Leucoptera malifoliella

Scientific Name
Leucoptera malifoliella (Costa)

Synonyms:
Cemiostama malifoliella
Cemiostoma scitella (Zeller)
Cemiostoma scitellum (Zeller)
Elachista malifoliella Costa
Leucoptera scitella (Zeller)
Opostega scitella Zeller

Figure 1. *Leucoptera malifoliella* adult (V. V. Neymorovets, VIZR, AgroAtlas.ru)

Common Name(s)
Pear leaf blister moth, pear leaf miner, apple leaf miner, ribbed apple leaf miner

Type of Pest
Leaf miner

Taxonomic Position
Class: Insecta, **Order:** Lepidoptera, **Family:** Lyonetiidae

Reason for Inclusion
CAPS Target: AHP Prioritized Pest List – 2006 through 2013

Pest Description
Eggs: "Diameter 0.3 mm. [< $^{1}/_{32}$ in], discoid, brownish (Alford 1984)" (Chang, 1985).

Larvae: "Head and prothoracic shield yellow, body greenish white turning darker near pupation. Full-grown length 4 mm [about $^{3}/_{16}$ in]. Head flattened with front and adfrontal sutures extending to vertical triangle. Thoracic segments and abdominal segments Al-7 broadly rounded giving larva moniliform appearance. Prothorax with lateral setae widely separated. Thoracic legs present. Abdominal segments Al-7 with setae D1 and D2 laterad and very close together, D1 lateral to and only slightly anterior to D2; setae L1 and L2 widely spaced below spiracle with L1 well behind spiracle. Abdominal prolegs A3-6 with uniserial circle of 12-15 crochets, anal prolegs with 10-11 crochets" (Chang, 1985).

Pupae: "Brown to dark brown, length 3 mm. [about $^{1}/_{8}$ in], usually clustered in flattened silk cocoons. Body with appendages soldered down and no movable abdominal segments. Maxillary and labial palps absent. Wings, antennae, and

metathoracic legs extending to posterior margin of abdominal segment 7" (Chang, 1985).

Adults: "Overall shiny metallic gray. Vertex of head with tuft of hair; antenna long and filiform, scape forms eyecap, antennal segments 28-32 in female, 28-30 in male. Female wingspan 7-8 mm [about 1/4 to 5/16 in], body length 2.6-3.0 mm [about 1/16 to 1/8 in], male wingspan 5.5-6.0 mm [about 3/16 to 1/4 in], maximum body length 2.0-2.3 mm [about 1/16 to 1/8 in] (Ferro 1961). Forewing lanceolate; outer and posterior margin fringed; at rest, apex pointed, upturned in lateral view, divergent outwards in dorsal view (Emmet 1981); fringe with 4 radiating black lines: 2 toward Costa, 3d horizontal, 4th directed posteriorly about 45° from long axis of wing; apical half, orange, enclosing 2 white, dark-edged costal spots and post tornal pale violet-golden spot strongly black-margined on both sides (Meyrick 1928, Stainton 1855). Hind wing narrowly lanceolate, evenly leaden gray, fringe longer than width of wing (Real 1966)" (Chang, 1985).

Biology and Ecology

This moth is multivoltine with one to five generations per year depending on the growing season length. Overwintering occurs as a diapausing pupa in either bark crevices or leaf litter surrounding host plants (USDA, 1993).

In France, adults begin to appear around the end of March; adults appear later in more northern regions (USDA, 1993). First generation adult flight coincides with host flowering beginning at the pink bud stage and ending with petal fall (Maciesiak, 1999). Flight of subsequent generations is strongly influenced by temperature (Koutinkova et al., 1999; Davis et al., 2009). Mating occurs 50 to 60 hours after adult emergence of overwintering generations and immediately for subsequent generations (Davis et al., 2009). Mating occurs on leaves or stems in the tree canopy and lasts from 15 to 45 minutes (Davis et al., 2009). Adult females live from eight to ten days while adult males live for approximately five days (Chang, 1985).

Females produce approximately 50 eggs and lay them individually on the underside of leaves (USDA, 1993). Egg density on leaves can range from a few (reviewed in Davis et al., 2009) to several hundred (CABI, 2009). Fresh leaves have a higher hatch rate than dry leaves (Davis et al., 2009). At 27 to 28°C, eggs hatch around 8 days with larvae boring directly into the leaf tissue (USDA, 1993). The upper epidermal layer is mined by the larvae (USDA, 1993). The larvae produce a spiral pattern containing frass in concentric rings as they feed on parenchyma tissue (Chang, 1985; Injac et al., 1987). The reported larval development threshold ranges from 8 to 12°C (USDA, 1993). Larvae go through 4 instars (reviewed in Davis et al., 2009) before they emerge from the upper surface of the leaf to search for pupation sites (USDA, 1993).

The first generation pupates mainly on leaves while the later generations pupate in bark crevices or on fruit (USDA, 1993).

