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

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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
- Inoculum Source
- Infection
- Symptoms
- Sporulation
Background

Epidemiology

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

Models

- DOWNCAST
  - DOWNCAST (de Visser)
- ONIMIL
- ZWIPERO
- 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)
# Models – Sporulation

<table>
<thead>
<tr>
<th>Cond</th>
<th>Time Start</th>
<th>Time End</th>
<th>Period</th>
<th>Param</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. $T &gt; 27^\circ C$ for $&lt;8$ hr OR b. $T &gt; 28^\circ C$ for $&lt;4$ hr OR c. $T &gt; 29^\circ C$ for $&lt;2$ hr $^1$</td>
<td>a. $T &gt; 27^\circ C$ for $&lt;8$ hr OR b. $T &gt; 28^\circ C$ for $&lt;6$ hr OR c. $T &gt; 29^\circ C$ for $&lt;4$ hr OR d. $T &gt; 30^\circ C$ for $&lt;2$ hr OR</td>
<td>$T_h \leq 26^\circ C$</td>
<td>a. $T &gt; 27^\circ C$ for $&lt;8$ hr OR b. $T &gt; 28^\circ C$ for $&lt;4$ hr OR c. $T &gt; 29^\circ C$ for $&lt;2$ hr OR e. $T_m \leq 24^\circ C$</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>20:00</td>
<td>08:00</td>
<td>night</td>
<td>temp</td>
<td>$4^\circ C \leq T_h \leq 24^\circ C$</td>
<td>$4^\circ C \leq T_h \leq 24^\circ C$</td>
<td>$4^\circ C \leq T_h \leq 24^\circ C$</td>
<td>$4^\circ C \leq T_h \leq 24^\circ C$</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>01:00</td>
<td>06:00</td>
<td>night</td>
<td>rain</td>
<td>(0100-0600) Rain = 0 (0100-0600) Rain $\leq 0.1$ mm$^2$</td>
<td>(0100-1000) Rain = 0 (0100-0600) Rain = 0</td>
<td>(0100-0600) Rain = 0</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>02:00</td>
<td>06:00</td>
<td>night</td>
<td>RH</td>
<td>$RH \geq 95%$ w/o interrupt</td>
<td>$RH \geq 94%$ w/o interrupt</td>
<td>$RH \geq 95%$ w/o interrupt</td>
<td>$RH \geq 95%$ w/o interrupt</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>night</td>
<td>spore</td>
<td>-</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$<em>{start} = 0900$) t$</em>{start} =$ sun $6^\circ$ below horizon AND $RH \geq 92%$ See A.3 MILIONCAST sporulation rate</td>
<td># of spores</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>

$^1$ See A.1
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
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
### Obj. B – Field Trial

<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>
</tbody>
</table>
## Obj. B – Field Trial

<table>
<thead>
<tr>
<th>Timing Code</th>
<th>Product</th>
<th>AI</th>
<th>Product/A</th>
<th>Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Ridomil Gold Bravo</td>
<td>mefenoxam + chlorothalonil</td>
<td>2.5 pt</td>
<td>7-14</td>
</tr>
<tr>
<td>B</td>
<td>Dithane F-45</td>
<td>mancozeb</td>
<td>2.4 qt</td>
<td>7</td>
</tr>
<tr>
<td>C</td>
<td>Orondis Ultra</td>
<td>oxathiapiprolin + mandipropamid</td>
<td>5.5 fl oz</td>
<td>?</td>
</tr>
<tr>
<td>D</td>
<td>Reason</td>
<td>fenamidone</td>
<td>5.5 fl oz</td>
<td>5-10</td>
</tr>
<tr>
<td>E</td>
<td>Presidio + Dithane</td>
<td>fluopicolide + mancozeb</td>
<td>4.0 fl oz + 2.4 qt</td>
<td>7-10</td>
</tr>
<tr>
<td>F</td>
<td>Zampro</td>
<td>dimethomorph + ametoctradin</td>
<td>14.0 fl oz</td>
<td>5-7</td>
</tr>
</tbody>
</table>
Obj. B – Field Trial – Weather
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- Two leaf wetness sensors in adjacent rows
  - 45 degree angle

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

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  - 45 degree angle

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

The diagram shows a time series analysis of sporulation and infection over the months of February. The x-axis represents the month and day, ranging from 02-01 to 02-08. The y-axis represents the variable 'value' with a scale from 0.00 to 1.00. The values are represented by horizontal bars, indicating the level of sporulation and infection during the trial period.
Obj. B – Field Trial – Weather

• No disease in trial

• Conditions turning a bit more favorable???

![Weather Chart]

- Mon 2/12: 73° | 45° F, Partly Cloudy
- Tue 2/13: 71° | 48° F, Partly Cloudy
- Wed 2/14: 71° | 47° F, Partly Cloudy
- Thu 2/15: 73° | 47° F, Mostly Sunny
- Fri 2/16: 74° | 45° F, Sunny
- Sat 2/17: 79° | 48° F, Sunny
- Sun 2/18: 82° | 47° F, Partly Cloudy
- Mon 2/19: 77° | 44° F, Sunny
- Tue 2/20: 71° | 41° F, Sunny
- Wed 2/21: 73° | 44° F, Mostly Sunny
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

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