NPAG DATA: *ARCHIPS XYLOSTEANUS*

VARIEGATED GOLDEN TORTRIX

POTENTIAL INTRODUCTION

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TAXONOMY:

Phylum: Arthropoda
Class: Insecta
Order: Lepidoptera
Family: Tortricidae

Full Name: *Archips xylosteanus* Linnaeus (Zhang 1994)
Synonyms: *Archips xylosteana* (Carter 1984)
Cacoecia xylosteana; *Tortrix xylosteana* (Zhang 1994)

Common Name: Variegated golden tortrix (Carter 1984, Zhang 1994)
Apple leaf roller (Shiraki 1952)
Brown oak tortrix moth (Alford 1991)
Brown oak tortrix (Dickler 1991)

DETECTION DATA:

Initial Detection in Canada:

Location: St. John's, Newfoundland (campus of Memorial University)
Date: August 2005 (early in the month)
Host: Various ornamental trees and shrubs (beaten from the branches)
Collector: Dr. E. Richard Hoebeke, Department of Entomology, Cornell University
Identifier: Dr. E. Richard Hoebeke, Department of Entomology
Comstock Hall, Cornell University
Ithaca, NY 14853-0901
Iden. Date: 2005 (detection confirmed in 29N0v05 e-mail from Dr. Hoebeke to Dr. Brian Spears, USDA-APHIS-PPQ, stationed at Raleigh, NC)

Detection(s) in the US:

No report of a detection in the US is known.

QUARANTINES:

The variegated golden tortrix appears to be of minor quarantine significance for one or more of the following reasons:

- The variegated golden tortrix is widely distributed in Europe and Asia (*see* Distribution).
- The variegated golden tortrix is of minor economic damage where established (*see* Damage Where Established).
- Articles which report damage often appear in publications that are less likely to be read (*see* References).
- The variegated golden tortrix does not appear in many commonly used references such as *Agricultural Pests of Temperate Regions and Their Control* (Hill 1987) and *Pests and Diseases of Forest Plantation Trees* (Browne 1968).

However, *A. xylosteanus* is mentioned in several publications dealing with quarantine issues:

- *Guidelines on Good Plant Protection Practice: Pome Fruits* OEPP/EPPO 2006
- *Import Health Standard Commodity Sub-class: Korean Pear, Pyrus pyrifolia, from the Republic of Korea* NZ Nat. Pl. Prot. Org. 1999
- *Importation of Fragrant and Ya Pear Fruit from China into the United States* Cave and Lightfield 1997

LIFE CYCLE:

The life cycle of the variegated golden tortrix involves complete metamorphosis:

Egg →Larva (caterpillar) →Pupa →Adult (moth)

According to Carter (1984), the eggs are present from July through April. The overwintering eggs are placed on trunks and branches in small batches covered with a brownish secretion (Alfaro 1950, Carter 1984, Dickler 1991). The larvae are present from April to June in "spun leaves" (Carter 1984). The pupae are present in June in the larval spinning. Flying at dusk, the adult is present in July (Carter 1984).

According to (Dickler 1991), there is one generation per year.

Egg: When the adults appear in July, eggs are laid in batches on the trunks or branches of various trees and shrubs. The eggs are then coated with a brownish secretion which camouflages them against the bark. The eggs will overwinter, hatching in the following April or early May (Alford 1991).

Larva: According to Alford (1991), the larvae are 16 to 22 mm in length. The larvae are whitish-grey, sometimes grey, or dark bluish-grey, with black pinacula. Heads are shiny black. The prothoracic plates are black or dark-brown, with whitish mid-lines and collars. Anal combs are present on the larvae.

According to Carter (1984), the larvae are whitish-grey to dark bluish-grey, paler laterally; the pinacula are light grey; the setae are whitish. Heads are shiny black. The prothoracic plates are dark brown or black, edged with white anteriorly. The anal plates are blackish-brown or black. The thoracic legs are black; the abdominal prolegs are green, dotted with black. An anal comb is present on each larva.

Each larva attacks the foliage and inhabits a rolled leaf. Larvae will be fully grown by June (Alford 1991).

