Archips xylosteanus

Scientific Name
Archips xylosteanus (Linnaeus)

Synonyms:
Archips xylosteana (Linnaeus)
Cacoecia xylosteana
var. *pallens* Kennel
Phalaena Tortrix xylosteana Linnaeus
Phalaena Tortrix desana Villers
Pyralis hybernana Fabricius
Pyralis obliquana Fabricius
Tortrix characterana Hübner
Tortrix westriana Thunberg

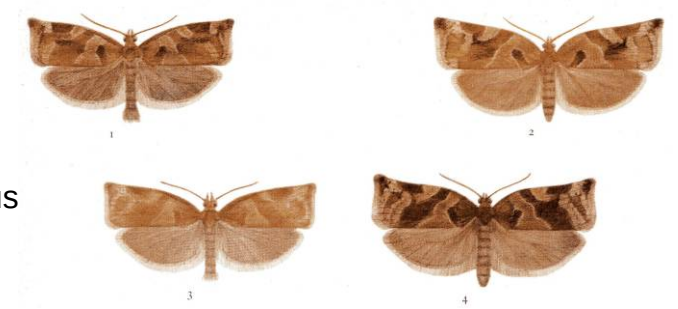

Fig. 1. Illustrations of adult *Archips xylosteanus* with males on left and females on right
[Image reproduced from Bradley et al. (1973)]

Common Names
Variegated golden tortrix, apple leafroller, brown oak tortrix, twist moth, forked red barred moth

Type of Pest
moth, leafroller, defoliator

Taxonomic Position
Kingdom: Animalia, **Phylum:** Arthropoda, **Order:** Lepidoptera, **Family:** Tortricidae

Reason for inclusion in manual
Recent detection in North America & classification as high risk (Spears 2006), CAPS Priority Pest (FY 2008 – FY 2013)

Pest Description
Eggs: "Cylindrical, greenish eggs are deposited in oval masses which are variable in size (3x7 to 4.5x10 mm). Eggs are covered with a brown secretion" (Bradley et al. 1973).

Larvae: "16-22 mm (Meijerman and Ulenberg 2000), "Head shining black; prothoracic plate dark brown or black, edged with white anteriorly and sometimes posteriorly, divided by a narrow whitish line; abdomen whitish grey varying to dark bluish grey, paler or whitish laterally; pinacula light grey; setae whitish; anal plate black or blackish brown; anal comb present; thoracic legs black; prolegs green dotted with black" (Bradley et al. 1973).

Fig. 2. Larva of *Archips xylosteanus*
[Image UGA1297014, www.forestryimages.org]

Pupae: 11-12 mm (Beeke and De Jong 1991) and “dark brown or black” (Bradley et al. 1973).

Adults: No clear sexual dimorphism (Bradley et al. 1973, Toimil 1987). Variation in coloration and forewing markings; “forewings whitish ochreous with ochreous brown or reddish brown, pale edged markings; a black-brown dot at disc; subterminal marking pistol-shaped in males. Hindwings greyish-brown” (Meijerman and Ulenberg 2000).

> Adult males: wingspan 15-21 mm, “Forewing ground colour whitish ochreous, partially suffused with olive-grey; markings reddish brown, thinly edged with clear ground colour; inner margin of median fascia sinuate, pre-apical spot semi-ovate, usually contiguous with stria-like marking to tornus” (Bradley et al. 1973).

Fig. 3. Adult *Archips xylosteanus*
[Image from: http://nrm.museum/en/svenska_fjarilar/a/archips_xylosteana.html]

> Adult females: wingspan 16-23 mm, “Forewing ground colour as in male; markings less reddish, often darker. Hindwing grey, apical area sometimes tinged with yellow or cupreous” (Bradley et al. 1973).

Archips xylosteanus has a similar appearance to *Archips crataegana* (also not known to occur in the United States) but is generally smaller and more variegated (Bradley et al. 1973).

Fig. 4. Adult (left) and pupa (right) of *Archips xylosteanus*
[Image from Federal Research Station of Changins, http://www.hortnet.co.nz/key/keys/bugkey2a/wings/dblwing/axylad1.htm]

A dichotomous key of common leafroller pests (Tortricidae) in larval and pupal stages is provided by Beeke and De Jong (1991).

