Evaluation of weather-based models for management of onion downy mildew

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Tulare, CA
February 12, 2018
You Will Be Able To:

• Describe the key weather conditions that favor downy mildew

• Identify critical sets of conditions to time fungicide applications for downy mildew management
Plant Disease

Susceptible host

Favorable environment

Virulent pathogen
Downy mildew

• Water molds
  - Like *Pythium, Phytophthora*

• Obligate biotroph (obligate parasite)
  - Requires living host to grow and reproduce

• Over 700 species, generally host-specific
Onion

Lettuce

Spinach

Brassica

*Peronospora destructor*

*Bremia lactucae*

*Peronospora effusa*

*Hyaloperonospora brassicae*
Disease Cycle

- **Incubation period**: 8 to 16 days
- **Latent period**:
Epidemiology

Hildebrand and Sutton (1982, 1984a,b,c)

Models

- DOWNCAST
- ONIMIL
- ZWIPERO

Gilles et al. 2004

MILIONCAST (sporulation only)

- Epidemiology: mostly under controlled conditions
- Models: tested in field
  - Only DOWNCAST tested as spray advisory model
Epidemiology

- High relative humidity in middle of night
- No rain after midnight
- Previous day air temperature < 75°F

- Leaf wetness beginning at sunrise
- Length of wetness needed is proportional to air temperature (> ~70°F)
<table>
<thead>
<tr>
<th>Cond</th>
<th>Time Start</th>
<th>Time End</th>
<th>Perio d</th>
<th>Par m</th>
<th>DOWNCAST</th>
<th>dvDOWNCAST</th>
<th>gDOWNCAST</th>
<th>ONIMIL</th>
<th>MILIONCAST</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>08:00</td>
<td>20:00</td>
<td>prev day</td>
<td>temp</td>
<td>a. T &gt; 27°C for &lt;8 hr OR b. T &gt; 28°C for &lt;4 hr OR c. T &gt; 29°C for &lt;2 hr&lt;sup&gt;1&lt;/sup&gt;</td>
<td>a. T &gt; 27°C for &lt;8 hr OR b. T &gt; 28°C for &lt;6 hr OR c. T &gt; 29°C for &lt;4 hr OR d. T &gt; 30°C for &lt;2 hr OR</td>
<td>T&lt;sub&gt;h&lt;/sub&gt; ≤ 26°C</td>
<td>a. T &gt; 27°C for &lt;8 hr OR b. T &gt; 28°C for &lt;4 hr OR c. T &gt; 29°C for &lt;2 hr OR e. T&lt;sub&gt;m&lt;/sub&gt; ≤ 24°C</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>20:00</td>
<td>08:00</td>
<td>night</td>
<td>temp</td>
<td>4°C ≤ T&lt;sub&gt;h&lt;/sub&gt; ≤ 24°C</td>
<td>4°C ≤ T&lt;sub&gt;h&lt;/sub&gt; ≤ 24°C</td>
<td>4°C ≤ T&lt;sub&gt;h&lt;/sub&gt; ≤ 24°C</td>
<td>4°C ≤ T&lt;sub&gt;h&lt;/sub&gt; ≤ 24°C</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>01:00</td>
<td>06:00 or 10:00</td>
<td>night</td>
<td>rain</td>
<td>(0100-0600) Rain = 0</td>
<td>(0100-0600) Rain ≤ 0.1 mm&lt;sup&gt;2&lt;/sup&gt;</td>
<td>(0100-1000) Rain = 0</td>
<td>(0100-0600) Rain = 0</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>02:00</td>
<td>06:00</td>
<td>night</td>
<td>RH</td>
<td>RH ≥ 95% w/o interrupt</td>
<td>RH ≥ 94% w/o interrupt</td>
<td>RH ≥ 95% w/o interrupt</td>
<td>RH ≥ 95% w/o interrupt</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td>night</td>
<td>spore</td>
<td>-</td>
<td>(2200 – 0400) See dvD Table 4</td>
<td>-</td>
<td>(2200 – 0700) See A.2 ONIMIL sporulation rate</td>
<td>(t&lt;sub&gt;start&lt;/sub&gt; = 0900) t&lt;sub&gt;start&lt;/sub&gt; = sun 6° below horizon AND RH ≥ 92% See A.3 MILIONCAST sporulation rate</td>
</tr>
<tr>
<td>Out</td>
<td>0 or 1</td>
<td>0, 1, 2, or 3</td>
<td>0 or 1</td>
<td>0-1</td>
<td>nightly</td>
<td>nightly</td>
<td>nightly</td>
<td>nightly</td>
<td>10 min</td>
</tr>
</tbody>
</table>

