Control of Powdery Mildew in Wine Grape

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Powdery mildew

- *Ucinula necator*
- Infection appears as a white or gray powdery coating on leaves or fruit
  - Consists of fungal thread (mycelium) and spores
Life Cycle...

**Cleistothecia** are small, brown to black fruiting bodies produced by the fungus in late summer. These remain in crevices on the bark over winter and release spores during spring rains.

**Ascospores** are discharged from cleistothecia and cause the primary infection. One ascospore infection can lead to production of thousands of conidia.

**Conidia** are the asexual spores that cause secondary infections throughout the season. They are spread by wind.
Notice! The chains of spores that can be moved by wind.
Weather and Powdery Mildew

- Primary infection requires a rainfall event for cleistothecia to release spores
- Secondary infection/conidia germinate under high humidity and warm temperatures
- Thrives in hot/dry
  - Unusual for fungi
Fruit Infections

- **Wine grape**
  - Severely infected fruit unusable
    - Imparts off-flavors and color
    - Wine made from PM-infected grapes is poor quality
  - Predisposes fruit to Botrytis bunch rot and sour rot
The recent problem...

- Increased disease pressure in hot/dry years

- In 2006, large proportion of winegrape acreage lost to PM
  - One grower estimated losses over $49,000
  - Currently rely on strobilurins, SI’s, and sulfur
The problem, cont.

- Dependence on strobilurins and SI’s
  - Growers have observed reduced efficacy in field
- PM are obligate parasites (cannot live independently from host)
  - Resistance can develop more quickly
  - Documented resistance in New York and Ontario
  - Is there resistance in Michigan?
Research Goals

• Determine if PM in tart cherries and wine grapes is resistant to SI’s and strobilurins
• Design sustainable, effective fungicide programs to minimize resistance
• Evaluate products for their potential to eradicate the fungus after infection
  - Grower observe PM after infection is well-established
  - Once established, PM is difficult to eradicate
Fungicide Eradication Trial, NWMHRS

- Variety: Pinot Noir
- 8 products tested in 2007 and 2008:
  - JMS Stylet Oil, Kaligreen, Sulfur, PrevAm, C + G, Cuprofix Ultra, Sulforix, Elite
- Rated percent leaf infection
- Counted cliestrothecia
Fungicide Eradication Results, NWMHRS 2007

Promising Eradicants:

- **JMS Stylet oil**
- **Prev-Am**: sodium tetraborohydrate decahydrate (1%)/99% other (citrus)
- **C+G**: food grade chemicals (organic acids)
- **Sulforix**: Calcium polysulfides
Fungicide Eradication Trial – Cleistotheccia 2007

Mature Cleistotheccia - Leaf Bottom

Cleistotheccia counted on October 17
Fungicide Eradication Results, NWMHRS 2008

First application on August 5
  - rated for infection on 8/11 and 8/20
Second application on August 26
  - rated for infection on 9/8 and 9/18
Fungicide Eradication Trial, Cliestothecia 2008

- Counted cliestotheicia on leaves, 9/9 and 9/17
Powdery Mildew Cleistothecia Trial, 2008

- To assess the timing and amount of cleistothecia produced by *Uncinula necator* on grape leaves under MI conditions

- Leaf samples collected from unsprayed Chardonel vines at CHES
  - 4 samples collected weekly (Sept. 4 - Oct. 2)
  - Cleistothecium counted on top and bottom surfaces of leaves

- Funnel traps: funnels attached to soda bottles to trap cleistothecia washed from vines during rain events
  - Two sites: CHES and NWMHRS
  - Bottles collected weekly unless no precipitation and cleistothecia were counted
Total number of *Uncinula necator* mature and immature cleistothecia on both bottom and top surfaces of Chardonel leaves in Clarksville, MI, in 2008.
Total number of *Uncinula necator* cleistothecia collected in rain water traps placed under Chardonel grapevines in Clarksville, MI, in 2008.
Total number of *Uncinula necator* cleistothecia counted in rain water traps placed under Pinot Noir grapevines in Traverse City, Michigan, in 2008.
Cleistothecia Trial Results

- More cleistothecia on bottom surface of leaves
- Maximum cleistothecia dispersal in mid-September at both sites
  - Possibility to control prior to peak production and dispersal?
Fungicide Trials, 2008

• NWMRHS – dormant sprays vs. one experimental product vs. two season-long programs

• CHES – comparing six season-long programs

• TNRC – comparing three organic programs to two-season long programs
### Season Long Spray Trial Results, NWMHRS 2008

