Vegetable:
Update on Organic Onion Pest and Disease Management

2020 NOFA-NY Winter Conference Workshop
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Lindsay Iglesias, Dept. of Entomology
Frank Hay, Dept. of Plant Pathology & Plant Microbe Biology
I. Onion maggot & Allium leafminer
   • Life history
   • Management options

II. Onion thrips
   • Life history
   • Management options

III. Stemphylium leaf blight
   • Biology
   • Management options
Onion maggot (*Delia antiqua*)

- Found in northern temperate regions worldwide
- Feeds only on *Allium* spp.
- Close relative includes seedcorn maggot – a generalist and sporadic pest of onion
Onion maggot

- Major pest of onion
- Can reduce plant stands by nearly 100%
- Three generations per year

No insecticide  Insecticide
Seasonal activity of onion maggot adults in New York (3 generations)

Number of flies/trap

Date

Cornell AgriTech
New York State Agricultural Experiment Station
Seasonal activity of onion maggot adults in New York (3 generations)

First-generation maggots kill plants, so most important to manage.
How best to manage onion maggot?

- **Plant Resistance**
  - None known

- **Chemical Control**
  - Insecticides

- **Cultural Control**
  - Crop rotation
  - Delayed planting
  - Sanitation

- **Biological Control**
  - Sterile Insect Technique
  - Sterile male release

Cornell AgriTech
New York State Agricultural Experiment Station
How best to manage onion maggot?

Plant Resistance
- None known
- Transplants
How best to manage onion maggot?

**Plant Resistance**
- None known
- Transplants

**Cultural Control**
- Crop rotation
- Sanitation
- Row covers
Row covers protect plants from egg-laying flies
NEWA onion maggot degree-day model for predicting fly activity

http://www.newa.cornell.edu/

- Degree-day model will generate information to help determine when to cover onions.
How best to manage onion maggot?

Plant Resistance
- None known
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Cultural Control
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Sterile Insect Technique
- Sterile male release
How best to manage onion maggot?

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- Entomopathogens

**Sterile Insect Technique**
- Sterile male release
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  - Crop rotation
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  - Row covers

- **Biological Control**
  - Entomopathogens

- **Sterile Insect Technique**
  - Sterile male release
Insecticide seed treatment for onion maggot control in organic production
Insecticide seed treatment for onion maggot control in organic production

Must have onion seed treated by commercial seed treatment company.
Seed treatment studies

- Seeds were treated by Dr. Alan Taylor (Horticulture, Cornell AgriTech)
- Test site in Oswego Co. where maggots were not controllable
- Onion seeds planted in April 2017 and April 2018
- Plots were two rows, 30-ft long and treatments replicated 5 times
- Numbers of onion plants dead or dying from maggots assessed 1-2 times per week during first generation (May through July)
RESULTS: Efficacy of Regard SC seed treatment for onion maggot control in bulb onions

Mean (±SEM) % plants killed by maggots

2017

No insecticide

Regard SC

Treatment

50% “control”

P<0.05; n=5
RESULTS: Efficacy of Regard SC seed treatment for onion maggot control in bulb onions

Mean (±SEM) % plants killed by maggots

2018

No insecticide  Regard SC

34% “control”

P<0.05; n= 5
Options for onion maggot control in transplanted onions?
Could Entrust SC protect transplants from onion maggot?

Dipping* bare-root onion plants in Entrust solution

*Currently NOT labelled
Onion maggot control using insecticide dip treatments for transplants
cv. ‘Bradley’ Oswego, NY (n = 5) 2018-2019

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Active ingredient</th>
<th>Rate(^a)</th>
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<tbody>
<tr>
<td>No insecticide</td>
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<tr>
<td>Entrust SC</td>
<td>spinosad</td>
<td>1 fl oz/10,000 plants</td>
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<tr>
<td>Entrust SC</td>
<td>spinosad</td>
<td>2 fl oz/10,000 plants</td>
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<td>Radiant SC(^b)</td>
<td>spinetoram</td>
<td>1 fl oz/gal of water</td>
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\(^a\) 1.25 gallons of solution treats 10,000 bare-root plants