Biology and Ecology

Archips xylosteanus has one generation per year (Dickler 1991). The insect overwinters in the egg stage (Razowski 1977, Benz 1991), and hatch begins in early spring (i.e., March) when host plants produce new growth on branches (Razowski 1977, Dickler 1991). Newly hatched larvae crawl to green branch tips and begin feeding. Later instars roll leaves diagonally and feed in seclusion (Razowski 1977). Collectively, larval development requires 30-40 days, but the pupal stage only lasts 9-12 days (Razowski 1977). Moths are active from late June or early July to mid August in Europe and Japan (Razowski 1977). Moths rest in foliage during the daytime and fly at night or when disturbed (Bradley et al. 1973). One female may deposit 200-3000 eggs in 5-8 egg masses (Razowski 1977).

Temperature thresholds for development or flight have not been reported in current, available literature.

See 'Known Hosts' for a listing of plants that can be attacked by *A. xylosteanus* and 'Pest Importance' for a discussion of its potential economic impact.

Damage

Archips xylosteanus larvae may cause significant defoliation by feeding on foliage and buds of deciduous trees and shrubs (Spears 2006). Developing larvae will roll leaves to create protected feeding sites.

Fig. 5. Oak leaf rolled by *Archips xylosteanus*
[Image from www.forestryimages.org]

Pest Importance

Archips xylosteanus is not known to occur in the United States and is a quarantine pest of concern. This insect was recently detected in Newfoundland, Canada, a first report for North America (Spears 2006).

Larvae are polyphagous feeders of ornamental trees and shrubs, particularly new foliage and buds (see 'Known Hosts') (Dickler 1991). Population size can vary from year to year, however, damage is usually not severe or economically important (Razowski 1977, Dickler 1991, Özbek and Calmasur 2005). In its native range, the insect is attacked by several natural enemies which may hold populations in check (Miczulski and Koślińska 1976). Thus, the potential economic impact in the United States in the absence of natural enemies is uncertain.

Risks associated with *A. xylosteanus* have not been evaluated formally in the past. Because the insect feeds on foliage, it is unlikely to be moved with fresh commodities for consumption (e.g., fresh fruit) (Spears 2006). The insect is more likely to be introduced in infested nursery stock (Dunkle 2006).

Known Hosts

The larvae of *A. xylosteanus* feed on the foliage of numerous trees and woody plants:

Hosts	**References**
Abies sp. (fir)	(Bradley et al. 1973, Zhang 1994)
Acer sp. (maple)	(Bradley et al. 1973)
Citrus sp.	(van der Geest et al. 1991)
Corylus sp. (hazelnut)	(Bradley et al. 1973)
Fraxinus sp. (ash)	(Bradley et al. 1973)
Hypericum sp.	(Bradley et al. 1973)
Lonicera sp. (honeysuckle)	(Bradley et al. 1973)
Malus domestica (apple)	(Hwang 1974, Miczulski and Koślińska 1976, Zhang 1994)

Hosts	References
Malus pumila (paradise apple)	(CAB 2006)
Prunus apetala (wild cherry)	(Konno 2005)
Prunus armeniaca (apricot)	(CAB 2006)
Prunus avium (sweet cherry)	(Safonkin 1998, CAB 2006)
Prunus grayana (wild cherry)	(Konno 2005)
Prunus persica (peach)	(Hrdý et al. 1979, CAB 2006)
Prunus verecunda (wild cherry)	(Konno 2005)
Prunus sp. (cherry, plum)	(Zhang 1994)
Pyrus sp. (pear)	(Zhang 1994)
Quercus borealis (red oak)	(Tomić and Mihajlović 1979)
Quercus ilex (holly oak)	(Toimil 1987, CAB 2006)
Quercus pyrenaica (black oak)	(CAB 2006)
Quercus robur (common oak)	(CAB 2006)
Quercus sp. (oak)	(Bradley et al. 1973, Zhang 1994)
Rhododendron sp.	(Zhang 1994)
Rubus sp. (raspberry)	(Bradley et al. 1973, Zhang 1994)
Rosa canina (dog rose)	(CAB 2006)
Rosa sp.	(Özbek and Calmasur 2005)
Solanum sp. (nightshade)	(CAB 2006)
Tilia sp. (basswood)	(Bradley et al. 1973)
Ulmus sp. (elm)	(Bradley et al. 1973)
Ornamental trees and shrubs (nursery stock)	(Dunkle 2006)

Known Distribution

Archips xylosteanus has been reported from:

Africa: Algeria; **Asia:** China, Iran, Japan, Kazakhstan, Korea, Russia, Turkey, and Turkmenistan; **Europe:** Albania, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Macedonia, Moldova, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, and United Kingdom; **North America:** Canada.

(Bradley et al. 1973, Koślińska 1973, Hwang 1974, Miczulski and Koślińska 1976, Razowski 1977, Hrdý et al. 1979, Tomić and Mihajlović 1979, Toimil 1987, Beeke and de Jong 1991, Zhang 1994, Safonkin 1998, Konno 2005, Özbek and Calmasur 2005, CAB 2006, Dunkle 2006, Aarvik 2011, USDA 2012).

