Onion thrips and onion maggot management strategies

Orange County Onion School

February 28, 2018

Brian Nault & Ashley Leach
Department of Entomology
Cornell University
New York State Agricultural Experiment Station
Geneva, NY
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I. Onion thrips
   - Evaluating IPM tactics for thrips
   - Influence of thrips IPM on plant diseases
   - Thrips management guidelines for 2018

II. Onion maggot
    - Evaluating seed treatments
    - Maggot management guidelines for 2018
Onion thrips

- Major pest of onion
- Feeding can reduce bulb weights 30-60%
Onion thrips spread pathogens

- *Iris yellow spot virus* (Iris yellow spot)
- *Pantoea ananatis* (bacterial center rot)
- *Alternaria porri* (Purple blotch)
- *Stemphylium vesicarium* (Stemphylium leaf blight)
Management possibilities for thrips

Plant Resistance

Chemical Control

Cultural Control

Biological Control
Plant resistance: Thrips-resistant cultivars often have yellow-green leaves, low amounts of epicuticular wax and H-16 ketone
Plant resistance: Thrips-resistant cultivars often have yellow-green leaves, low amounts of epicuticular wax and H-16 ketone

Cultural control: Thrips densities decrease with decreasing nitrogen rates
Plant resistance: Thrips-resistant cultivars often have yellow-green leaves, low amounts of epicuticular wax and H-16 ketone

Cultural control: Thrips densities decrease with decreasing nitrogen rates

Chemical control: Thrips control equivalent using scouting and action thresholds as a weekly insecticide program, but with fewer sprays
Integrated thrips management program

Plant Resistance
- Semi-glossy cultivar

Chemical Control
- Action-threshold based insecticide program

Cultural Control
- Reduced N at planting
Objectives

Examine the effect of an action-threshold insecticide program and reduced nitrogen rate at planting on:

1) Onion thrips densities and bulb yield

in 3 cultivars varying in levels of thrips resistance
Objectives

Examine the effect of an action-threshold insecticide program and reduced nitrogen rate at planting on:

1) Onion thrips densities and bulb yield

2) Incidence and/or severity of plant diseases (e.g., IYS and bacterial bulb rot)

in 3 cultivars varying in levels of thrips resistance
Methods

Plant resistance

More resistant to thrips

cv. ‘Avalon’
Yellow-green leaves
Lower amount of epicuticular wax

Less resistant to thrips

cv. ‘Delgado’

cv. ‘Bradley’
STANDARD
Blue-green leaves
Higher amount of epicuticular wax

More resistant to thrips

Less resistant to thrips
Methods

Cultural control

- 60 lbs. nitrogen per acre
- 90 lbs. nitrogen per acre
- STANDARD RATE 125 lbs. nitrogen per acre

All applied at planting
Methods

Chemical control

**STANDARD INSECTICIDE PROGRAM**

Insecticide applied every week.

**ACTION THRESHOLD INSECTICIDE PROGRAM**

Plots monitored weekly. Insecticide applied ONLY when thrips surpassed threshold of 1 thrips larva per leaf.

**UNTREATED CONTROL**

No insecticide applied.
Methods

Chemical control

STANDARD INSECTICIDE PROGRAM

Movento®  Agri-mek® SC  Radiant® SC  Exirel®

ONION THRIPS PRESSURE

ONION GROWING SEASON

MAY  JUNE  JULY  AUG  SEPT
Methods

Chemical control

ACTION THRESHOLD (AT) INSECTICIDE PROGRAM

ONION THRIPS PRESSURE

MAY JUNE JULY AUG SEPT

Action threshold (1 thrips per leaf)

Movento® Agri-mek® SC Radiant® SC Exirel®
<table>
<thead>
<tr>
<th>AVALON</th>
<th>DELGADO</th>
<th>BRADLEY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rep.1</td>
<td>Rep.1</td>
<td>Rep.1</td>
</tr>
<tr>
<td>Rep.2</td>
<td>Rep.2</td>
<td>Rep.2</td>
</tr>
<tr>
<td>Rep.3</td>
<td>Rep.3</td>
<td>Rep.3</td>
</tr>
<tr>
<td>Rep.4</td>
<td>Rep.4</td>
<td>Rep.4</td>
</tr>
<tr>
<td>Rep.5</td>
<td>Rep.5</td>
<td>Rep.5</td>
</tr>
</tbody>
</table>

