EPPO Datasheet: *Acleris gloverana*

Last updated: 2022-12-15

IDENTITY

Preferred name: *Acleris gloverana*
Authority: (Walsingham)
Taxonomic position: Animalia: Arthropoda: Hexapoda: Insecta: Lepidoptera: Tortricidae
Common names: western black-headed bud worm
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EPPO Categorization: A1 list
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EU Categorization: A1 Quarantine pest (Annex II A)
EPPO Code: ACLRGL

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Notes on taxonomy and nomenclature

The western black-headed budworm, *Acleris gloverana* (Walsingham), was described originally from a single specimen from California, USA. A later, more comprehensive description based on specimens from the Eastern USA was named *A. variana* (Fernald). The specific name *variana* was applied subsequently to black-headed budworms throughout North America. Powell (1962) decided eastern and western populations were sufficiently distinct to warrant separate species designations within the genus *Acleris*, applying the senior synonym *A. gloverana* to populations west of the Rocky Mountains and retaining *A. variana* for populations to the east. This biogeographical boundary, however, was assumed by Powell as he did not examine specimens from interior or Rocky Mountain locations when forming the new taxonomic combinations. These changes were not widely accepted until 1970, so earlier references to western black-headed budworm used the name *A. variana*, creating some confusion in the literature (Otvos & Fajrajsl, 1997). Currently, the name western black-headed budworm is used for *A. gloverana* and eastern black-headed budworm for *A. variana*.

The original consensus of the black-headed budworm as a single, transcontinental species with the name *Acleris variana* reflected the high polymorphism in colour variants of the moth, often from the same location. Variation was also recognized in primary host associations along a longitudinal cline; balsam fir (*Abies balsamea*) in eastern forests, white spruce (*Picea glauca*)/balsam fir in central forests; spruce (*Picea*), hemlock (*Tsuga*), and true firs (*Abies*) in interior montane western forests; and western hemlock (*Tsuga heterophylla*) in Pacific coastal forests. Application of modern taxonomic techniques may reveal a single species with longitudinal variation in characters. If this is the case, the senior synonym for the species would be *A. gloverana* (Walsingham).

