Powdery mildew
POWDERY MILDEW: EFFECT of TEMPERATURE on DISEASE SPREAD

<table>
<thead>
<tr>
<th>Temp. (°F)</th>
<th>Generation time (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>48</td>
<td>25</td>
</tr>
<tr>
<td>54</td>
<td>18</td>
</tr>
<tr>
<td>59</td>
<td>11</td>
</tr>
<tr>
<td>63</td>
<td>7</td>
</tr>
<tr>
<td>74</td>
<td>6</td>
</tr>
<tr>
<td>79</td>
<td>5</td>
</tr>
<tr>
<td>86</td>
<td>6</td>
</tr>
<tr>
<td>90</td>
<td>not active</td>
</tr>
</tbody>
</table>
RELATIVE HUMIDITY: Effects on Disease Development & Pathogen Sporulation

- **Disease Severity - All Expts**
  - $R^2 = 0.61$

- **Sporulation Potential - All Expts**
  - $R^2 = 0.39$

- **Disease Incidence - All Expts**
  - $R^2 = 0.45$

- **Conidia per Chain - All Expts**
  - $R^2 = 0.43$
Chardonnay

21 June
prebloom
Brix=nd

4 July
2mm fruit
Brix=nd

17 July
5mm fruit
Brix=4.6

2 August
Brix=4.2

15 August
Brix=4.8

29 August
Brix=9.3
POWDERY MILDEW CONTROL: EFFECT OF PREBLOOM & 1st POSTBLOOM SPRAYS (cv. 'Rosette', Geneva, NY)

<table>
<thead>
<tr>
<th>Treatment, rate/A</th>
<th>Spray dates</th>
<th># Sprays</th>
<th>% Area infected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated.............</td>
<td>none</td>
<td>0</td>
<td>25.8</td>
</tr>
<tr>
<td>Abound, 12 fl oz.....</td>
<td>24 Jun, 8 Jul</td>
<td>2</td>
<td>2.5</td>
</tr>
<tr>
<td>Abound, 12 fl oz.....</td>
<td>10 Jun-19 Aug</td>
<td>6</td>
<td>1.3</td>
</tr>
</tbody>
</table>
POWDERY MILDEW CONTROL: EFFECT OF CARRYOVER INOCULUM
(Chardonnay, Geneva 2002-03)

<table>
<thead>
<tr>
<th>Sept. 2002 (% Foliar PM)</th>
<th>Sept. 2003 (% Cluster PM)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inc.</strong></td>
<td><strong>Severity</strong></td>
</tr>
<tr>
<td>45</td>
<td>1</td>
</tr>
<tr>
<td>92</td>
<td>17</td>
</tr>
<tr>
<td>97</td>
<td>28</td>
</tr>
</tbody>
</table>

2003 sprays applied immediate prebloom through fruit set only
Most infections do not require rain

- Temperature is most important factor
  - Mid-60’s to mid-80’s is optimum range
Most infections do not require rain

- **Temperature** is most important factor
  - Mid-60’s to mid-80’s is optimum range
  - Moderately hot days + warm nights let disease “keep cooking” around the clock
Most infections do not require rain

- **Temperature** is most important factor
  - Mid-60’s to mid-80’s is optimum range
  - Toasty days and warm nights let disease “keep cooking” around the clock

- **High humidity also promotes disease**
POWDERY MILDEW, BIOLOGY & CONTROL: SUMMARY

- Most infections do not require rain
  - Temperature is most important factor
    - Mid-60’s to mid-80’s is optimum range
    - Toasty days and warm nights let disease “keep cooking” around the clock
  - High humidity also promotes disease
  - Shaded conditions also promote disease
    - Canopy management, removal of hedgerows
POWDERY MILDEW, BIOLOGY & CONTROL: SUMMARY

- Fruit are **highly** susceptible immediate prebloom thru 2 weeks later
POWDERY MILDEW, BIOLOGY & CONTROL: SUMMARY