(3 x 3 factorial) in a RCBD Elba, NY in 2015 and 2016

**Methods**

Replicate 1

1. 60 lbs. N X CONTROL
2. 60 lbs. N X STANDARD
3. 60 lbs. N X AT*
4. 90 lbs. N X CONTROL
5. 90 lbs. N X STANDARD
6. 90 lbs. N X AT*
7. 125 lbs. N X CONTROL
8. 125 lbs. N X STANDARD
9. 125 lbs. N X AT*

*AT = ACTION THRESHOLD

Commercial muck farm
Methods

• Numbers of *onion thrips larvae* on 15 plants per plot were visually recorded weekly.

• **Bulbs** were harvested at the end of the season and weighed and graded.
Results

- For each cultivar, **onion thrips densities** and **marketable yield** were not significantly affected by either **nitrogen rate** or the interaction of **nitrogen rate** and **insecticide program**

- For each cultivar, **onion thrips densities** and **marketable yield** were significantly affected by **insecticide program**
Results

2015

cv. ‘Avalon’

Economic injury level
2.2 thrips per leaf

Mean seasonal larvae per leaf

Control  AT  Standard

Leach et al. 2017. Agric., Ecosys. & Environ. 250: 89-101
## Results

### Average number of insecticide applications

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Year</th>
<th>AT insecticide applications</th>
<th>Standard insecticide applications</th>
<th>Percent reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avalon</td>
<td>2015</td>
<td>3.7</td>
<td>7</td>
<td>48% reduction</td>
</tr>
<tr>
<td>Delgado</td>
<td>2015</td>
<td>4.7</td>
<td>7</td>
<td>33% reduction</td>
</tr>
<tr>
<td>Bradley</td>
<td></td>
<td>3.7</td>
<td>7</td>
<td>48% reduction</td>
</tr>
<tr>
<td>Avalon</td>
<td>2016</td>
<td>3</td>
<td>6</td>
<td>50% reduction</td>
</tr>
<tr>
<td>Delgado</td>
<td>2016</td>
<td>4</td>
<td>6</td>
<td>33% reduction</td>
</tr>
<tr>
<td>Bradley</td>
<td></td>
<td>3.3</td>
<td>6</td>
<td>46% reduction</td>
</tr>
</tbody>
</table>
Results

2015

cv. ‘Avalon’

Marketable yield (tons/hectare)

Control: 40
AT: 50
Standard: 60

Leach et al. 2017. Agric., Ecosys. & Environ. 250: 89-101

cv. ‘Delgado’

Control: 20
AT: 30
Standard: 40

Leach et al. 2017. Agric., Ecosys. & Environ. 250: 89-101

cv. ‘Bradley’

Control: 30
AT: 40
Standard: 50

Leach et al. 2017. Agric., Ecosys. & Environ. 250: 89-101
Integrated thrips management program

Plant Resistance
- Semi-glossy cultivar

Chemical Control
- Action-threshold based insecticide program

Cultural Control
- Reduced N at planting
Objectives

Examine the effect of an action-threshold insecticide program and reduced nitrogen rate at planting on:

1) Onion thrips densities and bulb yield

2) Incidence and/or severity of plant diseases (e.g., IYS and bacterial bulb rot)

in 3 cultivars varying in level of thrips resistance
Thrips program impact on diseases?

**Plant Resistance**

- Semi-glossy cultivar
- Iris yellow spot

**Cultural Control**

- Reduced N at planting

**Chemical Control**

- Action-threshold based insecticide program
- Bacterial bulb rot
Methods

Iris yellow spot disease incidence and severity
(15 plants per plot)
Results

- For each cultivar, IYS incidence and severity were not significantly affected by either nitrogen rate or the interaction of nitrogen rate and insecticide program.