Pupa: According to Alford (1991), the pupae are 9 to 12 mm in length, dark-brown or black in color; the cremasters are elongate.

According to Carter (1984), the pupae are dark-brown or black in color; the cremasters are strongly sculptured, elongate, flattened, and terminate in eight robust, hooked spines.

Fully grown in June, the larvae pupate in the larval habitation, rolled leaves; the adults emerge a few weeks later (Alford 1991).

Adult: According to Alford (1991), adult moths have a 15 to 23 mm wingspan. The forewings are whitish-ocherous with reddish-brown, variegated markings; the hindwings are greyish.

According to Carter (1984), the wingspan is 20 mm. The forewings are light purplish-brown with dark chocolate-brown, reddish-brown, or yellowish-brown bands and markings. The forewings are edged with ochreous white. The hindwings are grey with a metallic cupreous sheen towards the apex.

The head and thorax are light purplish-brown; the abdomen is grey. The antennae are simple and filiform (Carter, 1984).

Reproduction: Sticky traps baited with mixtures of (Z)-11-tetradecenyl acetate and (E)-11-tetradecenyl acetate caught males of *Archips xylosteanus*; these attractants were most effective at a ratio of 92:8 (Frerot et al. 1983).

Information on the sex pheromone (semiochemical) is available from The Pherobase (2006) which has a website.

Ecology: The variegated golden tortrix is generally common in woodland habitats on trees, shrubs, and certain herbaceous plants; minor infestations occur occasionally in gardens and nurseries (Alford 1991).

DISTRIBUTION:

Besides noting that the variegated golden tortrix is widespread in the British Isles, Carter (1984) states that the range extends "through Europe to Asia Minor, eastern Siberia, China, and Japan."

Asia:	Iran, Kazakhstan, Turkmenia (in mountains) (Kuznetsov 1978)
	China (Heilongjiang), Japan, Russia (Siberia) (Zhang 1994)
	Japan (Hokkaido, Honshu), Korea (Shiraki 1952)
Europe:	Europe including Bulgaria, Britain (UK), France, Germany, Lithuania,
	Poland, Romania, Ukraine, Sweden (Zhang 1994)
	Southern France, Portugal, Spain (Leraut and Luquet 1995, ssp. *sabrinae*)
Africia:	Algeria (Leraut and Luquet 1995, requested, subspecies *sabrinae*)
Asia Minor:	Turkey (Zhang 1994)

HOSTS:

Acer sp.	Maple	Kuznetsov 1978
Abies sp.	Fir	Carter 1984, Zhang 1994
Betula sp.	Birch	Alford 1991
Citrus sp.	Citrus	Shiraki 1952 (*see* Pertinent Points)
Corylus avellana	Hazel, hazelnut	Alford 1991
Fraxinus excelsior	Ash	Alford 1991
Hypericum sp.	St. John's wort	Alford 1991
Lonicera sp.	Honeysuckle	Alford 1991
Malus sp.	Apple	Carter 1984, Zhang 1994
Populus sp.	Poplar	Shiraki 1952
Prunus spp.	Cherries, plum	Carter 1984, Zhang 1994
P. apetala	A Japanese cherry	Konno 2005
P. verecunda	A Japanese cherry	Konno 2005
Pyrus sp.	Pear	Carter 1984, Zhang 1994
Quercus sp.	Oak	Carter 1984, Zhang 1994
Rhododendron sp.	Rhododendrom	Carter 1984, Zhang 1994
Rubus sp.	Raspberry	Carter 1984, Zhang 1994
Salix sp.	Willow	Shiraki 1952
Thelycrania sp.	*Cornus* (*Hortus Third*)	Kuznetsov 1978
Tilia sp.	Basswood, lime	Alford 1991, Kuznetsov 1978
Ulmus sp.	Elm	Alford 1991, Kuznetsov 1978

Kuznetsov (1978) states that the larvae are omnivorous, damaging orchard, ornamental, and forest crops. The larvae especially damage fruit plants in the family Rosaceae, oak, maple, ash, elm, linden, and dogwood.

After presenting a host list, Carter (1984) states that the hosts include "many other deciduous trees and shrubs, occasionally on *Abies*." Zhang (1994) repeats this statement.