\(^b\) Not OMRI-Listed
Onion maggot control using insecticide dip treatments for transplants
cv. ‘Bradley’ Oswego, NY

Mean (±SEM) % plants killed by maggots

- Untreated control
- Entrust (low)
- Entrust (high)
- Radiant

2018

P<0.05; n= 6

82% “control”
Onion maggot control using insecticide dip treatments for transplants
cv. ‘Bradley’ Oswego, NY

Mean (±SEM) % plants killed by maggots

Untreated control  Entrust (low)  Entrust (high)  Radiant

2019

97% “control”

P<0.05; n= 4

Treatment
Onion maggot control summary

- Important to use multiple management tactics, especially crop rotation
- Regard SC seed treatment is the only option for direct-seeded onions
- Entrust SC may be a future option for transplanted onions
Allium leafminer (ALM), *Phytomyza gymnostoma*

- First detected in North America in 2015
- New invasive pest of crops in the *Allium* genus
- Related to *Liriomyza* spp., but is monophagous

Photo: Andre Megroz
Origin – Poland (1858)
21 countries in Europe; 2 in Asia; 1 in NA
North American distribution of Allium leafminer

- First detected in Lancaster County, PA (2015)
- Confirmed in CT, MA, MD, NJ, NY & PA (as of Nov. 2019)
Diagnostic features of an Allium leafminer infestation

- Larvae mine down the leaf to the lower portions of the plant where they will pupate.

Photo: R. Harding
Damage by Allium leafminer

- Relatively large leafminer
- Infested plants often associated with bacterial rot

Larva (8 mm)

Pupa 3-4 mm

Photo: T. Rusinek

Photo: R. Harding
Allium leafminer has caused catastrophic crop losses on small farms

Organic leeks in Seneca County, NY
# Life Cycle of Allium leafminer in Northeastern US

## Spring Generation
- Jan. to May: Larvae and Pupae
- June to July: Adults

## Fall Generation
- Sept. to Dec.: Larvae and Pupae
- Jan. to Feb.: Adults

### Table: Life Cycle Stages by Month

<table>
<thead>
<tr>
<th>Month</th>
<th>Pupa</th>
<th>Adult</th>
<th>Eggs/Larva</th>
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Bulb onion foliage availability for ovipositing Allium leafminer in Northeastern US

Transplanting

Sowing seeds

|------|------|-------|------|-----|------|------|------|------|------|------|------|

seeded onion

transplanted onion
Bulb onion foliage availability for ovipositing Allium leafminer in Northeastern US

|------|------|-------|------|-----|------|------|------|-------|------|------|------|

*Transplanted onions are at risk for Allium leafminer infestation only in the spring

**Spring Generation**

- Seeded onion
- Transplanted onion

**Fall Generation**

Cornell AgriTech
New York State Agricultural Experiment Station
Other Allium crop foliage availability for ovipositing Allium leafminer in Northeastern US

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**Spring Generation**

- Scallions and wild *Allium* spp.
- Leek
- Garlic

**Fall Generation**
Other Allium crop foliage availability for ovipositing Allium leafminer in Northeastern US


**Spring Generation**
- Scallions and wild *Allium* spp.
- Garlic

**Fall Generation**
- Leek

*Scallions, leek and garlic are at high risk for Allium leafminer infestation*
How best to manage Allium leafminer?
How best to manage Allium leafminer?

Plant Resistance

- None known
How best to manage Allium leafminer?

**Plant Resistance**
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**Cultural Control**
- Reflective mulch
- Delayed planting
- Crop rotation
- Row covers
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**Biological Control**
- Parasitoids
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How best to manage Allium leafminer?