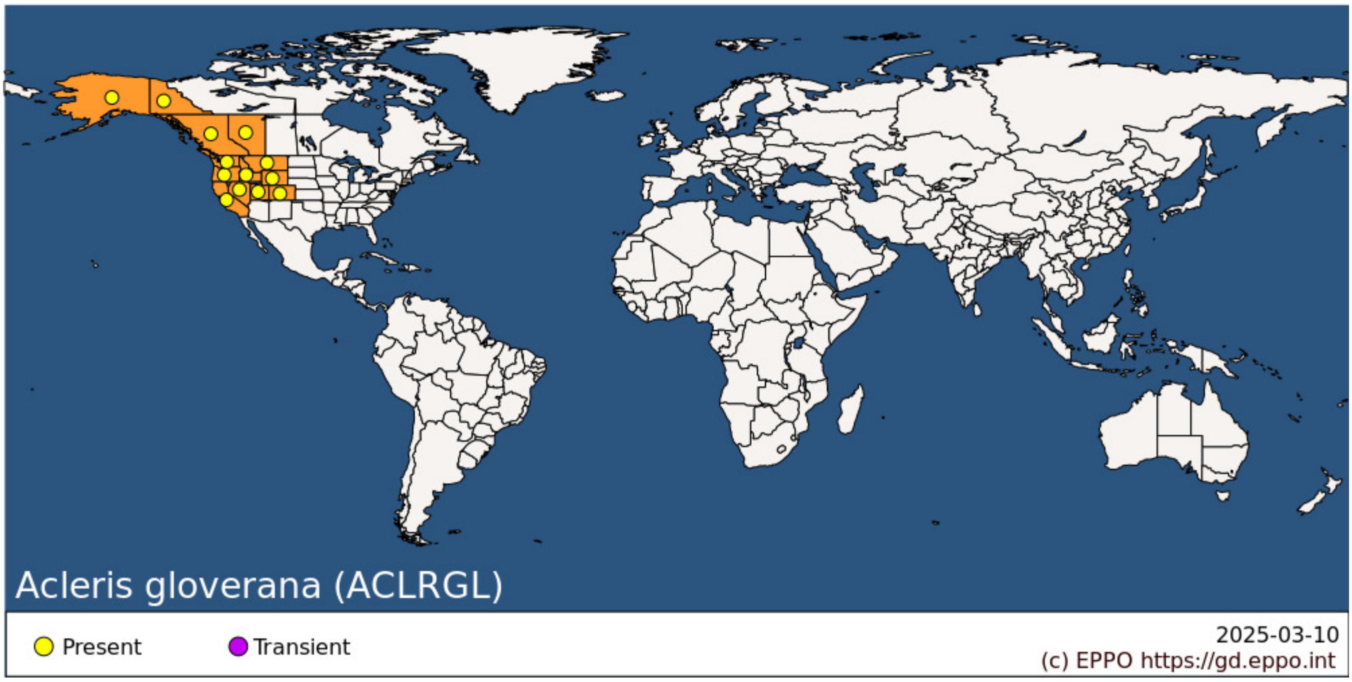
HOSTS

The main hosts of *A. gloverana* are hemlocks (*Tsuga* spp.), true firs (*Abies* spp.), and spruce (*Picea* spp.). Other hosts include Douglas-fir (*Pseudotsuga menziesii*). Major historical outbreaks are recorded principally on western hemlock (*T. heterophylla*) in Pacific coastal forests. Both mature and juvenile stands may support dense populations of western black-headed budworm (Prebble & Graham 1945, Powell 1962, Furniss & Carolin 1977, Koot 1991, Nealis *et al.* 2004).

Host list: *Abies amabilis*, *Abies concolor*, *Abies grandis*, *Abies lasiocarpa*, *Picea engelmannii*, *Picea glauca*, *Picea mariana*, *Picea sitchensis*, *Pseudotsuga menziesii*, *Tsuga heterophylla*, *Tsuga mertensiana*

GEOGRAPHICAL DISTRIBUTION

A. gloverana is native to North America west of the Rocky Mountains. Its distribution extends from Sierra Nevada and Cascade ranges in Northern California and the Rocky Mountains in Colorado, northwards through Wyoming, Montana, the Pacific Northwest, and Alaska in the USA, and British Columbia, Alberta, and Yukon in Canada. The Rocky Mountains are an area of likely overlap of western (*A. gloverana*) and eastern (*A. variana*) black-headed budworms.



North America: Canada (Alberta, British Columbia, Yukon Territory), United States of America (Alaska, California, Colorado, Idaho, Montana, Nevada, Oregon, Utah, Washington, Wyoming)

BIOLOGY

Western black-headed budworm is univoltine throughout its range. Adult moths are active mainly in August and September, but flight and oviposition can extend to October under cool, Pacific coastal conditions. Eggs are deposited singly on the undersides of needles on the outer extremities of the crowns of dominant and co-dominant trees. In cage experiments, a mean oviposition rate of 86 eggs per female has been recorded (Schmiege, 1965).

The egg is the overwintering stage. Survival during the egg stage appears relatively high and consistent from year to year. Hatching coincides with budbreak the following May and June. Neonate larvae move to feed at the bases of expanding buds and disperse on silk threads within and between tree crowns. In the early feeding stages, larvae may feed on a succession of small buds. Relatively low survival has been reported for western black-headed budworm during the dispersal period (Prebble & Graham, 1945; Shepherd & Gray, 2001).

As shoots elongate, larvae web the needles and twigs into a protective shelter where they continue to feed. Larvae prefer current-year foliage, but the last instar larvae can subsist on old foliage, particularly the softer foliage of western hemlock and true firs. Life-table studies report five larval instars for *A. gloverana*. This is unlike *A. variana*, for which studies suggest a proportion of a population, especially males, have only four instars. Larval survival rates are a function of weather and parasitism. Correlations between weather and survival can be difficult to interpret. Anecdotal observations suggest cool, wet weather during the larval period reduces survival, but this seems inconsistent with the observed prevalence of outbreaks in wet, northern coastal forests. Many species of generalist parasitoids and predators have been recorded attacking western black-headed budworm along with a polyhedral disease which affects it, but quantitative estimates of impact are sparse and not related readily to generation survival of the insect (Prebble & Graham, 1945; Torgersen, 1970; Gray & Shepherd, 1993).

