KEY TO LARVAE OF CASTANEA-FEEDING
OLETHREUTINAE FREQUENTLY INTERCEPTED
AT U.S. PORTS-OF-ENTRY
(LEPIDOPTERA: TORTRICIDAE)

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Abstract - At least six species of olethreutine moths are common pests of chestnut (Castanea spp.) outside of the United States. Three are native to, or naturalized in the Mediterranean Region of Europe: Pammene fasciana (L.), Cydia splendana (Hübner) and Cydia lappalana (Zeller). Three are native to the Far East: Eucoenogenes aestivalis (Meyrick), Cydia kuroki (Arms), and Cydia glandulosana (Danilevsky). Commercial chestnuts imported into the U.S. from these regions are fumigated routinely to prevent entrance of these and other pests. However, larvae of these species frequently are encountered by agricultural inspectors at ports-of-entry in personal baggage and other cargo. A key to the larvae of these six species is presented, along with summary descriptions and select references on their biology, detection, and control in association with chestnuts.

Key words: chaetotaxy, chestnuts, China, Cydia, distribution. Eucoenogenes, Europe, Fagaceae, Far East, immature stages, India, introductions, invasive species, Iran, Italy, Japan, Korea, larvae, Neurectes, Netherlands, New Zealand, Pammene, Portugal, Russia, Spain, Turkestan, United Kingdom, Valsecce.

The American chestnut (Castanea dentata (Marsh) Borkh.; Fagaceae) formerly was one of the most common forest trees in eastern North America, ranging from Maine to Michigan and south to Louisiana. It was prized for its lumber and nuts. In about 1904, a disease known as chestnut blight, caused by a fungus (Cryptosperma parasitica (Murrill) Barr; Valsecce), was inadvertently introduced into New York. It spread rapidly throughout the eastern United States virtually eliminating the species as a canopy tree by the mid 1930s (Anagnostakis, 1972). Subsequently, several foreign chestnut trees were introduced into the United States, including the European chestnut (Castanea sativa Mill.), the Japanese chestnut (Castanea crenata Sieb. & Zucc.), and the Chinese chestnut (Castanea mollissima Blume). These three species are comparatively tolerant or resistant to chestnut blight.

Domestic production of chestnuts does not meet U.S. demands; consequently, each year tons of commercial chestnuts are imported from abroad. Based on data from the U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS) (pers. comm.), in 1998 approximately 2,872,006 kilograms (over 3,000 tons) were imported, primarily from Northern Hemisphere countries. The main geographic sources were the Mediterranean Region of Europe (Spain, Portugal, and Italy) and the Far East (China and Korea) (Table 1). Imported chestnuts are treated routinely with methyl bromide to prevent the entry into the United States of non-native weevils (Coleoptera: Curculionidae) and moths (primarily Tortricidae). However, based on inspections of personal baggage and other cargo, it is likely that hundreds of kilograms of chestnuts enter this country illegally, undetected, and untreated every year (Table 2).

The larvae of several Olethreutinae (Tortricidae) are encountered by APHIS personnel when untreated chestnuts are intercepted at quarantine facilities at U.S. ports-of-entry. Historically, most of these larvae have been identified as either Pammene fasciana (Linnaeus) or Cydia splendana (Hübner); Weisman’s (1986) key, widely used by APHIS personnel, includes P. fasciana (from Europe), C. splendana (from Europe), and Cydia spp. (from Europe and Asia). Recent work has shown that none of the three major Table 1. Chestnut imported into the United States for fiscal year 1998. Source: USDA/APHIS/PPQ, Riverdale, Maryland.

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th># SHIPMENTS</th>
<th>KILOGRAMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>6</td>
<td>41,454</td>
</tr>
<tr>
<td>Italy</td>
<td>112</td>
<td>1,526,252</td>
</tr>
<tr>
<td>Korea</td>
<td>67</td>
<td>1,083,872</td>
</tr>
<tr>
<td>Netherlands</td>
<td>2</td>
<td>6,000</td>
</tr>
<tr>
<td>New Zealand</td>
<td>189</td>
<td>180</td>
</tr>
<tr>
<td>Portugal</td>
<td>15</td>
<td>55,208</td>
</tr>
<tr>
<td>Spain</td>
<td>8</td>
<td>159,040</td>
</tr>
<tr>
<td>TOTAL</td>
<td>211</td>
<td>2,872,006</td>
</tr>
</tbody>
</table>

European pests of chestnuts is found in Asia, where three other species frequently infest this crop (Komai & Ishikawa 1987). The purpose of this paper is to present a key to the larvae of the six Castanea-feeding Olethreutinae frequently intercepted at U.S. ports-of-entry, along with brief descriptions of the larvae and select references to information on biology, detection, and control of these species in association with chestnuts.