Damage

Mines can be up to 2 cm (about $^{13}/_{16}$ in) wide and appear as circular blotches with concentric frass rings (Fig. 2) (Briolini, 1960; USDA, 1985). On host plants, mines appear brownish, turning first purplish-brown then black (Alford, 1984). Mines may appear to be blistered or scorched "with darker spiral markings and paler margins" (Chang, 1985). Infestations can lead to premature leaf loss which can be observed beginning in the top of the tree crown (Chang, 1985).

Figure 2. Damage by *Leucoptera malifoliella* (Gyorgy Csoka, Hungary Forest Research Institute, Bugwood.org)

Pest Importance

This moth is considered a significant pest of orchards in Ukraine, the Northern Caucasus, the Central Chernozem Region, Kazakhstan, and Central Asia (Ovsyannikova and Grichanov, 2005).

Leaves of host plants are damaged and premature leaf fall can occur leading to yield reduction when infestations are high (Ovsyannikova and Grichanov, 2005). A large amount of tunneling in the leaves may also cause shoot growth delay and reduction of fruit weight (Ovsyannikova and Grichanov, 2005). Repeated, heavy defoliation can lead to weakened trees (Chang, 1985).

Figure 3. Arrow pointing to silken casing surrounding a pupa of *Leucoptera malifoliella* (Canada Agriculture and Agri-Food Canada Archive, Bugwood.org)

For pest management, the damage threshold for *L. malifoliella* is 0.5 to 1 mine per leaf following host blossom (EPPO, 1999).

Known Hosts

This species is considered polyphagous (EPPO, 1999).

Major hosts

Cydonia oblonga (quince), *M. domestica* (apple), *Prunus* spp., *Prunus avium* (sweet cherry), *Pyrus* spp. (*P. communis* (pear)).

Minor hosts
Alnus spp. (alder), *Amelanchier* spp. (serviceberry), *Betula* spp. (birch) (*B. pendula*, *B. pubescens*), *Cerasus* spp. (cerasus), *Chaenomeles* spp. (flowering quince), *Corylus* spp. (hazelnut), *Cotoneaster* spp. (cotoneaster) *Cotoneaster horizontalis*, *Crataegus* spp. (hawthorn), *Crataegus laevigata*, *Crataegus monogyna*, *Crataegus oxyacantha*), *Cydonia* spp. (quince), *Malus* spp. (apple), *Malus baccata, Malus prunifolia, Malus pumila, Malus sieboldi, Malus sylvestris*), *Mespilus* spp. (mespilus), *Mespilus germanica*), *Pistacia* spp. (pistachio), *Prunus* spp. (stone fruit), *Prunus cerasus*, *Prunus domestica*, *Prunus persica*, *Prunus spinosa*, *Prunus vulgaris*, *Pyrus communis* (European pear), *Rosa* spp. (rose), *Sorbus* spp. (mountain ash), *Sorbus aucuparia* (Chang, 1985; Fitter and Peat, 1994; Seven, 2006; Pitkin et al., 2009; BioLib, 2010; Robinson et al., 2010).

Pathogens or Associated Organisms Vectored
This pest is not currently known to vector any pathogens or other associated organisms.

Known Distribution
Leucoptera malifoliella is a temperate pest present throughout much of Europe and Asia (Davis et al., 2009).

Asia: Armenia, China, Iran, Russia, Kazakhstan, Turkey, Turkmenistan, and Uzbekistan; **Europe:** Albania, Austria, Belarus, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Macedonia, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Spain, Sweden, Switzerland, Ukraine, and the United Kingdom (Ovsyannikova and Grichanov, 2005; EPPO, 2007; Fauna Europaea, 2010).

CABI (2012) states that this species is present in Slovenia, but the original source could not be verified. Fauna Europaea (2010) states that this species is absent from Slovenia.

Pathway
According to CABI (2012) the most likely pathway for introduction of *L. malifoliella* is through commercial shipment of apples from Europe and Asia. This pest can be difficult to see due to its small size (3mm, $<^1/_8$ in) and its location (usually around the calyx). According to the Fruits and Vegetables Import Requirements (FAVIR) database, the United States accepts apples (*Malus domestica*) into all ports from France, Italy, and Spain, countries where this pest is known to occur (FAVIR, 2014, queried July 8, 2014).

This species has been intercepted at U.S. ports of entry over 400 times. The majority of these were intercepted on *Malus* sp. (fruit) and were either for consumption or non-entry. The last recorded interception at U.S. ports of entry occurred in 2008 (AQAS, 2014, queried July 8, 2014)

Other potential pathways include nursery stock and scion material (reviewed in CABI (2012).

Potential Distribution within the United States

This pest may move to new areas through infested fruit or nursery stock (USDA, 1985).

Survey

CAPS-Approved Method*:

The CAPS-approved method is a trap and lure combination. The trap is the large plastic delta trap. The lure is effective for 70 days (10 weeks).