Pupation occurs in damaged feeding sites from late July through September. Some larvae may drop from the foliage and pupate in the shrub layer. Adults emerge approximately two weeks after pupation. In captivity, male budworms lived an average of 15 days and females 22 days (Schmiege, 1965).

Periodic, damaging outbreaks of *A. gloverana* occur at approximately 10- to 15-year intervals and last 2 to 6 years

(Nealis *et al.*, 2004). More details are provided in the section *Economic impact* further down.

DETECTION AND IDENTIFICATION

Symptoms

Defoliation appears first in the upper portion of the tree canopy. Damaged foliage attached to the larval webs dries, giving the forest a reddish-brown appearance by the end of the feeding period. In severe cases, the entire leader may be stripped bare of needles. The most severe impacts, including tree mortality, occur in juvenile stands (< 25 years of age) (Prebble & Graham, 1945; Nealis *et al.*, 2004). Despite their alarming appearance, most damaged trees recover within a few years of the end of an outbreak (Nealis & Turnquist, 2010).

Outbreaks of western black-headed budworm are often concurrent with those of other irruptive insects such as the hemlock sawfly, *Neodiprion tsugae*. It is difficult to distinguish their specific damage without close inspection during the feeding period (Koot, 1991).

Morphology

Eggs

Single, pale-yellow, oval, approximately 0.8-1 mm long, flattened (Koot, 1991; Furniss & Carolin, 1977). The egg chorion becomes flattened after hatching and may remain on the needle for the following year.

Larva

Newly hatched larvae are 1 mm long, pale green with dark brown prolegs and brown or black headcapsules. Fully grown larvae are 12-16 mm in length, uniformly green with no distinctive markings. Thoracic shield is black and head capsule dark brown to black (Furniss & Carolin, 1977; Duncan, 2006).

Pupa

Pupae measure 7- 9 mm long, sometimes females are up to 12 mm long (Koot, 1991). Pupae are at first green to brown, turning to dark brown shading to green on the wing pads. Cremaster broad, curved ventrally with a long hooklet on each side; one pair of long hooklets on the dorsal surface and two shorter pairs on the ventral surface.

Adult

Adults are small, overall grey to brownish with polymorphic wing colour and patterns. Forewings present variations in colour and patterns of spots or bands. Hindwings are grey or brownish grey (Koot, 1991; Powell, 1962; Furniss & Carolin, 1977; CABI, 2019). The forewing measures 8.0-9.8 mm (Powell, 1962). Abdomen and dorsum are grey. The genital tuft of females is relatively small and more dorsal compared to that of *A. variana* (Powell, 1962).

Detection and inspection methods

Adult male *A. gloverana* can be captured in pheromone traps baited with 1000 mg (E)-11,13-tetradecadienal (E11, 13-14: Ald) as the primary component of the lure, with (Z)-11,13-tetradecadienal added as a secondary component in the ratio of 95:5 (E):(Z). Traps should be deployed by late July and retrieved in October. There is a good correlation between pheromone trap catches and subsequent egg density with predictive value for expected defoliation levels the next season (Nealis *et al.*, 2010).

Eggs can be detected by inspection of the underside of host foliage between October and April. Estimates of egg density are obtained by washing eggs off foliage with boiling water and recovering on filter paper and expressing the density as number of eggs per 45-cm branch tip. A sequential sampling plan has been developed (Shepherd & Gray, 1990).

Larval and pupal stages can be sampled directly by removing and inspecting branch tips.