Pathway

Because this species is a leaf roller, it could potentially move to new areas through nursery stock. This species is currently found in Newfoundland and could potentially be

introduced into the United States through individuals carrying infested material. If this species is present on the Canadian mainland, it can potentially enter the United States through natural spread (USDA, 2012).

This species has not been intercepted at U.S. ports of entry. However, the genus has been intercepted three times at U.S ports of entry. Two interceptions originated from Japan while surveying ships. The other interception originated from the Philippines and was found on the fruit of *Psophocarpus tetragonolobus* (winged bean) (AQAS 2013, queried January 25, 2013).

Potential Distribution within the United States

Archips xylosteanus is a Palearctic species. Based on the list of countries In Europe and Asia from which the species has been reported, Schall (2006) predicts the species is likely to occur in regions (zonobiomes) with climates characterized as warm-temperate, typical-temperate, arid-temperate, and transitional to cold-temperate or boreal. Consequently, using this approach most of the contiguous United States is predicted to be climatically suitable, with the exception of southern Florida, southern Texas, the desert southwest, and California's coast and Central Valley (Schall 2006).

Our own analysis of the reported geographic distribution of *A. xylosteanus* gives a similar, albeit slightly more restricted, prediction. Our analysis suggests that this insect is most likely to be associated with biomes defined by Olson et al. (2001) as temperate-broadleaf-and-mixed forest and boreal forest. Boreal forest does not occur in the United States. Temperate-broadleaf-and-mixed forest is the most common biome east of the Mississippi River and accounts for 28% of the area within the contiguous United States.

In a recent risk analysis by USDA-APHIS-PPQ-CPHST, most of states in the eastern and western portion of the United States have a moderate to high risk of *A. xylosteanus* establishment. Areas that are at most risk include the Arizona, California, Idaho, Michigan, Minnesota, northeast, Oregon, southeast, Wisconsin, and Washington.

Survey

CAPS-Approved Method*:

The CAPS-approved method is a trap and lure combination. The trap is a wing trap kit. The lure is effective for 28 days (4 weeks).

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

Wing Trap Kit, Paper
Wing Trap Kit, Plastic

The Lure Product Name is "*Archips xylosteanus* Lure."

IMPORTANT: Placing lures for two or more target species in a trap should never be done unless otherwise noted here.

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

*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/.

Literature-Based Methods:
Male *A. xylosteanus* are attracted to blends of Z-11-tetradecenyl acetate and *E*-11-tetradecenyl acetate (El-Sayed 2006). Ando et al. (1978) were the first to demonstrate that male moths were attracted to a 4:1 mixture of *Z*-11-tetradecenyl acetate: *E*-11-tetradecenyl acetate, but captures with this blend were relatively low (only 13 moths over an unspecified length of time). This mixture also attracted the tortricids *Archippus piceanus similis* Butler and *Pandemis cinnamomeana* Treitschke (Ando et al. 1978). Frerot et al. (1979, 1983) found that the same two compounds in a 92:8 [*Z*:*E*] mixture captured substantially more male *A. xylosteanus* than any other ratio tested (approximately 150 males over an unspecified length of time). This ratio of these compounds may also be attractive to *Cacaecimorpha pronubana* Hübner and *Argyrotaenia pulchellana* Haw (Frerot et al. 1979). Conversely, *A. xylosteanus* may be attracted to pheromone lures for oriental fruit moth, *Grapholita molesta* (93:7 *Z*-8-dodecenyl acetate:E-8-dodecenyl acetate + docecanol), red-banded leafroller, *Argyrotaenia velutinana* (2:3 Z-11-tetradecenyl acetate:dodecyl acetate), and the oblique banded leafroller, *Choristoneura rosaceana* (Z-11-tetradecenyl acetate) (Hrdý et al. 1979).

Pheromones produced by *Archips rosana* may interfere with attractants for *A*. *xylosteanus* (Safonkin 1998).

Pheromone traps should be placed approximately 1.6 m [5 ft] above the ground and 50-100 m [150-300 ft] apart (Hrdý et al. 1979, Frerot et al. 1983). Pherocon 1C traps are more effective at capturing males than Stuttgart pot traps (Hrdý et al. 1979).

Fig. 7. Adult *Archips fervidana* (upper) and *A. semiferana* (lower). Images not to scale.
[Images from T.M. Gilligan, Academy of Natural Sciences, Philadelphia, PA, www.tortricidae.com]

Key Diagnostics

CAPS-Approved Method*:

Confirmation of *A. xylosteanus* is by morphological identification.

