United States Department of Agriculture

Animal and Plant Health Inspection Service

Plant Protection and Quarantine

New Pest Response Guidelines

Variegated Golden Tortrix (*Archips xylosteanus*)

First Edition Issued 2012

Variegated Golden Tortrix

Contents

Variegated Golden Tortrix

Figures

Variegated Golden Tortrix

Tables

Variegated Golden Tortrix

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Cover Image

Images of *Archips xylosteanus* courtesy of Gyorgy Csoka, Hungary Forest Research Institute, http://www.bugwood.org.

Chapter

1

Introduction

Contents

Introduction

Use *New Pest Response Guidelines: Variegated Golden Tortrix (*Archips xylosteanus*)*, when designing a program to detect, monitor, control, contain, or eradicate an infestation of this insect in the United States and collaborating territories.

The United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine (USDA–APHIS–PPQ) developed the guidelines through discussion, meeting, or agreement with staff members at the USDA-Agricultural Research Service and advisors at universities.

Any new detection may require the establishment of an Incident Command System to facilitate emergency management. This document contains the necessary information to launch a response to a detection of the variegated golden tortrix.

If the variegated golden tortrix is detected, PPQ personnel will produce a site-specific action plan based on the guidelines. As the program develops and new information becomes available, the guidelines will be updated.

Users

The guidelines is intended as a reference for the following users who have been assigned responsibilities for a plant health emergency for variegated golden tortrix:

- PPQ personnel
- Emergency response coordinators
- State agriculture department personnel
- Others concerned with developing local survey or control programs

Contacts

When an emergency pest response program for variegated golden tortrix has been implemented, the success of the program depends on the cooperation, assistance, and understanding of other involved groups. The appropriate liaisons and information officers should distribute news of the program's progress and developments to interested groups, including the following:

- Academic entities with agricultural interests
- Agricultural interests in other countries
- Commercial interests
- Grower groups such as specific commodity or industry groups
- Land-grant universities and Cooperative Extension Services
- National, State and local news media
- Other Federal, State, county, and municipal agricultural officials
- Public health agencies
- The public
- State and local law enforcement officials
- Tribal governments

Initiating an Emergency Pest Response Program

An emergency pest response program consists of detection and delimitation, and may be followed by programs in regulation, containment, eradication and control. The New Pest Advisory Group (NPAG) will evaluate the pest. After assessing the risk to U.S. plant health, and consulting with experts and regulatory personnel, NPAG will recommend a course of action to PPQ management.

Follow this sequence when initiating an emergency pest response program:

1. A new or reintroduced pest is discovered and reported
2. The pest is examined and pre-identified by regional or area identifier
3. The pest's identity is confirmed by a national taxonomic authority recognized by USDA–APHIS–PPQ-National Identification System
4. Published New Pest Response Guidelines are consulted or a new NPAG is assembled in order to evaluate the pest
5. Depending on the urgency, official notifications are made to the National Plant Board, cooperators, and trading partners
6. A delimiting survey is conducted at the site of detection
7. An Incident Assessment Team may be sent to evaluate the site
8. A recommendation is made, based on the assessment of surveys, other data, and recommendation of the Incident Assessment Team or the NPAG, as follows:
   - **A.** Take no action
   - **B.** Regulate the pest
   - **C.** Contain the pest
   - **D.** Suppress the pest
   - **E.** Eradicate the pest
9. State Departments of Agriculture are consulted
10. If appropriate, a control strategy is selected
11. A PPQ Deputy Administrator authorizes a response
12. A command post is selected and the Incident Command System is implemented
13. State departments of agriculture cooperate with parallel actions using a Unified Command structure

14. Traceback and trace-forward investigations are conducted
15. Field identification procedures are standardized
16. Data reporting is standardized
17. Regulatory actions are taken
18. Environmental Assessments are completed as necessary
19. Treatment is applied for required pest generational time
20. Environmental monitoring is conducted, if appropriate
21. Pest monitoring surveys are conducted to evaluate program success
22. Programs are designed for eradication, containment, or long-term use

Preventing an Infestation

Federal and State regulatory officials must conduct inspections and apply prescribed measures to ensure that pests do not spread within or between properties. Federal and State regulatory officials conducting inspections should follow the sanitation guidelines in the section *Preparation, Sanitization, and Clean-Up* on page 4-2 before entering and upon leaving each property to prevent contamination.

Scope

The guidelines is divided into the following chapters:

1. *Introduction* on page 1-1
2. *Pest Information* on page 2-1
3. *Identification* on page 3-1
4. *Survey Procedures* on page 4-1
5. *Regulatory Procedures* on page 5-1
6. *Control Procedures* on page 6-1
7. *Environmental Compliance* on page 7-1
8. *Pathways* on page 8-1

The guidelines also includes appendixes, a references section, a glossary, and an index.

The Introduction contains basic information about the guidelines. This chapter includes the guideline's purpose, scope, users, and application; a list of related documents that provide the authority for the guidelines content; directions about how to use the guidelines; and the conventions (unfamiliar or unique symbols and highlighting) that appear throughout the guidelines.

Authorities

The regulatory authority for taking the actions listed in the guidelines is contained in the following authorities:

- Plant Protection Act of 2000 (Statute 7 USC 7701-7758)
- Executive Order 13175, Consultation and Coordination with Indian and Tribal Governments
- Fish and Wildlife Coordination Act
- National Historic Preservation Act of 1966
- Endangered Species Act
- Endangered and Threatened Plants (50 CFR 17.12)
- National Environmental Policy Act

Program Safety

Safety of the public and program personnel is a priority in pre-program planning and training and throughout program operations. Safety officers and supervisors must enforce on-the-job safety procedures.

Support for Program Decisionmaking

USDA–APHIS–PPQ-Center for Plant Health, Science and Technology (CPHST) provides technical support to emergency pest response program directors about risk assessments, survey methods, control strategies, regulatory treatments, and other aspects of pest response programs. PPQ managers meet with State departments of agriculture in developing guidelines and policies for pest response programs.

How to Use the Guidelines

The guidelines is a portable electronic document that is updated periodically. Download the current version from its source, and then use Adobe Reader® to view it on your computer screen. You can print the guidelines for convenience. However, links and navigational tools are only functional when the document is viewed in Adobe Reader®. Remember that printed copies of the guidelines are obsolete once a new version has been issued.

Conventions

Conventions are established by custom and are widely recognized and accepted. Conventions used in the guidelines are listed in this section.

Advisories

Advisories are used throughout the guidelines to bring important information to your attention. Please carefully review each advisory. The definitions have been updated so that they coincide with the America National Standards Institute (ANSI) and are in the format shown below.

EXAMPLE Example provides an example of the topic.

Important Important indicates information that is helpful.

CAUTION

CAUTION indicates that people could possibly be endangered and slightly hurt.

DANGER

DANGEROUS indicates that people could easily be hurt or killed.

NOTICE

NOTICE indicates a possibly dangerous situation where goods might be damaged.

⚠ WARNING

WARNING indicates that people could possibly be hurt or killed.

Boldfacing

Boldfaced type is used to highlight negative or important words. These words are: never, not, do not, other than, prohibited.

Lists

Bulleted lists indicate that there is no order to the information being listed. Numbered lists indicate that information will be used in a particular order.

Disclaimers

All disclaimers are located on the unnumbered page that follows the cover.

Table of Contents

Every chapter has a table of contents that lists the heading titles at the beginning to help facilitate finding information.

Control Data

Information placed at the top and bottom of each page helps users keep track of where they are in the guidelines. At the top of the page is the chapter and first-level heading. At the bottom of the page is the month, year, title, and page number. PPQ-Emergency and Domestic Programs-Emergency Programs is the unit responsible for the content of the guidelines.

Change Bar

A vertical black change bar in the left margin is used to indicate a change in the guidelines. Change bars from the previous update are deleted when the chapter or appendix is revised.

Decision Tables

Decision tables are used throughout the guidelines. The first and middle columns in each table represent conditions, and the last column represents the action to take after all conditions listed for that row are considered. Begin with the column headings and move left-to-right, and if the condition does not apply, then continue one row at a time until you find the condition that does apply.

Table 1-1 How to Use Decision Tables

If you:	And if the condition applies:	Then:
Read this column cell and row first	Continue in this cell	TAKE the action listed in this cell
Find the previous condition did not apply, then read this column cell	Continue in this cell	TAKE the action listed in this cell

Footnotes

Footnotes comment on or cite a reference to text and are referenced by number. The footnotes used in the guidelines include general text footnotes, figure footnotes, and table footnotes. General text footnotes are located at the bottom of the page.

When space allows, figure and table footnotes are located directly below the associated figure or table. However, for multi-page tables or tables that cover the length of a page, footnote numbers and footnote text cannot be listed on the same page. If a table or figure continues beyond one page, the associated footnotes will appear on the page following the end of the figure or table.

Heading Levels

Within each chapter and section there can be four heading levels; each heading is green and is located within the middle and right side of the page. The first-level heading is indicated by a horizontal line across the page, and the heading follows directly below. The second-, third-, and fourth-level headings each have a font size smaller than the preceding heading level. The fourth-level heading runs in with the text that follows.

Hypertext Links

Figures, headings, and tables are cross-referenced in the body of the guidelines and are highlighted in boldface type. These appear in blue hypertext in the online guidelines.

Italics

The following items are italicized throughout the guidelines:

- Cross-references to headings and titles
- Names of publications
- Scientific names

Numbering Scheme

A two-level numbering scheme is used in the guidelines for pages, tables, and figures. The first number represents the chapter. The second number represented the page, table, or figure. This numbering scheme allows for identifying and updating. Dashes are used in page numbering to differentiate page numbers from decimal points.

Transmittal Number

The transmittal number contains the month, year, and a consecutively-issued number (beginning with -01 for the first edition and increasing consecutively for each update to the edition). The transmittal number is only changed when the specific chapter sections, appendixes, or glossary, tables, or index is updated. If no changes are made, then the transmittal number remains the unchanged. The transmittal number only changes for the entire guidelines when a new edition is issued or changes are made to the entire guidelines.

Acknowledgements

Writers, editors, reviewers, creators of cover images, and other contributors to the guidelines, are acknowledged in the acknowledgements section. Names, affiliations, and Web site addresses of the creators of photographic images, illustrations, and diagrams, are acknowledged in the caption accompanying the figure.

How to Cite the Guidelines

Cite the guidelines as follows: U.S. Department of Agriculture, Animal Plant Health Inspection Service, Plant Protection and Quarantine. 2011. *New Pest Response Guidelines: Variegated Golden Tortrix (*Archips xylosteanus*)*. Washington, D.C.: Government Printing Office. http://www.aphis.usda.gov/import_export/plants/manuals/online_manuals.shtml

How to Find More Information

Contact USDA–APHIS–PPQ–EDP-Emergency Management for more information about the guidelines. Refer to *Resources* on page A-1 for contact information.

Chapter

2

Pest Information

Contents

Introduction

Use *Chapter 2 Pest Information* to learn more about the classification, history, host range, and biology of the variegated golden tortrix (*Archips xylosteanus* Linneaus 1758).

Classification

The variegated golden tortrix (VGT) belongs in the phylum Arthropoda, class Insecta, order Lepidoptera, family Tortricidae, and species *Archips xylosteanus*. Use *Table 2-1* on page 2-2 as a guide to the classification of the VGT and the names used to describe it in the guidelines.

Both *Archips xylosteanus* and *Archips xylosteana* are the same organism. The ending (-a, -us) indicates agreement of gender with the genus (Dombroskie, 2010). Do not confuse with the Xylosteana group of *Archips*, which is a subdivision of the genus and consists of 28 different described species, one of which is *Archips xylosteanus* (Kruse and Sperling, 2002).