Overview surveys rely on aerial detection of severe defoliation which results in reddish-brown discoloration of tree crowns. Damage estimates are affected by the time of the survey relative to period between maximum discoloration and eventual needle loss. If there are concurrent outbreaks of hemlock sawfly, ground inspections are recommended to confirm relative impacts of the co-occurring defoliators.

PATHWAYS FOR MOVEMENT

Adults can fly long distances, but natural spread from the current distribution in North America to the EPPO region is unlikely. The most likely pathway for international movement is via host plants for planting (except seeds) and cut branches (including Christmas trees - although host plants are not common Christmas trees). Viable eggs reside on foliage for several months and could go unnoticed. Egg laying occurs on both mature trees and juvenile trees less than 25 years old. Non-foliated portions of host trees are unlikely to harbour viable life stages outside the feeding and maturation period.

PEST SIGNIFICANCE

Economic impact

Recurrent outbreaks of western black-headed budworm have been recorded in North America from the Pacific Northwest states through British Columbia and north to Alaska and the Yukon. Surveys suggest population maxima occur every 10-15 years in susceptible forests, *i.e*., a high content of western hemlock, *T. heterophylla*. Notable outbreaks have been most frequent, extensive, and severe in wet, coastal Pacific forests. Both mature and juvenile stands (< 25 years of age) are susceptible (Prebble & Graham, 1945; Nealis *et al.*, 2004). Scattered outbreaks have been reported on hemlock and spruce in interior montane forests.

Defoliating outbreaks of western black-headed budworm are often concurrent with infestations of hemlock sawfly, *Neodiprion tsugae* (Hymenoptera: Diprionidae) although black-headed budworm is usually the most abundant of the two.

Outbreaks may last 2-6 years at the regional level, but most stands are defoliated for only 1, sometimes 2, years. Tree mortality is infrequent in large trees. Stands with juvenile trees comprise a greater proportion of the area defoliated in recent outbreaks. In these stands, the most vigorous trees in spaced stands were the most susceptible (Nealis *et al.*, 2004). Despite high levels of defoliation, tree mortality is patchy and infrequent overall. Decreases in radial growth and occasional top-kill of leaders is common but most trees in these younger age classes recover by 5 years post-defoliation (Nealis & Turnquist, 2010).

Control

Several insecticides typically used for forest defoliators have been tested or used operationally against western black-headed budworm on hemlock (Lejeune, 1975). However, the short-lived nature of outbreaks makes operational planning difficult and the resilience of coastal forests to defoliation makes it generally unnecessary (Hard, 1974).

Phytosanitary risk

A. gloverana presents a threat to several introduced conifer species and a potential threat to related, native conifer species in the EPPO region. Native *Abies* and *Picea* species are widespread in the EPPO region. Several North American host species have also been extensively planted for wood production, such as *Pseudotsuga menziesii* and *Picea sitchensis* in North-Western and Central Europe (Da Ronch *et al*., 2016; Houston Durrant *et al*., 2016). Other host species may also be planted to a more limited extent in the EPPO region, as forest or amenity trees. Additional studies are required for a better understanding of the areas where *A. gloverana* would present the highest risk.

PHYTOSANITARY MEASURES

Requiring that plants for planting or cut branches of hosts (including Christmas trees) originate from a pest free area is an appropriate phytosanitary measure (EPPO, 2018). Other risk management options may be relevant, as recommended for similar Lepidoptera, but whether they are appropriate and feasible for the specific host and commodity should be determined (EPPO, 2021). Such measures include growing the plants under complete physical isolation (EPPO, 2016, 2021, 2022). Measures should be combined with requirements to avoid infestation of the consignments during storage and transport (EPPO, 2022). It is noted that plants for planting of some host species from North America are currently prohibited in the EU (EU, 2022).

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Datasheet history

This datasheet was first published in the EPPO Bulletin in 1980 (as part of *Acleris variana*) and revised in the two editions of 'Quarantine Pests for Europe' in 1992 and 1997, as well as in 2022. It is now maintained in an electronic format in the EPPO Global Database. The sections on 'Identity', ‘Hosts’, and 'Geographical distribution' are automatically updated from the database. For other sections, the date of last revision is indicated on the right.

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