Asian Citrus Psyllid and Huanglongbing

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Overview

• Introduction to pest and pathogen
• Indication of California situation
• Industry, State and federal responses to HLB threat
Asian Citrus Psyllid (*Diaphorina citri*) and HLB (*Candidatus Liberibacter asiaticus*)

http://californiacitrusthreat.org/
ACP/HLB situation in California

http://www.cdfa.ca.gov/plant/acp/index.html

• ACP first discovered in 2008
• Now widespread in much of southern California
• In 2013 ACP detections in southern San Joaquin Valley became more frequent
• To date only 1 confirmed case of HLB: tree in residential neighborhood of greater LA.
Incursion of ACP into the San Joaquin Valley

ACP detections in 2013

Source: CDFA CA ACP Quarantine areas; web interface
Purpose of a CA Residential Survey

**Justification:**
- Early detection of HLB to:
  - Maximize regulatory intervention and disease control.
  - Minimize disease incidence, spread, and impact to commercial citrus industry.
- The recent finds of HLB underscore the urgency
  - Los Angeles basin (residential)
  - Texas (Commercial planting)

**Requisites and Goals:**
- A statistically accurate and justifiable survey protocol to be used pre- and post-discovery - for early detection across all citrus industries within the US that:
  - Incorporates all HLB/ACP biological and epidemiological factors.
  - Can be applied across residential areas and commercial citrus.
  - Has high probability for early detection of both HLB and ACP.
  - Maximizes targeting of control/mitigation efforts.
  - Maximizes fiscal and manpower resources.
Model framework

Original Census tract

Filtering
- Elevation
- Water
- Land cover
- Military
- Indian Reservation

Risk modeling
- Weather
- Population & race
- Citrus transport
- ACP-
  (Nursery & Big box store
  Citrus green waste)

ACP+

Final risk mapping and survey protocol
2. Risk Modeling
Determining risk variables and their effects
Formula & algorithm

Estimate total risk in residential area, including:

1. Residential citrus population and distribution
2. Residential Asian population risk
3. ACP+ location risk
4. Citrus production related transport corridors
5. Potential ACP spread risk from commercial nursery, green waste facility, military installation, packing house and flea market
6. Distance to Mexico-TX border crossing
7. HLB and ACP -- LAS+ locations risk
8. Proximity to commercial citrus groves (adjustment for sampling intensity)

Output variables

- Residential citrus: \( P_{\text{citrus}} \)
- Residential Asian risk: \( R_{\text{Asian}} \)
- ACP+ risk: \( R_{\text{ACP+}} \)
- Transportation risk: \( R_{\text{Road}} \)
- Potential ACP risk: \( R_{\text{ACP-}} \)
- LAS+ risk: \( R_{\text{LAS}} \)
- Border crossing risk: \( R_{\text{Border}} \)

Total risk = Residential citrus \* \{([\text{Asian}] + [\text{ACP+}] + [\text{Road}] + [\text{ACP-}] + [\text{Border}]) / 5 + [\text{LAS+}]\}

\[= \log(P_{\text{citrus}}) \* \left\{ \frac{(R_{\text{Asian}} + R_{\text{ACP+}} + R_{\text{Road}} + R_{\text{ACP-}} + R_{\text{Border}})}{5} + R_{\text{LAS}} \right\} \]

No prior preference for each risk factor, so equal weight is applied. The suitable weighting to be determined later from survey results.

Total risk

Sampling intensity

Proximity to commercial citrus groves

Adjusted for sampling intensity
4. Estimate risk from citrus fruit transport corridor (to packinghouse and juice plants)

- Apply HLB/ACP spread curve determined from Florida data

**Route 27, 29, 50, 70, 95, 98**

- Major routes with strong effects on HLB

**Route 29, 50, 60, 64, 70, 98**

- Major routes with strong effects on ACP

**Adjusted $R^2 = 0.86$**

**Adjusted $R^2 = 0.97$**

Full information available: Gottwald & Luo, An investigation of transport network on HLB/ACP spread.
Distance to commercial citrus groves
Not ‘Risk’ but affects sampling intensity

Southern California

Rio Grande Valley, TX

Proposed new sampling scheme

Linked with ACP dispersal curve determined from FL data
3. Risk Mapping

Integrating filtering and risk variables with GIS data to develop survey design and intensity
Total risk map (Considers all variables and filtering)

Southern California

Rio Grande Valley, TX
Incursion of ACP into the San Joaquin Valley

Source: CDFA CA ACP Quarantine areas; web interface
Manpower and number of survey cycles/year

- 1 cycle/year
- 2 cycles/year

2 cycles/yr does not detect disease at as low an incidence
Risk-based sampling (1 or 2 cycles/year)

1 cycle/year
2830 STR grids selected based on risk

2 cycles/year
Cycle 1: 1393 STR grids
Cycle 2: 1464 STR grids

Extra assurance = Includes random selection of a small proportion of low risk STR areas.
In case we are totally wrong!!!!
For more information on risk assessment

A webcast by Dr Gottwald describing the process of building and deploying the risk model, mapping, and survey protocols is available at:

http://www.plantmanagementnetwork.org/edcenter/seminars/outreach/Citrus/HLB/
Medium to long-term solutions

• Organize growers into neighborhood (area-wide) response groups (learn from unfortunate FL experience).

• Breed and release an altered Psyllid which is not competent as a vector for Clas.
  – Subject of $15M USDA/Industry CAP grant
Where would νPsyllid sit in the spectrum of opinion about GM traits?

Division of Google ranked pages on page 1 of searches for “GM corn”, “GM papaya” and “GM mosquito”.

Human health benefit
Technology dread
Ecological risk
Genetic pollution
Corporate greed/monopolies
Unnatural technology

For
Neutral
Against

Scientific merits
Agricultural sustainability
Editorializing
Crossing the Rubicon

Adopting a biotech solution moves the industry to a qualitatively different place in public perception

Does it have to?
Simple causal model: a first look at $\nu$Psyllid deployment

Industry see $\nu$ACP as useful

Use of $\nu$ACP

Industry backs $\nu$ACP

$\nu$ACP developed

Decrease insecticide use

Public thinks $\nu$ACP is harmful

Public thinks $\nu$ACP is dangerous

Political support for $\nu$ACP

Public thinks $\nu$ACP is dangerous
Demonstrating benefit and avoiding antagonism could lead to sustainable ψPsyllid use

It may even be possible at low direct cost to the industry
What happens if public opinion is strengthened by industry promotion?

- Industry see vACP as useful
- Industry backs vACP
- vACP developed
- Use of vACP
- Decrease insecticide use
- Political support for vACP
- Public thinks vACP is dangerous
- Public thinks vACP is harmful
With feedback between industry PR and public opinion things get messy
What happens if public opinion is strengthened by industry promotion?

- Industry sees vACP as useful.
- Industry backs vACP.
- vACP is developed.
- Use of vACP.
- Decrease in insecticide use.
- Political support for vACP.
- Public thinks vACP is harmful.
- Public thinks vACP is dangerous.
With negative feedback between industry PR and skeptical public opinion there is hope

Growers perceive nu_ACP as beneficial

Adoption of nuPsyllid

Decrease in pesticide use

Industry promotes GM technology

Industry develops GM technology

Political support for GM technology

Public perceives GM technology as dangerous

Public perceives GM crops as harmful
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