Table 2-1 Classification of *Archips xylosteanus*

Phylum	Arthropoda
Class	Insecta
Order	Lepidoptera
Family	Tortricidae
Genus	*Archips*
Full Name	*Archips xylosteanus* Linnaeus 1758
Preferred Common Name	variegated golden tortrix (Carter, 1984, Meijerman and Ulenberg, 2006)
Synonyms	*characterana* Hübner *densana* Villers *densata* Fourcroy *gilvana* Eversmann *hybnerana* Fabricius *obliquana* Fabricius, *pallens* Kennel *westriniana* Thunberg and Borgstroem (Brown, 2005, Brown, 2010)
Subspecies	*sabrinae* Leraut and Luquet (subspecies) (Brown, 2005, Brown, 2010)
Other Common Names	brown oak tortrix moth (Alford, 1991), brown oak tortrix (Dickler, 1991, Riedl and Avilla, 2007), apple leafroller (CABI, 1994, Meijerman and Ulenberg, 2006), tordeuse verte du theier (France; CABI, 1994), apple leaf roller (FAO, 2007), kakumon-hamaki (Japan; CABI, 1994), bladroller bruingevlekte (Netherlands; CABI, 1994), yaprak buken (Turkey; CABI, 1994), kukumon-hamaki (Kakumon-hamakiga; ringo-no-hamakimushi; Hamaki; Hamakimushi) (Shiraki, 1952)

Historical Information

The variegated golden tortrix (VGT) is a leaf-roller native to Europe and Asia (Hoebeke et al., 2008). It is polyphagous and can damage the leaves of its host trees (Alford, 1991). In August of 2005 during a routine survey for non-native (immigrant) insects, adults of VGT were collected by beating branches and foliage of a variety of ornamental trees and shrubs on the campus of Memorial University in St. John's, Newfoundland, by A.G. Wheeler and E. R. Hoebeke (Hoebeke et al., 2008). This is the first record of VGT in both North America and the Nearctic Region (Hoebeke et al., 2008). Twenty-four native species in the genus *Archips* are known in North America, and *A. xylosteanus* is the fifth immigrant *Archips* species discovered here after *A. fuscocupreana*, *A. oporana*, *A. podana*, and *A. rosana* (Hoebeke et al., 2008; Jason Dombroskie, personal communication).

St. John's, Newfoundland, is located 60 miles off the coast of Maine (*Figure 2-1* on page 2-4). Although tortricid moths are strong fliers they cannot fly that distance (FAO, 2007). However, the variegated golden tortrix can be transported on people travelling from Newfoundland to Maine or from Newfoundland to the mainland of Canada, at which point it can establish and quickly move across the border to the United States by natural means (Eggert, 2006).

In its native habitat, the variegated golden tortrix is controlled by native egg and larval parasitoids (Meijerman and Ulenberg, 2006), but agents of natural control may not be present when the VGT reaches the United States. There are a large number of possible hosts and therefore a high potential for economic and environmental damage by VGT.

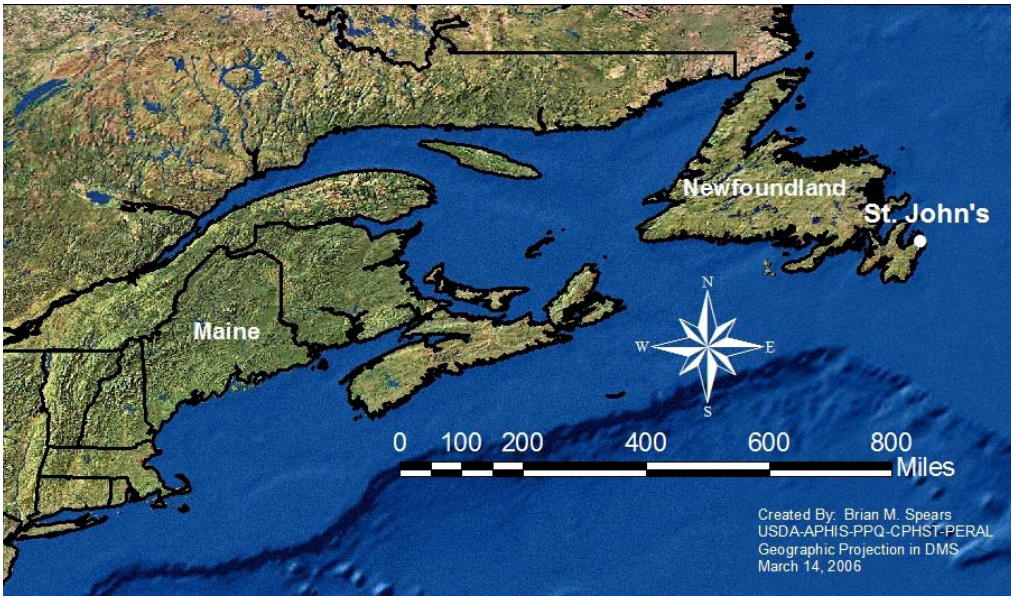

Figure 2-1 Distance From St. John's Newfoundland to Maine

Ecological Range

The variegated golden tortrix (VGT) is native to most of Europe, central and eastern Asia, Japan, China, and northern Africa (Hoebeke et al., 2008, Razowski, 1977, Alford, 1991, Carter, 1984, Meijerman and Ulenberg, 2006, Byun et al., 2003).

Asia. China (1994; Byun et al., 2003, Razowski, 1977, Hoebeke et al., 2008, Meijerman and Ulenberg, 2006), Iran (Hoebeke et al., 2008), Japan (Razowski, 1977, Meijerman and Ulenberg, 2006, Hoebeke et al., 2008), Kazakhstan (Meijerman and Ulenberg, 2006, Hoebeke et al., 2008), Korea (North and South) (Byun et al., 2003, Meijerman and Ulenberg, 2006, Razowski, 1977, Hoebeke et al., 2008), Russia (Siberia and eastern Russia) (Meijerman and Ulenberg, 2006, Hoebeke et al., 2008), Turkey (Riedl and Avilla, 2007, Hoebeke et al., 2008), Turkmenistan (Meijerman and Ulenberg, 2006, Byun et al., 2003, Hoebeke et al., 2008)

Africa. Algeria (Hoebeke et al., 2008)

Europe. Bulgaria (Velcheva, 2009, FAO, 2007), France, Germany, Lithuania, Poland, Portugal, Romania, Spain, Sweden, United Kingdom, Ukraine (Hoebeke et al., 2008), Croatia (Trematerra and Baldizzone, 2004), Republic of Moldova (FAO, 2007)

North America. Canada (St. John's, Newfoundland) (Hoebeke et al., 2008)

Potential Distribution

At least two views exist regarding the risk potential of the variegated golden tortrix: Either the entire United States has a suitable climate and the pest will enter in the northeastern United States and establish there first; or, the climatic zones in the northeastern United States (Typical-Temperate zonobiome (Zone VI) and an intermediate zonobiome (Zone V to VI)) are most likely to be infested. These zonobiomes include important temperate fruit-growing areas.

Because this pest is polyphagous, hosts can be found across the United States with a majority of the hosts on the east and west coasts (*Distribution of Hosts* on page E-1).

Comparing locations of the variegated golden tortrix to zonobiomes leads one to interpret that it occurs in zonobiomes V through VIII. If VGT is found on citrus in Japan (Shiraki, 1952) and Spain (Alfaro, 1950), and occurs in Algeria (subspecies *sabrinae*) (Leraut and Luquet 1995, 1996), then it also occurs in zonobiome IV and possibly zonobiome III. Thus, VGT potentially could occupy most of the conterminous United States. Even if the pest can't occupy zonobiomes III and IV, only small areas in the southern United States would be immune. Zonobiomes V and VI in the United States contain important temperate fruit-growing areas. If VGT were introduced into these areas without natural enemies, the economic impact could be significant.

Refer to *Distribution of Hosts* on page E-1 for more risk maps of specific host genera (*Malus, Pyrus*, *Prunus, Ribes*, *Rubus*, and *Quercus* species).

Pest Development Maps

NAPPFAST (North Carolina State University APHIS Plant Pest Forecasting System) maps were used in this section to describe the potential distribution.

In a cooperative venture, North Carolina State University (NCSU), USDA–APHIS, and the information technology company ZedX, Inc., developed the Web tool known as NAPPFAST. NAPPFAST uses weather, climate, and soil data, to model pest development. The models supply the predictive pest mapping needs of the Cooperative Agricultural Pest Survey (CAPS) program. In addition, the models produce potential establishment maps for exotic pests, which supports the risk assessment activities of the Plant Epidemiology Risk Assessment Laboratory (PERAL).

Figure 2-2 on page 2-6 is the NAPPFAST risk map for establishment potential based on climatic suitability of variegated golden tortrix in the conterminous United States. The NAPPFAST risk map describes the relative climatic suitability (on a scale of 1 to 10) for a pest to grow and survive. The maps are

based on 10-years of daily data from NAPPFAST. A value of 1 represents a low likelihood of pest growth and survival, while a 10 indicates high likelihood of pest growth and survival.

Figure 2-3 on page 2-7 is the host risk map of relative density (on a scale of 1 to 10) of susceptible hosts of variegated golden tortrix in the conterminous United States. The map is based on National Agricultural Statistics Service (NASS) data and Forest Inventory and Analysis (FIA) data. The scale of 1 to 10 describes the proportion of total host acreage per county: for example, a rank of 1 indicates no host acreage, while a score of 10 indicates that 75 to 100 percent of the acres in the county contain suitable hosts for the pest.

Figure 2-4 on page 2-7 is the risk map for establishment potential of variegated golden tortrix in the conterminous United States. This risk map describes the combined host and climatic suitability on a scale of 1 to 10.

How to Download Risk Maps from NAPPFAST

The risk maps featured in this section can be downloaded from the NAPPFAST Web site.

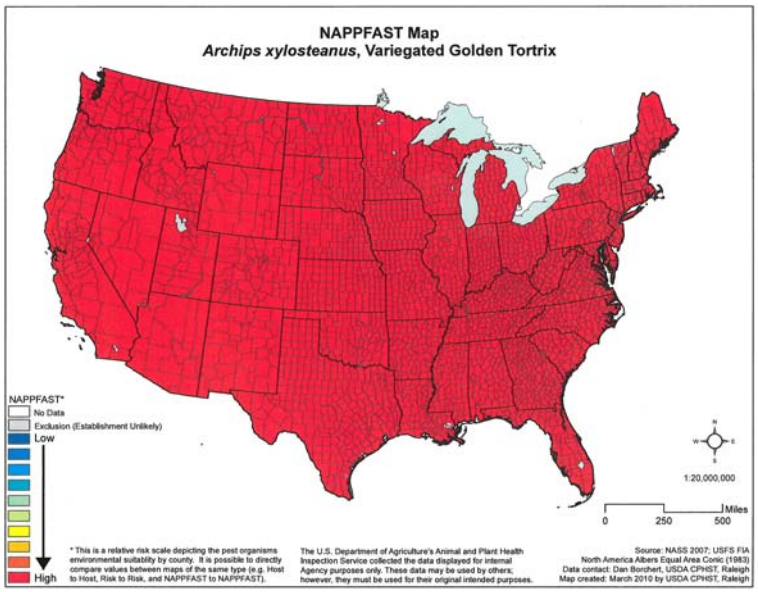

Figure 2-2 Risk Map Based on Climatic Suitability for Establishment Potential for *Archips xylosteanus* Within the Continental United States (http://www.nappfast.org/)