- For each cultivar, IYS incidence and severity were significantly affected by insecticide program.
cv. ‘Bradley’

Results

- Delaying IYSV incidence using insecticide programs in 2016

% IYS incidence

- Untreated
- Insecticide (AT)
- Insecticide (weekly)

Leach et al. 2017. Agric., Ecosys. & Environ. 250: 89-101
cv. ‘Bradley’

Results

- Reduced severity of IYSV using insecticide programs in 2016

Leach et al. 2017. Agric., Ecosys. & Environ. 250: 89-101
cv. ‘Bradley’

Results

➢ Reduced yield in untreated control due to thrips/ IYSV in 2016

% IYS incidence

IYS Severity

Mean marketable yield (kg/ha)

Leach et al. 2017. Agric., Ecosys. & Environ. 250: 89-101
Methods

Internal bulb decay (100 bulbs per plot; 50 bulbs at harvest and 50 bulbs after 3 months in storage)
Results

Bacterial species present:

- *Burkholderia cepacia*
- *Enterobacter ludwigii*
- *Klebsiella oxytoa*
- *Klebsiella pneumoniae*
- *Lactococcus lactis*
- *Pantoea agglomerans*
- *Rahnella spp.*
- *Serratia marcescens*
Results

- For each cultivar, incidence of bacterial bulb rot was not consistently affected by either nitrogen rate, insecticide program or the interaction of nitrogen rate and insecticide program.

- ‘Avalon’ (semi-glossy cultivar) tended to have more bacterial bulb rot than the other cultivars, especially after 3 months in storage.
Results

Incidence of bacterial rot (%)

2015

- cv. ‘Avalon’
- cv. ‘Delgado’
- cv. ‘Bradley’

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Thrips Program impact on Diseases?

Plant Resistance
- Semi-glossy cultivar
- Iris yellow spot

Chemical Control
- Action-threshold based insecticide program

Cultural Control
- Reduced N at planting

Bacterial bulb rot
Take Home Message #1

- **Plant resistance** (semi-glossy cultivar – ‘Avalon’) showed some promise for reducing thrips, but was vulnerable to bacterial bulb rot.
- **Cultural control** (reducing N at planting) had no impact on thrips or diseases.
- **Chemical control** (action-threshold based program) effectively controlled thrips and reduced incidence and severity of IYSV; no consistent impact on bulb decay.
I. Onion thrips
   - Evaluating IPM tactics for thrips
   - Influence of thrips IPM on plant diseases
   - Thrips management guidelines for 2018

II. Onion maggot
    - Evaluating seed treatments
    - Maggot management guidelines for 2018
Insecticides registered for managing onion thrips in NY

- Agri-Mek SC (abamectin)
- Exirel (cyantraniliprole)
- Lannate LV (methomyl)
- Minecto Pro (abamectin+cyantraniliprole)
- Movento (spirotetramat)
- Radiant SC (spinetoram)
- Warrior II w/Zeon tech (lambda-cy)
Insecticides registered for managing onion thrips in NY

- Agri-Mek SC (abamectin)
- **Exirel** (cyantraniliprole)
- Lannate LV (methomyl)
- **Minecto Pro** (abamectin+cyantraniliprole)
- Movento (spirotetramat)
- Radiant SC (spinetoram)
- Warrior II w/Zeon tech (lambda-cy)
### Evaluating efficacy of new products for onion thrips management – 2017

<table>
<thead>
<tr>
<th>Product*</th>
<th>Active Ingredient</th>
<th>Rate per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Agri-Mek SC</td>
<td>abamectin</td>
<td>3.5 fl oz</td>
</tr>
<tr>
<td>Agri-Mek SC + Warrior II w/zeon</td>
<td>abamectin + lambda cy</td>
<td>3.5 fl oz + 2 fl oz</td>
</tr>
<tr>
<td>Exirel</td>
<td>cyantraniliprole</td>
<td>13.5 fl oz</td>
</tr>
<tr>
<td>Exirel</td>
<td>cyantraniliprole</td>
<td>20.5 fl oz</td>
</tr>
<tr>
<td>Minecto Pro</td>
<td>cyantraniliprole + abamectin</td>
<td>7 fl oz</td>
</tr>
<tr>
<td>Minecto Pro</td>
<td>cyantraniliprole + abamectin</td>
<td>10 fl oz</td>
</tr>
</tbody>
</table>

*Each product applied twice one week apart
Onion thrips management in onion

‘Fortress’     Elba, NY     (n = 4)     August 23, 2017

Mean number larvae/ leaf 1 week after second spray

P<0.0001

Minecto Pro (10 fl oz/A)
Minecto Pro (7 fl oz/A)
Exirel (20.5 fl oz/A)
Exirel (13.5 fl oz/A)
Agri-Mek + Warrior (3.5 fl oz+2 fl oz)
Agri-Mek SC
Untreated

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How should products be used in a season-long program?