**Powdery Mildew Leaf Infection - 'Chardonnay'**

<table>
<thead>
<tr>
<th>Treatment, rate/A</th>
<th>Application Timing*</th>
<th>Overall Severity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated</td>
<td></td>
<td>68.3 a</td>
</tr>
<tr>
<td>Sulfur 6L 7 pt</td>
<td>1</td>
<td>70.8 a</td>
</tr>
<tr>
<td>JMS Sytlet Oil 1 gal</td>
<td>1</td>
<td>59.8 ab</td>
</tr>
<tr>
<td>Sulforix 1 gal</td>
<td>1</td>
<td>45.4 b</td>
</tr>
<tr>
<td>BASF 56000F 15.4 fl oz + Kenetic 1 pt/100 gal</td>
<td>2, 3, 4, 5, 6, 7, 8</td>
<td>0.9 c</td>
</tr>
<tr>
<td>Sulfur 6L 7 pt</td>
<td>2, 3, 4, 7, 8</td>
<td>0.2 c</td>
</tr>
<tr>
<td>Elite 4 oz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pristine 10 oz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quintec 4 fl oz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulfur 6L 7 pt</td>
<td>2, 3, 4, 7, 8</td>
<td>0.2 c</td>
</tr>
<tr>
<td>Elite 4 oz</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Spray dates: 1 = Dormant, 2 = 3-5” shoot, 3 = 8-10” shoot, 4 = immediate pre-bloom, 5 = 1st post-bloom, 6 = 2nd post-bloom, 7 = 3rd post-bloom, 8 = 4th post-bloom*
# Season Long Spray Trial, Clarksville 2008

## Powdery Mildew Leaf Infection - 'Chardonnel'

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<th>Treatment, rate/A</th>
<th>Application Timing*</th>
<th>Overall Severity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated</td>
<td></td>
<td>76.5 a</td>
</tr>
<tr>
<td>Dithane Rainshield 3 lb Pristine 12 oz Sulforix 1 gal</td>
<td>1, 2, 5, 4, 6</td>
<td>11.9 b</td>
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<tr>
<td>Flint 2 oz Elite 45 WP 4 oz</td>
<td>1, 2, 4, 5, 6</td>
<td>7.9 c</td>
</tr>
<tr>
<td>Adament 3 oz</td>
<td>1, 2, 4, 5, 6</td>
<td>5.3 cd</td>
</tr>
<tr>
<td>Adament 4 oz</td>
<td>1, 3, 5, 7</td>
<td>6.6 c</td>
</tr>
<tr>
<td>Dithane Rainshield 3 lb Quintec 4 oz Vintage 4 oz + Ziram 3 lb</td>
<td>1, 2, 5, 4, 6</td>
<td>5.2 cd</td>
</tr>
<tr>
<td>Dithane Rainshield 3 lb Pristine 12 oz Elite 45 WP 4 oz + Ziram 3 lb</td>
<td>1, 2, 5, 4, 6</td>
<td>2.2 d</td>
</tr>
</tbody>
</table>

Spray dates: 1 = immediate pre-bloom, 2 = 14 day 1st post-bloom, 3 = 21 day 1st post-bloom, pea sized fruit, 4 = 14 day 2nd post bloom, start of bunch closure, 5 = 14 day 3rd post-bloom; 21 day 2nd post-bloom, 6 = 14 day 4th post-bloom, 7 = 21 day 3rd post-bloom
## Season Long Spray Trial, Fennville 2008

### Powdery Mildew Leaf Infection – ‘Chancellor’

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<tr>
<th>Treatment, rate/A</th>
<th>Application Timing*</th>
<th>Overall Severity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated</td>
<td></td>
<td>82.8 a</td>
</tr>
<tr>
<td>Sonata + NuFilm 17 0.5 pt</td>
<td>1, 3, 5</td>
<td>41.8 b</td>
</tr>
<tr>
<td>Kaligreen 3 lb</td>
<td>2, 4,</td>
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<tr>
<td>Sonata + NuFilm 17 0.5 pt</td>
<td>1, 3, 5</td>
<td>29.9 b</td>
</tr>
<tr>
<td>JMS Sytlet Oil 2% (v/v)</td>
<td>2, 4,</td>
<td></td>
</tr>
<tr>
<td>Serenade Max 1.5 lb + NuFilm 17 0.5 pt</td>
<td>1, 3, 5</td>
<td>14.7 c</td>
</tr>
<tr>
<td>JMS Sytlet Oil 2% (v/v)</td>
<td>2, 4,</td>
<td></td>
</tr>
<tr>
<td>Dithane Rainshield 3 lb</td>
<td>1, 2, 3, 4, 5</td>
<td>8.0 cd</td>
</tr>
<tr>
<td>Pristine 12 oz</td>
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<td></td>
</tr>
<tr>
<td>Elite 4 oz</td>
<td>3, 5</td>
<td></td>
</tr>
<tr>
<td>Dithane Rainshield 3 lb</td>
<td>1, 2, 3, 4, 5</td>
<td>3.4 d</td>
</tr>
<tr>
<td>Pristine 12 oz</td>
<td>3, 5</td>
<td></td>
</tr>
<tr>
<td>Elite 4 oz + Ziram 3 lb</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Spray dates: 1 = bloom, 2 = 1<sup>st</sup> post-bloom, 3 = 2<sup>nd</sup> post-bloom, 4 = 3<sup>rd</sup> post-bloom, 5 = 4<sup>th</sup> post-bloom
Dormant Spray Trial, 2008

- Grower-cooperator site in NW
- 3 blocks:
  - 1 Pinot gris,
  - 2 Pinot noir
- Half sprayed w/ sulforix before bud break, other half untreated
- Rated for PM leaf infection on 9/3
THANKS!

- Project GREEEN
- Jerri Gillett, Plant Pathology, MSU
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- Laura Avila, Plant Pathology, MSU
- NWMHRS Summer Crew