Foliar Protectant Strategies for Control of Potato Virus Y

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Increase proportion of down-grades and rejections resulting from PVY

Percent of lots without mosaic symptoms

Trajectory

Year

20%
Potato virus Y (PVY) re-emergence in the United States

- **Asymptomatic varieties** (certification problems):
  - 'Silverton Russet'
  - 'Russet Norkotah'

- **PVY\(^N:O\)**, Recombinant Strains:
New Insect Vector, Soybean aphid in the Eastern US

*Aphis glycines*, soybean aphid

Lee 2002

Davis et al. 2008. **Transmission efficiencies ranged from 17 – 74%**
Managing Aphid Transmitted Viruses: Elevated Risk of Spread

➢ Crop protection during periods of greatest risk

2008 A. glycines flights

- Walworth
- Lancaster
- Arlington
- Hancock
- Seymour
- Eau Claire
- Antigo

Crop protection during periods of greatest risk
Non-Persistent Transmission

**Acquisition**
- seconds

**Transmission**
- seconds

**Retention**
- hours

Reproduced from T.L. German
Research Objectives

- **Determine:** (1) seasonal phenology of dispersing aphid vectors and (2) crop protection options to limit spread of PVY.

**Goal:** Accurately determine periods of elevated risk for PVY transmission and develop disease management strategies to limit PVY spread.

**Goal:** Evaluate the influence of well-timed, foliar control product (combinations) to limit the spread of PVY.
Seasonal Dispersal of Corn Leaf Aphid: Relationship to PVY Spread, 2009

2009, Langlade County

T_{50} = 28 June

T_{50} = 2 Aug

Seasonal dispersal of corn leaf aphid: Relationship to PVY spread, 2009.
Seasonal Dispersal of Pea Aphid: Relationship to PVY Spread

2009, Langlade County

T<sub>50</sub> = 12 July

T<sub>50</sub> = 2 Aug

A. pisum

alightment traps
Seasonal Dispersal of Soybean Aphid: Relationship to PVY Spread

2009, Langlade County

T_{50} = 21 July

T_{50} = 2 Aug

A. glycines

alightment traps
Research Objectives

- **Determine**: (1) seasonal phenology of dispersing aphid vectors and (2) crop protection options to limit spread of PVY.

Goal: Accurately determine periods of elevated risk for PVY transmission and develop disease management strategies to limit PVY spread.

**Goal**: Evaluate the influence of well-timed, foliar control product (combinations) to limit the spread of PVY.
PVY Foliar Oil Protectant Trial, 2008

- **Selection of mineral oils**
  - Aphoil
  - JMS Stylet Oil
  - QRD-416 (Requiem)

- **Application Frequency**
  - once weekly (every 7 days)
  - twice weekly (every 4 days)

- **Application rates**
  - Aphoil (2 and 4%)
  - JMS Stylet Oil (0.75 and 1.5%)

- **Application Technology**
  - D3-DC25 (hollow-cone)
  - XR-11004 (flat fan)
  - 80 and 45 psi
  - 21.1 and 37.5 gpa
Greatest Protection Level with cv. Silverton Russet Achieved with:
(1) 2X weekly applications, and
(2) highest product concentrations

Mean Proportion of PVY-Infected Plants

UTC
Aphoil (2%)
Aphoil (4%)
Aphoil (2%)
Aphoil (4%)
Stylet Oil (0.75%)
Stylet Oil (1.5%)
Stylet Oil (0.75%)
Stylet Oil (1.5%)
QRD 416 (1.0%)

5% mosaic ‘Certified’

P= 0.0213
# Products Evaluated for Managing Aphid Transmission of PVY in Wisconsin, 2009