- Agri-Mek SC (abamectin)
- Exirel (cyantraniliprole)
- Lannate LV (methomyl)
- Minecto Pro (abamectin+cyantraniliprole)
- Movento (spirotetramat)
- Radiant SC (spinetoram)
- Warrior II w/Zeon tech (lambda-cy)
Onion thrips management 20 years ago

Week 1: Warrior
Week 2: Warrior
Week 3: Warrior
Week 4: Warrior
Week 5: Warrior
Week 6: Warrior
Week 7: Warrior
Week 8: Warrior
Onion thrips management 20 years ago

Week 1: Warrior
Week 2: Warrior
Week 3: Warrior
Week 4: Warrior
Week 5: Warrior
Week 6: Warrior
Week 7: Warrior
Week 8: Warrior

“The Pinto”
- Cheap, but didn’t last long
Guidelines for 2018 onion thrips management

Week 1: Product A
Week 2: Product A
Week 3: Product B
Week 4: Product B
Week 5: Product C
Week 6: Product C
Week 7: Product D
Week 8: Product D

- Use a sequence of insecticides belonging to different classes
- Do NOT use the same product more than twice during the season
- Apply the same product in consecutive weeks
- Use an action threshold of 1 thrips/leaf to determine whether or not to spray
Guidelines for 2018 onion thrips management

- Movento
  - Assumes 6 insecticide applications within a growing season
  - Use action threshold of 1 thrips per leaf

Movento
Guidelines for 2018 onion thrips management

• Assumes 6 insecticide applications within a growing season
• Use action threshold of 1 thrips per leaf.

OPTION A
Minecto Pro¹
Minecto Pro¹
Radiant
Radiant

1. Agri-mek and Exirel should not be used in sequence with Minecto Pro
Guidelines for 2018 onion thrips management

OPTION A

1. Agri-mek and Exirel should not be used in sequence with Minecto Pro
2. Warrior II w/ Zeon technology

- Assumes 6 insecticide applications within a growing season
- Use action threshold of 1 thrips per leaf.
Guidelines for 2018 onion thrips management

“The Cadillac”
- Expensive and you won’t be disappointed

1. Agri-mek and Exirel should not be used in sequence with Minecto Pro
2. Warrior II w/ Zeon technology
Guidelines for 2018 onion thrips management

1-2 thrips per leaf

Movento

Movento

Agri-Mek

Agri-Mek

OPTION B

Exirel

Exirel

Agri-Mek can be tank mixed with Warrior² if needed
Guidelines for 2018 onion thrips management

Movento

Movento

OPTION B

Agri-Mek

Agri-Mek

Agri-Mek can be tank mixed with Warrior² if needed

Above 2 thrips per leaf

Radiant

Radiant
Guidelines for 2018 onion thrips management

- Movento
  - Assumes 6 insecticide applications within a growing season
  - Use action threshold of 1 thrips per leaf.

- OPTION B
  - Movento
  - Agri-Mek
  - Above 2 thrips per leaf
  - Exirel
  - Agri-Mek can be tank mixed with Warrior if needed
  - Radiant
  - 8-10 fl oz/A

- The “Silverado”
  - A bit less expensive, and dependable

- The “F-150”

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Guidelines for 2018 onion thrips management

- Assumes 6 insecticide applications within a growing season
- Use action threshold of 1 thrips per leaf.

OPTION B

- Agri-Mek can be tank mixed with Warrior² if needed

1. Agri-mek and Exirel should not be used in sequence with Minecto Pro
2. Warrior II w/ Zeon technology

Cornell CALS
College of Agriculture and Life Sciences
Guidelines for 2018 onion thrips management

- Assumption: 6 insecticide applications within a growing season
- Use action threshold of 1 thrips per leaf.

