Cameraria ohridella

Scientific Name
Cameraria ohridella

Synonyms:
Lithocolletis ohridella

Common Names
Horse chestnut leaf miner, horse chestnut miner

Figure 1. *C. ohridella* adult (Image courtesy of Leo Janssen, Flemish Entomological Society, Bugwood.org)

Type of Pest
Leaf miner

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

Reason for Inclusion
CAPS Target: AHP Prioritized Pest List for FY 2012

Pest Description
Eggs: "eggs are 0.2-0.4 mm in length, round to oval in shape and a transparent white color (Fischer et al. n.d.)" (Ciesla, 2004).

Figure 2. *C. ohridella* larva (Image courtesy of Gyorgy Csóka, Hungary Forest Research Institute, Bugwood.org)

Larvae: "mature larvae are about 3-4 mm long and substantially flattened" (Ciesla, 2004).

Pupae: "the pupal stage is 3-5 mm in length and brown in color. Abdominal segments 2 to 6 carry a pair of introversive spines, designed to serve as support by hooking into the cocoon, or upper epidermis of the leaf during emergence. There is a sexual dimorphism in the pupae. The male pupae have a distally reinforced seventh abdominal segment, and the female lacks this characteristic (Friese and Heitland 1999). The head is pointed for making holes in the cocoon and the upper leaf epidermis when emerging" (Ciesla, 2004).

Adults: "adults are up to 5 mm long. The forewings are metallic chestnut brown with silvery white transverse stripes edged in black. The hindwings are dark grey with long fringes." (Tilbury and Evans, 2003).

Biology and Ecology:
In the warmer parts of Austria, both flight period and oviposition begin during the end of April and early May. The exact time is dependent on weather conditions. Eggs are laid individually and usually between leaf veins on the upper surface of host leaves (Tomiczek and Krehan, 1998). Females lay 20-40 eggs each (Tilbury and Evans, 2003).

After two to three weeks, small, comma-shaped mines can be seen. Larval development takes 4 to 5 weeks. Larval mines are light brown and can be 3 to 4 cm (1.2 to 1.6 in.) long (Tomiczek and Krehan, 1998). Larvae go through five feeding instars (Ciesla, 2004; Tilbury and Evans, 2003) and two non-feeding, cocoon-spinning instars (Ciesla, 2004).

The caterpillars pupate and emerge 2 to 3 weeks later. Pupation and emergence takes another 2 to 3 weeks with the total developmental time from egg to adult taking 7 to 10 weeks for the first generation (Tomiczek and Krehan, 1998). Warmer climatic regions can have up to 3 generations a year with optimal weather conditions.

The 3rd generation pupal stage usually overwinters in the leaf litter. Young larvae live within the palisade parenchyma (the portion of the leaf that is directly beneath the epidermis) feeding on sap; the older larvae (3rd stage up) mine between leaf veins (Tomiczek and Krehan, 1998).

There is no third generation if leaves are not available for oviposition due to heavy infestations of previous generations (Tomiczek and Krehan, 1998). Some literature suggests that there can be 3-5 generations a year (Avtzis and Avtzis, 2002), depending on the weather and climate (Tilbury and Evans, 2003). Adult flight can occur between 16 to 24°C (61 to 75°F) (Stigter, 2000).

Parasitism rates of *C. ohridella* are generally low in Europe, but populations can be limited by intraspecific competition between the larvae (namely for space and food) (Tomiczek and Krehan, 1998).

Symptoms/Signs

Larvae mine the upper leaf surface and can cause defoliation leading to loss of foliage (DePrins et al., 2003). The mines lead to yellowing and browning of leaves (Tomiczek and Krehan, 1998). Individual leaves can have up to 700 mines (Great Britain Forestry

Figure 3. Damage caused by *C. ohridella* (Image courtesy of Gyorgy Csóka, Hungary Forest Research Institute, Bugwood.org).

Commission, 2009). First generation larvae feed mainly in the lower parts of the crown; second generation larvae feed mainly in the upper crown of the host tree (Tomiczek and Krehan, 1998).