- **Fruit** are **highly** susceptible **immediate** prebloom thru 2 weeks later
  - Susceptibility declines **rapidly** from 2 - 4 wk **postbloom**
POWDERY MILDEW, BIOLOGY & CONTROL: SUMMARY

- **Fruit** are **highly susceptible** immediate prebloom thru 2 weeks later
  - Susceptibility declines **rapidly from 2 - 4 wk postbloom** (*V. vinifera*)
  - **Essentially immune** after 4 wk postbloom
**POWDERY MILDEW, BIOLOGY & CONTROL: SUMMARY**

- Fruit are **highly** susceptible immediate prebloom thru 2 weeks later
  - Susceptibility declines rapidly from 2 - 4 wk postbloom (*V. vinifera*)
  - Essentially immune after 4 wk postbloom
  - ‘Concord’ fruit become immune just 2 wk postbloom; may be true also for other American varieties (not studied)
POWDERY MILDEW, BIOLOGY & CONTROL: SUMMARY

- **Fruit** are highly susceptible immediate prebloom thru 2 weeks later
  - Susceptibility declines rapidly from 2 - 4 wk postbloom (*V. vinifera*)
  - Essentially immune after 4 wk postbloom

- Immediate prebloom thru bunch closure is the **CRITICAL** time to control **fruit** infection
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Control of foliar infections remains necessary on highly susceptible cultivars so long as new leaves and favorable temps.

- Importance on ‘Concord’ (other natives?) dependent on crop size and quality needs.
POWDERY MILDEW FUNGICIDES:
SULFUR

- ADVANTAGES
  - Cheap
  - Effective
  - No resistance concerns
POWDERY MILDEW FUNGICIDES: SULFUR

- DISADVANTAGES
  - No other diseases
  - Relatively short residual
    - Washes off easily
  - Temperature dependent (?)
    - Reportedly less effective <60-65°F (??)
    - Phytotoxic >90°F
POWDERY MILDEW FUNGICIDES: STEROL INHIBITORS (SIs, DMIs)

ADVANTAGES

- Very effective at low use rates
- Locally systemic (rainfast)
- Relatively long application intervals
POWDERY MILDEW FUNGICIDES:
STEROL INHIBITORS (SIs, DMIs)

- ADVANTAGES
  - Very effective at low use rates
  - Locally systemic (rainfast)
  - Relatively long application intervals

- DISADVANTAGE
  - Resistance is widespread in Calif., NY, Europe
  - Still useful, but not like before
POWDERY MILDEW FUNGICIDES: STROBILURINS

- Most significant new group of fungicides since SI’s
- Very broad spectrum
- Resistance is now a serious problem in NY
Pristine (pyraclostrobin + boscalid)

- Mixture of two unrelated fungicides
- (1) A strobilurin (pyraclostrobin)
  - Excellent versus powdery mildew
  - Excellent versus downy (≥ Abound)
  - Very good/excellent versus black rot
    (= other strobies)
POWDERY/DOWNY MILDEW
FUNGICIDES: NEW IN 2004

■ Pristine (pyraclostrobin + boscalid)
  ◆ Mixture of two unrelated fungicides
  ✦ (2) New chemistry (boscalid)
    ● Excellent versus powdery mildew
    ● Very good/excellent versus Botrytis
    ● No black rot or downy mildew
    ● Labeled as “Endura” for use alone
POWDERY MILDEW Fungicides: New in 2004

- Quintec (quinoxyfen)
  - New chemical class
    - No cross-resistance, good rotational component
  - CONTROLS POWDERY MILDEW ONLY
POWDERY MILDEW FUNGICIDES: “ALTERNATIVE” PRODUCTS

- Primarily contact action, “body” of PM fungus is on outside of plant
  - Oils
  - Potassium salts (Armicarb, Kaligreen, Nutrol)
  - Hydrogen peroxide (Oxidate)
POWDERY MILDEW FUNGICIDES: “ALTERNATIVE” PRODUCTS

- Short-term “knock-down”, relatively little residual activity
- **Complete coverage is imperative**