*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/.

Literature-Based Methods:

This insect can be difficult to identify, so any identification should be confirmed by an appropriately trained entomologist (Bradley et al. 1973, Beeke and De Jong 1991). Dichotomous keys for later instars and pupae of common leafrollers are provided by Beeke and De Jong (1991).

Easily Confused Pests

Individual species of leafrollers are difficult to detect with visual inspections of foliage. Leaf rolling is common among many tortricids, and *A. xylosteanus* may closely resemble related species. *Archips xylosteanus* is the type species for the Xylosteana group (Razowski 1997). Other introduced and native members of the Xylosteana group in North America include *A. argyrospila*, *A. cerasivorana*, *A. eleagnana*, *A. fervidana*, *A. fuscocupreana* (introduced), *A. georgiana*, *A. goyerana*, *A. grisea*, *A. infumatana*, *A. magnoliana*, *A. mortuana*, *A. myricana*, *A. negundana*, *A. nigriplagana*, *A. purpurana*, *A. rileyana*, *A. rosana* (introduced), and *A. semiferana* (Kruse and Sperling 2002). Like *A. xylosteanus*, *A. fervidana* and *A. semiferana* (Fig. 7) feed on oak. Both native species are common in the United States.

References

Aarvik, L. 2011. Fauna Europaea: *Archips xylosteana*. Fauna Europaea version 2.5. Accessed January 29, 2013 from: http://www.faunaeur.org

AQAS. 2013. *Archips* sp. interceptions. Agricultural Quarantine Activity Systems. Accessed January 25, 2013 from: https://aqas.aphis.usda.gov/aqas/.

Ando, T., H. Kuroko, S. Nakagaki, O. Saito, T. Oku, and N. Takahashi. 1978. Two-component sex attractants for male moths of the subfamily Tortricinae (Lepidoptera). Agricultural Biology and Chemistry 42: 1081-1083.

Beeke, H., and D. J. De Jong. 1991. Identification of Larvae and Pupae, pp. 65-76. *In* L. P. S. van der Geest and H. H. Evenhuis [eds.], World Crop Pests: Tortricid Pests. Their Biology, Natural Enemies and Control. Elsevier Science Publishers B.V., Amsterdam.

Benz, G. 1991. Physiology and Genetics, pp. 89-147. *In* L. P. S. van der Geest and H. H. Evenhuis [eds.], World Crop Pests: Tortricid Pests. Their Biology, Natural Enemies and Control. Elsevier Science Publishers B.V., Amsterdam.

Bradley, J. D., W. G. Tremewan, and A. Smith. 1973. British Tortricoid Moths. The Ray Society, London.

CAB. 2006. Forestry Compendium. CAB International. Available on-line at: http://www.cabicompendium.org/fc/home.asp. Accessed 7 July 2006.

Dickler, E. 1991. Tortricid Pests of Pome and Stone Fruits, Eurasian Species, pp. 435-452. *In* L. P. S. van der Geest and H. H. Evenhuis [eds.], World Crop Pests: Tortricid Pests. Their Biology, Natural Enemies and Control. Elsevier Science Publishers B.V., Amsterdam.

Dunkle, R. L. 2006. Presence of *Archips xylosteanus* Linnaeus, Variegated Golden Tortrix (Lepidoptera/Tortricidae) on Memorial University Campus, St. Johns, Newfoundland. Available on-line at: http://nationalplantboard.org/docs/spro_tortrix_2006_05_14.pdf. Accessed 2006.

El-Sayed, A. M. 2006. Semiochemicals of *Archips xylosteana*, the Brown oak tortrix. The Pherobase: Database of Insect Pheromones and Semiochemicals. Available on-line at: http://www.pherobase.net. Accessed 22 September 2006.

Frerot, B., M. Renou, M. Gallois, and C. Descoins. 1983. Un attractif sexuel pour la tordeuse des bourgeons: *Archips xylosteana* L. (Lepid., *Tortricidae*, *Tortricinae*). Agronomie 3: 173-178.

Frerot, B., C. Descoins, B. Lalanne-Cassou, P. Saglio, and F. Beauvais. 1979. Essais de piégeage sexuel des lépidoptères *Tortricidae* des vergers de pommiers par des attractifs de synthèse. Annales de Zoologie, Écologie Animale 11: 617-636.

Hrdý, I., J. Marek, and F. Krampl. 1979. Sexual pheromone activity of 8-dodecenyl and 11-tetradecenyl acetates for males of several lepidopteran species in field trials. Acta Entomologica Bohemoslovaca 76: 65-84.