**OPTION A**

- Minecto Pro
- Minecto Pro
- Radiant
- Radiant
- Lannate + Warrior

**OPTION B**

- Movento
- Agri-Mek
- Agri-mek can be tank mixed with Warrior if needed

1. Agri-mek and Exirel should not be used in sequence with Minecto Pro
2. Warrior II w/ Zeon technology
Guidelines for 2018 onion thrips management

1. Agri-mek and Exirel should not be used in sequence with Minecto Pro
2. Warrior II w/ Zeon technology
Take Home Message #2

- Multiple effective insecticides are available for onion thrips control
- Multiple options exist for obtaining season-long control and these options may be influenced by thrips pressure and cost of products
I. Onion thrips
   - Evaluating IPM tactics for thrips
   - Influence of thrips IPM on plant diseases
   - Thrips management guidelines for 2018

II. Onion maggot
   - Evaluating seed treatments
   - Maggot management guidelines for 2018
Onion maggot damage

Larval feeding damage
Seasonal Activity of Onion Maggot Adults In New York (3 generations)
Seasonal Activity of Onion Maggot Adults In New York (3 generations)

*First-generation maggots are targeted with at-plant treatment
<table>
<thead>
<tr>
<th>Trade Name</th>
<th>Company</th>
<th>Active Ingredient</th>
<th>Class (IRAC(^2) group)</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>FarMore FI500</td>
<td>Syngenta</td>
<td>thiamethoxam + spinosad</td>
<td>Neonicotinoid (4) + Spinosyn (5)</td>
<td>Seed treatment</td>
</tr>
<tr>
<td>FarMore OI100</td>
<td>Syngenta</td>
<td>spinosad</td>
<td>Spinosyn (5)</td>
<td>Seed treatment</td>
</tr>
<tr>
<td>Sepresto</td>
<td>Bayer CropScience</td>
<td>clothianidin + imidacloprid</td>
<td>Neonicotinoid (4) + Neonicotinoid (4)</td>
<td>Seed treatment</td>
</tr>
<tr>
<td>Trigard</td>
<td>Syngenta</td>
<td>cyromazine</td>
<td>Triazine (17)</td>
<td>Seed treatment</td>
</tr>
<tr>
<td>Diazinon AG500</td>
<td>Makhteshim</td>
<td>diazinon</td>
<td>OP (1)</td>
<td>Pre-plant broadcast &amp; incorporate</td>
</tr>
<tr>
<td>and OLF(^1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lorsban Advanced</td>
<td>Dow Agro-Sciences</td>
<td>chlorpyrifos</td>
<td>OP (1)</td>
<td>At planting in-furrow, or</td>
</tr>
<tr>
<td>and OLF(^1)</td>
<td>and others</td>
<td></td>
<td></td>
<td>Post-plant band</td>
</tr>
</tbody>
</table>

\(^1\)OLF: other labeled formulation. \(^2\)IRAC: Insecticide resistance action committee
A year ago, EPA proposed to pull all food uses for chlorpyrifos (e.g., Lorsban), including onion. What is future outlook?
Potential Labelled Products to Replace Lorsban?

Diazinon AG500 – diazinon
(broadcast and incorporate)

Majestene – bionematicide
(in-furrow drench)
Insecticide Evaluation Trial in Sodus, NY  2016

Products Evaluated and Application Method*

- Diazinon AG500 (broadcast and incorporated @ 128 fl oz/A)
- Majestene (in-furrow drench @ 14 fl oz/1,000 row ft)
- Lorsban Advanced (in-furrow drench @ 0.92 fl oz/1,000 row ft)
- FarMore FL500 (seed treatment)
- FarMore FL500 + Diazinon AG500
- FarMore FL500 + Majestene
- FarMore FL500 + Lorsban Advanced

*Seed for all at-plant products treated with FarMore F300 + ProGro
*All treatments received Dithane F-45 Rainshield @77 fl oz/A
Onion Maggot Control Using FarMore FI500

Sodus, NY 2016

No insecticide

FarMore FI500
Onion maggot control in onion using insecticides

‘Safrane F1’    Sodus, NY    (n = 5)    2016

No Insecticide
Diazinon AG500
Majestene XC
Lorsban Advanced
FarMore FI500
FarMore + Diazinon
FarMore + Majestene
FarMore + Lorsban

Mean % plants killed by maggots

F = 528; df = 7, 28; P < 0.0001
How do alternative insecticide seed treatments compare with FarMore FI500?