DAMAGE WHERE ESTABLISHED:

Indicators of Significant Damage: In the *Index of Economically Important Lepidoptera*, Zhang (1994) lists the variegated golden tortrix; however, this mention may not indicate significant damage.

From 1965 to 1969, the most important tortricids damaging fruit trees in the Kyustendil district of Bulgaria were *Archips crataeganus*, *A. xylosteanus*, and *A. rosanus*: they destroyed up to 32, 42.9, and 71.4% of the flowers, fruits, and leaves, respectively, of cherry; they destroyed 26, 35.1, and 95.2% of the flowers, fruits, and leaves, respectively, of apple (Kolev 1972). (Because the damage caused by *A. xylosteanus* is combined with the damage of two more important pest, it is difficult, if not impossible, to estimate the damage from *A. xylosteanus*.)

Indicators of Minor Damage: In *A Colour Atlas of Pests of Ornamental Trees, Shrubs, and Flowers*, Alford (1991) makes the following statement: "Larval habitations may disfigure host plants and cause concern but feeding is confined mainly to fully expanded leaves and is, therefore, of little or no significance."

In *Tortricid Pests: Their Biology, Natural Enemies, and Control*, Dickler (1991; table 5.3.2.1) lists *A. xylosteanus*, under the synonym *X. xylosteana,* as an occasional pest. The rating scale used for economic importance was occasional pest (+), important pest (++), key pest (+++).

In *Pest Lepidoptera of Europe*, Carter (1984) makes the following statement: "This polyphagous species is recorded as a minor pest of ornamental trees and shrubs in Britain and is one of the few species that regularly eats rhododendron leaves (Wilson and Becker 1960). In continental Europe it is an occasional pest of fruit trees and bushes (Bovey 1966)."

Hwang (1974) collected ten species of trortricids on apple trees in northern China; *A. xylosteanus* was among the ten species collected. However, *A. xylosteanus* was *not* among the "most injurious."

When leafrollers were examined in apple orchards in 12 provinces of Poland from 1965 to 1973 (Koslinska 1973, Miczulski and Koslinska 1972), three groups of leafrollers were distinguished: (1) species of relatively high frequency, occurring in large numbers in various climatic and agricultural regions, (2) species common and numerous only in some regions, and (3) species of low frequency, occurring in low numbers in a limited area. *Archips xylosteana* was in the second group: species common and numerous only in some regions. (It is interesting to note that *A. rosana* was in the first group.)

Indicators of Little or No Damage: In *Agricultural Pests of Temperate Regions and Their Control*, Hill (1987) does *not* list *Archips xylosteanus*; however, other species in the genus *Archips* are listed: *A. argyrospila*, *A. crataegana*, *A. podana*, and *A. rosana*.

In *Pests and Diseases of Forest Plantation Trees*, Browne (1968) does *not* mention *Archips xylosteanus* or *X. xylosteana*; Browne does mention 11 other species in the genus *Archips*.

In *The Pests of Fruits and Hops*, Massee (1954) does *not* mention *Archips xylosteanus* or *X. xylosteana*.

METHODS OF CONTROL:

Chemical Control: For several of the more important tortricid pests, sex pheromones are now available; it has become standard practice to use ultra-violet light traps, sticky traps, and other traps baited with sex attractants to monitor the emergence of the moths so as to permit precise timing of insecticide sprays (Hill 1987).

A number of insecticides are "effective" against a wide range of tortricid pests (Hill 1987, Lo 2003). However, the insect growth regulator diflubenzuron was not effective against *A. xylosteanus* (Horstmann 1982).

Biological Control: In Europe, a number of braconids are parasites of *A. xylosteanus* (Balevski 2000). In Asia, the braconid *Apanteles ater* attacks *A. xylosteanus* (You, Xiong, and Cao 1983).

In the Dnepropetrovsk region of Russia, the most common parasites of the tortricids *Archips xylosteanus* and *A. rosanus* was *Trichomma enecator* (Ichneumonidae), which parasitised up to 14.5% of pupae (Osipenko and Marlevich 1978).