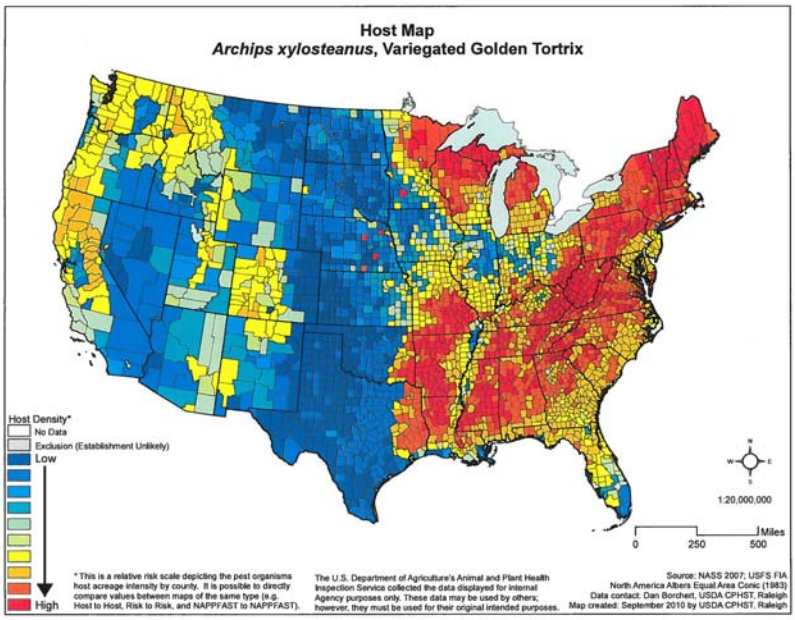

Figure 2-3 Host Risk Map for Establishment Potential Based on *Archips xylosteanus* Within the Continental United States (http:// www.nappfast.org/)

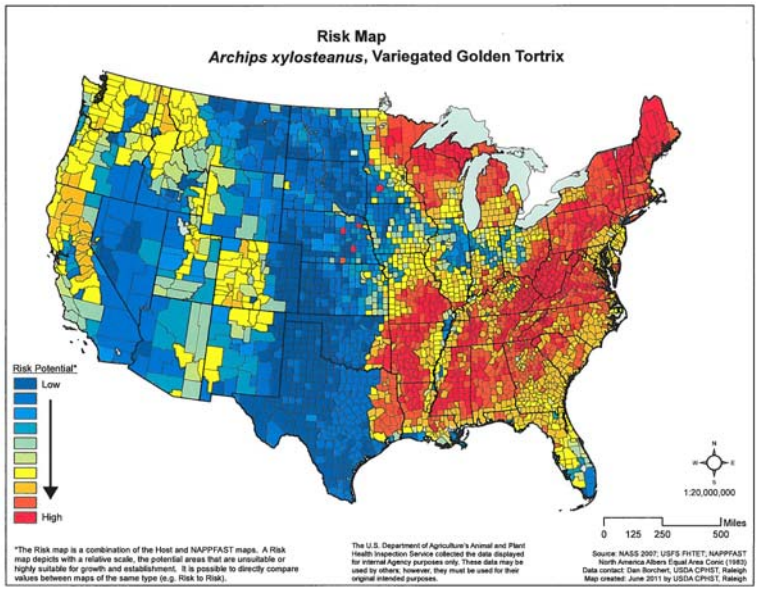

Figure 2-4 Risk Map for Establishment Potential Based on Host and Climatic Suitability of *Archips xylosteanus* in the Conterminous United States (http://www.nappfast.org/)

Economic Impact

The variegated golden tortrix (VGT) is polyphagous (Carter, 1984, Hoebeke et al., 2008, Meijerman and Ulenberg, 2006), feeding on numerous plant genera in many plant families. Potential hosts include both wild and commercial species that occur throughout the United States. Although VGT is known as a minor or occasional pest in its native range (Carter, 1984, Alford, 1991, Razowski, 1977), it is also controlled with naturally occurring egg and larval parasitoids (Meijerman and Ulenberg, 2006). It also may occur in conjunction with other leaf-rollers making the specific contribution of VGT to the overall damage almost impossible to distinguish (FAO, 2007).

Although variegated golden tortrix could potentially enter the United States via shipping routes from countries in which it is already present, there have been no incidences of *Archips xylosteanus* in the PPQ PestID database. Therefore, the most likely entry point into the United States may be Maine because VGT is established in St. John's, Newfoundland (Hoebeke et al., 2008, Eggert, 2006). Although VGT is polyphagous, some of the main hosts are in Rosaceae, more specifically *Prunus* spp, *Malus* spp., and *Pyrus* spp. Maine is an important apple producing state in New England with 3100 bearing acres and a crop value of 13.6 million dollars in 2009 (NASS, 2010). In the US, apple acreage was 347,800 with a utilized production value of $2,246,584,000 in 2009.

Other fruit tree crops in the United States with the potential to be affected by the variegated golden tortrix include the following: sweet cherry (85,310 bearing acres and $505,881,000 utilized production in 2009); tart cherry (35,550 bearing acres and $63,231,000 utilized production in 2009); peaches (118,830 bearing acres and $593,653,000 utilized production in 2009); and pears (57,000 bearing acres and $355,192,000 utilized production in 2009) (NASS, 2010). If the variegated golden tortrix moves far enough south for citrus to become a host, the economic impact can be much greater.

Hosts

The variegated golden tortrix (VGT) is polyphagous (Carter, 1984, Hoebeke et al., 2008, Meijerman and Ulenberg, 2006). Yasuda (1972) reports VGT as a pest of all Rosaceae. Shiraki (1952) reported that the VGT is a pest of citrus, but the report may be questionable because he also reported that the VGT is only present in areas without citrus.

Table 2-2 Reported True Hosts for the Variegated Golden Tortrix (continued)

Family	Scientific	Common	Source
Pinaceae	*Abies* Mill.	fir	Meijerman and Ulenberg, 2006; Razowski, 1977; Bradley et al., 1973
Aceraceae	*Acer* L.	maple	Trematerra and Baldizzone, 2004; Meijerman and Ulenberg, 2006; Razowski, 1977; FAO, 2007; Bradley et al., 1973
Betulaceae	*Alnus japonica* (Thunb.) Steud.	Japanese alder	Yasuda, 1972
Betulaceae	*Alnus japonica* var. rufa Nak.	--	Lia 1983 via Byun et al., 2003
Betulaceae	*Alnus* Mill.	alder	Yasuda, 1972
Betulaceae	*Betula* L.	birch	Lia 1983 via Byun et al., 2003, Trematerra and Baldizzone, 2004, Meijerman and Ulenberg, 2006, Yasuda, 1972, Razowski, 1977
Asteraceae	*Calendula officinalis* L.	pot marigold	CABI (1994)
Theaceae	*Camellia* L.	camellia	Lia (1983) via Byun et al., (2003)
Fagaceae	*Castanea crenata* Siebold & Zucc.	Japanese chestnut	Yasuda (1972)
Fagaceae	*Castanea* Mill.	chestnut	Meijerman and Ulenberg, (2006); Yasuda (1972)
Cornaceae	*Cornus controversa* Hemsl. ex Prain	giant dogwood	Yasuda (1972)
Betulaceae	*Corylus avellana*	hazel	(Bradley et al., 1973)

Table 2-2 Reported True Hosts for the Variegated Golden Tortrix (continued)

Family	Scientific	Common	Source
Betulaceae	*Corylus* L.	hazelnut	(Meijerman and Ulenberg, 2006, Gantner, 2003)
Rosaceae	*Crataegus* L.	hawthorn	(Trematerra and Baldizzone, 2004, Meijerman and Ulenberg, 2006, Razowski, 1977)
Fagaceae	*Fagus* L.	beech	(Meijerman and Ulenberg, 2006)
Apiaceae	*Foeniculum* Mill.	fennel	(CABI, 1994)
Oleaceae	*Fraxinus excelsior* L.	European ash	(Alford, 1991)
Oleaceae	*Fraxinus mandishurica* Rupr.	Manchurian ash	(Lia 1983 via Byun et al., 2003)
Oleaceae	*Fraxinus* L.	ash	(Meijerman and Ulenberg, 2006, FAO, 2007)
Clusiaceae	*Hypericum monogynum* L.	--	(Lia 1983 via Byun et al., 2003)
Clusiaceae	*Hypericum* L.	St. Johnswort	(Meijerman and Ulenberg, 2006)
Caprifoliaceae	*Lonicera japonica* Thunb.	Japanese honeysuckle	(Lia 1983 via Byun et al., 2003)
Caprifoliaceae	*Lonicera periclymenum*	honeysuckle	(Bradley et al., 1973)
Caprifoliaceae	*Lonicera* L.	honeysuckle	(Trematerra and Baldizzone, 2004, Meijerman and Ulenberg, 2006, Razowski, 1977)
Rosaceae	*Malus pumila* Mill.	paradise apple	(Carter, 1984, Alfaro, 1950, Lia 1983 via Byun et al., 2003)
Rosaceae	*Malus* Mill.	apple	(Trematerra and Baldizzone, 2004, Meijerman and Ulenberg, 2006)
Rosaceae	*Malus* x *domestica* Borkh.	apple	(1994, Yasuda, 1972, Bulgaria (Velcheva, 2009)
Myricaceae	*Morella rubra* Lour. (listed as *Myrica rubra* Siebold et Zucc.)	red bayberry	(Lia 1983 via Byun et al., 2003)
Myricaceae	*Myrica* L.	sweetgale	(Meijerman and Ulenberg, 2006)

Table 2-2 Reported True Hosts for the Variegated Golden Tortrix (continued)

Family	Scientific	Common	Source
Betulaceae	*Nothofagus oblique* (Birb.) Blume	roble beech	(Welch and Greatorex-Davies, 1993)
Pinaceae	*Pinus* L.	pine	(Lia 1983 via Byun et al., 2003)
Salicaceae	*Populus alba* L.	white poplar	(Alfaro, 1950)
Salicaceae	*Populus nigra* L.	lombardy poplar	(Alfaro, 1950)
Salicaceae	*Populus* L.	cottonwood	(Lia 1983 via Byun et al., 2003)
Rosaceae	*Prunus armeniaca* L.	apricot	(CABI, 1994, Byun et al., 2003)
Rosaceae	*Prunus avium* (L.) L.	sweet cherry	(CABI, 1994, Razowski, 1977, Meijerman and Ulenberg, 2006)
Rosaceae	*Prunus cerasus* L.	sour cherry	(Carter, 1984; Dickler, 1991)
Rosaceae	*Prunus domestica* L.	plum	(Carter, 1984; Dickler, 1991, Razowski, 1977, Meijerman and Ulenberg, 2006)
Rosaceae	*Prunus persica* (L.) Batsch	peach	(CABI, 1994)
Rosaceae	*Prunus salicina* Lindl.	Japanese plum	
Rosaceae	*Prunus serrulata* Lindl	--	(Gilligan, 2010)
Rosaceae	*Prunus* L.	plum	(Yasuda, 1972, Meijerman and Ulenberg, 2006)
Rosaceae	*Pyrus communis* L.	common pear	(Carter, 1984; Dickler, 1991, Alfaro, 1950, Razowski, 1977, Meijerman and Ulenberg, 2006)
Rosaceae	*Pyrus pyrifolia* (Burm. f.) Nakai	--	(Gilligan, 2010)
Rosaceae	*Pyrus simoni*	pear	(Yasuda, 1972)
Rosaceae	*Pyrus* L.	pear	(Lia 1983 via Byun et al., 2003, Meijerman and Ulenberg, 2006, Trematerra and Baldizzone, 2004)
Rosaceae	*Pyrus ussuriensis* Maxim.	--	(Gilligan, 2010)

Table 2-2 Reported True Hosts for the Variegated Golden Tortrix (continued)