Before using the key, non-tortricid Lepidoptera can be eliminated by the following characters (also see Fig. 1). All tortricid larvae infesting Castanea have a trisetose L-group on the prothorax (Fig. 1, T1); species with a bisetose L-group may be Pyraloidea, Noctuoidae, or Carposinidae. All tortricid larvae have L1+L2 close together on abdominal segments 1-8, usually on the same pinaculum (Fig. 1); in Tineoidea and Yponomeutoidea the Ls are distant from each other. Finally, all tortricid pests of Castanea (and Tortricidae in general), SD1 is located anterior or only slightly dorso-anterior to the spiracle on abdominal segment 9; this is in contrast to the condition in most Gelechioidea where it is dorsal to the spiracle.
KEY TO LARVAE OF CASTANEA-FEEDING OLETHREUTINAE

1 From Europe (primarily Portugal, Spain, Italy, Greece)............2
1' From Asia (primarily Korea, Japan, China)..........................4
2 Anal fork present (Fig. 2), pinacula extremely large, dark......Pammene fasciana
2' Anal fork absent, pinacula usually moderately small...........3
3 Body whitish, pinacula mostly concolorous with body; distance between Vs on A9 slightly to conspicuously greater than that between Vs on A8 (Fig. 3b); number of crochets on prolegs usually less than 18.............Cydia splendana
3' Body reddish white, pinacula red; distance between Vs on A9 usually about the same as (sometimes slightly greater than) that between Vs on A8 (Fig. 3a); number of crochets on prolegs usually more than 18.....Cydia fagiglandana
4 SV-group on A9 bisetose (Fig. 4a); head dark brown, often with darker maculations; crochets biordinal..........Eucoenogenes aestuosa
4' SV-group on A9 unisetose (Fig. 4b), head yellowish brown, without maculations; crochets mostly uniordinal.............5
5 Body red, pinacula inconspicuous, concolorous with body; 19-26 crochets on abdominal prolegs..................Cydia glandicolana
5' Body whitish, pinacula conspicuous, darker than body; 25-35 crochets on abdominal prolegs..............Cydia kurokoi

BRIEF DESCRIPTIONS OF CASTANEA-FEEDING LARVAE

The following descriptions are based on a combination of published literature and personal examination of larvae by the authors. Additional details of the morphology and biology of European species can be found in Swatschek (1958) and Bradley et al. (1979), and the Asian species in Komai and Ishikawa (1987). Terminology for larval characters follows Stehr (1987). The SV formula (i.e., SV-group) refers to abdominal segments 1, 2, 7, 8, and 9.

Cydia splendana (Hühner)
Head light yellowish brown; prothoracic and anal shields yellow; body grayish green or yellowish white, pinacula concolorous with body. SV-group 3:3:2:1:1; crochets on prolegs uniordinal, 15-19; crochets on anal proleg 7-9; L3 sometimes slightly separated from L2+L1 pinaculum on A9; distance between Vs usually slightly greater on A9 than on A8 (Fig. 3b); D2s often on separate pinacula on A9; anal fork absent. Although reported from chestnuts worldwide, Komai and Ishikawa (1987) present compelling evidence that this species is restricted primarily to Europe (ranging east to northern Iran and the Ural Mountains) and does not occur in the Far East. As with most of the species treated here, it has been recorded from Quercus spp. (Fagaceae) as well as Castanea (Bradley et al., 1979).

References: Swat schek (1958), Bradley et al. (1979), Rotundo

Fig. 1-4. Features of the larvae of Castanea-feeding Olethreutinae. 1, Chaetotaxy of Cydia glandicolana (from Komai & Ishikawa, 1987); 2, Last abdominal segment of Pammene fasciana illustrating presence of anal fork; 3, Venter of abdominal segments 7, 8, and 9 illustrating relative positions of V setae: setae about as far apart on A9 as on A8 (3a) and setae farther apart on A9 than on A8 (3b); 4, Lateral view of abdominal segment 9 illustrating two (4a) versus one (4b) seta in the SV-group.

Cydia fagiglandana (Zeller)

Head light brown; prothoracic and anal shields reddish yellow; body whitish, with orange-to-red, suffused, longitudinal stripes, pinacula orange to red. SV-group 3:3:2:1:1; crochets on prolegs uniodinal, 18-21; crochets on anal proleg 11-14; L3 sometimes slightly separated from L2+L1 pinaculum on A9; distance between Vs about the same on A9 as on A8 (Fig. 3a); D2 pinaculum not fused to each other on A9; anal fork absent. This species is a common pest of Castanea, Fagus, and Quercus (all Fagaceae) throughout much of Europe, ranging south to northern Iran and east to the Trans-Caucasus and the mountains of Turkestan (Bradley et al. 1979; Kuznetsov, 1987).


Cydia glandicolana (Danilevsky)

Head yellowish brown; prothoracic shield pale yellowish brown, mottled with yellowish brown along posterior margin; anal shield yellowish brown, usually without mottling; body yellowish, tinged with red, with inconspicuous, concolorous pinacula (discernible only in mounted specimens viewed under a microscope). SV-group 3:3:2:1:1; crochets on prolegs uniodinal, 22-29; crochets on anal proleg 10-11; all three L setae on a common pinaculum, or L3 absent (rarely); distance between Vs greater on A9 than on A8 (Fig. 3b); D2 pinaculum completely fused to each other on A9; anal fork absent. This species is a major pest of chestnuts in China, Korea, and Japan; it is a common pest of chestnuts in Japan (Takamura, 1974). The larvae are considerably more active than those of other Castanea-feeding Olethreutinae. References: Takamura (1974) (Kazim and Ishikawa, 1987), Byun et al. (1998).

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