Figure 4. Damage caused by *C. ohridella* (Gyorgy Csóka, Hungary Forest Research Institute, Bugwood.org).

In Europe, *C. ohridella* mainly attack *A. hippocastaneum* by making irregular blotch mines on the upper surface of host leaves. *C. ohridella* has been reported from some *Acer* species (Csóka, 2004) but it is thought that these are opportunistic infestations close to heavily infested *A. hippocastanum* (Augustin et al., 2009). Mines can reach 4 cm in length. When trees are heavily infested, mines may merge together. Mines lead to leaf browning and drying and leaves will eventually curl upwards and inwards at the edges, falling prematurely (Tilbury and Evans, 2003).

Trees may reflush in the autumn after defoliation and leave fall have occurred (Great Britain Forestry Commission, 2009).

The fungus *Guignardia aesculi* causes damage similar to that of *C. ohridella* and may be confused with the pest. *G. aesculi* damage includes large red-brown blotches. These are usually concentrated at the tips and margins of the leaflets and can superficially resemble *C. ohridella* mines. The mines caused by *G. aesculi* are usually outlined by a yellow band and will not appear translucent if held up to light, unlike *C. ohridella* mines. *G. aesculi* infected leaves may also have tiny black pimples called pycnidia on the upper surface of the browned leaf parts. Severely infected leaves may roll upwards and fall prematurely (Tilbury and Evans, 2003).

Pest Importance

This pest was first reported from Macedonia in 1985, causing severe damage to *A. hippocastanum* (horse chestnut) (Tomiczek and Krehan, 1998). Since its discovery, it has spread throughout central and eastern Europe. The origin of this species is unknown although it is probably a southeastern European relict species (a once widespread species that is now found in restricted or isolated areas) (Tomiczek and Krehan, 1998). It is now extending its range throughout Europe.

In 1996 in central Europe, more that 250,000 km^2 (9,600mi^2) of land with *A. hippocastaneum* was damaged by the moth (Tomiczek and Krehan, 1998). The long term effects of the chronic defoliation are not yet known (Csóka, 2004).

In Hungary, pupae are reported to survive winter temperatures as low as -23°C [-9°F] (Tilbury and Evans, 2003). Populations can increase from year to year even after severe winter temperatures (Tilbury and Evans, 2003).

C. ohridella mostly causes aesthetic damage to the host tree. Horse chestnuts are often used as ornamentals and shade trees in public areas, so damage by the larvae can lead to early loss of leaves and unsightly trees (Ciesla, 2004). Because damage occurs so late in the growing season, it does not greatly impact the overall health of the trees (Great Britain Forestry Commission, 2009).

Known Hosts

Major hosts

Aesculus hippocastanum (horse chestnut), *Aesculus* spp. (buckeye), *Aesculus turbinata* (Japanese horse chestnut), and *Aesculus* × *bushii* (Bush's chestnut) (Great Britain Forestry Commission, 2009; Tomiczek and Krehan, 1998).

Minor hosts

Acer platanoides (Norway maple), *Acer pseudoplatanus* (sycamore), *Acer* spp. (maple), *Aesculus carnea* (red horse chestnut), *Aesculus dupontii*, *Aesculus flava* (yellow buckeye), *Aesculus glabra* (Texas buckeye), *Aesculus pavia* (red buckeye), *Aesculus sylvatica* (painted buckeye), *Aesculus* × *dallimorei*, *Aesculus* × *glaucescens*, *Aesculus* × *plantierensis*, and *Aesculus* × *worlitzensis* (Worlitz's chestnut) (Great Britain Forestry Commission, 2009; Tilbury and Evans, 2003; Stigter, 2000).

Avtzis and Avtzis (2002) found that *C. ohridella* will attack both wild and planted *A. hippocastanum* with equal intensity.

Some literature reports development of *C. ohridella* on the leaves of *Acer platanoides* and *A. pseudoplatanus* (Avtzis and Avtzis, 2002) while others have not seen *O. ohridella* attack *Acer* species (Tomiczek and Krehan, 1998). These occasions may be opportunistic infestations close to heavily infested *A. hippocastanum* (Augustin et al., 2009).

