Integrated Pest Management: The strawberry perspective

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eNewsletters: ucanr.edu/strawberries-vegetables and ucanr.edu/pestnews
IPMinfo smartphone app for iOS devices
Strawberries
Lygus Bugs

Biology

Life cycle includes eggs, five nymphal instars, and adults. Depending on temperature, it can take about 21 days from egg stage to adult emergence. Females start laying eggs in about 9 days and continue the process for 21 days. Eggs are mostly laid in the inflorescence. First instar nymphs are light colored. Second and third instars have a dark spot on the abdominal segment. Fourth and fifth instars have two spots on each of the first two thoracic segments. Developing wing pads are visible in the last two instars.
IPMinfo smartphone app for iOS devices

SELECT AN ISSUE

Angular Leaf Spot

Anthracnose

Botrytis Fruit Rot

Charcoal Rot

Common Leaf Spot

Fusarium Wilt

Leaf Blotch & Petiole Blight

Mucor Fruit Rot

Pallidosis Disease

Phytophthora Crown Rot

Powdery Mildew

Red Stele

Rhizopus Fruit Rot

Verticillium Wilt
“Integrated pest management (IPM) is an ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties. Pesticides are used only after monitoring indicates they are needed according to established guidelines, and treatments are made with the goal of removing only the target organism. Pest control materials are selected and applied in a manner that minimizes risks to human health, beneficial and non-target organisms, and the environment.” UC IPM
IPM and its components

- Cultural
- Chemical
- Biological
- Microbial
- Mechanical
IPM and its components

COMMUNICATION
- Within the community
- Staying up-to-date
- Actions
- Managing Info
- Monitoring

MANAGEMENT/CONTROL
- Cultural
- Chemical
- Biological
- Pest
- Control options
- Tools & Technology

PLANNING & ORGANIZATION
- Within the group
- Cultural
- Chemical
- Biological

KNOWLEDGE & RESOURCES
- Pest
- Control options
- Tools & Technology
Current pest management practices

• Chemical pesticides
• Biological control
Current pest management practices

- Low fences
- Watering the road ways
Current pest management practices

- Bug vacuums
UC IPM Recommendations

- Cultural control
- Chemical control
- Biological control
- Microbial control
IPM-Cultural Control

- Selection of the field
- Avoiding second year berries
- Managing weeds and alternate hosts that serve as sources of pest populations
- Adequate chilling of transplants
- Obtaining transplants from a clean source
- Irrigation management
- Nutrition management
- Regular monitoring
IPM-Chemical Control

- Choosing the right chemical
- Rotating different modes of action to reduce the risk of resistance
- Reducing the number of chemical applications and using other alternatives
- Using softer chemicals to conserve natural enemies
- Test for resistance
• Timing chemical sprays to conserve released or native natural enemies
• Choosing the right species at the right time
• Multiple natural enemies for different life stages of pest
Pesticide use in California strawberries

Can we use non-chemical alternatives in conventional agriculture along with chemical pesticides to develop a sound IPM program?
<table>
<thead>
<tr>
<th>Mode of Action Group</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4A</td>
<td>Neonicotinoids</td>
</tr>
<tr>
<td>4C</td>
<td>Sulfoximines</td>
</tr>
<tr>
<td>6</td>
<td>Chloride channel activators</td>
</tr>
<tr>
<td>9C</td>
<td>Selective homopteran feeding blockers</td>
</tr>
<tr>
<td>15</td>
<td>Inhibitors of chitin biosynthesis</td>
</tr>
</tbody>
</table>
Non-chemical alternatives

- Entomopathogenic fungi, *Beauveria bassiana* and *Metarhizium brunneum*
- Botanical insect growth regulator, azadirachtin
- Diatomaceous earth
Entomopathogenic fungus mode of action
Azadirachtin mode of action

- Interferes with protein synthesis
- Affects molting and metamorphosis
- Disturbs mating and sexual communication
- Sterilizes adults
- Reduces reproductive ability
- Acts as antifeedant and repellent
Diatomaceous earth mode of action