**Chemical Control**
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**Biological Control**
- Parasitoids

**Cultural Control**
- Reflective mulch
- Delayed planting
- Crop rotation
- Row covers

**Plant Resistance**
- None known

Needed an immediate, highly effective solution
Effective active ingredients

Active ingredient (IRAC classification)

- abamectin (6)
- acetamiprid (4A)
- cypermethrin + chlorpyrifos (3A + 1B)
- cyromazine (17)
- dimethoate (1B)
- imidacloprid w and w/o deltamethrin (4A + 3A)
- spinosad (5)
- fenitrothion (1B)
- novaluron (15)

(Coman and Rosca 2011; Tallotti et al. 2003, 2004)
Insecticides for Allium leafminer control in Europe

Effective active ingredients

Active ingredient (IRAC classification)

- abamectin (6)
- acetamiprid (4A)
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- spinosad (5)
- fenitrothion (1B)
- novaluron (15)

Registered on bulb vegetable crops in US and OMRI-Listed

(Coman and Rosca 2011; Tallotti et al. 2003, 2004)
What insecticides and delivery strategies control ALM?

- Identify effective OMRI-Listed products
- Optimize frequency of foliar applications
- Evaluate at-plant transplant treatments
New York

- Bulb onions in spring 2018
- Leeks in fall 2018 (2 locations)
- Scallions in fall 2018 and 2019
Insecticides evaluated for Allium leafminer control

<table>
<thead>
<tr>
<th>Active ingredient⁴</th>
<th>Product</th>
<th>IRAC Group</th>
<th># trials</th>
</tr>
</thead>
<tbody>
<tr>
<td>azadirachtin</td>
<td>Aza-Direct</td>
<td>unknown</td>
<td>4</td>
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<tr>
<td>azadirachtin + pyrethrin</td>
<td>Azera</td>
<td>unknown + 3A</td>
<td>1</td>
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<tr>
<td>kaolin clay</td>
<td>Surround WP</td>
<td>unknown</td>
<td>1</td>
</tr>
<tr>
<td>pyrethrin</td>
<td>PyGanic Specialty</td>
<td>3A</td>
<td>4</td>
</tr>
<tr>
<td>spinosad</td>
<td>Entrust SC</td>
<td>5</td>
<td>3</td>
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</table>

⁴ Co-applied with either Nu-Film or M-Pede
Foliar application strategy

- Two-row plots (10-ft long)
- Plots sprayed with a **hand-held CO₂ -backpack sprayer** (twin-flat fan nozzles, 48 gpa @ 40 psi)
- Applications made weekly either in May (n=4) or Sept/Oct (n=5 or 6)
- Ten to 50 plants per experimental unit were removed, **dissected and inspected** for larvae and pupae
# RESULTS: Foliar application strategy for Allium leafminer control

<table>
<thead>
<tr>
<th>Active ingredient</th>
<th>Product</th>
<th>% trials significantly reduced damage</th>
<th>Mean % control</th>
</tr>
</thead>
<tbody>
<tr>
<td>spinosad*</td>
<td>Entrust SC</td>
<td>25 (n=4)</td>
<td>70</td>
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<tr>
<td>kaolin clay*</td>
<td>Surround WP</td>
<td>0 (n=1)</td>
<td>44</td>
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<tr>
<td>azadirachtin + pyrethrin*</td>
<td>Azera</td>
<td>0 (n=1)</td>
<td>22</td>
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<td>azadirachtin*</td>
<td>Aza-Direct</td>
<td>0 (n=4)</td>
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<tr>
<td>pyrethrin*</td>
<td>PyGanic Specialty</td>
<td>0 (n=4)</td>
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**NOTE:** Results for each trial are available at: [http://nault.entomology.cornell.edu/extension/](http://nault.entomology.cornell.edu/extension/)
Efficacy of Entrust SC with Nu-Film or M-Pede for ALM control in scallions

<table>
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<tr>
<th>Treatment</th>
<th>Mean % damaged plants (±SEM)</th>
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<tbody>
<tr>
<td>No insecticide</td>
<td>100</td>
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<tr>
<td>Entrust + Nu-Film</td>
<td>60</td>
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<tr>
<td>Entrust + M-Pede</td>
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F=67.6; df= 2, 6; P<0.0001; n= 4
Optimize number of Entrust SC applications for ALM control