Pathogens Vectored

This pest is not currently known to vector any pathogens or other associated organisms; however, early leaf loss may cause the tree to be more susceptible to secondary infections and abiotic stresses (Tomiczek and Krehan, 1998).

Known Distribution

Albania, Austria, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Denmark, Finland, France, Germany, Greece, Guernsey Island, Hungary, Italy, Liechtenstein, Lithuania, Luxembourg, Macedonia, Moldova, Netherlands, Poland, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, and the United Kingdom (Fauna

Europaea, 2011; Great Britain Forestry Commission, 2009; Augustin et al., 2009; EPPO, 2007; States of Guernsey, 2006; Tomiczek and Krehan, 1998).

Potential Distribution within the United States

The main host of *C. ohridella*, *A. hippocastanum*, is a popular shade tree in many areas of the United States (Ciesla, 2004) and is found throughout most of the eastern part of the country, as well as Oregon (USDA NRCS, 2011). There are 6 native species of *Aesculus* in the United States that may serve as acceptable host plants to *C. ohridella* (Ciesla, 2004).

No NAPPFAST risk or host map is currently available.

Pathway

According to Stigter (2000), this pest may be moved by ornamental plants for planting. Human-mediated movement by cars, trucks and trains is likely how this pest has rapidly spread throughout Europe. Wind dispersal may help adults and overwintering pupae in leaves spread to new areas (Ciesla, 2004). If introduced into the United States, this pest may spread in a similar fashion.

Survey

CAPS-Approved Method*:

Visual inspection. Even though a pheromone has been identified for this species, identification of targets from sticky traps is nearly impossible.
This species is a microlepidoptera with many similar-looking native species. The CAPS-approved survey method is visual inspection of host leaves for leaf mines.

If leaf mines are found, bring the live larvae and mined leaf back to the lab. Extract the larvae from the leaf mines and boil the larvae in water for two minutes. Remove the larvae from the water and place them in a vial filled with 80% ethanol or isopropyl alcohol. Press the leaf with the mine in a flower/ plant press and submit the leaf along with the larvae. Submit the specimens to your regional domestic identifier. If known, submit the species name of the host that the larvae were extracted from.

Literature-Based Methods:

Trapping:

A sex pheromone ((8E,10Z)-tetradeca-8,10-dienal) has been identified (Svatos et al., 2001) and subsequently used in surveying for this pest. Sukovata et al. (2009) found that males showed no color preference to traps; colors tested included white, blue, and green. The most effective trap for this study was the PL-2 trap (also tested were the delta PL-1 and the barrier trap) (Sukovata et al., 2009). Trapping was more effective when traps were “located on a stem below a tree crown or in its lower part for the first *C. ohridella* generation and in crowns for the second and later insect generations” (Sukovata et al., 2009).

Because sticky traps can become saturated quickly, a bottle trap was developed by Gilbert et al. (2003) that allowed for less frequent visits to pheromone traps.

During delimitation surveys in Greece, delta traps with pheromone dispensers were placed in the lower crown of the host tree (Avtzis and Avtzis, 2002). Lures were changed every four weeks (Avtzis and Avtzis, 2002).

Augustin et al. (2004) used delta traps with baited rubber septas containing 500 ng of pheromone; traps were hung 2-4m aboveground with the sticky inserts being replaced after each flight period.

Visual:
If a tree is suspected of being infested with *C. ohridella*, surveyors can check for their presence by holding up the mined leaves to the light where they may be able to see larvae, pupae, or larval frass (Ciesla, 2004).

Identification

CAPS-Approved Method*:

Morphological. Positive identification should be performed by a taxonomist with expertise in the family Gracillariidae. For CAPS surveys, identification will be based on both larval specimens and leaf mines from the host tree. Follow the instructions for submitting samples in the **Survey, CAPS-Approved Method** section above.

Identification of adults requires genitalia dissection.

Image of male genitalia dissection.

*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 Pests

There is already a North American species that mines *Aesculus* species, *Cameraria aesculisella* (Tilbury and Evans, 2003). There are many similar-looking native species that resemble *C. ohridella* adults.

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