Soybean Aphid and virus incidence in snap beans

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Outline

Why do we care?
Viruses and vectors involved
Extent of the problem
Approaches/Methods
Data/Observations
Future directions
Snap Bean Industry

• In 2001,
  – ~225,000 lbs of beans were produced
  – Over 73,000 acres were harvested
  – With a crop value >$28 million
  – Which represents >25% of total US production
• $8 million in losses recorded from 2000 to 2001
  – Appearance of the soybean aphid
  – Associated with the occurrence of virus
    • Alfalfa Mosaic Virus (AMV)
    • Cucumber Mosaic Virus (CMV)
Insect transmitters of plant viruses

Thrips

Whiteflies

Beetles

Leafhoppers / Planthoppers

Aphids

J. Cho

nationalgardening.com

UNL Dept. Entomology

Clemson University
Detection of the soybean aphid

Map by R. Venette
Population Growth of Soybean Aphid

Arlington Research Station

Rate of Increase = 126.25 Aphids/Day from July 22\textsuperscript{th} to July 29\textsuperscript{th}

Capozzi
The Problem

Lee 2002
The Players

Alfalfa Mosaic Virus (AMV)

Bean Pod Mottle Virus (BPMV)

Cucumber Mosaic Virus (CMV)

Tomato Spotted Wilt Virus (TSWV)
Transmission pathways

- **propagative**
- **circulative**
- **insect**
- **persistent**
- **non persistent**
- **plant**
Non-persistent transmission

<table>
<thead>
<tr>
<th>Acquisition</th>
<th>Transmission</th>
<th>Retention</th>
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<td>seconds</td>
<td>seconds</td>
<td>hours</td>
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Snap Bean Survey Data

- 42,386 total leaves tested
- 4,172 composites of 10 leaves
- 4,949 single leaves tested
- 15,105 total wells used
Door County Region
8900 acres
800 leaves sampled

Oconto County Region
4900 acres
300 leaves sampled

New Richmond Region
8400 acres
600 leaves sampled

Central Sands Region
32900 acres
800 leaves sampled

Spring Green Region
4400 acres
600 leaves sampled

Door County Region
8900 acres
800 leaves sampled

Oconto County Region
4900 acres
300 leaves sampled

New Richmond Region
8400 acres
600 leaves sampled

Central Sands Region
32900 acres
800 leaves sampled

Spring Green Region
4400 acres
600 leaves sampled
The Process

- Stacking samples
- Cork-boring samples
- Picking leaf samples
The Process

- Grinding samples
- Plating samples
### Wisconsin Snap Bean Survey

- **Central Sands**: 35.3% AMV, 1.9% CMV
- **New Richmond**: 14.7% AMV, 6.7% CMV
- **Spring Green**: 50.4% AMV, 9.2% CMV
- **Door County**: 33.2% AMV, 7.5% CMV
- **Oconto County**: 11% AMV, 0.0% CMV

**Locations**: Central Sands, New Richmond, Spring Green, Door County, Oconto County.
IPM Applications

- Pesticide Application
**Stylet Oils**

![Graph showing mean % virus incidence for different treatments.](image)

- **JMS Stylet Oil**
  - 3qt/100gal @400psi: a
  - 6qt/100gal @400psi: b
  - 3qt/100gal @35psi: c

- **Glacial Oil**
  - 3qt/100gal @400psi: a
  - 6qt/100gal @400psi: b
  - 3qt/100gal @35psi: c

- **Untreated Control**
  - a

**P = 0.05**

*Wyman, Capozzi*
IPM Applications

• Pesticide Application

• Cultivar Resistance
Visual Symptom Analysis vs. ELISA Data

Visual Severity

ELISA Data

Grau, Stevenson
IPM Applications

• Pesticide Application
• Cultivar Resistance
• Alternative Cultivar Resistance
Alternative Source of Resistance

• Most of the lines were 100 percent infected with virus

• Some escapes were found
  – 22 PI lines
  – 2 cultivars
  – 7 crosses

• Seven PI lines showed some escapes in both replications

• One PI line showed 100% escape in both replications

Michell Sass, Felix Navarro, James Nienhuis
IPM Applications

- Pesticide Application
- Cultivar Resistance
- Alternative Cultivar Resistance
- Seed Transmission
Seed Testing

- In progress
Aphids role of spreading a non-persistent virus

1/500 acre field surrounded by weeds

~ 0.3% seed borne virus infection
Aphids role of spreading a non-persistent virus

1 hour after aphid landing

1000 aphids per plant
Each winged aphid visits 5 different plants
Aphids role of spreading a non-persistent virus

1 week after aphid landing

Each winged aphid visits 5 different plants
Aphids role of spreading a non-persistent virus

2 weeks after aphid landing

Each winged aphid visits 1 different plants
Future Directions

- Determine the effects of virus on the yield and quality of beans
- Identify useful resistance to virus
- Identify inoculum sources
The Source of Virus Inoculum

- Do weeds that surround fields contain virus?
- Do aphids arrive with or without virus?
- Do seed borne viruses spread at a high rate?

Sow thistle infected with AMV
Future Directions

• Determine the effects of virus on the yield and quality of beans
• Identify useful resistance to virus
• Identify inoculum sources
• Characterize other viruses affecting snap beans
• What other viruses are present?
  – Bean common mosaic
  – Tomato spotted wilt virus
Future Directions

• Determine the effects of virus on the yield and quality of beans
• Identify useful resistance to virus
• Identify inoculum sources
• Characterize other viruses affecting snap beans

• Develop IPM procedures
  – Planting date
  – Variety resistance
  – Weed management
  – Pesticide application
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Thank you.

Questions?