- Powder form of fossilized remains of diatoms (contains silicon dioxide)
- Absorbs waxy layer of insect cuticle causing water loss
- Causes death due to desiccation
# Lygus Bug Management Study

<table>
<thead>
<tr>
<th></th>
<th>1st application (Rate/acre)</th>
<th>2nd application (Rate/acre)</th>
<th>3rd application (Rate/acre)</th>
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<tbody>
<tr>
<td>1</td>
<td>Untreated</td>
<td>Untreated</td>
<td>Untreated</td>
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<tr>
<td>2</td>
<td>Assail 70 WP (3 oz) 4A*</td>
<td>Assail 70 WP (3 oz) 4A</td>
<td>Assail 70 WP (3 oz) 4A</td>
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<td>Rimon 0.83 EC (12 fl oz) 15 + Assail 30SG (6.9 oz) 4A</td>
<td>Rimon 0.83 EC (12 fl oz) 15 + Sequoia SC (4.5 fl oz) 4C</td>
<td>Rimon 0.83 EC (12 fl oz) 15 + Assail 30SG (6.9 oz) 4A</td>
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<td>4</td>
<td>Rimon 0.83 EC (12 fl oz) 15 + Brigade (16 oz) 3A</td>
<td>BotaniGard ES (2 qrt) + Molt-X (8 fl oz)</td>
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<td>5</td>
<td>Rimon 0.83 EC (12 fl oz) 15 + Assail 30SG (6.9 oz) 4A</td>
<td>Rimon 0.83 EC (12 fl oz) 15 + Beleaf 50 SG (2.8 oz) 9C</td>
<td>Rimon 0.83 EC (12 fl oz) 15 + Assail 30SG (6.9 oz) 4A</td>
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<td>BotaniGard ES (2 qrt) + Molt-X (8 fl oz)</td>
<td>BotaniGard ES (2 qrt) + Low Beleaf 50 SG (1.4 oz) 9C</td>
<td>Low BotaniGard ES (1 qrt) + Low Sequoia (3 oz) 4C</td>
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<td>Low Sequoia (3 oz) 4C</td>
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<td>Low Sequoia (3 oz) 4C</td>
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<td>10</td>
<td>High Diafil 610 Slurry (70 lb)</td>
<td>Low BotaniGard ES (1 qrt) + Low Sequoia (3 oz) 4C</td>
<td>Met52 EC (16 fl oz) + Assail 70 WP (3 oz) 4A</td>
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<td>High Diafil 610 Dust (70 lb)</td>
<td>Low BotaniGard ES (1 qrt) + Assail 70 WP (3 oz) 4A</td>
<td>Met52 EC (16 fl oz) + Molt-X (8 fl oz)</td>
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*MoA group
4A Neonicotinoids
4C Sulfoximines
6 Chloride channel activators
9C Selective homopteran feeding blockers
15 Inhibitors of chitin biosynthesis
2014 Strawberry IPM trial

Goodwin Berry Farms, Santa Maria
Treatments and sampling

- Treatments applied on 4, 12, and 20 June, 2014
- Spray volume was 110 gpa for all treatments, but diatomaceous earth slurry (70 gpa)
- Sampled 5-6 days after each application
Strawberry IPM Trial 2014-Lygus bug