<sup>1</sup> RH ≥ 92% w/o interrupt
Objectives

A. Adapt all models to the same computer program language

B. Compare the effectiveness of the models as advisory tools for managing downy mildew with fungicides in a field trial
Obj. A – Adapt Models

Diagrams showing sporulation and infection over time.
Obj. B – Field Trial

• Planted at Desert REC in Holtville first week of Oct.
  - 6 lines on 40 in. beds
  - 20 plants/bed-ft.

• Randomized complete block with 6 replications
  - Plots: 2 beds x 25 ft.
  - Non-treated buffer on 2 sides
<table>
<thead>
<tr>
<th>Trt #</th>
<th>Model</th>
<th>Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Standard Calendar</td>
<td>7 or 14</td>
</tr>
<tr>
<td>2</td>
<td>DOWNCAST</td>
<td>Weather-based</td>
</tr>
<tr>
<td>3</td>
<td>DOWNCAST de Visser</td>
<td>Weather-based</td>
</tr>
<tr>
<td>4</td>
<td>DOWNCAST Guelph</td>
<td>Weather-based</td>
</tr>
<tr>
<td>5</td>
<td>MILIONCASTCAST</td>
<td>Weather-based</td>
</tr>
<tr>
<td>6</td>
<td>ONIMIL</td>
<td>Weather-based</td>
</tr>
<tr>
<td>7</td>
<td>Untreated</td>
<td>-</td>
</tr>
<tr>
<td>8</td>
<td>Untreated</td>
<td>-</td>
</tr>
<tr>
<td>Timing Code</td>
<td>Product</td>
<td>Al</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>A</td>
<td>Ridomil Gold Bravo</td>
<td>mefenoxam + chlorothalonil</td>
</tr>
<tr>
<td>B</td>
<td>Dithane F-45</td>
<td>mancozeb</td>
</tr>
<tr>
<td>C</td>
<td>Orondis Ultra</td>
<td>oxathiapiprolin + mandipropamid</td>
</tr>
<tr>
<td>D</td>
<td>Reason</td>
<td>fenamidone</td>
</tr>
<tr>
<td>E</td>
<td>Presidio + Dithane</td>
<td>fluopicolide + mancozeb</td>
</tr>
<tr>
<td>F</td>
<td>Zampro</td>
<td>dimethomorph + ametoctradin</td>
</tr>
</tbody>
</table>
Obj. B – Field Trial – Weather
Obj. B – Field Trial – Weather

- Two leaf wetness sensors in adjacent rows
  - 45 degree angle

- Temp/relative humidity “in canopy”
Obj. B – Field Trial – Weather

• Two leaf wetness sensors in adjacent rows
  - 45 degree angle

• Temp/relative humidity “in canopy”
Obj. B – Field Trial – Weather
Obj. B – Field Trial – Weather

• No disease in trial

• Conditions turning a bit more favorable???
Downy Mildew Summary

• Conditions favorable for sporulation: high RH and no rain during night, previous day air temperature < 75°F

• Conditions favorable for infection: leaf wetness at sunrise, cool temperatures (< ~70°F)

• Modeling
  - Needs more testing and development
  - Tool to help you to make decisions on applications
Acknowledgements

• Funding: CA Garlic and Onion Research Advisory Board
  - Also UC Riverside College of Nat. Ag. Sci/USDA Hatch Multistate W3008

• Seed and planter
  - Sensient, Dan Brotslaw and Theo Hudson
  - Olam, Larry Hanson

• Weather data and tips
  - Univ. of Guelph: Mary Ruth McDonald, Zach Telfer, Kevin Vander Kooi

• UC Desert Research and Extension Center, Holtville
  - Jairo Diaz, Gilberto Magallon, Fernando Miramontes

• Tom Turini, Bob Ehn

• UC Riverside
  - Sonali Singh