Research Update on Non-Antibiotic Control of Fire Blight

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March 19, 2013

http://www.extension.org/organic_production

Fire Blight Control in Organic Pear and Apple without Antibiotics

Ken Johnson, Oregon State University
Rachel Elkins, University of California
Tim Smith, Washington State University
This webinar is about fire blight suppression without antibiotics:

**Antibiotics:**
- Streptomycin < 2014 NOP expiration (set by NOSB in 2011) *
- Oxytetracycline < 2014 NOP expiration

*Industry has petitioned to re-instate normal sunset review process

**Our focus: Floral infection in susceptible cultivars**

*Strategies and data shown are most applicable to semi-arid production regions of the western U.S.

**This webinar is not about:**
- Host resistance (ideal but longer-term goal)
- Management of host susceptibility (nutrition)

Significance of old cankers & bloom temperature
Materials we have chosen to focus on for non-Antibiotic fire blight control:

**Prebloom:**
NOP-approved fixed copper  poor to good

**Early bloom:**
- Bloomtime Biological (pears)  poor to good
- Lime Sulfur (and Fish Oil) (Apple)  good

**Mid- to full bloom:**
- Blossom Protect (new in 2012)  very good to excellent

**Full bloom and beyond**
- Gowan Previsto  excellent
  (still needs EPA registration and NOP/OMRI approval)

**Systems Approach** to non-antibiotic control

**Questions:**

- When does fire blight pathogen become active and does delayed dormant copper effect this pathogen activity?
- How does bloom thinning effect fire blight control?
- Integrated control: Can effective non-antibiotic control be achieved?
Q1: When is the fire blight pathogen active in orchards?

Is the fire blight pathogen in this bag of flowers?

Answered by ‘LAMP’ assay that detects pathogen DNA:

< 1 hour to get an answer

Q2: Does delayed dormant copper affect pathogen activity?

- Delayed dormant oil plus CuOH+CuOCl (6 lbs/A)
- In 2010-2012 we split fourteen ~10-acre blocks
- Delayed dormant oil

Walk 1
Walk 2
Walk 3

Rachel Elkins
Pomology Farm Advisor
UC Lake County

Overall probability of pathogen detection ~ 16%

Mid-bloom \( P(\text{detect } Ea) < 5\% \)

Petal fall \( P(\text{detect } Ea) = 50\% \)

\( P(\text{detect } Ea) \) in ‘Copper + Oil’ \( \frac{1}{2} \) of ‘Oil alone’
Does delayed dormant copper effect pathogen activity?

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Average Russeting (greater than 7%)</th>
<th>Russet Severity (less than 3%)</th>
<th>Russet Severity (76%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper + oil</td>
<td>2.7</td>
<td>10.5</td>
<td>76.0</td>
</tr>
<tr>
<td>Oil alone</td>
<td>2.7</td>
<td>10.2</td>
<td>76.1</td>
</tr>
</tbody>
</table>

Rachel Elkins and Steve Lindow have obtained fruit finish data from all plots. No difference in Russet Severity among the ‘Copper & Oil’ and ‘Oil only’ plots.

Summary of California LAMP Surveys

- When is the fire blight pathogen active in orchards?
  Depends on orchard, but late (PF) is more the norm

- Does delayed dormant copper effect pathogen activity?
  Yes, it delays time to when the pathogen is detectable (PF)

Think about Questions on ‘LAMP’ and ‘Delayed Dormant Copper’
Apples

Q: How does the bloom thinning material, LIME SULFUR, effect fire blight control?

• As used for thinning, does LS provide a benefit to fire blight suppression?

• Is LS bactericidal? If so, does it replace other fire blight products in early bloom?

• Typical protocol: Spray lime sulfur @ king bloom open then repeat in 3 days (70-80% bloom)

Q: How does bloom thinning effect fire blight control?

Replicated, inoculated orchard trials:

Golden/Gala 2009
0 30 60 90 120 150
Water
Lime sulfur & Fish oil 2.5X
BlightBan 2X then Oxytet 1X
Gala 2010
0 40 80 120 160 200
Golden Delicious 2011
0 40 80 120 160 200
Water
Lime sulfur & Fish oil 2X
Bloomtime 1X then Oxytet 1X
Gala 2011
0 20 40 60 80

Fire blight strikes per tree

Conclusion: Lime sulfur treatments results in fewer flowers to flowers

Q: How does bloom thinning effect the fire blight pathogen?

Lime sulfur directly suppresses epiphytic pathogen population

Population size of E. amylovora

One million cells per flower

Ten thousand cells per flower

Conclusion: Lime sulfur is bactericidal
Q: How does bloom thinning affect biological agents?