Family	Scientific	Common	Source
Fagaceae	*Quercus acutissima* Carruthers	sawtooth oak	(Yasuda, 1972)
Fagaceae	*Quercus cerris* L.	--	(Gilligan, 2010)
Fagaceae	*Quercus dentata* Thunb.	daimyo oak	(Yasuda, 1972)
Fagaceae	*Quercus ilex* L.	holm oak	(CABI, 1994)
Fagaceae	*Quercus petraea* (Mattuschka) Liebl.	durmast oak	(Zwolfer and Kraus, 1957)
Fagaceae	*Quercus robur* L.	common oak	(CABI, 1994)
Fagaceae	*Quercus serrata* Thunb.	bao li	(Yasuda, 1972)
Fagaceae	*Quercus* L.	oak	(Meijerman and Ulenberg, 2006, FAO, 2007, FAO, 2007, Zwolfer and Kraus, 1957)
Ericaceae	*Rhododendron* L.	rhododendron	(Carter, 1984, Razowski, 1977)
Grossulariaceae	*Ribes uva-crispa* L. var. *sativum* DC. (listed as *Ribes grossularia* L.)	gooseberry	(Carter, 1984)
Rosaceae	*Rosa canina* L.	dog rose	(CABI, 1994)
Rosaceae	*Rubus fruticosus* L.	European blackberry	(Alfaro, 1950)
Rosaceae	*Rubus idaeus* L.	American red raspberry	(Carter, 1984, Lia 1983 via Byun et al., 2003, Razowski, 1977, Meijerman and Ulenberg, 2006)
Rosaceae	*Rubus* spp.	Brambles	(Bradley et al., 1973)
Rosaceae	*Salix cinerea* L.	--	(Gilligan, 2010)
Salicaceae	*Salix koreensis* Andersson	--	(Lia 1983 via Byun et al., 2003)
Salicaceae	*Salix* L.	willow	(Yasuda, 1972, Meijerman and Ulenberg, 2006)
Solanaceae	*Solanum* L.	nightshade	(CABI, 1994)
Rosaceae	*Sorbus aucuparia* L.	--	(Gilligan, 2010)
Rosaceae	*Sorbus* L.	mountain ash	Meijerman and Ulenberg, 2006

Table 2-2 Reported True Hosts for the Variegated Golden Tortrix (continued)

Family	Scientific	Common	Source
Tiliaceae	*Tilia* L.	basswood	(Lia 1983 via Byun et al., 2003, Meijerman and Ulenberg, 2006, Razowski, 1977)
Ulmaceae	*Ulmus davidiana* Planch.	Japanese elm	(Yasuda, 1972)
Ulmaceae	*Ulmus* L.	elm	(Meijerman and Ulenberg, 2006, FAO, 2007)

Life Cycle

The variegated golden tortrix (VGT) undergoes complete metamorphosis from egg to larva to pupa to adult.

Eggs

The VGT overwinters as an egg on the branches of host plants (Byun et al., 2003, Dickler, 1991). Eggs are cylindrical (Meijerman and Ulenberg, 2006), laid in imbricate (shingle-like) clusters, and covered with a brownish or purplish brown secretion that camouflages them against the bark of trunks and branches of trees and shrubs (Alford, 1991, Carter, 1984). Eggs are reported to be laid in autumn (Umeya, 1950).

Eggs do not diapause and hatch within a month of oviposition if the temperature is suitable. The optimum temperature is 25°C, although development may proceed when temperature is from 15 to 20°C. The embryo forms all appendages within this month; development stops under low temperatures. Development resumes again in the spring with blastokinesis (early April). Soon afterward, larval formation takes place and hatching occurs in late April or in the beginning of May (Umeya, 1950).

Larvae

Eggs hatch (in England) from late April to early May (Alford, 1991), or from late March to early April (Razowski, 1977). After hatching, the young larvae attack the new buds of the host (Byun et al., 2003) or feed on the underside of leaves (Meijerman and Ulenberg, 2006). They then move to the flowers and young fruits (Byun et al., 2003). From April to June (Carter, 1984) the larvae feed primarily on leaves (Meijerman and Ulenberg, 2006, Dickler, 1991, Riedl and Avilla, 2007), specifically on the underside (Meijerman and Ulenberg, 2006) and tie leaves together, making a rolled shelter open on each end, from which they forage (Byun et al., 2003). When not feeding the larva stays in this tightly rolled leaf (Alford, 1991, Meijerman and Ulenberg, 2006). In June, larvae begin to pupate (Byun et al., 2003).

Eggs hatch (in England) from late April to early May (Alford, 1991), or from late March to early April (Razowski, 1977). After hatching, the young larvae attack the new buds of the host (Byun et al., 2003) or feed on the underside of leaves (Meijerman and Ulenberg, 2006), then move to the flowers and young fruits (Byun et al., 2003). From April to June (Carter, 1984), the larvae feed primarily on leaves (Meijerman and Ulenberg, 2006, Dickler, 1991, Riedl and Avilla, 2007) on the underside (Meijerman and Ulenberg, 2006). Their feeding ties the leaves together, forming a rolled shelter open on each end from which larvae forage (Byun et al., 2003). When not feeding, the larvae stay in this tightly rolled leaf (Alford, 1991, Meijerman and Ulenberg, 2006). In June, larvae begin to pupate (Byun et al., 2003).

Pupae

Pupation occurs in June (in Europe) within the rolled leaf or between two spun leaves (Meijerman and Ulenberg, 2006, Carter, 1984). Adults emerge a few weeks later (Meijerman and Ulenberg, 2006).

Adults

Adults have been recorded from late June to early August in Europe (Carter, 1984, Alford, 1991, Meijerman and Ulenberg, 2006), and from late May to early July in Japan (Meijerman and Ulenberg, 2006). They are most active at dusk (Carter, 1984). The variegated golden tortrix is univoltine (one generation per year) (Dickler, 1991, Byun et al., 2003).

Each female may lay 200 to 300 eggs in several egg masses of 5 to 8 eggs each (Razowski, 1977).

Behavior

Upon hatching, larvae feed at the green tip stage of buds of the host plants. Soon after, they construct a shelter from tightly rolled leaves (FAO, 2007). Under certain conditions the variegated golden tortrix (VGT) may become a broadleaf defoliator (FAO, 2007), and larval feeding has been reported to disfigure host plants when confined mainly to fully expanded leaves; however, such damage may have little or no significant impact on the host (Alford, 1991).

The species has been reported as a minor pest of ornamental trees and shrubs in Britain, and as pest of fruit trees and bushes in Europe (Carter, 1984, Meijerman and Ulenberg, 2006). Alford (1991) reported VGT to be common on trees, shrubs, and some herbaceous plants in woodland habitats; minor infestations occur occasionally in gardens and nurseries. Moths in the family Tortricidae are strong fliers and the first-instar larvae of some species are transported on silken threads by air currents and wind (FAO, 2007).

Environmental Impact

The plants listed on the Federally Registered Threatened and Endangered Species list that may be attacked by the variegated golden tortrix (VGT) are listed in *Table 2-3* on page 2-15. In addition to these, species in the Rosaceae family are known to be hosts of VGT and in addition to *Prunus geniculata*, there are five Rosaceae species listed as threatened or endangered: *Acaena exigua, Cercocarpus traskiae, Geum radiatum, Ivesia kingie* var. *eremica*, and *Potentilla hickmanii*.

Table 2-3 Potentially Threatened and Endangered[1] Hosts of the Variegated Golden Tortrix[2]

Scientific Name	Common Name	Family Name	U.S. Location
Betula uber	Virginia round-leaf birch	Betulaceae	VA
Hypericum cumulicola	highlands scrub hypericum	Hypericaceae	FL
Prunus geniculata	scrub plum	Rosaceae	FL
Quercus hinckleyi	Hinckley oak	Fagaceae	TX
Rhododendron chapmanii	Chapmon rhododendron	Ericaceae	FL
Solanum drymophilum	erubia	Solanaceae	Puerto Rico
Solanum incompletum	popolo ku mai	Solanaceae	HI
Solanum sandwicense	popolo ‘aiakeakua	Solanaceae	HI

1 Endangered and Threatened Plants (50 CFR 17.12).

2 USFWS (2011).

Chapter

3

Identification

Contents

Introduction

Use *Chapter 3 Identification* as a guide to recognizing the variegated golden tortrix (*Archips xylosteanus* Linneaus 1758).

Authorities

Qualified State, County, or cooperating university, personnel may do the preliminary identification and screening of suspect variegated golden tortrix (VGT). Before survey and control activities are initiated in the United States, an authority recognized by USDA–APHIS–PPQ-National Identification Services must confirm the identity of such pests. Submit specimens to the USDA-National Identification Services (NIS). For further information refer to *How to Submit Plant Samples* on page C-1 and *Taxonomic Support for Surveys* on page D-1.

Reporting

Forward reports of positive identifications by national specialists to PPQ-National Identification Service (NIS) in Riverdale, Maryland, according to Agency protocol. NIS will report the identification status of these tentative and confirmed records to PPQ-Emergency and Domestic Programs (EDP). EDP will report the results to all other appropriate parties. For further information refer to *Taxonomic Support for Surveys* on page D-1.

Description

Refer to Hoebeke et al. (2008) in *Supporting Publication* on page H-1 for the descriptions and diagnostic images necessary to identify suspected variegated golden tortrix (VGT); or, use the sequencing protocols for Tortricidae used by T. M. Gilligan at Colorado State University (Gilligan, 2010). Refer to *Tortricidae Molecular Protocols* on page F-1 for further information about the protocols.

There are no North American keys for the identification of the variegated golden tortrix. Identification in Canada is based on comparison to reference specimens (Schmidt, 2010).

Refer to the Web site of the Mississippi Entomological Museum for a series of plates to aid in the identification of tortricid Archipini adult moth identification.

Information	Mississippi Entomological Museum Identification of Tortricid Archipini Adult http://mothphotographersgroup.msstate.edu/pinned.php?plate=09.1&size=m&sort=h

Use the images in this section as aids to identify *Archips xylosteanus*.

Figure 3-1 Larva of *Archips xylosteanus* (Fabio Stergulc, Università di Udine, http://www.bugwood.org)

Figure 3-2 Larva of *Archips xylosteanus* (Fabio Stergulc, Università di Udine, http://www.bugwood.org)

Figure 3-3 Pupa of *Archips xylosteanus* (Fabio Stergulc, Università di Udine, http://www.bugwood.org)

Figure 3-4 Adult of *Archips xylosteanus* (Fabio Stergulc, Università di Udine, http://www.bugwood.org)

Figure 3-5 Adult of *Archips xylosteanus* (Fabio Stergulc, Università di Udine, http://www.bugwood.org)

Similar Species

Similar species include *Archips xylosteana, A. crataegana,* and *A. rosana*. Refer to Hoebeke et al. (2008) in *Supporting Publication* on page H-1 for further information.

Chapter

4

Survey Procedures

Contents

Introduction

Use *Chapter 4 Survey Procedures* as a guide when conducting a survey for the variegated golden tortrix (*Archips xylosteanus* Linneaus 1758).

Survey Types

Plant regulatory officials will conduct detection, delimiting, and monitoring surveys for the variegated golden tortrix (VGT). Conduct detection surveys to determine the presence or absence of the tortrix in an area where it is not known to occur. After a new U.S. detection, or when detection in a new area is confirmed, conduct a delimiting survey to define the extent of an infestation. Conduct a monitoring survey to determine the success of control or mitigation activities conducted against this pest.

Preparation, Sanitization, and Clean-up

This section provides information that will help personnel prepare to conduct a survey; procedures to follow during a survey; and instructions for proper cleaning and sanitizing of supplies and equipment after the survey is finished.

