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Western lentiform Leafminer

Diane G. Alston
Utah State University Extension

Michael E. Reding
Utah State University Extension

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Western tentiform leafminer populations can vary tremendously between years or even between generations within a single year. Increasing resistance to organophosphate insecticides and variable effectiveness of at least six parasitic wasp species that attack the leafminer can influence the population size.

In Utah, the leafminer typically has three generations per year but may have as many as four in some years. The immature larval stages—sap feeders and tissue feeders—feed on apple and cherry leaves. When densities are high enough, feeding can cause a reduction in fruit size and quality.

**Hosts**

apple  
cherry  
pear  
prune
**Western Tentiform Leafminer Life History**

**Pupa—Overwintering Stage**
- **Size**: ½ to 1/2 inch long
- **Color**: yellow-brown changing to dark brown just before the adult emerges
- **Shape**: cylindrical tapering sharply at the rear end
- **Where**: overwintering pupae are inside mines in fallen leaves; summer pupae are inside mines in trees
- **Summer pupation lasts**: 7-10 days
- **Just before emerging**: pupae crawl out through mine and protrude out of the lower leaf surface
- **Pupal skins remain attached to the mine after adults emerge and are called “emergence tubes”**

**Adult**
- **Size**: ½ to ¾ inch long, small, slender moth
- **Color**: forewings with golden brown and white edges with black bands; hindwings are gray with brown bands on the edges
- **Shape**: wings are held flat—like the body when at rest
- **When**: first generation moths emerge from overwintering pupae in early spring often around the green tip stage of apple
- **May be up to three additional flights** in the summer and fall; adult moth emerges continuously from June through September
- **Life stages**: begin to overlap after the first generation
- **Females lay eggs shortly after emerging**

**Egg**
- **Size**: extremely small, about 1/20 to 1/60 inch in diameter and difficult to see without magnification
- **Color and shape**: transparent when first laid; turning yellowish green; round and flat
- **Where**: on the undersides of leaves
- **Hatch in**: 1-2 weeks

**Larva—Damaging Stage**
- **Newly hatched larva mines down through egg case into leaf tissue**
- **Passes through five instars**

**Sampling Threshold**
- **Second Generation**: Mid-June to Early July
  - If terminals have
    - $\leq 1/2$ mine per leaf
  - Return in 5-7 days to do another quick evaluation.
  - Take a complete sample (see below).
- **Sampling should continue** until August.

**Complete Sampling Method**
Scouting for western tentiform leafminer can be done at the same time as mine sampling (see “Web-Spinning Spider Mite” bulleted). If there is a large acreage of apples and cherries, you may want to select several representative blocks where you will conduct the scouting program. Randomly select 10 rows scattered throughout a 2-3 acre block to sample. If the orchard block is larger than 5 acres, it may be necessary to sample more rows.

**How to Sample**
- If the quick evaluation method indicates the need for a complete sample, sample for second generation leafminers during mid-June and early July.
- Scout designated orchard blocks every 1-2 weeks.
- On each sampling date, collect 10 leaves from each of the 10 trees (100 leaves total).
- Count the number of mines that you find and determine the average number of mines per leaf for the orchard block (divide the total number of mines by 100. See Western Tentiform Leafminer Sampling Form.)
- Those same leaves can be sent to monitor for mines.
- Third generation leafminers should be sampled in early to mid-August as a quick evaluation or complete method as indicated by the density of the mines present.
- If the second generation was treated or if sap feeders do not appear until late August or September, then it is not necessary to sample the third generation.

**Management**
Insecticides targeted for leafminer control are most effective against the sap feeding stage; though parasitism is not usually evident until the tissue feeder stage. Therefore, parasite levels from earlier generations should be considered along with current sapfeeders or mine densities during second and third generations to determine if treatment thresholds have been reached.

**Treatment Thresholds**
- **Leafminer Generation**
  - **Second**: Early June
    - 1 or more mines per leaf and parasitism of larvae is less than 30%
  - **Third**: August
    - 5 or more active mines per leaf

**Quick Evaluation Method**
- **How to Sample**
  - Begin sampling in mid-June.
  - Walk through the orchard and quickly scan tree tops (leaf clusters at the ends of branches) to estimate the number of mines per leaf.
- **Sap feeders are the predominant stage at this time**, so look for the undersides of leaves for mines.