Hwang, K. H. 1974. Identification of ten species of leaf-rollers (Lepidoptera: Tortricidae) on apple trees in north China. Acta Entomologica Sinica 17: 29-42.

Konno, Y. 2005. Species composition of leaf-rolling caterpillars on three wild cherry strains. Japanese Journal of Applied Entomology and Zoology 49: 57-61.

Koślińska, M. 1973. Fauna zwójkówek (*Lepidoptera*, *Tortricidae*) na jabłoniach w niektórych okolicach Polski. Część II. Polskie Pismo Entomologiczne 43.

Kruse, J. J., and F. A. H. Sperling. 2002. Phylogeny of nearctic species of the Xylosteana group of *Archips* Hübner (Lepidoptera: Tortricidae) based on combined analysis of morphological and mitochondrial DNA data sets. Annals of the Entomological Society of America 95: 288-301.

Meijerman, L., and S. A. Ulenberg. 2000. Arthropods of Economic Importance: Eurasian Tortricidae. Expert Center for Taxonomic Identification and Zoological Museum of Amsterdam. Available on-line at: http://ip30.eti.uva.nl/BIS/tortricidae.php. Accessed 22 September 2006.

Miczulski, B., and M. Koślińska. 1976. Pasożytnicza entomofauna motyli zwókowatych (*Tortricidae*) występujących w sadach jabłoniowych w niektórych rejonach Polski. Polskie Pismo Entomologiczne 46: 165-178.

Olson, D. M., E. Dinerstein, E. D. Wikramanayake, N. D. Burgess, G. V. N. Powell, E. C. Underwood, J. A. D'Amico, I. Itoua, H. E. Strand, J. C. Morrison, C. J. Loucks, T. F. Allnutt, T. H. Ricketts, Y. Kura, J. F. Lamoreux, W. W. Wettengel, P. Hedao, and K. R. Kassem. 2001. Terrestrial ecoregions of the world: a new map of life on earth. BioScience 51: 933-938.

Özbek, H., and Ö. Calmasur. 2005. A review of insects and mites associated with roses in Turkey, pp. 167-174. *In* H. Nybom and K. Rumpunen [eds.], Proceedings of the 1st International Rose Hip Conference.

Razowski, J. 1977. Monograph of the genus *Archips* Hübner (*Lepidoptera*, *Tortricidae*). Acta Zoologica Cracoviensia 22: 55-205.

Razowski, J. 1997. Generic composition of the New World Archipini (Lepidoptera, Tortricidae) with description of two new genera and two new species. Miscellània Zoològica 20: 125-130.

Safonkin, A. F. 1998. Ecological significance of pheromones and some abiotic factors in sexual behaviour of *Archips rosana* L. and *A. xylosteana* L. females (Lepidoptera: Tortricidae). Russian Entomological Journal 7: 231-235.

Schall, R. A. 2006. NPAG Data: *Archips xylosteanus* Variegated Golden Tortrix: potential introduction. U.S. Department of Agriculture New Pest Advisory Group (NPAG). Available on-line at: http://cphst.aphis.usda.gov/npag/docs/Archips_xylosteanus_Datasheet_060126.pdf. Accessed 22 September 2006.

Spears, B. M. 2006. NPAG Report: *Archips xylosteanus* Linnaeus: Variegated Golden Tortrix. U.S. Department of Agriculture New Pest Advisory Group (NPAG). Available on-line at: http://cphst.aphis.usda.gov/npag/docs/Archips_xylosteanus_NPAG_et_Report_060505.pdf. Accessed 22 September 2006.

Toimil, F. J. 1987. Algunos insectos defoliadores de la encina (*Q. ilex* L.) en la provincia de Huelva. Boletín de Sanidad Vegetal. Plagas. 13: 173-188.

Tomić, D., and L. J. Mihajlović. 1979. Štetna insekatska fauna crvenog hrasta (*Quercus borealis* Michx.) u Srbiji. Arhiv Bioloskih Nauka 28: 189-197.

USDA. 2012. New Pest Response Guidelines. Varigated Golden Tortrix (*Archips xylosteanus*). United State Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine. 139 pp.

van der Geest, L. P. S., C. H. Wearing, and J. S. Dugdale. 1991. Tortricids in Miscellaneous Crops. *In* L. P. S. van der Geest and H. H. Evenhuis [eds.], World Crop Pests: Tortricid Pests. Their Biology, Natural Enemies and Control. Elsevier Science Publishers B.V., Amsterdam.

Zhang, B. C. 1994. Index of Economically Important Lepidoptera. CAB International, Wallingford.