Onion Thrips: Contributions of Egg Survival and Adult Dispersal to Populations on Plants

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Why are onion thrips such a pest?

- Life history and ecology are well-adapted to onions
  - Females reproduce asexually (parthenogenesis)
  - Short generation time (2-3 wk)
  - High mobility of adults
  - Rapid development of resistance to insecticides
- Life stage survival strategies
  - Later larval instars are non-feeding & protected ("prepupae" & "pupae")
  - Eggs are protected – females insert them into leaf tissue
Sources of onion thrips

- Eggs, Larvae, & Adults
- Prepupae & Pupae
- Adults
Thrips sampling tools

1. Whole plant wash
2. Stain 3rd leaf
3. Aerial sticky traps

Larva
Adult
Egg
Adult
1. Quick knock-down (short-term suppression) Insecticide efficacy on motile life stages: adults and larvae

Examples from 2006 & 07 insecticide trials
USU Experiment Station, Kaysville, UT
Thrips sampling tools

1. Whole plant wash

Larva

Adult
Insecticide efficacy
Motile thrips (Adults and Larvae)
July, 2006

Days after treatment

1% Stylet oil added to Success, Carzol, and Warrior treatments
Insecticide efficacy
Adult Onion Thrips (Thrips tabaci)
July, 2007

In an August trial, NS differences among treatments
Insecticide efficacy
Adult Western Flower Thrips (Frankliniella occidentalis)
July, 2007

Mean # of thrips per plant

- Untreated
- Movento 5 oz + MBO
- Movento 8 oz + MBO
- Movento 5 oz + Induce
- Radiant 8 oz + Oil
- Carzol 0.75 lb + Oil
- Vydate 4 pt + Oil
- Lannate 3 pt + Oil
- Warrior 3 oz + Oil

Graph showing the efficacy of different insecticides against thrips.
Insecticide efficacy
Thrips Larvae
July, 2007

Similar results in an August trial
Summary of insecticide efficacy on adult thrips

- In 2006:
  - Success, Carzol, and Warrior effectively suppressed adults & larvae for 14 days
  - Surround & 2% Stylet oil slowed thrips for 7 days

- In 2007:
  - Adult OTs were minimally affected
  - Adult WFTs densities were 10-100X less than OTs & a number of insecticides suppressed WFTs for 14 days
    - Vydate, Carzol, Lannate, Radiant, Warrior
  - Adults may escape whole plant wash method
Summary of insecticide efficacy on larvae

In 2007:

- Lannate & Radiant most consistently suppressed larvae (2 trials)
- Movento showed delayed effects of 2-3 wks
  - Systemic - delay in uptake & translocation within plant
- Vydate, Carzol, & Warrior performed better in an August trial (data not shown), but not as well as Lannate, Radiant, and Movento

Insecticide resistance (Warrior, Carzol) after 2-3 yrs of use?
2. Reduce re-infestation (longer-term suppression)

Insecticide efficacy on thrips egg densities & egg hatch

Examples from 2006 & 07 insecticide trials
USU Experiment Station, Kaysville, UT
Thrips sampling tools

2. Stain 3rd leaf

Egg
Effect of immobile life stages on plant thrips populations

Reduce re-infestation of plants

Eggs, Larvae, & Adults

Prepupae & Pupae

Adults
Insecticide efficacy
Thrips Eggs (Stained within leaves)
July, 2007

Mean # of eggs per leaf

- Untreated
- Movento 5 oz + MEO
- Movento 8 oz + MEO
- Movento 5 oz + Induce
- Radiant 8 oz + Oil
- Vydate 4 pt + Oil
- Lannate 3 pt + Oil
- Carzol 0.75 lb + Oil
- Warrior 3 oz + Oil

Pre 1 wk 2 wk 3 wk
Insecticide efficacy
Thrips Eggs (Stained within leaves)
August, 2007

![Graph showing the mean number of eggs per leaf for different insecticide treatments over time. The treatments include Untreated, Movento 5 oz + M5O, Movento 8 oz + M5O, Radiant 8 oz + Oil, Vydate 4 pt + Oil, Lannate 3 pt + Oil, Carzol 0.75 lb + Oil, and Warrior 3 oz + Oil. The graph indicates the effectiveness of each treatment over a three-week period.]
## Composition of thrips populations on plants (2005-07)

<table>
<thead>
<tr>
<th>Life stage on plant</th>
<th>% composition of total population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eggs in leaves</td>
<td>60-75%</td>
</tr>
<tr>
<td>Larvae in neck</td>
<td>15-30%</td>
</tr>
<tr>
<td>Adults in neck</td>
<td>1-3%*</td>
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</tbody>
</table>

*Adults are likely under-represented in whole plant wash samples*
Egg hatch from leaves