In Poland, 90% of parasites were reared from leafroller species in the first group, species of relatively high frequency that occurred in large number in various climatic regions; 9% of parasites were reared from leafroller species in the second group, species common and numerous only in some regions; 1% of parasites were reared from leafroller species in the third group, species of low frequency that occurred in low numbers in a limited area (Miczulski and Koslinska 1976).

In a study on *A. xylosteanus* in the Kyustendil district of Bugaria, parasitism of the eggs by a *Trichogramma* species was 2.9 to 29.2%; *Nythobia exareolata*, a *Scambus* species, and a *Parasierola* species were reared from the larvae (Kolev 1971, abstract).

In the genus *Archips*, there are at least 24 species in North America. As an example, the fruit-tree leafroller, *A. argyrospila*, is a wide-spread polyphagous pest on orchard trees throughout the northern United States and southern Canada (Kruse and Sperling 2002, 2001). Two species in the genus *Archips* are introduced: *A. rosana* introduced before 1890 and *A. fuscocupreana* introduced

before 1982 (Kruse and Sperling 2002). It is probable that biological control organisms, either native or introduced, are available for *A. xylosteanus*.

Cultural Control: In home gardens, removal of the rolled leaves on low-growing trees and shrubs may give a measure of population control; however, the effect could be minimal because of the unaffected larvae and pupae in the high branches of trees.

Resistance: Control by resistance is a possibility. A study of species composition of microlepidoptera on three species of wild cherry (*Prunus verecunda*, *P. apetala*, and *P. grayana*) found that species composition was quite different on the three species. Both *P. verecunda* and *P. apetala* were hosts for *A. xylosteanus*, but not *P. grayana*. In this study using a number of species, the results clearly show that the species composition of leaf-rolling microlepidoptera among the three wild cherries species was quite different, although the three cherries were sympatric species (Konno 2005).

Mass Trapping: Because a sex attractant exists (Frerot et al. 1983), population reduction by mass trapping or mating disruption is possible (Madsen and Madsen 1982, Stelinski et al. 2004).

PERTINENT POINTS:

Damage to Native Plants: Because the variegated golden tortrix feeds on a number of genera, this pest should be able to adapt to numerous native plants. As a result, significant damage may occur to native species and introduced crops.

Among the potential native hosts, probably very numerous, are the following species:

• *Betula papyrifera*	Canoe birch, paper birch	NE and NW North America
• *Fraxinus americana*	White ash	Nova Scotia to FL, west to TX
• *Malus coronaria*	American crabapple	Ont. and WI, south to NC, TN, and MO
• *Prunus pensylvanica*	Pin cherry	Lab. to BC, south to NC, IA, CO
• *P. serotina*	Black cherry	Nova Scotia to ND, south to FL and TX
• *P. virginiana*	Chokecherry	Nfld. to Sask., south to NC, MO, and KS
• *Quercus alba*	White oak	ME to FL and TX
• *Rhododendron maximum*	Great laurel, rosebay	NC to GA and AL
• *Tilia americana*	Amer. linden, basswood	New Brunswick, south to VA and TX
• *Ulmus americana*	American elm	Newfoundland to FL, w. to Rocky Mts.

Dispersal: For some tortricid species, first-instar larvae are transported on silken threads by air currents and wind (Hill 1987). This may be the case with *A. xylosteanus*; therefore, besides flight of the adult moths, transport of the larvae will aid dispersal.

Chemical Control in the United States: Because the fruit tree leafroller, *A. argyrospila*, and the codling moth, *Cydia pomonella*, are serious pests in the United States and Canada, chemical controls for these and other orchard pests will probably reduce the damage from *A. xylosteana*.

Biological Control in the United States: In the United States and Canada, the fruit-tree leafroller, *Archips argyrospila*, is a serious fruit orchard pest (Hill 1987). Because they are in the same genus, native biological control organism may be effective against *A. xylosteanus*. If native biological control organisms are not effective, the importation of European or Asian organisms may be necessary. Because minor pests often become major pests when introduced without their biological control organisms, importation of biological control organisms may be of particular importance.

Gillespie and Gillespie (1982) note that *A. podana* and *A. rosanus*, the European leafroller, have been introduced into the United States and Canada. It is possible that European and Asian biological control agents have been introduced with the exotic leafrollers.