1. Before starting a survey, determine if there have been recent pesticide applications that would make it unsafe to inspect the nursery, grove, or landscape planting. Contact the property owner or manager and ask if there is a re-entry period in effect due to pesticide application. Look for posted signs indicating recent pesticide applications, particularly in commercial fields or greenhouses.
2. Conduct the survey at the proper time. Each larva feeds on and inhabits a tightly rolled leaf edge from April to June in Europe (Alford, 1991, Razowski, 1977). Adults may be seen from late May to early August (Meijerman and Ulenberg, 2006, Carter, 1984).
3. Get permission from the landowner before entering a property.
4. Determine if quarantines for other pests are in effect for the area being surveyed. Comply with any and all quarantine requirements.
5. When visiting the field, nurseries, or landscape planting to conduct surveys or to take samples, everyone must take strict measures to prevent contamination by the variegated golden tortrix or other pests between properties during inspections.
6. Before entering a new property, make certain that clothing and footwear are clean and free of pests and soil to avoid moving soil-borne pests and arthropods from one property to another. Wash hands.
7. Gather together all supplies.
8. Mark the plant or sampled location with flagging whenever possible, and draw a map of the immediate area and show reference points so that the areas can be found in the future if necessary. Do not rely totally on the flagging or other markers to re-locate a site as they may be removed. Record the GPS coordinates for each infested host plant location so that the area or plant may be re-sampled if necessary.
9. Survey task forces should consist of an experienced survey specialist or entomologist familiar with the variegated golden tortrix and the symptoms of its presence.

Detection Survey

The purpose of a detection survey is to determine whether a pest is present in a defined area. This can be broad in scope, as when assessing the presence of the pest over large areas or it may be restricted to determining if a specific pest is present in a focused area.

Statistically, a detection survey is not a valid tool to claim that a pest does not exist in an area, even if results are negative. Negative results can be used to provide clues about mode of dispersal, temporal occurrence, or industry practices. Negative results are also important when compared with results from sites that are topographically, spatially, or geographically similar.

Procedure

Use the following tools singly or in any combination to detect the variegated golden tortrix (VGT):

- Focus on high risk areas where VGT is more likely to be found. Refer to *Targeted Surveys* on page 4-5 for further information
- Establish regular sites to inspect along your normal surveying route. Refer to Sentinel Sites for detailed information
- Check plants for the presence and damage caused by VGT. Refer to *Visual Inspection* on page 4-5 for further information

Delimiting Survey After Initial U.S. Detection

If the variegated golden tortrix (VGT) is detected in the United States, surveys will be conducted in the area to determine the distribution of the pest. In large areas, locating the source of an infestation could be difficult. Moths in the family Tortricidae are strong fliers, and Hill (1987) stated that for some tortricid species the first-instar larvae are transported on silken threads by air currents and wind.

Procedure

Use visual inspection of host plants, especially apple trees, and other nearby plants to determine presence of VGT. Once VGT has been confirmed in an area, surveys should continue in nearby areas in order to determine the full extent of the infestation. Inspections should encompass continually larger areas particularly where hosts are known to occur. Surveys should be most intensive around the known positive detections and any discovered through traceback and trace-forward investigations.

Traceback and Trace-Forward Survey

Traceback and trace-forward investigations help determine priorities for delimiting survey activities after an initial U.S. detection. Surveyors use traceback investigations to determine the source of infestation. Trace-forward investigations attempt to define further potential dissemination through means of natural and artificial spread (commercial or private distribution of infested plant material). Once a positive detection is confirmed, investigations are conducted to determine the extent of the infestation or suspect areas in which to conduct further investigations.

The domestic movement of agricultural commodities from Puerto Rico to the mainland is regulated by quarantine Title 7 CFR Part 318 (Fruits and Vegetable, 318.58), and Title 7 CFR 330.105 (Bare Rooted Plants or Plant Cuttings).

Procedure

If the variegated golden tortrix is found in nursery stock, then surveyors should compile a list of facilities associated with nursery stock. The State will distribute the lists to the field offices.

Important	Do not share the lists with individuals outside USDA–APHIS–PPQ and State regulatory cooperators. Grower names and field locations on these lists are strictly confidential, and any distribution of lists beyond appropriate regulatory agency contacts is prohibited. Each State is only authorized to see locations within their State and sharing of confidential business information may be restricted between State and Federal entities. Check the privacy laws with the State Plant Health Director for the State.

When contacting growers on the list, be sure to identify yourself as a USDA or State regulatory official conducting an investigation of facilities that may have received material infested with the variegated golden tortrix. Speak to the growers or farm managers and get proper permission before entering private property. Check nursery records to get names and addresses for all sales or distribution sites (if any sales or distribution has occurred from infested nursery during the previous 6 months).

Monitoring Surveys

If the variegated golden tortrix is detected in the United States, a Technical Working Group will be assembled to provide guidance on using a monitoring survey to measure the effectiveness of applied treatments on the pest population.

Targeted Surveys

Conduct targeted surveys in areas where the introduction of the variegated golden tortrix may be considered more likely. This may include apple orchards in Maine and the rest of the New England states close to where it is known to be established in St. John's, Newfoundland (Hoebeke et al., 2008).

Visual Inspection

This section contains instructions for inspecting plants for infestations of the variegated golden tortrix (VGT).

1. Inspect apple trees, other potential host plants, and nearby resting places for larval and adult VGT. Refer to the images of the VGT in *Identification* on page 3-1. Refer to the images of plant damage in this section.
2. Collect samples of leaf-rollers and other tortricids while inspecting potential host plants.

Important Do not move live insects from survey sites.

3. Submit specimens and plant material to the proper authority. Follow the instructions described in *How to Submit Insect Specimens* on page C-1 when preparing specimens.
4. If the VGT is detected in an area, a Technical Working Group for this pest will be assembled; the group will provide further guidance about more surveys.

Procedure

The variegated golden tortrix causes damage to leaves, buds and flowers of apple trees, as well as other Roseaceae crops. Look for the following symptoms of larval damage:

- Tightly rolled leaf edges on full grown leaves of apple trees, caused by larvae (*Figure 4-1* on page 4-6 and *Figure 4-2* on page 4-6)
- Skeletonized leaves

Figure 4-1 Damage Caused by Larval *Archips xylosteana* http://www.bugwood.org)

Figure 4-2 Damage Caused by Larval *Archips xylosteana* http://www.bugwood.org)

Pheromones

Leaf-rollers are detected by scouting and pheromone traps. One pheromone exists for the variegated golden tortrix moth (Frerot et al., 1983, Ando et al., 1978, Pheronet, 2010). The pheromone is a combination of Z-11 tetradecenyl acetate (Z-11TDA, or Z11-14Ac) and E-11 tetradecenyl acetate (E-11 TDA, or E11-14Ac). Frerot et al. (1983) reports using this at the concentration of 920 µg Z-11 TDA and 80 µg E-11 TDA. Ando et al. (1978) reports the ratio of Z-11 TDA: E-11 TDA to be 8:2 for use as a pheromone for the VGT.

Traps

A trap and lure is the Cooperative Agriculture Pest Survey (CAPS)-approved method for surveying for variegated golden tortrix. The recommended trap is the wing trap. The lure is a combination of Z11- 14Ac and E11-14Ac. The gray rubber septum dispenser should be used and it has a 4 week length of effectiveness. These can be ordered through the respective CAPS regional program manager. When trapping for more than one species of moth, separate traps for different moth species by at least 20 meters (65 feet) (CAPS, 2010).

Data Collection

Recording negative results in surveys is just as important as positive detections since it helps define an area of infestation. A system of data collection should include an efficient tracking system for suspect samples such that their status is known at various stages and laboratories in the confirmation process. If available, use pre-programmed hand-held units with GPS capability.

Moths should be field pinned, placed in an envelope, or ideally packed in cotton.

Data collected during surveys should include the following:

- Date of survey
- Collector’s name and affiliation
- Full name of business, institution, or agency
- Full mailing address including country
- Type of property (commercial nursery, hotel, natural field, residence)
- GPS coordinates of the host plant and property

- Host species and cultivar
- General conditions or any other relevant information
- Positive or negative results from specimen collection

Cooperation With Other Surveys

Other surveyors regularly sent to the field should be trained to recognize infestations of the variegated golden tortrix (VGT). Large aggregations of the VGT may occur on nearly any surface, including trunks, leaves, and fruit of non-host plants.

Chapter

5

Regulatory Procedures

Contents

Introduction

Use *Chapter 5 Regulatory Procedures* as a guide to the procedures that must be followed by regulatory personnel when conducting pest survey and control programs against variegated golden tortrix (*Archips xylosteanus* Linneaus 1758).

Instructions to Officials

Agricultural officials must follow instructions for regulatory treatments or other procedures when authorizing the movement of regulated articles. Understanding the instructions and procedures is essential when explaining procedures to people interested in moving articles affected by the quarantine and regulations. Only authorized treatments can be used in line with labeling restrictions. During all field visits, ensure that proper sanitation procedures are followed as outlined in *Preparation, Sanitization, and Clean-up* on page 4-2.

Regulatory Actions and Authorities

After an initial suspect positive detection, an Emergency Action Notification may be issued to hold articles or facilities, pending positive identification by a USDA–APHIS–PPQ-recognized authority and/or further instruction from the PPQ Deputy Administrator. If necessary, the Deputy Administrator will issue a letter directing PPQ field offices to initiate specific emergency action under the Plant Protection Act until emergency regulations can be published in the *Federal Register.*

The Plant Protection Act of 2000 (Statute 7 USC 7701-7758) provides the authority for emergency quarantine action. This provision is for interstate regulatory action only; intrastate regulatory action is provided under State authority.

State departments of agriculture normally work in conjunction with Federal actions by issuing their own parallel hold orders and quarantines for intrastate movement. However, if the U.S. Secretary of Agriculture determines that an extraordinary emergency exists and that the States measures are inadequate, USDA can take intrastate regulatory action provided that the governor of the State has been consulted and a notice has been published in the Federal Register. If intrastate action cannot or will not be taken by a State, PPQ may find it necessary to quarantine an entire State.

PPQ works in conjunction with State departments of agriculture to conduct surveys, enforce regulations, and take control actions. PPQ employees must have permission of the property owner before entering private property. Under certain situations during a declared extraordinary emergency or if a warrant is obtained, PPQ can enter private property without owner permission. PPQ prefers to work with the State to facilitate access when permission is denied, however each State government has varying authorities regarding entering private property.

A General Memorandum of Understanding (MOU) exists between PPQ and each State that specifies various areas where PPQ and the State department of agriculture cooperate. For clarification, check with your State Plant Health Director (SPHD) or State Plant Regulatory Official (SPRO) in the affected State. Refer to *Resources* on page A-1 for information on identifying SPHD's and SPRO's.

Tribal Governments

USDA–APHIS–PPQ also works with federally-recognized Indian Tribes to conduct surveys, enforce regulations and take control actions. Each Tribe stands as a separate governmental entity (sovereign nation) with powers and authorities similar to State governments. Permission is required to enter and access Tribal lands.

Executive Order 13175, Consultation and Coordination with Indian and Tribal Governments, states that agencies must consult with Indian Tribal governments about actions that may have substantial direct effects on Tribes. Whether an action is substantial and direct is determined by the Tribes. Effects are not limited to Tribal land boundaries (reservations) and may include effects on off-reservation land or resources which Tribes customarily use or even effects on historic or sacred sites in States where Tribes no longer exist.

Consultation is a specialized form of communication and coordination between the Federal and Tribal governments. Consultation must be conducted early in the development of a regulatory action to ensure that Tribes have opportunity to identify resources which may be affected by the action and to recommend the best ways to take actions on Tribal lands or affecting Tribal resources. Communication with Tribal leadership follows special communication protocols. For more information, contact PPQ's Tribal Liaison. Refer to *Table A-1* on page A-1 for information on identifying PPQ's Tribal Liaison.

To determine if there are Federally-recognized Tribes in a State, contact the State Plant Health Director (SPHD). To determine if there are sacred or historic sites in an area, contact the State Historic Preservation Officer (SHPO). For clarification, check with your SPHD or State Plant Regulatory Official (SPRO) in the affected State. Refer to *Resources* on page A-1 for contact information.

Overview of Regulatory Program After Detection

Once an initial U.S. detection is confirmed, holds will be placed on the property by the issuance of an Emergency Action Notification. Immediately put a hold on the property to prevent the removal of any host plants of the pest.