- **Egg hatching chamber**
  - Heavy-duty gallon-sized ziplock plastic bags
  - Collect onion leaves (3rd leaf) from field plants 1, 2, & 3 wk after insecticide treatment (8 leaves per treatment)
  - Wash leaves & place in hatching chamber with moist filter paper
  - Placed at 25°C for 2 wk
  - Wash to collect thrips from leaf & inside of bag at 1 & 2 wk

High-tech thrips hatching chamber
Insecticide efficacy
Thrips egg hatch (over 2 wk)
July, 2007

Results from an August trial were similar
Influence of insecticides on rate of thrips egg hatch – 2 weeks after treatment, July 10, 2007

Week 1 > Week 2: $p < 0.001$
Trt x Week interaction: $p = 0.007$
Influence of insecticides on rate of thrips egg hatch - 3 weeks after treatment, July 17, 2007

Mean # of hatched thrips per leaf

Week 1 > Week 2: p < 0.001
Summary of insecticide efficacy on egg densities in leaves

- Eggs are the major contributor to populations on plants (60-75%)
  - Eggs abundant in leaves (13-112 per 3rd leaf)
  - Previous study: total eggs per plant ≈ 3 × 3rd leaf

- Insecticides had little effect on numbers of eggs within leaves
  - Similar to minimal effects on adult OTs
Some insecticides suppressed egg hatch up to 3 wk (4-5 wk):

- Lannate & Movento (+ MSO) – greatest reductions; kept hatch < 14 thrips per leaf
- 1-54 eggs hatched per leaf across 2 trials

Most eggs hatched within 1 week

Future studies: Larger sample sizes needed (8 leaves)
3. Reduce re-infestation by adult immigrants (longer-term suppression)

Influence of immigration on thrips populations on plants

Examples from 2006 & 07 insecticide trials
USU Experiment Station, Kaysville, UT
**Thrips survival on plants vs. immigration**

Immediately after insecticides were applied:

- **Open plants** (allow immigration & natural enemies)
- **Spray with soap and Caged plants** (remove motile stages & exclude immigrants & NEs)
Importance of egg survival

Influence of exclusion (caging) on onion thrips populations on plants 2 wk after insecticides 2006

Egg survival was more important than new immigrants
Influence of exclusion (caging) on onion thrips densities (adults and larvae) on plants 2 wks after treatment
July 10, 2007

Open is not different from Caged: \( p = 0.86 \)
Presence of cage X insecticide interaction: \( p = 0.007 \)
Influence of exclusion (caging) on onion thrips densities (adults and larvae) on plants 3 wks after treatment July 17, 2007

Caged > Open: p = 0.05
Thrips sampling tools

3. Aerial sticky traps
Abundance of Immigrating Adults

Influence of insecticides on thrips adult dispersal: before compared to after insecticides 2006

Mean # of adult thrips per trap per week

Success Carzol Warrior Surround 2% Stylet Oil 1% Stylet Oil Untreated

3 wk Before 3 wk After

1% Stylet oil added to Success, Carzol, and Warrior treatments
Summary of insecticide effects on adult immigration and egg survival on plants

- In general, more thrips occurred on caged than open plants 2-3 wk after treatment
  - Egg reservoir in leaves is important to re-infestation of plant
  - Exceptions: Lannate, Movento, & Radiant – longer-term suppression of thrips on plants
- Flying thrips adults: highly abundant
  - ~150-300 adults per trap per week after insecticide applications
Summary of insecticide effects on adult immigration and survival on plants

- Egg survival and immigrating adults following insecticide applications help perpetuate thrips population on onions
- Suppression strategies: include prevention of egg-laying and egg hatch
- Future studies:
  - Larger sample sizes (improve consistency)
  - Evaluate survival of non-feeding 3rd and 4th instar larvae (pre-pupae & pupae)
Onion thrips life history

Reduce re-infestation of plants

Reduce/repel dispersing adults

Eggs, Larvae, & Adults

Prepupae & Pupae

Egg-laying

Egg hatch
Many ways to “skin a cat” - Multi-pronged approach will be the most sustainable

Mortality factor (insecticide):

- Short-term ➔ quick knock-down of adults & larvae
- Longer-term ➔ egg reservoir in leaves (2 wk)
- Longer-term ➔ immigration of adults
- Longer-term ➔ survival of pre-pupae & pupae
Multi-pronged approach will be the most sustainable

Sustained Mortality / Repellency

Cultural practices:
- Sprinkler irrigation
- Varietal tolerance
- Mulches
- Trap crops
- Nitrogen management

Insecticides:
- Manage use to prevent resistance
- Systemic activity
- Slow release (microencap)
- Ovicide, larvicide, adulticide
- Repellents
- Combinations
Thrips population suppression strategies

- Make onions as tolerant / unattractive to thrips as possible
- Start suppression early in the season
- Use long-term suppressive controls
  - Target egg reservoir in leaves
  - Target multiple life stages

Morgan Reeder field on 2006 Utah Onion Tour, Corinne, UT