<table>
<thead>
<tr>
<th>Product</th>
<th>Active Ingredient</th>
<th>Rate</th>
<th>Application Frequency</th>
<th>Application Interval (days)</th>
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<tbody>
<tr>
<td>UTC</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>2) Aphoil</td>
<td>mineral oil</td>
<td>4.0 % V/V</td>
<td>weekly</td>
<td>7 (June 5)</td>
</tr>
<tr>
<td>3) Aphoil</td>
<td>mineral oil</td>
<td>4.0 % V/V</td>
<td>weekly</td>
<td>7 (July 15)</td>
</tr>
<tr>
<td>4) Aphoil</td>
<td>mineral oil</td>
<td>4.0 % V/V</td>
<td>weekly</td>
<td>7 (June 5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.0 % V/V</td>
<td>weekly</td>
<td>4 (July 15)</td>
</tr>
<tr>
<td>5) Aphoil</td>
<td>mineral oil</td>
<td>4.0 % V/V</td>
<td>weekly</td>
<td>7 (June 5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.0 % V/V</td>
<td>weekly</td>
<td>4 (July 15)</td>
</tr>
<tr>
<td>Fulfill</td>
<td>pymetrozine</td>
<td>5.5 fl oz / ac</td>
<td>2X</td>
<td>2 (July 20)</td>
</tr>
<tr>
<td>6) Aphoil</td>
<td>mineral oil</td>
<td>4.0 % V/V</td>
<td>weekly</td>
<td>7 (June 5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.0 % V/V</td>
<td>weekly</td>
<td>4 (July 15)</td>
</tr>
<tr>
<td>Beleaf</td>
<td>flonicamid</td>
<td>2.8 fl oz / ac</td>
<td>3X</td>
<td>3 (July 20)</td>
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<tr>
<td>7) Aphoil</td>
<td>mineral oil</td>
<td>4.0 % V/V</td>
<td>weekly</td>
<td>7 (June 5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.0 % V/V</td>
<td>weekly</td>
<td>4 (July 15)</td>
</tr>
<tr>
<td>NNI-0101</td>
<td>pyrfluquinizone</td>
<td>3.2 fl oz / ac</td>
<td>3X</td>
<td>3 (July 20)</td>
</tr>
</tbody>
</table>

**Do all varieties require similar levels of protection?**
*(Goldrush vs. Snowden)*

**Can we define periods of greatest – need for protection?**
PVY Foliar Oil Protectant Trial, 2010
Summer DAS-ELISA Results

Goldrush

Initial Inoculum = 1.25%
P = 0.2774
PVY Foliar Oil Protectant Trial, 2010
Winter Grow-Out Results

Mean Proportion of PVY-Infected Plants

Initial Inoculum = 1.25%
P= 0.0113

5% mosaic

Goldrush

Foliar Protectant
PVY Foliar Oil Protectant Trial, 2010
Summer DAS-ELISA Results

Snowden

Initial Inoculum = 1.25%
P = 0.8263

5% mosaic

Mean Proportion of PVY-Infected Plants
PVY Foliar Oil Protectant Trial, 2010 Winter Grow-Out Results

Snowden

Initial Inoculum = 1.25%
P = 0.0391

Mean Proportion of PVY-Infected Plants

- Untrated Control
- Aphoil 1X/week June 15
- Aphoil 1X/week July 15
- Aphoil 1X/2X June 15 - July 15
- Aphoil 1X/2X Fullfill (2X)
- Aphoil 1X/2X June 15 - July 15 Beleaf (3X)
- Aphoil 1X/2X NNL-0101 (3X)

5% mosaic
Minimizing Current Season Infection: 
Foliar Protectant Summary

- In 2008, 2X weekly oil applications of Aphoil and Stylet Oil reduced PVY in daughter tubers of Silverton Russet.

- Again in 2009, Aphoil weekly (June 15) and twice weekly (July 15), resulted in lowest overall PVY in winter test.

  - Suggests that the bulk of infection / transmission occurs in late season
  - Additive effects of selective feeding blockers / behavioral modifiers warrants further investigation

- Level (degree) of foliar protection required varied by cultivar

  - Mature plant resistance in Snowden vs. Goldrush

- Improved understanding of disease progress curve and relationship to primary insect vectors – *A. glycines*
PVY Foliar Oil Protectants
‘Mature Plant Resistance’

**Pre-Flower Inoculation**

- ‘High’ Susceptibility
- ‘Medium’ Susceptibility
- ‘Low’ Susceptibility

**Post-Flower Inoculation**

- ‘High’ Susceptibility
- ‘Medium’ Susceptibility
- ‘Low’ Susceptibility

Mean percent PVY daughter tubers (N=40 tubers)

- Cultivar
  - Silverton
  - Russet
  - Norland
  - Atlantic
  - Yukon Gold
  - Snowden
  - Dark Red Norland
  - Villela Rose

P-values:
- Pre-Flower Inoculation: P = 0.0085
- Post-Flower Inoculation: P < 0.0001
Potato Crop Protection
Future Directions

• Accurately predict dispersal dynamics of the soybean aphid
  - physical factors (temperature, precipitation) - abiotic

• Repeat and refine crop protection strategies
  - crop protection combinations
  - application rates, frequency, and intervals
  - cultivar responses to infection
    ‘mature plant resistance’

• Initial inoculum levels and PVY increase

• Examine novel crop protectants
Current Season PVY Spread: Multi-tactic Approach

I. Avoidance in Time: early vine kill

II. Avoidance in Space

III. Plant Clean Potato Seed

IV. Improved Crop Protection