Traceback and trace-forward investigations from the property will determine the need for subsequent holds for testing and/or further regulatory actions. Further delimiting surveys and testing will identify positive properties requiring holds and regulatory measures.

Record-Keeping

Record-keeping and documentation are important for any holds and subsequent actions taken. Rely on receipts, shipping records and information provided by the owners, researchers or manager for information on destination of shipped plant material, movement of plant material within the facility, and any management (cultural or sanitation) practices employed.

Keep a detailed account of the numbers and types of plants held, destroyed, and/or requiring treatments in control actions. Consult a master list of properties, distributed with the lists of suspect nurseries based on traceback and trace-forward investigations, or nurseries within a quarantine area. Draw maps of the facility layout to located suspect plants, and/or other potentially infected areas. When appropriate, take photographs of the symptoms, property layout, and document plant propagation methods, labeling, and any other information that may be useful for further investigations and analysis.

Keep all written records filed with the Emergency Action Notification copies, including copies of sample submission forms, documentation of control activities, and related State issued documents if available.

Issuing an Emergency Action Notification

Issue an Emergency Action Notification to hold all host plant material at facilities that have the suspected plant material directly or indirectly connected to positive confirmations. Once an investigation determines the plant material is not infested, or testing determines there is no risk, the material may be released and the release documented on the EAN.

Regulated Area Requirements Under Regulatory Control

Depending upon decisions made by Federal and State regulatory officials in consultation with a Technical Working Group, quarantine areas may have certain other requirements for commercial or research fields in that area, such as plant removal and destruction, cultural control measures, or plant waste material disposal.

Any regulatory treatments used to control this pest or herbicides used to treat plants will be labeled for that use or exemptions will be in place to allow the use of other materials.

Establishing a Federal Regulatory Area or Action

Regulatory actions undertaken using Emergency Action Notifications continue to be in effect until the prescribed action is carried out and documented by regulatory officials. These may be short-term destruction or disinfestation orders or longer term requirements for growers that include prohibiting the planting of host crops for a period of time. Over the long term, producers, shippers, and processors may be placed under compliance agreements and permits issued to move regulated articles out of a quarantine area or property under an EAN.

Results analyzed from investigations, testing, and risk assessment will determine the area to be designated for a Federal and parallel State regulatory action. Risk factors will take into account positive testing, positive associated, and potentially infested exposed plants. Boundaries drawn may include a buffer area determined based on risk factors and epidemiology.

Regulatory Records

Maintain standardized regulatory records and databases in sufficient detail to carry out an effective, efficient, and responsible regulatory program.

Use of Chemicals

The PPQ *Treatment Manual* and the guidelines identify the authorized chemicals, and describe the methods and rates of application, and any special instructions. For further information refer to *Control Procedures* on page 6-1. Agreement by PPQ is necessary before using any chemical or procedure for regulatory purposes. No chemical can be recommended that is not specifically labeled for this pest.

Chapter

6

Control Procedures

Contents

Introduction

Use *Chapter 6 Control Procedures* as a guide to controlling the variegated golden tortrix (VGT), *Archips xylosteanus* Linnaeus 1758. Consider the treatment options described within this chapter when taking action to eradicate, contain, or suppress VGT.

Leaf-rollers are a low threshold pest (Cross et al., 1999), requiring a successful management program. Biological insecticides including *Bacillus thuringiensis*, baculoviruses and spinosad can also be integrated into a management program. Biological control organisms are present in the environment, and help control the VGT population.

Overview of Emergency Programs

APHIS–PPQ develops and makes control measures available to involved States. United States Environmental Protection Agency-approved treatments will be recommended when available. If the selected treatments are not labeled for use against the pest or in a particular environment, PPQ's FIFRA Coordinator is available to explore the appropriateness in developing an Emergency Exemption under Section 18, or a State Special Local Need under section 24(c) of FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act), as amended.

The PPQ FIFRA Coordinator is also available upon request to work with EPA to rush the approval of a product that may not be registered in the United States, or to get labeling for a new use. The PPQ FIFRA Coordinator is available for guidance pertaining to pesticide use and registration. Refer to *Resources* on page A-1 for information on contacting the Coordinator.

Treatment Options

All treatments listed in the guidelines should only be used as a reference to assist in the regulatory decisionmaking process. It is the National Program Manager's responsibility to verify that treatments are appropriate and legal for use. Upon detection and when a chemical treatment is selected, the National Program Manager should consult with PPQ's FIFRA Coordinator to ensure the chemical is approved by EPA for use in the United States before using. Refer to *Resources* on page A-1 for information on contacting the Coordinator.

Treatments can include any combination of the following options described in this chapter:

- Sanitation and other cultural control methods
- Application of insecticides

Eradication

Eradication is the first action to consider when a new pest is introduced. Eradication may be feasible under some conditions, but if it fails other strategies will be considered. Eradication may be feasible when the following conditions exist:

- Pest population is confined to a small area
- Detection occurs soon after the introduction
- Pest population density is low

If an infestation of the variegated golden tortrix is discovered that is limited in distribution, eradication will be attempted. Measures will include but may not be limited to the following:

- Removal and destruction of all infested plant material
- Removal of host material within 2 miles of the find
- Treatment of the soil and surrounding vegetation with an approved pesticide after removal of the infested plants

Cultural Control

Treatments can include sanitation and other cultural controls.

Sanitation

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 if the larvae and pupae in the high branches are not removed.

Other Cultural Controls

Mulching has been shown to enhance alternative hosts for parasitoids of leaf-rollers and to improve the natural control of leaf-roller species. Mulching methods that encourage undergrowth of nectar plants and habitat conditions (vegetation height) in the orchard on longevity, fertility and abundance (habitat preference) of parasitoids should be investigated. Based on such data, vegetation management might be used as a tool to enhance parasitoid efficiency in biological control (Kienzle et al., 1997).

Managing Insecticide Resistance

The non-judicious use of insecticides can lead to the development of resistance. Dunley et. al., (2006) reported that some populations of the tortricids *Choristoneura rosaceana* (Harris) and *Pandemis pyrusana* Kearfott exhibited cross-resistance to the organophosphate azinphosmethyl , and the insect growth regulators, tebufenozide and methoxyfenozide.

An appropriate cross-resistance program should consist of use of insecticides of the same class to alternating generations. Insecticides have been organized into mode of action (MOA) groups based on how they work to kill insects. This classification system makes it easy for applicators to understand which pesticides share the same MOA without having to know the biochemical basis. The MOA classification provides growers, advisors, Extension staff, consultants, and crop protection professionals with a simple guide to the selection of insecticides for use in an effective and sustainable insecticide resistance management strategy.

Procedure

Minimize the continuous use of pesticides within the same MOA classification.

Environmental Documentation and Monitoring

Get all required environmental documentation before beginning. For further information, refer to *Environmental Compliance* on page 7-1. Contact Environmental Services staff for the most recent documentation. Refer to *Resources* on page A-1 for contact information.

Efficacy of Treatment

For further information, refer to *Monitoring Survey* on page 4-7.

Site Assessment

When visiting a site keep a log of observations, flag the infested areas, and record the coordinates. Record also the name of the property owner. Some of this information may have been recorded during the survey. Communicate frequently with the person responsible for the site.

Classification

Information on the type of property needs to be recorded to help develop a control plan. Site access, security, containment, and ownership type may dictate a particular direction in control options. Prepare a concise overview of the infested area. Record information about the infested property, including the following:

- Location
- Type of property ownership (government, private, Tribal, commercial, residential, or agricultural)
- Current and past users of the property
- Distribution of infected plants
- Status of security and containment
- Modes of artificial movement

Insecticides

Important All treatments listed in the guidelines should only be used as a reference to assist in the regulatory decisionmaking process. It is the National Program Manager's responsibility to verify that treatments are appropriate and legal for use. Upon detection and when a chemical treatment is selected, the National Program Manager should consult with PPQ's FIFRA Coordinator to ensure the chemical is approved by EPA for use in the United States before use. Refer to *Resources* on page A-1 for contact information.

Table 6-1 Insecticides Available for Use in the United States

MOA	Chemical	Pome[1]	Stone[2]	U.S.[3]	Comments	Reference
4A	acetamiprid	Yes	Yes	Yes	Tested on leaf-rollers in the U.S.	Dunley et al. (2006)
11	*Bacillus thuringiensis*				Tested on leaf-rollers in U.S.	Van der Geest and Evenhuis (1991), van der Geest (1971), Brunner et al. (2010)
11	*Bacillus thuringiensis* aizawai	Yes	Yes	Yes	Tested on leaf-rollers	Pollini (2009)
11	*Bacillus thuringiensis* kurstaki	Yes	Yes	Yes	Tested on leaf-rollers	Trona et al. (2008), Pollini (2009)
28	chlorantranilip-role	Yes	Yes	Yes	Tested on leaf-rollers in U.S. Pre-bloom only	Sial and Brunner (2010)
1B	chlorpyrifos	Yes	Yes	Yes	Tested on leaf-rollers in the U.S. Pre-bloom only	Dunley et al. (2006)
1B	chlorpyrifos-methyl	No	No	Yes	Tested on the summer fruit tortrix moth (*Adoxo-phyes orana*)	Kehrli et al. (2009), Charmillot et al. (2006)
6	emamectin benzoate	Yes	No	Yes	Tested on leaf-rollers in the U.S.	Brunner et al. (2010)
7B	fenoxycarb	No	No	Yes	Approved on ornamentals and some flowers.	Schmid et al. (1978), Cross (1997b), Cross (1997a)
22A	indoxacarb	Yes	Yes	Yes	Tested on leaf-rollers in US	Kehrli et al. (2009), Charmillot et al. (2006), Brunner et al. (2010), Dunley et al. (2006)
N/A[4]	kaolin clay	Yes	Yes	Yes	Tested on leaf-rollers in the U.S.	Brunner et al. (2010)

Table 6-1 Insecticides Available for Use in the United States

MOA	Chemical	Pome[1]	Stone[2]	U.S.[3]	Comments	Reference
18	methoxyfeno-zide	Yes	Yes	Yes	Tested on leaf-rollers in US	Hoelscher and Barrett (2003), Brunner et al. (2010), Dunley et al. (2006), Bylemans et al. (2003), Cantoni et al. (2004), Kehrli et al. (2009)
1B	methyl-para-thion	No	No	Yes	Tested on leaf-rollers in the U.S.	Dunley et al. (2006)
7C	pyriproxyfen	Yes	Yes	Yes	Tested on leaf-rollers in the U.S.	Brunner et al. (2010)
5	spinetoram	Yes	Yes	Yes	Tested on leaf-rollers in U.S.	Sial and Brunner (2010)

1 Approved on pome fruit.

2 Approved on stone fruit.

3 Approved in the United States.

4 Not applicable.

Oxadiazine

Indoxacarb is effective through oral or contact and blocks the sodium channels in the nervous system. It is a newly registered insecticide in the United States. It is registered for use on leaf-rollers on pome fruit. Brunner et al. (2010) reported that some leaf-rollers are already exhibiting resistance. It is not an effective control of the codling moth.

Insect Growth Regulators

An insect growth regulator (IGR) is a compound that mimics a natural chemical that is produced by the insect. The application of these compounds can lead to premature molts and deformities. IGR's mimic insect hormones and therefore interrupt normal biological processes. Insect growth regulators have been tested for efficacy against tortricids and have been found to be effective.

Methoxyfenozide

Methoxyfenozide is a molt accelerating compound. It is lethal to larvae and may have ovicidal properties against the adult variegated golden tortrix (VGT). It has also been reported that the use of this compound disrupts adult communication and female reproduction (Hoelscher and Barrett, 2003). These sublethal effects can be an important part of VGT control. Methoxyfenozide has low toxicity to bees and natural enemies on pome fruit including lacewings, parasites and predatory bugs (Bylemans et al., 2003).

