Ecoinformatics and the curious case of katydids in California citrus

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Ecoinformatics

Data mining approach to ecological questions

Data tends to be:

• observational
• pooled from pre-existing sources
• plentiful, creating increased statistical power
• from broad spatial and temporal scales
• from the full range of field conditions

Complementary to experimental studies

Forktailed bush katydid *Scudderia furcata* - Direct pest of citrus in California
The challenge:

- Year-round citrus IPM program established from experiments in navel oranges (*Citrus sinensis*)

- Recent drastic increase in mandarin acreage (*Citrus reticulata, C. clementina*)

- Current guidelines for mandarins have been borrowed from oranges

Do mandarins need different IPM guidelines? If so, how?
Citrus IPM database

Built in collaboration with 11 California citrus growers

Current version contains records for 327 different commercial citrus blocks each surveyed for 1-20 years (~1,800 field-years)

- Field pest density scouting reports
- Fruit scarring evaluations at harvest

Photo credit: J Kelly Clark, E Grafton-Cardwell UC IPM for Citrus Manual (2012)
Katydid are present in mandarin fields, yet scarring is rare in mandarins.
Katydids are present in mandarin fields, yet scarring is rare in mandarins

Are we ready to update the IPM guidelines?

Hypotheses for underlying mechanism:

1. Feeding preference
2. Preferential abscission of damaged fruit
3. Different scar appearance

...have different management implications
Hypothesis 1. Feeding preference

- Orange
- Mandarins

Proportion of fruit damaged:
- Deep chewed holes
- Surface scratches
- No damage

Bar chart showing proportion of fruit damaged:
- Katydid: n = 69
- Control: n = 62
Hypothesis 2. Preferential abscission of damaged fruit

Fruit retention

Days since petal fall

Oranges

Mandarins
Hypothesis 3. Different scar appearance

Deep chewed holes

Surface scratches

Oranges

Mandarins
Summary

A large ecoinformatics database of commercial pest management in citrus showed that katydids are present in mandarin fields, yet scarring is rare in mandarins.

Field experiments suggest that this is due to:
1. Feeding preference i.e. previously unrecognized natural resistance

...Katydids might not be a pest in mandarins

Growers have responded positively to results generated from their own data.
Acknowledgements

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Citrus growers and Pest Control Advisors
Hypothesis 1. Feeding preference – floral feeding

Foliar damage - none
Hypothesis 1. Feeding preference – katydid survival

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<thead>
<tr>
<th></th>
<th>Proportion of katydids alive</th>
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<tbody>
<tr>
<td></td>
<td>early</td>
</tr>
<tr>
<td>C. sinensis</td>
<td>0.75</td>
</tr>
<tr>
<td>C. reticulata</td>
<td>0</td>
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</tbody>
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Hypothesis 1. Feeding preference – katydids in commercial fields
Forktailed bush katydid  
*Scudderia furcata*

- Cause deep fruit scars and leaf damage
- No research-based economic injury level
- Broad-spectrum organophosphates & pyrethroids most effective control options
Researcher-generated survey of katydid scarring

From 21 citrus fields

125 of 9446 oranges vs. 2 of 8537 mandarins had katydid scars at harvest
Field experiments

1. Feeding preference
2. Preferential abscission
3. Developmental recovery/modification
Heavy damage (deep chewed holes) in oranges

Light damage (shallow cuts/scratches) in mandarins
Katydids are present in mandarin fields, yet scarring is rare in mandarins

Hypotheses for underlying mechanism:

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