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

Source: CDFA CA ACP Quarantine areas; web interface
IRCHLB III: Risk-based Residential HLB/ACP Survey for California, Texas, and Arizona

Tim Gottwald
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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

Resulting residential area

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

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

Integration

Final risk mapping and survey protocol
2. Risk Modeling
Determining risk variables and their effects
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)

Potential HLB risk

Known HLB risk

Total risk = Residential citrus \times \left\{ (\text{Asian} + \text{ACP+} + \text{Road} + \text{ACP-} + \text{Border})/5 + \text{LAS+} \right\}

= \log(Pop_{\text{citrus}}) \times \left\{ \frac{(R_{\text{Asian}} + R_{\text{ACP+}} + R_{\text{Road}} + R_{\text{ACP-}} + R_{\text{Border}})}{5} + R_{\text{LAS}} \right\}

Output variables

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential citrus</td>
<td>$Pop_{\text{citrus}}$</td>
</tr>
<tr>
<td>Residential Asian risk</td>
<td>$R_{\text{Asian}}$</td>
</tr>
<tr>
<td>ACP+ risk</td>
<td>$R_{\text{ACP+}}$</td>
</tr>
<tr>
<td>Transportation risk</td>
<td>$R_{\text{Road}}$</td>
</tr>
<tr>
<td>Potential ACP risk</td>
<td>$R_{\text{ACP-}}$</td>
</tr>
<tr>
<td>LAS+ risk</td>
<td>$R_{\text{LAS}}$</td>
</tr>
<tr>
<td>Border crossing risk</td>
<td>$R_{\text{Border}}$</td>
</tr>
</tbody>
</table>

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

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

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

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

Proposed new sampling scheme

Linked with ACP dispersal curve determined from FL data

Southern California

Rio Grande Valley, TX
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)

Rio Grande Valley, TX

Southern California
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)

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 _Psyllid_ 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”.

- **For**
  - Corn: Genetic pollution
  - Papaya: Genetic pollution
  - Mosquito: Genetic pollution
- **Neutral**
  - Corn: Corporate greed/monopolies, Unnatural technology
  - Papaya: Genetic pollution, Unnatural technology
  - Mosquito: Genetic pollution, Unnatural technology
- **Against**
  - Corn: Scientific merits, Agricultural sustainability
  - Papaya: Scientific merits, Agricultural sustainability
  - Mosquito: Scientific merits, Agricultural sustainability
  - Genetically modified organisms (GM)
  - Human health benefits
  - Technology dread
  - Ecological risk

- **Editorializing**
  - Corporate greed/monopolies
  - Unnatural technology

- **Human health benefit**
  - Corn: 0.5
  - Papaya: 0.3
  - Mosquito: 0.2

- **Technology dread**
  - Corn: 0.3
  - Papaya: 0.2
  - Mosquito: 0.1

- **Ecological risk**
  - Corn: 0.7
  - Papaya: 0.6
  - Mosquito: 0.4
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 Psyllid deployment
Demonstrating benefit and avoiding antagonism could lead to sustainable Psyllid use

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

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

- Use of vACP
- Industry sees vACP as useful
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- Decrease insecticide use
- 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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