In Washington State, it is commonly applied to apple trees against leaf-rollers. It is recommended that this pesticide should be applied in the spring from bloom to 2 weeks before petal fall. A single application can be effective against low leaf-roller densities, but a second may be needed during times of higher populations (Brunner et al., 2010).

Resistance

Insecticides containing methoxyfenozide are approved for use in the United States. In Washington State, resistance of leaf-rollers to methoxyfenozid has been reported (Dunley et al., 2006). Cross-resistance between methoxyfenozide and diflubenzuron was reported in codling moth (Bylemans et al., 2003).

Tebufenozide

This product is a specific anti-lepidopteran insecticide which is successful in controlling spring populations of many tortricid species. It is selective to lepidopteran pests and will not affect bees (Dhadialla et al., 1998). There have also been reports of tebufenozid resistance developing in Europe.

Tebufenozide is a compound used on leaf-rollers in Washington State. Brunner et. al. (2010) reported that it is not as effective on leaf-rollers as methoxyfenozide. It also may require two applications to control higher densities of leaf-rollers.

Fenoxycarb

Fenoxycarb is an insect growth regulator and works as a juvenile hormone mimic, causing premature and deformed molting to occur. It has been used in Europe to control other leaf-rollers on fruit trees since the 1980s (Cross, 1997a).

Fenoxycarb research in the United Kingdom was found to be highly effective with two applications pre- and post-blossom (Cross, 1997a). However, due to its broad selectivity this insecticide can also have deleterious effects on natural enemies (Dhadialla et al., 1998).

In the United States, fenoxycarb has not been approved for use on tortricids in apples and pears. However, fenoxycarb is approved for use on ornamentals, flowers, replace with non-bearing citrus, fruit and nut trees.

Organophosphates

The use of broad-spectrum organophosphates is being phased out in tree fruits (Sial and Brunner, 2010). One reason for the phase-out is that resistance and cross-resistance has been documented for leaf-rollers to organophosphates (Dunley et al., 2006, Sial and Brunner, 2010, Sial et al., 2010). Resistance to the organophosphate azinphosmethyl was found in the leafrollers *Choristonneura rosaceana* and *Pandemis pyrusana* in Washington State.

Two new active ingredients, chlorantraniliprole and spinetoram, have been registered as an alternative to broad-spectrum organophosphates and have been registered for use in tree fruit. The chlorantraniliprole is from the anthranilic diamide class. These insecticides bind to the ryanodine receptors disrupting the calcium balance in the muscles eventually causing paralysis and death.

Spinetoram belongs to the spinosyns class of insecticides. Spinosyns activate the nicotinic acetlcholine receptors, activating the nerves and resulting in death. Sial and Brunner (2010) tested the resistance risk of these two new insecticides on the oblique-banded leaf-roller. Their research showed there is reason for concern for rapid resistance development.

Spinosad

Spinosad is a selective broad-spectrum insecticide that has also been found to be effective against leaf-rollers, particularly on overwintered and summer generations (Bylemans and Schoonejans, 2000). Bylemans and Schoonejans (2000) reported that it is equally as effective on overwintered caterpillars as the IGR, tebufenozide, and the pyrethroid, deltamethrin. Research at Washington State University showed that spinosad was effective on leaf-rollers, but not codling moth (Brunner et al., 2010). It has been documented that there is cross-resistance between spinosad and spinetoram for the obliquebanded leaf-roller, *Choristoneura rosaceana* (Harris) (Sial et al., 2010, Sial and Brunner, 2010). Spinosad was found to be harmless to predatory mites and bugs (Asnthocoridae) (Bylemans and Schoonejans, 2000).

Bacillus thuringiensis

Bacillus thuringiensis (Bt) is a naturally occurring bacterium that is considered to be an effective insecticide against Lepidoptera (van der Geest, 1981). There have been mixed results of Bt efficacy on leaf-rollers. Research performed at Washington State University determined that Bt is effective against leaf-rollers in the United States (Brunner et al., 2010).

Baiting With Pheromones

Finding mates and reproducing are chemically-mediated processes for the variegated golden tortrix (VGT). One pheromone is available for VGT at two concentrations (Frerot et al., 1983, Ando et al., 1978). The following are approved by the Cooperative Agricultural Pest Survey (CAPS 2010):

- Z11-14:Ac
- E11-14:Ac

Pheromone lures are commonly used in detection surveys, but may also be used in mating disruption by interfering with the ability of the male to find the female and disrupt the reproductive success of the VGT. Large concentrations of the pheromones would be required to confuse the adults. Sex pheromone may also be used for control (attract and kill) or monitoring.

Attract and Kill

The attract and kill method is an IPM technique that combines the use of pheromones and insecticides. The technique is used to reduce populations of the pest, but does not substitute for survey trapping. To implement this method, apply both pheromones and insecticides in droplet form to the upper canopy of an orchard. The pheromones will attract the male moths to the orchard where they are confused by the amount of pheromones and killed by the insecticide.

To control the leaf-roller *Adoxophyes orana*, researchers applied the sex pheromone to the top of fruit trees, followed by the use of a pyrethroid at a ratio of 9:1 (Somsai et al., 2009). The method has been found effective at reducing populations, particularly when the populations are of medium to low densities (Jakab et al., 2009). Oltean et al., (2009) claim that if used properly, the pheromone alone could decrease fruit damage by 77 percent; adding the insecticide offered an additional 15 percent of control.

This technology has been used on the codling moth in Washington State. It is an effective practice, as well as being less disruptive to predatory insects and mites (Knight, 2010).

Biological Control

Biological control organisms help suppress and control pest populations, but they do not eradicate them. The organisms can be effective when used in combination with other IPM techniques. They are characterized as predators, parasites, parasitoids, or pathogens.

Egg Parasitoids

Trichogrammatidae is the only family of Hymenoptera that parasitizes tortricid eggs (Cross et al., 1999). The rearing and release of these organisms has been successfully used to control lepidopteran pests (Hassan, 1992, Li, 1994). A mass rearing program of *Trichogramma* egg parasites was completed by Hassan (Hassan, 1993). However, the cost of mass rearing the egg parasitoid is too great when compared to the cost of insecticides. Trichogramma rearing programs have been successful worldwide to reduce populations of the European corn borer *Ostrinia nubilalis* (Hb.) (Hassan, 1993, Smith, 1996).

Larval Parasitoids

More parasitism of larvae of leaf-rollers was found in orchards that were not commercial sprayed (Pluciennik 2010). Higher percentages of parasitisms were found in the summer than the spring populations (Kienzle et al. 1997).

Research in Poland recorded parasitoids of leaf-rollers (Pluciennik and Olszak, 2010). On average, 9 percent of all leaf-roller species were parasitized (a range of 2 to 32 percent). Research in Poland recorded parasitoids of leaf-rollers (Pluciennik and Olszak, 2010). On average, 9 percent of all leaf-roller species were parasitized (a range of 2 to 32 percent).

Pupal Parasitoids

There are fewer listed species of pupal than larval parasitoids.

Table 6-2 Egg Parasitoids of the Variegated Golden Tortrix

Taxon	Species	Reference
Hymenoptera: Encyrtidae	*Copidosoma* Ratzeburg, 1844	CABI (1994)
Hymenoptera: Tricho-grammatidae	*Trichocgramma* sp.	Meijerman and Ulenberg (2006)

Table 6-3 Larval Parasitoids of the Variegated Golden Tortrix

Taxon	Species	Reference
Hymenoptera: Braconidae	*Apenteles* sp.; *Apanteles albipennis* Nees; *Apanteles viminetorum* Wesmael; *Chremylus rubiginosus* Nees; *Clinocentrus* sp.; *Meteorus pallidipes* Wesm.; *Microbracon crassipes* Thomson; *Microgaster* sp.; *Oncophanes lanceolator* Nees	(Zwolfer and Kraus, 1957, Meijerman and Ulenberg, 2006)
Diptera: Tachinidae	*Cadurcia casta* (Rondani); *Cestonia cineraria* Rondani, 1861; *Pseudoperichaeta nigrolineata* (Walker); *Steiniomyia bakeri* Townsend	(Cerretti and Tschorsnig, 2010, Kara and Tschorsnig, 2003, Meijerman and Ulenberg, 2006, Yasuda, 1972)
Hymenoptera: Ichneumonidae	*Blaptocampus nigricornis* Wesm.; *Lissonota* sp.; *Phytodietus* sp. nr *segmentator* Grav.; *Tranosema arenicola* Thoms.	(Zwolfer and Kraus, 1957)

Table 6-4 Pupal-Larval Parasitoids of the Variegated Golden Tortrix

Taxon	Species	Reference
Hymenoptera: Chalcididae	*Brachymeria lasus* (Walker)	(CABI, 1994)
Hymenoptera: Ichneumonidae	*Phaeogenus eurydoxae Uchida*; *Triclistus globulipes* Desv.	(Jonaitis, 2000, Meijerman and Ulenberg, 2006, Yasuda, 1972)

Table 6-5 Pupal Parasitoids of the Variegated Golden Tortrix

Taxon	Species	Reference
Hymenoptera: Ichneumonidae	*Anilisatus carbonarius* Thoms.; *Apechthis rufata* Gmel.; *Exochus decoratus* Holmgr.; *Itoplectis maculator* Fabricius; *Phytodietus segmentator* Gravenhorst; *Pimpla maculator* F.	(Georgiev and Kolarov, 1999, Meijerman and Ulenberg, 2006, Zwolfer and Kraus, 1957)
Hymenoptera: Chalcididae	*Brachymeria obscurata* Walker; *Brachymeria observator* Walker; *Neocopidosoma komobae* Ishic.	(Meijerman and Ulenberg, 2006; Yasuda, 1972)

Table 6-6 Other Parasitoid of the Variegated Golden Tortrix

Taxon	Species	Reference
Encyrtidae	*Neocopidosoma komabae* Ishic.	(Meijerman and Ulenberg, 2006)

Environmental Documentation and Monitoring

Get all required environmental documentation before beginning. Contact Environmental Services staff for the most recent documentation. For further information, refer to *Environmental Compliance* on page 7-1.

Chapter

7

Environmental Compliance

Contents

Introduction

Use *Chapter 7 Environmental Compliance* as a guide to the environmental regulations concerning the insect variegated golden tortrix (*Archips xylosteanus* Linneaus 1758).

Overview

Program managers of Federal emergency response or domestic pest control programs must ensure that their programs comply with all Federal Acts and Executive Orders pertaining to the environment, as applicable. Two primary Federal Acts, the National Environmental Policy Act (NEPA) and the Endangered Species Act (ESA), often require the development of significant documentation before program actions may begin.

Program managers should also seek guidance and advice as needed from Environmental and Risk Analysis Services (ERAS), a unit of APHIS' Policy and Program Development (PPD) staff. ERAS is available to give guidance

and advice to program managers and prepare drafts of applicable environmental documentation.

In preparing draft NEPA documentation ERAS may also perform and incorporate assessments that pertain to other acts and executive orders described below, as part of the NEPA process. The Environmental Compliance Team (ECT), a part of PPQ's Emergency Domestic Programs (EDP), will assist ERAS in the development of documents, and will implement any environmental monitoring.

Leaders of programs are strongly advised to meet with ERAS and/or ECT early in the development of a program in order to conduct a preliminary review of applicable environmental statutes and to ensure timely compliance. Environmental monitoring of APHIS pest control activities may be required as part of compliance with environmental statutes, as requested by program managers, or as suggested to address concerns with controversial activities. Monitoring may be conducted with regards to worker exposure, pesticide quality assurance and control, off-site chemical deposition, or program efficacy. Different tools and techniques are used depending on the monitoring goals and control techniques used in the program. Staff from ECT will work with the program manager to develop an environmental monitoring plan, conduct training to carry out the plan, give day-to-day guidance on monitoring, and provide an interpretive report of monitoring activities.