Number of all stages/20 plants

- **Untreated**
- Assail 70 WP
- Rim+Assail 30SG-R+SeqHi+R+A30
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- Rim+Assail 30SG-R+SeqHi+R+A30
- Rim+Assail 30SG-R+SeqHi+R+A30
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<th>%Change</th>
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<tr>
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<td>Sequoia High</td>
<td>Sequoia High</td>
<td>Sequoia High</td>
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<tr>
<td>II</td>
<td>17</td>
<td>Diafil Dust High</td>
<td>BotaniGard Low + Assail 70WP</td>
<td>Met52 + Molt-X</td>
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<tr>
<td>III</td>
<td>48</td>
<td>Rimon + Assail 30SG</td>
<td>Rimon + Beleaf 50SG</td>
<td>Rimon + Assail 30SG</td>
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<tr>
<td>IV</td>
<td>54</td>
<td>Rimon + Brigade</td>
<td>BotaniGard ES + Molt-X</td>
<td>BotaniGard ES + Molt-X</td>
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<tr>
<td>V</td>
<td>81</td>
<td>Sequoia Low</td>
<td>Sequoia Low + BotaniGard ES Low</td>
<td>Met52 + Assail 70WP</td>
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<tr>
<td>VI</td>
<td>143</td>
<td>Diafil Slurry High</td>
<td>Sequoia Low + BotaniGard ES Low</td>
<td>Met52 + Assail 70WP</td>
</tr>
<tr>
<td>VII</td>
<td>167</td>
<td>Rimon + Assail 30SG</td>
<td>Rimon + Sequoia High</td>
<td>Rimon + Assail 30SG</td>
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<tr>
<td>VIII</td>
<td>280</td>
<td>Actara</td>
<td>Actara + Agri-Mek</td>
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<td>IX</td>
<td>307</td>
<td>BotaniGard ES + Molt-X</td>
<td>BotaniGard ES + Beleaf 50SG Low</td>
<td>BotaniGard ES Low + Sequoia Low</td>
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<td>367</td>
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<td>Sequoia Low</td>
<td>Met52 + Molt-X</td>
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<tr>
<td>XI</td>
<td>383</td>
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<tr>
<td>XII</td>
<td>1083</td>
<td>Assail 70WP</td>
<td>Assail 70WP</td>
<td>Assail 70WP</td>
</tr>
</tbody>
</table>
Strawberry IPM Trial 2014-Natural Enemies

Tukey’s HSD $P < 0.05$

Number of natural enemies/20 plants

- Untreated
- Assail 70 WP
- Rim+Assail 30SG-R+SeqHi+R+A30
- Rim+Assail 30SG-R+MoltX+BG+MX
- BG+MX+BG+ResiHi+R+A30
- Actara Act+AgriM-BG+MX
- SeqHi-SeqHi-SeqLo
- SeqLo-SeqLo-SeqLo
- SeqLo-SeqLo-Met52+A70
- DiaSil+SeqLo+MX+Met
- DiaDH+BGLo+A70-Met+MX

Pre-treatment
Post-treatment
Strawberry IPM Trial 2014
Strawberry Miticide Trial 2013

Treatments

1. Untreated
2. Acramite 50 WS (bifenazate) 1 lb
3. Agri-Mek SC (abamectin) 4.29 fl oz
4. BotaniGard ES (*B. bassiana*) 1qrt + Acramite 0.75 lb
5. Eco-Mite 1% (rosemary and cotton seed oils)
6. Fujimite 5 EC (fenpyroximate) 2 pt
7. Fujimite XLO 2 pt
8. Grandevo (*C. subtsugae*) 2 lb
9. Venerate (*Burkholderia spp.*) 2 gal
10. Nealta (cyflumetofen) 13.7 fl oz

Spraying  150 gal/acre at 70 psi with hollow cone nozzle

Plot size  14’ longX44” wide bed replicated 4 times

Treated on  May 16 and 25, 2013
Strawberry Miticide Trial 2013-TSSM

Post-treatment number/leaflet

Eggs  Mobile

Untreated  Acramite 50WS  Agri-Mek SC  BotaniGard+Acramite  Eco-Mite  Fujinite SEC  Fujinite XLO  Grandevo  Venerate  Nealta

$P \geq 0.05$
Conclusions

• Integrating various tools is critical in pest management.
• Botanical and microbial pesticides can be an important addition to chemical pest management options.
Acknowledgements

Growers
David Peck
Francisco Bautista

Technicians
Andrew Reade
Anthony Reade
Michael McNulty
Ryan Sheppard
Suchitra Dara
Sumanth Dara

Industry collaborators
Arborjet
BASF
Bioworks
Chemtura
Dow AgroSciences
Imerys
Marrone Bio Innovations
Monsanto BioAg
Nichino America
Syngenta