Fall Generation

|------|------|-------|------|-----|------|------|------|-------|------|------|------|

Weekly sprays

leek

Cornell AgriTech
New York State Agricultural Experiment Station
Optimize number of Entrust SC applications for ALM control

- Number of applications for each product is limited (< 6 sprays)
- Weekly sprays are expensive
- Weekly sprays may not be needed; females likely do not lay eggs in earliest oviposition marks
## Optimizing Entrust applications in leeks for ALM control

*Hurley, NY* 2018

<table>
<thead>
<tr>
<th>Insecticide timing treatment</th>
<th>Week 1</th>
<th>Week 2</th>
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<th>Total # sprays</th>
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- Entrust SC applied at 6 fl oz/acre with M-Pede @ 1.5% v:v
- Spray dates Sept. 14, 21, 28 and October 5, 12 and 19
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- Entrust SC applied at 6 fl oz/acre with M-Pede @ 1.5% v:v
**RESULTS: Mean % ALM maggot damage in leeks**

**cv. ‘Megaton’**  
Hurley, NY (n = 4)  
2018

<table>
<thead>
<tr>
<th>Insecticide timing treatment</th>
<th>Week 1</th>
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<tbody>
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Grundberg & Rusinek (unpublished)  
\( P<0.0001 \)
# RESULTS: Mean % ALM maggot damage in leeks

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Grundberg & Rusinek (unpublished) *P*<0.0001
RESULTS: Mean % ALM maggot damage in leeks

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- Entrust SC applied at 6 fl oz/acre with M-Pede @ 1.5% v:v

Grundberg & Rusinek (unpublished) \( P<0.0001 \)
Transplant application strategies

- **Spinosad (Entrust SC)** used in all trials @ a rate of 1 fl oz/10,000 plants (*this use is not currently labelled*)

- Two most common transplant types
  - Bare root
  - Plug plant
RESULTS: Transplant application strategy (bare-root dip) for Allium leafminer control in bulb onions

Mean % damaged plants (±SEM)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Mean % Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Entrust</td>
<td>18.2 ± 1.2</td>
</tr>
<tr>
<td>Entrust</td>
<td>1.2 ± 0.2</td>
</tr>
</tbody>
</table>

F=90.6; df= 1, 45; P<0.0001

88% control!
RESULTS: Transplant strategies (plug plant & bare-root) for Allium leafminer control in scallions

Transplant strategies (plug plant & bare-root) for Allium leafminer control in scallions

Mean % damaged plants (±SEM)

<table>
<thead>
<tr>
<th></th>
<th>Untreated</th>
<th>Entrust (plug drench)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>NS</td>
<td>48% reduction</td>
</tr>
</tbody>
</table>

P>0.05; n= 4

Cornell AgriTech
New York State Agricultural Experiment Station
RESULTS: Transplant strategies (plug plant & bare-root) for Allium leafminer control in scallions

- Untreated Entrust (plug drench)
- Entrust (bare-root dip)

Mean % damaged plants (±SEM) from 2019:
- Untreated: ≥ 97% control
- Entrust (plug drench)
- Entrust (bare-root dip)

$F=23.96; \text{df}= 2, 6; P=0.0014; n= 4$
Allium leafminer control summary

- Important to use multiple management tactics, especially crop rotation and planting date selection

- Most consistently effective foliar-applied insecticides
  - spinosad (Entrust) [labeled for leafminers on bulb vegetables]

- Two well-timed Entrust SC applications were effective

- Spinosad (Entrust SC) was effective as a bare-root dip and plug plant drench treatment *(but not labeled for this use...yet)*
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Megan Kelly

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Sarah Elone           Laura McDermott
Nate MengaziioI

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NY ORDP

FFAR

NY Farm Viability Institute

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