 a	43,8 b	- 8
I.T. (kg ss/cx)	1,77 a	1,31 b	- 26

Brazil – Cambuhy Farm – HLB Vector Control

Action	Before HLB Per year	After HLB Per year
Sprays Young plants (0-3 years)	6	18 October to May Every 15 days
Sprays Systemic insecticides Young plants (0-3 years)	1	2
Sprays Mature plants	0	4
Fog	3	0
Insecticide by plane	0	3
Total	10	27

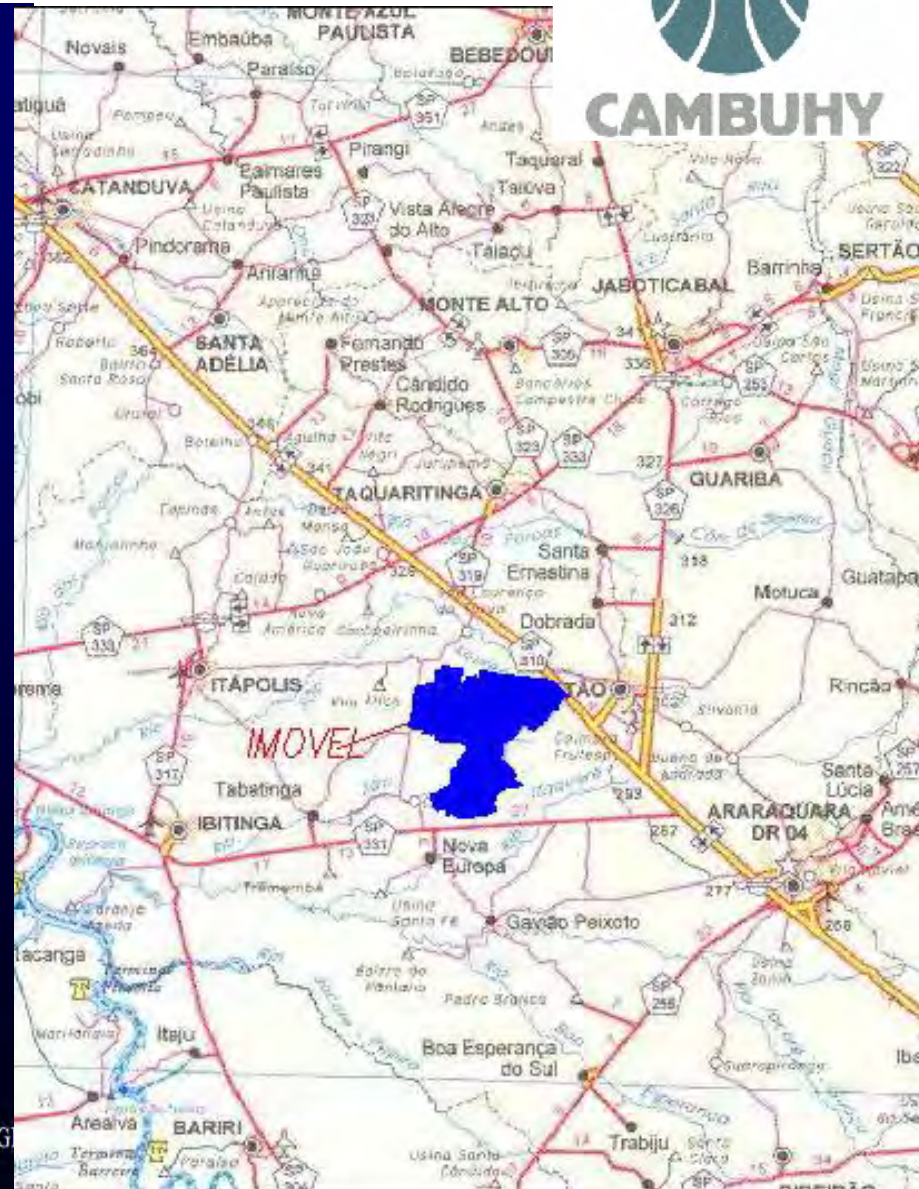
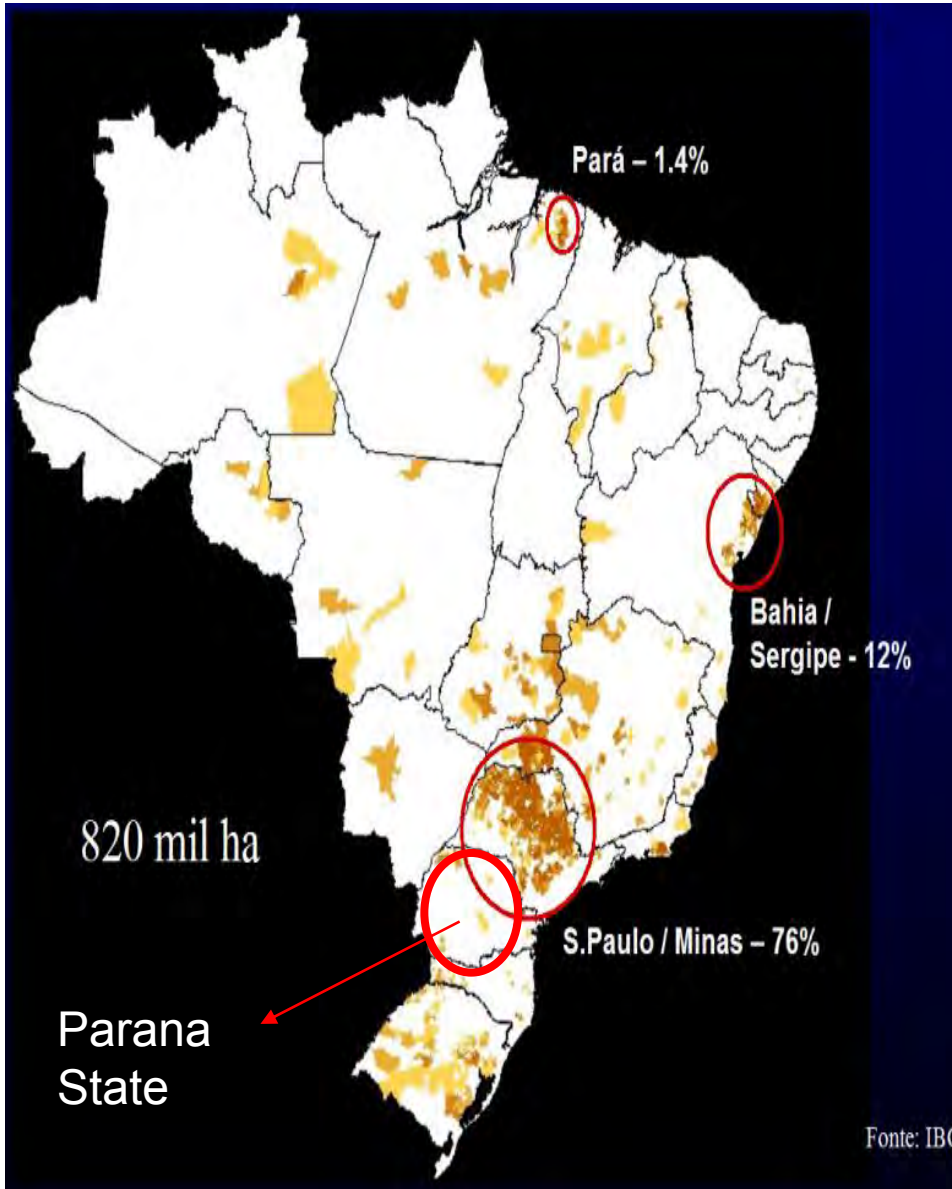
Citrus Production, HLB, and Survey and Method Development Sites