**Life History**

**Pupa—Overwintering Stage**
- **Size**: 1/4 to 1/2 inch long, creamy color
- **Shape**: flat, wedge-shaped, and legless
- **Where**: feeds on sap from the spongy mesophyll layer of leaves with sucking mouthparts
- **Separates outer layer of the leaf underside from the tissue above to form a mine, which is often foliow leaf veins**
- **Mines appear as a bluish and are only visible from the undersides of leaves at this stage**

**Tissue Feeder**
- **Size and color**: ½ to 3/4 inch long, creamy yellow turning to white by the fifth instar
- **Shape**: cylindrical with legs, round head, and chewing mouthparts
- **Where**: feeds on leaf tissue just up to, but not through, the epidermis
- **Attaches silken threads to both sides of the mine pulling them together to form a tent-like structure in the leaf**
- **Mines can be seen from the upper leaf surfaces and have a characteristic motled appearance with white spots on top where green tissue has been removed**
- **Fifth instar larva spins a silk chamber for pupating inside the mine**

**Host Injury**
- Larvae feeding on leaves can:
  - Disrupt the photosynthetic capability of leaves
  - Reduce chemical or photosynthetic capability of leaves
  - Affect fruit quality by slowing sugar development
  - Cause leaf drop, premature ripening, and fruit drop in severe situations

**Insecticides**
- Chemical control is most effective against sapfeeding larval stages and adults. Insecticide sprays should only be applied when leafminer treatment thresholds are exceeded during the second or third generation (see above).
- Pre-bloom applications targeting first generation sapfeeders are only recommended if large numbers of adult moths are observed in the orchard during April or May, or egg counts exceed three per leaf during tight cluster to pink stage of apple.

**Biological Control**
- There are six species of parasitic wasps that attack leafminers in the Northwest, and their presence in Utah orchards is common. Leafminer parasitism can be as high as 90% and can eliminate the need for chemical control of even a formerly high population. The wasps lay their eggs inside the mines on the underside of the leafminer larva. Sap larval hatch from the eggs and feed on developing leafminer larva from the outside.

**Pheromone**
- To determine if a leafminer larva has been parasitized, open a mine and look for one of the following:
  - A wasp larva emerging from a damaged leafminer larva
  - The pupal stage of the wasp along with a shriveled leafminer larva
  - An empty mine with the remains of a leafminer larva and a wasp pupal case and no emergence tube formed by the adult leafminer moth

**Parasitoid**
- In the case of the leafminer larva, the adult wasp has already emerged from its pupa and exited through a smaller hole, which is difficult to observe.

**Insecticides to Avoid**
- Insecticides that are toxic to the parasites should be avoided during mid- to late summer. In Washington, studies indicated that insecticides were shown to have moderate to high toxicity to *Spathytes flavipes*, the main parasite of western tentiform leafminer in the Northwest.
- *Encapsulated methyl parathion* (Parasoc)
- *Chlorpyrifos* (Lorsban)
- *Endosulfan* (Aranza)
- *Etozadin* (Thiodan)
- *Oxamyl* (Vyzdine)

**Conservation of parasites** is important to a good biological control program and can reduce the need for insecticide control.
Western Tentiform Leafminer Sampling Form—Apple and Cherry
Complete Sampling Method for Second and Third Generations
(Mid-June to August)

Orchard Block ______________________ Scout ______________________ Date ________________

<table>
<thead>
<tr>
<th>Number of Mines Per Leaf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaf 1</td>
</tr>
<tr>
<td>Tree 1</td>
</tr>
<tr>
<td>Tree 2</td>
</tr>
<tr>
<td>Tree 3</td>
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<tr>
<td>Tree 4</td>
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<tr>
<td>Tree 5</td>
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<tr>
<td>Tree 6</td>
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<tr>
<td>Tree 7</td>
</tr>
<tr>
<td>Tree 8</td>
</tr>
<tr>
<td>Tree 9</td>
</tr>
<tr>
<td>Tree 10</td>
</tr>
</tbody>
</table>

Total number of mines for 10 trees

Average number of mines per leaf for 10 trees (divide above sum by 100) per leaf

Instructions
1. Every 1-2 weeks, choose one or several representative orchard blocks for sampling.
2. Randomly select 10 trees scattered throughout a 2- to 5-acre block. If orchard is larger than 5 acres, it may be necessary to sample more trees.
3. On each sampling date, collect 10 leaves from each of the 10 trees (100 leaves total). These same leaves can be used to monitor for mites (refer to mite sampling form).
4. Count the number of mines and determine the average number of mines per leaf for each orchard block (to find the average, divide the total number of mines by 100).
5. If leaf mine counts are high, record counts from every leaf. Otherwise, record only total mine counts from all 10 leaves for each tree.

Treatment Thresholds*

Second Generation
Early June—one or more mines per leaf and parasitism less than 30%
Mid-June to July—two or more mines per leaf and parasitism less than 30%

Third Generation
August—five or more active mines per leaf

*See manual for more complete information