12/27/2013: A new type of sticky trap insert (liner), which uses a hard type of adhesive, has been approved for use in *Leucoptera malifoliella* CAPS surveys. Previously, *L. malifoliella* was not available as a survey target due to the large number of non-targets caught in traps and the time-consuming identification process.

These new trap liners allow the identifiers to process specimens more quickly. The product name in the IPHIS survey Supply Catalog is Large Plastic Delta Trap - Liners - Hard Glue.

Any of the following Trap Product Names in the IPHIS Survey Supply Ordering System may be used for this target:

Large Plastic Delta Trap Kits, Orange
Large Plastic Delta Trap Kits, Red
Large Plastic Delta Trap Kits, White

The Lure Product Name is *Leucoptera malifoliella* Lure.

Trap color is up to the State and does not affect trap efficacy.

IMPORTANT: Do not include lures for other target species in the trap when trapping for this target.

Trap spacing: When trapping for more than one species of moth, separate traps for different moth species by at least 20 meters (65 feet).

Literature-Based Methods:

Trapping: A female sex pheromone, 5,9-dimethylheptadecane, was identified by Francke et al. (1987). Triangular delta type sticky traps are used in Bulgaria and baited with 300 µg of pheromone on red rubber tubing (Koutinkova et al., 1999). Traps are placed 1.5-2 m aboveground on hosts; trap placement should begin 1-2 weeks before flight period is expected to begin and should be checked every 2-

5 days (Radoslav et al., 2001). Replacement of pheromone capsules should occur every 40 days (Radoslav et al., 2001).

Visual: Inspection can also be done visually to look for all life stages (Chang, 1985). Eggs may be found on the underside of leaves during spring and autumn (Injac et al., 1987). Larvae may be observed in the outer margin of the mines when using a black light to examine (Chang, 1985). They may also be seen dispersing on silk threads to find suitable pupation sites (Chang, 1985). Pupae can be found in leaf litter or tree bark as well as on tree fruits near the calyx or stem end, Fig. 3 (Chang, 1985). Adults can be found resting on the underside of leaves (Davis et al., 2009).

In Bulgaria, visual inspections are carried out to help forecast population levels. Orchards are examined by inspecting trunks for overwintering pupae during non-vegetation periods and inspecting tree crowns for specific leaf injuries during vegetation periods (Radoslav et al., 2001).

Key Diagnostics/Identification

CAPS-Approved Method*:

Morphological. This species is characterized by the wing color pattern. Authoritative identification requires close examination of both wing pairs and head. Dissection of internal structures may be needed for final determination (Brambila, 2013).

For field level screening and diagnostics, use:
Brambila, J. 2013. *Leucoptera malifoliella* (Pear Leaf Blister Moth) – Field Screening Aid and Diagnostic Aid.

For sorting and levels 1 and 2 screening, use:
Gilligan, T.M., J. Brambila, and S.C. Passoa. 2014. Screening aid: Pear leaf blister moth, *Leucoptera malifoliella* (Costa). Identification Technology Program (ITP), USDA-APHIS-PPQ-S&T, Fort Collins, CO. 5 pp.

*For the most up-to-date methods for survey and identification, see Approved Methods on the CAPS Resource and Collaboration Site, at http://caps.ceris.purdue.edu/.

Easily Confused Species

Leucoptera malifoliella is a member of Lyonetiidae, a family of minuscule moths. Some native moths in the family Lyonetiidae, such as *Proleucoptera* species look similar to *Leucoptera malifoliella.* These specimens should be sent to a Domestic Identifier for final identification.

The larval mines of *Leucoptera malifoliella* are difficult to mistake for other species. *Leucoptera susinella* produces similar though larger mines (Davis et al., 2009). The host range between the two species is not known to overlap

(reviewed in CABI, 2009). Similar mines are also created by *Rhamphus oxyacanthae*, but the frass is concentrated within the middle of the mines for this species (reviewed in CABI, 2009).

Commonly Encountered Non-targets

In the northeastern United States, non-targets attracted to the *Leucoptera malifoliella* lure include: *Proleucoptera* species and moths in the families Geometridae, Noctuidae, Pyralidae, and Tortricidae (J. Brambila, personal communication, 2013). Moths in the families Geometridae, Noctuidae, Pyralidae, and Tortricidae do not closely resemble *Leucoptera malifoliella.*

In addition, large numbers of caddisflies (order Trichoptera) are sometimes found in traps as well (J. Brambila, personal communication, 2013). The caddisflies are not similar in size or color to the target.

The pheromone of *Leucoptera malifoliella* also attracts *L. spartifoliella* in the western United States. *Leucoptera spartifoliella* is a biological control agent for Scot's broom that has been redistributed throughout the western United States (E. LaGasa, personal communication, 2013).

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Revisions

April 2015
1) Replaced **Figure 1.**
2) Revised the **Known Distribution** section.
3) Added the **Pathway** section.
4) Revised the **Survey** section.
5) Revised the **Key Diagnostics/Identification** section.