Brazil - Oranges production areas

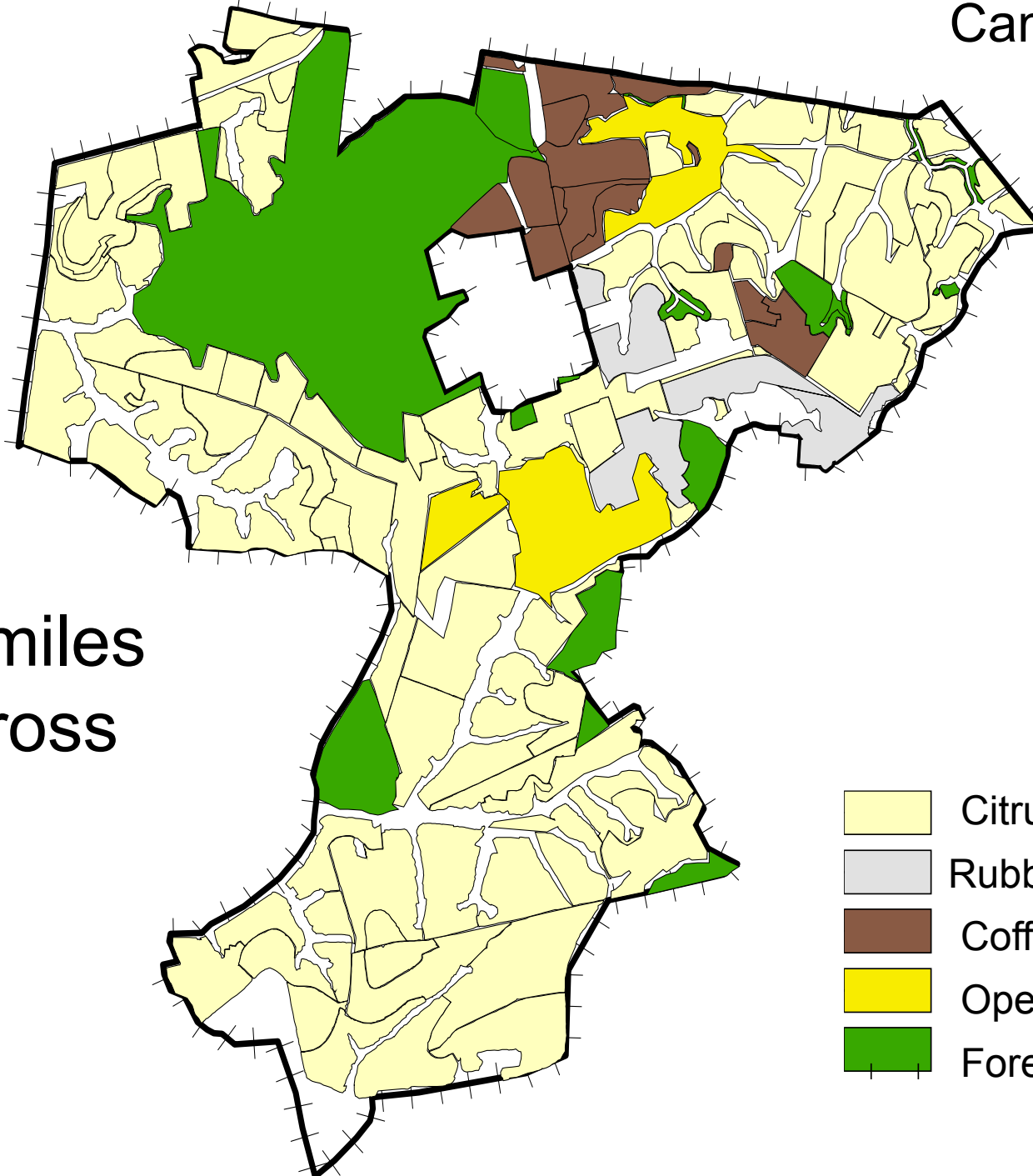


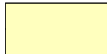




CAMBUHY



Cambuhy Farm Map

28 miles
across



-  Citrus
-  Rubber Trees
-  Coffee
-  Opened blocks
-  Forest

Training and motivation = is the key of the success in Greening Handling



Motivation – a good job ambient



California HLB-ACP Program Cooperators

- **Federal**
 - **USDA**
- **State**
 - **California Department of Food & Agriculture**
 - **Dept. of Pesticide Regulation**
 - **Office of Health Hazard Assessment**
 - **University of California - Cooperative Extension**
- **Local**
 - **County Agricultural Commissioners**
- **Industry**
 - **California Citrus Research Board**
 - **Growers**
- **Residents**



California HLB-ACP Program Activities


- Detection Trapping
- Visual Survey
- Delimitation Trapping
- Residential & Area wide Treatments
- Outreach
- Quarantine



Asian Citrus Psyllid 2015


51,411 sq miles

ACP Quarantine Boundaries

 51,411 sq miles on 03/20/2015

 Citrus Layer

0 50 100 Miles



Why Areawide Treatments?