Lime sulfur directly suppresses populations of biological agents

Population size of *A. pullulans*

- LS thins flowers
- LS is bactericidal & fungicidal

Conclusion: Delay biologicals to after 2\textsuperscript{nd} LS treatment

Think about Questions on ‘Bloom Thinning’

Q4: Can effective non-antibiotic control be achieved?

- Combined a stigma product with a floral cup product improves control
- Antibiotic approach: e.g., *Bloomtime Biological* then *Oxytetracycline*
- Non-antibiotic approach: e.g., *Bloomtime Biological* then *Blossom protect PEARs*
- *Lime sulfur & fish oil* then *Blossom protect APPLES*

Very good to excellent control
**A. pulillans Yeast "Blossom Protect" Performance**

Percent Control Re: Check

- **10 year: 1/2 buffer 3 apr**
- **10 Pear, Full, 2 apr**
- **09 Apple, Full, 2 apr**
- **08 Pear, Full, 2 apr**
- **09 Pear, Pfizer**
- **09 Apple, Pfizer**
- **10 May, Full, 2 apr**
- **09 Apple, Pfizer**
- **09 Apple, Full, No Buffer**

<table>
<thead>
<tr>
<th>Year</th>
<th>Condition</th>
<th>Percent Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>Full, 3 apr</td>
<td>88.5</td>
</tr>
<tr>
<td>2010</td>
<td>Full, 4 apr</td>
<td>90.1</td>
</tr>
<tr>
<td>2011</td>
<td>Full, 3 apr</td>
<td>90.3</td>
</tr>
<tr>
<td>2011</td>
<td>Full, 4 apr</td>
<td>90.1</td>
</tr>
<tr>
<td>2012</td>
<td>Full, 3 apr</td>
<td>87.6</td>
</tr>
<tr>
<td>2012</td>
<td>Full, 4 apr</td>
<td>87.2</td>
</tr>
</tbody>
</table>

08 = Year, Full = Rate of Product and Buffer A, apr = Number of Applications to Bloom

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**Integrated control ✓**
Lime sulfur plus fish oil ✓
Followed by new yeast product ✓

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Yeast cells on nectary of pear flower sampled near petal fall
Blossom Protect YEAST colonizes both stigmas and floral cup

Number of yeast cells on each floral cup was ~ 5000

Blossom Protect is an excellent colonizer of flowers

Potential drawback of Blossom Protect: increased russetting of fruit surface

Data from Stefan Kunz 2011 – German scientist and inventor of Blossom Protect

Multiple applications and wetter conditions during & after bloom raise the concern

Evidence to date is 2-3 applications in semi-arid regions (e.g., central WA) is safe
Think about Questions about the ‘YEAST’

- When to apply
- Availability
- Drawbacks

Soluble Coppers
-- Intended as bloom and petal fall treatments --

- Gowan Previso (pending registration)
  - Copper sulfate in a carrier that reduces phytotoxicity
  - Extensive fruit finish testing (Smith, Hubbard, Sugar)
  - “Expected ~July, 2013. Components of the formulation have been accepted as organic”
Copper in organic acid products contain less metallic copper

Can effective non-antibiotic control be achieved?

Yes, via ‘integrated control’:
- utilizing delayed dormant, fixed copper in orchards with history of fire blight
- in apples, using lime sulfur to thin bloom and delay pathogen ‘build-up’ in flowers
- in pears, using a bacterial biocontrol agent to delay pathogen ‘build-up’ in flowers
- utilizing the yeast Blossom Protect near full bloom to protect floral cup
- utilizing a soluble copper at later bloom to substitute for oxytetracycline

What are the cautions and risks of non-antibiotic control compared to antibiotics?

<table>
<thead>
<tr>
<th>Control Practice</th>
<th>EPA &amp; NOP approved</th>
<th>Grower experience</th>
<th>FB control at orchard scale</th>
<th>Cost</th>
<th>Fruit finish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delayed dormant copper</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Lime sulfur (+ fish oil) thinning</td>
<td>WA</td>
<td>WA</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>YEAST - Blossom Protect</td>
<td>2012</td>
<td>little</td>
<td>little</td>
<td>-2X higher</td>
<td>Safe in West for apples but data limited</td>
</tr>
<tr>
<td>PREVISTO - bloom-safe copper</td>
<td>2013?</td>
<td>not yet</td>
<td>not yet</td>
<td>?</td>
<td>Safe in West for apples but data limited</td>
</tr>
</tbody>
</table>
Questions?

- delayed dormant, fixed copper
- lime sulfur effects on fire blight pathogen
- integrated, non-antibiotic control
- the yeast product
- copper materials during bloom

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