New materials for fire blight control:
How do they work?
What are the risks?

Kasumin 2L   Non-antibiotic programs for certified organic

Ken Johnson
Oregon State University

What is Kasumin?

- registered for fire blight control in Sept 2014
- 1st antibiotic registration for a crop in 35 years!
- aminoglycoside antibiotic similar to streptomycin but different mode of action
- kasugamycin is produced by fermenting Streptomyces kasugaensis
- inhibits protein synthesis in ribosomes
- there is a potential for resistance development in E. amylovora via chromosomal mutation
Erwinia spp. are especially sensitive to kasugamycin

Bacterial Pathogens-MIC* (ppm)

- Acidivorax avenae >100
- Escherichia coli K-12 R5 100^\(^\text{a}\)
- Clavibacter michiganensis 100
- Erwinia spp. 20 – 50 (low MIC)
- Pseudomonas spp. 25 – 100
- Xanthomonas spp. >100

*MIC = minimum inhibitory concentration

In some tests Kasumin hasn’t looked quite as good as strep

Antibiotic resistance in *E. amylovora*

<table>
<thead>
<tr>
<th>Mechanism (registration)</th>
<th>Antibiotic</th>
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<tbody>
<tr>
<td></td>
<td>Strep (late 1950s)</td>
</tr>
<tr>
<td>Mutation</td>
<td>+</td>
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<td></td>
<td>One step – field</td>
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<td>Fitness cost</td>
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Based on mutation mechanism, risk of fire blight pathogen developing resistance to Kasumin is intermediate compared to strep and oxytet.

Kasumin-resistant *Ea* causing blight in pear
McGhee & Sundin 2011

Slight potential of phyto with Kasumin with > 3 applications

Hood River 2007
IR-4 residue study
cv. Granny Smith
Applications were made on 4/24, 5/1, 5/8, 5/15.
Phyto observed after 4th application
Photo taken on 6/27
By Joe DeFrancesco
Combining a stigma product with a floral cup product improves control.

Antibiotic approach: e.g., Bloomtime Biological then Kasumin

Then:
e.g., Blossom Protect then Kasumin

Then:
Lime sulfur & oil then Kasumin

very good to excellent control

Where does Kasumin fit the program?

‘Integrated control’

Strategies for delaying the development of resistance in target organisms to chemicals

includes:

– apply full dose (max label rate)

– limits to material use

  • 90 day PHI *
  • no apps after petal fall
  • no more than 2 consecutive apps
  • no more than 4 total apps
  • no alternate row spraying

  On Kasumin label

• Price material high: ~$80/A

– mixture partners

  • oxytet at ½ to full rate
Antibiotic Mixtures

Oregon State Inoculated Fire Blight Trials 2007-2010

Relative Disease Incidence

Antibiotic Standards
Kasumin
Kasumin Oxytet Mixes
Water Control

Kasumin ~ full rate plus ½ label
Oxytet (100 ppm = 8 oz/100 gal)
A very effective treatment and
good resistance management

Think about Questions
on ‘Kasumin’
Example non-antibiotic program with considerations for fruit safety:

1) Prebloom (just prior to green tip):
   Fixed copper sanitation if fire blight was in orchard last year (5 to 6 lb/A)

2) Early bloom apple:
   Lime sulfur (plus oil) early bloom at 20 and 70% bloom
   Reapply biological if LS goes on after biological

3) Early bloom pear and apple Blossom Protect:
   One full, or two half apps, or two full apps if blight in orchard last year
   In apple, Blossom Protect immediately after 2nd LS.
   In smooth-skinned pears in wetter areas, russet risk might be unacceptably high
   - Bloomtime Biological is an alternative, fruit-safe biological material

4) Full bloom to petal fall, depending on cultivar russet risk/fb model risk:
   Serenade Optimum every 2 to 5 days (most fruit safe)
   Improved control: Mix Serenade Opt with Cueva (2 to 3 qts/A)
   Cueva every 3 to 6 days (3 to 4 qts/A) (least fruit safe)

Putting integrated non-antibiotic control to the test:

Replicated, inoculated orchard trials:

- In this trial, Blossom Protect (applied once) carried the load
- Corvallis is a wet climate: An amount of russet above control was attributable to Blossom Protect; a bit more to Cueva
Blossom Protect: A potential for fruit russet

Kunz 2011 – Apples in Germany

'More applications & wetter conditions raise the concern
Pears are more susceptible than apples

Blossom Protect & Cueva on Bartlett pear
Kelseyville, Lake County - 2014

Slight increase in russet?
**Blossom Protect & Cueva -- 2014**

**Bartlett pear**

**Corvallis, Oregon:**

**Comice Pear**

**Medford, Oregon:**

**Average russet severity**

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Average russet severity</th>
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</thead>
<tbody>
<tr>
<td>Water (full bloom &amp; petal fall)</td>
<td>1</td>
</tr>
<tr>
<td>Streptomycin (100) (full bloom)</td>
<td>2</td>
</tr>
<tr>
<td>Oxytetracycline (200) (full bloom &amp; petal fall)</td>
<td>3</td>
</tr>
<tr>
<td>Serenade Optimum (full bloom &amp; petal fall)</td>
<td>4</td>
</tr>
<tr>
<td>Blossom Protect (70% bloom)</td>
<td>5</td>
</tr>
<tr>
<td>Blossom Protect (70% with citric acid as buffer)</td>
<td>6</td>
</tr>
<tr>
<td>Blossom Protect (70% bloom) + Serenade &amp; Cueva 1 pint (FB &amp; PF)</td>
<td>7</td>
</tr>
<tr>
<td>Blossom Protect (70% bloom) + Serenade &amp; Cueva 1 qt. (FB &amp; PF)</td>
<td>8</td>
</tr>
<tr>
<td>Blossom Protect (70% bloom) + Serenade &amp; Cueva 1.5 qt. (FB &amp; PF)</td>
<td>9</td>
</tr>
<tr>
<td>Blossom Protect (70% bloom) + Serenade &amp; Cueva 2 qt. (FB &amp; PF)</td>
<td>10</td>
</tr>
<tr>
<td>Blossom Protect (70% bloom) + Cueva 3 Qt. (FB &amp; PF)</td>
<td>11</td>
</tr>
<tr>
<td>Blossom Protect (70% bloom) + Serenade &amp; Actigard 50W (FB &amp; PF)</td>
<td>12</td>
</tr>
<tr>
<td>Luna Sensation</td>
<td>13</td>
</tr>
</tbody>
</table>

**Cueva on Comice:**

**Russet severity on Bosc pears treated with Blossom Protect, Lake County, 2014**

- Situation: Wet weather, copper on trees, Blossom Protect with buffer (pH 4) goes on 3 days after copper.
- We think the acidic buffer increased concentration of copper ions in solution, resulting in a damaging russet to Bosc pear.
Non-antibiotic fire blight control

Cultivar specific recommendations:

**Russet-susceptible, smooth skinned pears (d’Anjou, Comice)**
- Avoid Blossom Protect and Cueva
- Utilize Bloomtime Biological and Serenade Optimum

**More russet-tolerant, smooth skinned pears (Bartlett)**
- **In wet climate**, russet risk with Cueva is probably unacceptably high. Blossom Protect should be restricted to early/mid-bloom.
- **Dry climate**, create program to minimize Blossom Protect and Cueva apps. E.g., 1-2 apps. of each is better than 3-4 apps. either alone.

**All pear cultivars (including Bosc)**
- Sequence copper to follow Blossom Protect (not the other way around)

Think about questions on non-antibiotic control