- **Because coordinated pesticide applications in commercial citrus help obtain better control of Asian citrus psyllid (ACP) while minimizing resistance.**
- **Citrus Health Management Areas (CHMAs) – In Florida - Grower defined grouping of citrus acreage where grower participants coordinate ACP control efforts and management of pesticide resistance.**
- **In California, the areawide control concept has already successfully been done for glassy-winged sharpshooter (GWSS).**

ACP Biocontrol-Pakistan Collections

- **September 2010**
 - Reconnaissance completed in Pakistan
 - Demonstrated it was feasible to collect & rear ACP parasitoids
- **March 10 to April 10 2011**
 - Set up long-term replicated phenology studies
 - Collected ~ 200 parasitoids
- **June 4-13 2011**
 - ~400 parasitoids returned to UCR
- **Oct. 23-28 2011**
 - > 1,000 parasitoids returned to UCR
- **June 16-23 2012**
 - > 1,000 parasitoids returned to UCR
- **April 15-22 2013**
 - > 400 parasitoids returned to UCR



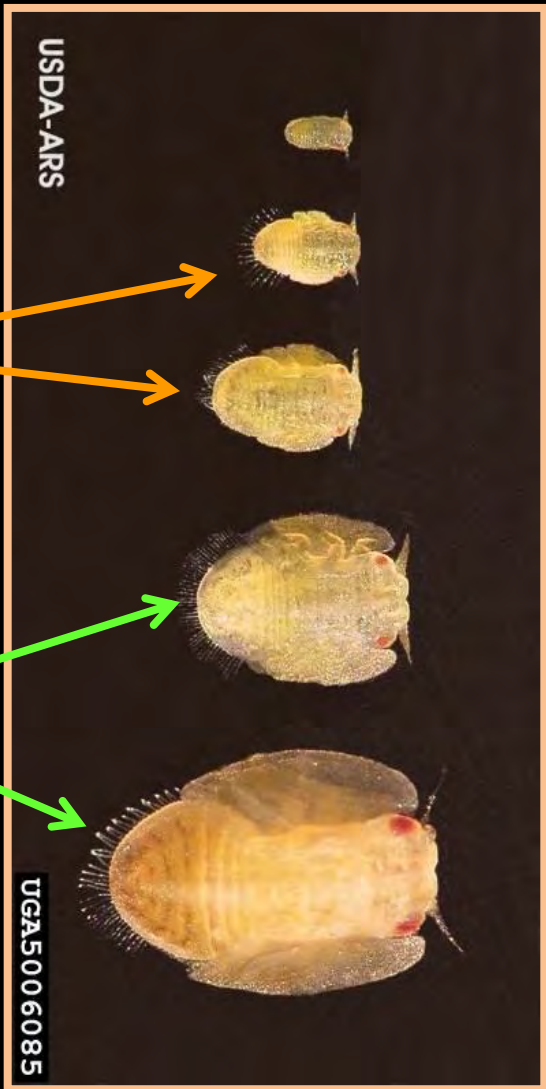
ACP Natural Enemies Collected in Pakistan are Returned to the Insectary & Quarantine Facility at UC Riverside for Safety Testing



Diaphorencyrtus



Tamarixia



Biocontrol Releases – Through June 1, 2015

Tamarixia – 437,702
Diaphorencyrtus – 60,927



County	Urban Grid Releases			Organic Grove Releases		Total # of Tamarixia Released	Total # of Diaphorencyrtus Released
	Est Total	% Complete	# Visits	# Groves	# Released		
Imperial	80	83	1	1	4,000	29,467	0
Los Angeles	188	119	1	3	4,500	99,000	8,104
Orange	70	124	1	0	0	41,200	0
Riverside	197	124	1	8	10,378	88,900	29,104
San Bernardino	72	83	1	1	2,000	31,246	5,775
San Diego	206	117	1	19	29,879	120,589	15,680
Ventura	69	62	1	1	500	16,400	500
Santa Barbara	58	36	1	1	1,000	10,900	1,764
TOTAL	940	3		34	52,257	437,702	60,927

Citrus Huanglongbing (HLB) - My Prediction

I am optimistic that we will make history but...

- **HLB was first reported in China in 1919**
- **In other words we need to cover 100 years worth of research in a very short period of time.**
- **We have achieved a lot but we need your support to keep moving**
- **Short term solutions**
 - **ACP control & HLB eradication**
- **Medium term**
 - **Horticultural practices & treatments (heat, tristeza virus vector... 1930s-1960s pandemic, 100 million trees dead)**
- **Long term**
 - **Breeding for resistance tolerance (classical and engineering) & Integrated pest management**

Thank You

Thank You

<http://www.saveourcitrus.org/>



<http://www.californiacitrusthreat.com/>