Because the variegated golden tortrix is (1) likely to have an extended range in the United States, (2) likely to have numerous hosts, including several important fruit crops, and (3) likely to cause occasional damage on fruit crops, although probably rarely, the biological control agents in the United States should be compared with those in Europe and Asia to ensure full biological control.

Ecological Information: Climatic maps divide the world into zonobiomes (Breckle 2002, Walter et al. 1975). A zonobiome is a biome (plant/animal association) with a large and climatically uniform environment. In Europe and Asia the variegated golden tortrix is established in several zonobiomes:

• The Warm-Temperate Zonobiome	Zone V	NW Spain, Japan (possibly, a mention of Honshu by Shiraki)
• An intermediate zonobiome	Zone V-VI	Japan (Honshu) (Shiraki 1952)
• An intermediate zonobiome	Zone VI-IV	Bulgaria (Zhang 1994)
• An intermediate zonobiome	Zone VI-V	British Isles (Carter 1984)
• The Typical-Temperate Zonobiome	Zone VI	Germany (Zhang 1994)
• An intermediate zonobiome	Zone VI-VII	Ukraine (Zhang 1994)
• An intermediate zonobiome	Zone VI-VIII	Japan (Hokkaido) (Shiraki 1952) Lithuana (Zhang 1994)
• The Arid-Temperate Zonobiome	Zone VII	Southern Russia (?) (Carter 1984)
• An intermediate zonobiome	Zone VIII-VI	China (Heilongjiang) Sweden (Zhang 1994)

Because the variegated golden tortrix survives in a number of climatic zones in Europe, it will probably suvive in similar climatic zones in the United States. (See attached maps.)

Potential for Damage in the United States: The climatic zones in the United States most likely to be infested are the climatic zones of the northeastern United States: The Typical-Temperate Zonobiome (Zone VI) and an intermediate zononbiome (Zone V-VI). These zonobiomes contain very important temperate fruit-growing areas. According to the National Agricultural Statistics Service (USDA-NASS 2006), various fruit-growing areas are in these zonobiomes:

Table 1: Fruit Production in Selected States in 2004

States	Apples	Tart Cherries	Peaches	Pears
	Million pounds		Tons	
CA	410.0	-	949,000	269,000
MI	720.0	149.0	18,700	3,460
NY	1,100.0	10.7	6,000	16,500
NC	160.0	-	3,500	-
OR	166.0	3.9	3,300	210,000
PA	410.0	3.0	23,000	4,500
UT	32.0	22.0	-	300
VA	300.0	-	4,500	-
WA	5,900.0	17.5	19,500	386,000
US TOTAL	10,078.3	213.0	1,279,110	893,260
Source	Table 5-3	Table 5-23	Table 5-54	Table 5-59

In Japan, Shiraki (1952) states that "Citrus" is a host. However, Shiraki states that the variegated golden tortrix only occurs in Hokkaido and Honshu, not in Kyushu and the southern islands! If "Citrus" is really a host, the range of the variegated golden tortrix must extend into the Warm-Temperate Zonobiome (Zone V) and into even warmer zonobiomes, such as the Mediterranean-type Zonobiome (Zone IV) or an intermediate zonobiome (Zone II-V). In Europe, Leraut and Luquet (1995) state that the subspecies *sabrinae* occurs in southern France, Portugal, and Spain (article requested). (Extension even into the Warm-Temperate Zonobiome would affect peach production; as an example, Georgia is in the Warm-Temperate Zonobiome.)

In the *Guidelines on Good Plant Protection Practice: Pome Fruits*, the range of *A. xylosteanus* is given as "northern Europe" (OEPP/EPPO 2006). A range restricted to northern Europe would

indicate that damage would be likely in the northeastern United States. Leraut and Luquet (1995) report the present of *A. xylosteana* ssp. *sabrinae* in Algeria, southern France, Portugal, and Spain; however, the lateness of the report (1995) seems to indicate that this subspecies is of minor importance (article requested for confirmation).

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The Pherobase. 2006. Information on available pheromones, among them the pheromone for the variegated golden tortrix, is at the following website:
http://www.pherobase.com/database/family/family-Tortricidae.php

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