- Sepresto
- Trigard
Onion maggot control in onion using seed treatments
‘Lasalle’ Oswego, NY (n = 5) 2017

<table>
<thead>
<tr>
<th>Trt#</th>
<th>Treatment (type of insecticide is underlined)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No insecticide + Dynasty + Maxim + Apron XL + Pro-Gro + Dithane F45 Rainshield</td>
</tr>
<tr>
<td>2</td>
<td><strong>Sepresto</strong> + Dynasty + Maxim + Apron XL + Pro-Gro + Dithane F45 Rainshield</td>
</tr>
<tr>
<td>3*</td>
<td><strong>Regard + Cruiser</strong> + Dynasty + Maxim + Apron XL + Pro-Gro + Dithane F45 Rainshield</td>
</tr>
<tr>
<td>4</td>
<td><strong>Regard</strong> + Dynasty + Maxim + Apron XL + Pro-Gro + Dithane F45 Rainshield</td>
</tr>
<tr>
<td>5</td>
<td><strong>Trigard</strong> + Dynasty + Maxim + Apron XL + Pro-Gro + Dithane F45 Rainshield</td>
</tr>
<tr>
<td>6</td>
<td><strong>Sepresto</strong> + Thiram + Penflufen + Dithane F45 Rainshield</td>
</tr>
<tr>
<td>7**</td>
<td><strong>Entrust</strong> + Dithane F45 Rainshield</td>
</tr>
<tr>
<td>8</td>
<td><strong>Sepresto</strong> + Thiram + Penflufen</td>
</tr>
</tbody>
</table>

* FarMore FI500 (= trt #3)
** FarMore OI100 (= trt #7)
Onion maggot control in onion using seed treatments
cv. ‘Lasalle’ Oswego, NY (n = 5) 2017

1) No Insecticide
2) Sepresto
3) FarMore FI500
4) Regard
5) Trigard
6) Sepresto
7) FarMore Ol100
8) Sepresto

% Plants killed by maggots

F = 42.5; df = 7, 28; P < 0.0001
Insecticides for onion maggot control in direct-seeded onions

Summary

- Failed to identify a replacement for Lorsban: Diazinon AG500 and Majestene bionematicide were NOT effective

- FarMore FI500 was effective; inclusion of other products did not improve control

- Trigard 75WP also was effective

- Sepresto failed to provide acceptable control
Annually rotate insecticide seed treatments to slow down resistance

* Only 1 of 6 generations will be exposed to the same insecticide in 2 yrs

2018

FarMore
FI500

2019

Trigard ± Lorsban

* Only 1 of 6 generations will be exposed to the same insecticide in 2 yrs
### Onion Maggot IRM Plan

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>FarMore</td>
<td>Trigard ±</td>
<td>FarMore</td>
<td>Trigard ±</td>
</tr>
<tr>
<td>FI500</td>
<td>Lorsban</td>
<td>FI500</td>
<td>Lorsban</td>
</tr>
</tbody>
</table>

- Annually rotate FarMore FI500 and Trigard ± Lorsban
- Establish a similar rotation pattern with neighbors

Pro-Gro must be added for smut control to both Trigard ± Lorsban and to FarMore FI500
Insecticides for onion maggot control in **transplanted** onions

Summary – Additional Information

- **Lorsban Advanced** or OLF is labeled, but effective maggot control is not likely (i.e., resistance)

- **Radiant SC** applied as a dip treatment for bare-root transplants (NOT labelled use)
  
  - IR-4 provided my efficacy data and residue data
  
  - Registrant (Dow AgroSciences) has all of the information, but has not made an amendment to the label
Take Home Message #3

- FarMore FI500 and Trigard ± Lorsban are the best options for onion maggot control

- Consider annually rotating these seed treatments to slow down insecticide resistance
Future Research

- Continue evaluating management tactics for onion thrips
  - identify new conventional AND organically approved materials for thrips control (i.e., USDA OREI and ORDP)
  - host plant resistance; reduced fertility programs [P and split applications of N]) (i.e., NE SARE)

- Continue evaluating new products for maggots
  - compare insecticides applied in-furrow at planting and those delivered as seed treatments (i.e., ORDP)
  - determine impact of soil moisture on seed treatment efficacy (i.e., Mellon grant)
Future Research

- Identify management tactics for Allium leafminer
  - identify conventional AND organically approved materials for Allium leafminer control (i.e., NYFVI and ROAR)
  - determine optimal window of control
Questions?

http://nault.entomology.cornell.edu/