National Environmental Policy Act

The National Environmental Policy Act (NEPA) requires all Federal agencies to examine whether their actions may significantly affect the quality of the human environment. The purpose of NEPA is to inform the decisionmaker before taking action, and to tell the public of the decision. Actions that are excluded from this examination, that normally require an Environmental Assessment, and that normally require Environmental Impact Statements, are codified in APHIS' NEPA Implementing Procedures located in 7 CFR 372.5.

The three types of NEPA documentation are Categorical Exclusions, Environmental Assessments, and Environmental Impact Statements.

Categorical Exclusion

Categorical Exclusions (CE) are classes of actions that do not have a significant effect on the quality of the human environment and for which neither an Environmental Assessment (EA) nor an environmental impact statement (EIS) is required. Generally, the means through which adverse environmental impacts may be avoided or minimized have been built into the actions themselves (7 CFR 372.5(c)).

Environmental Assessment

An Environmental Assessment (EA) is a public document that succinctly presents information and analysis for the decisionmaker of the proposed action. An EA can lead to the preparation of an environmental impact statement (EIS), a finding of no significant impact (FONSI), or the abandonment of a proposed action.

Environmental Impact Statement

If a major Federal action may significantly affect the quality of the human environment (adverse or beneficial) or the proposed action may result in public controversy, then prepare an Environmental Impact Statement (EIS).

Endangered Species Act

The Endangered Species Act (ESA) is a statute requiring that programs consider their potential effects on federally-protected species. The ESA requires programs to identify protected species and their habitat in or near program areas, and document how adverse effects to these species will be avoided. The documentation may require review and approval by the U.S. Fish and Wildlife Service and the National Marine Fisheries Service before program activities can begin. Knowingly violating this law can lead to criminal charges against individual staff members and program managers.

Migratory Bird Treaty Act

The statute requires that programs avoid harm to over 800 endemic bird species, eggs, and their nests. In some cases, permits may be available to capture birds, which require coordination with the U.S. Fish and Wildlife Service.

Clean Water Act

The statute requires various permits for work in wetlands and for potential discharges of program chemicals into water. This may require coordination with the Environmental Protection Agency, individual States, and the Army Corps of Engineers. Such permits would be needed even if the pesticide label allows for direct application to water.

Tribal Consultation

The Executive Order requires formal government-to-government communication and interaction if a program might have substantial direct effects on any federally-recognized Indian Nation. This process is often incorrectly included as part of the NEPA process, but must be completed before general public involvement under NEPA. Staff should be cognizant of the conflict that could arise when proposed Federal actions intersect with Tribal sovereignty. Tribal consultation is designed to identify and avoid such potential conflict.

National Historic Preservation Act

The statute requires programs to consider potential impacts on historic properties (such as buildings and archaeological sites) and requires coordination with local State Historic Preservation Offices. Documentation under this act involves preparing an inventory of the project area for historic properties and determining what effects, if any, the project may have on historic properties. This process may need public involvement and comment before the start of program activities.

Coastal Zone Management Act

The statute requires coordination with States where programs may impact Coastal Zone Management Plans. Federal activities that may affect coastal resources are evaluated through a process called Federal consistency. This process allows the public, local governments, Tribes, and State agencies an opportunity to review the Federal action. The Federal consistency process is administered individually by states with Coastal Zone Management Plans.

Environmental Justice

The Executive Order requires consideration of program impacts on minority and economically disadvantaged populations. Compliance is usually achieved within the NEPA documentation for a project. Programs are required to consider if the actions might impact minority or economically disadvantaged populations and if so, how such impact will be avoided.

Protection of Children

The Executive Order requires Federal agencies to identify, assess, and address environmental health risks and safety risks that may affect children. If such a risk is identified, then measures must be described and carried out to minimize such risks.

Chapter

8

Pathways

Contents

Introduction

Use *Chapter 8: Pathways* as a source of information on the pathways of introduction of the variegated golden tortrix (*Archips xylosteanus* Linneaus 1758) (VGT) in the United States. The VGT is a leaf-roller with little risk for transport with fruit but with high risk of transport with nursery stock.

Natural Movement

The variegated golden tortrix may be introduced into the continental United States through natural movement. Moths in the family Tortricidae are strong fliers, and for some tortricid species the first-instar larvae are transported on silken threads by air currents and wind (Hill 1987). However, since Newfoundland is an island, the risk of VGT flying or being carried by wind to the New England States is low or nonexistent. If the pest becomes established on the Canadian mainland, it would at some point reach the United States by natural means.

Commerce

As of December 12, 2010, no specimens of *Archips xylosteanus* have been intercepted at ports of entry into the United States. (PestID, 2011).

Since the pest is a leaf roller, it has a high risk of being transported with nursery stock either commercially or with individuals traveling from Newfoundland to Maine. This would be the most likely pathway for introduction into the United States if the pest is restricted only to Newfoundland. If it is present on the Canadian mainland, it will move into the

United States by natural means since wild and commercial hosts occur throughout North America.

Variegated Golden Tortrix

References

Use the References section to learn more about the publications, Web sites, and other resources, that were consulted during the production of the guidelines.

Publications, Web Sites, and Other

Alford, D. V. 1991. *Archips xylosteana* (Linnaeus), p.238. In: A Colour Atlas of Pests of Ornamental Trees, Shrubs, and Flowers. Wolfe Publishing Ltd., Barcelona, Spain, 448 pp.

Alfaro, A. 1950. Orugas de *Archips* en el arbolado frutal de la ribera del Jalon. *Entomologia Agricola* 17:37-59.

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 and Biological Chemistry* 42(5):1081-1083.

Bradley, J. D., W. G. Tremewan, and A. Smith. 1973. *Cochylidae and Tortricidae: Tortricinae*. The Ray Society, London. 251 pp.

Brown, J. B. 2005. *World Catalogue of Insects. Volume 5. Tortricidae (Lepidoptera)*. Apollo Books, Denmark. 741 pp.

Brown, J. W. 2010. Re: questions about *Archips xylosteanus*. Personal communication to K. Maguylo on October 20, 2010, from John Brown (archived at PERAL).

Brunner, J., J. Dunley, E. Beers, and M. Doerr. 2010. New Insecticides and Miticides for Apple and Pear IPM. Washington State University Tree Fruit Research and Extension Center, Wenatchee, WA. Accessed September 24, 2010. http://entomology.tfrec.wsu.edu/jfbhome/growerarticles/New_Insecticides_IPM.pdf

Bylemans, D., L. De Maeyer, A. Auwerkerken, H. De Craen, J. Wijsmuller, and D. Peeters. 2003. Methoxyfenozide, a reliable IPM compatible compound against Lepidoptera in pome fruit and vegetables with sterilising, ovicidal and larvicidal efficacy on codling moth. *Commun Agric Appl Biol Sci*. 68:189-202.

Bylemans, D., and T. Schoonejans. 2000. Spinosad, a useful tool for insect control in top fruit. *Brighton Crop Protection Conference Pests & Diseases* 1:33-40.

Byun, B.-K., S.-c. Yan, and C.-d. Li. 2003. Revision of tribe Archipini

(Totricidae:Tortricinae) in northeast China. *Journal of Forestry Research* 14(2):10.

CABI. 1994. Crop Protection Compendium. Index of Economically Important Lepidoptera. CAB International, Wallingford UK. Accessed XXDATEXX. Web site URL.

Cantoni, A., M. Gollo, A. Gualco, and S. R. Tiraferri. 2004. Methoxyfenozide (Prodigy®): a new insecticide for the control of Lepidoptera on fruit trees, grapevine and citrus. Italian Phytopathological Society. Biennial Meeting. Italy, Bologna.

Cooperative Agricultural Pest Survey. 2010. Variegated Golden Tortrix-*Archips xylosteanus*. United States Department of Agriculture, Cooperative Agricultural Pest Survey. Accessed August 31, 2010. http://pest.ceris.purdue.edu/services/napisquery/pam_detail.php?id=ITBUITA&v=2010/08/31

Carter, D. J. 1984. Pest Lepidoptera of Europe with Special Reference to the British Isles. Dordrecht: Dr W. Junk Publishers. 431 pp.

Cerretti, P., and H.-P. Tschorsnig. 2010. Annotated host catalogue for the Tachinidae (Diptera) of Italy. *Stuttgarter Beiträge zur Naturkunde A*, 3:305-340.

Charmillot, P. J., G. Blanc, and D. Pasquier. 2006. First case of summer fruit tortrix moth (*Adoxophyes orana*) resistance to insecticides in Switzerland. *Revue Suisse de Viticulture, Arboriculture et Horticulture* 38(2):87-93.

Cross, J. V. 1997a. Insegar Intervention. *Grower* (127):15-16.

Cross, J. V. 1997b. Susceptibility of the summer fruit tortrix moth, *Adoxophyes orana* (Lepidoptera: Tortricidae), to chlorpyrifos and strategies for insecticidal control in orchards. *Annals of Applied Biology* 131(2):197-212.

Cross, J. V., M. G. Solomon, D. Babandreier, L. Blommers, M. A. Easterbrook, C. N. Jay, G. Jenser, R. L. Jolly, U. Kuhlmann, R. Lilley, E. Olivella, S. Toepfer, and S. Vidal. 1999. Biocontrol of pests of apples and pears in northern and central Europe: 2. Parasitoids. *Biocontrol Science and Technology* 9(3):277-314.

Dhadialla, T. S., G. R. Carlson, and D. P. Le. 1998. New insecticides with ecdysteroidal and juvenile hormone activity. *Annual Review of Entomology* 43(1):545-569.

Dickler, E. 1991. Tortricid pests of pome and stone fruits, Eurasian species. in L. P. S. Van der Geest and H. H. Evenhuis, eds. Tortricid pests: their biology, natural enemies, and control. Elsevier, Amsterdam-Oxford-New York-Tokyo, 808 pp.

Dombroskie, J. J. 2010. Re: Fwd: *Archips xylosteanus* information. Personal communication to K. Maguylo on September 21, 2010, from J. Dombrowskie.

Dunley, J. E., J. F. Brunner, M. D. Doerr, and E. H. Beers. 2006. Resistance and cross-resistance in populations of the leafrollers, Choristoneura rosaceana and Pandemis pyrusana, in Washington apples. *Journal of Insect Science (Tucson)* 6:6.14.

Eggert, P. R. 2006. Presence of *Archips xylosteanus* Linneaus (Zhang 1994), variegated golden tortrix (Lepidoptera/Tortricidae) on Memorial University Campus, St. John's, Newfoundland. National Plant Board: DA-2006-22.

FAO. 2007. Overview of forest pests - Republic of Moldova (Working Paper FBS/25E). 20 pp. Frerot, B., M. Renou, M. Gallois, and C. Descoins. 1983. Un attractif sexuel pour la tordeuse des bourgeons: *Archips xylosteana* L. *Agronomie* 3:173-178.

Gantner, M. 2003. Lepidoptera of hazel plants in Poland (Part I). Occurrence, species, composition and economic importance. *Electronic Journal of Polish Agricultural Universities* 6(2):07.

Georgiev, G., and J. Kolarov. 1999. New Ichneumonidae (Hymenoptera) parasitoids of forest insect pests in Bulgaria. *Journal of Pest Science* 72:57-61.

Gilligan, T. M. 2010. Tortricid.net: Tortricidae resources on the web, version 2.0. Last accessed November 3, 2010. http://www.tortricid.net.

Hassan, S. A. 1992. Erfahrungen bei der Anwendung von Trichogramma spp. sur Bekämpfung des Apfelwicklers Cydia pomonella L. und des Apfelscaalenwicklers Adoxophyes orana F.R. Mitt. Dtsch. Allg. Angew. Ent. 8(1-3):70-74.

Hassan, S. A. 1993. The mass rearing and utilization of Trichogramma to control lepidopterous pests: Achievements and outlook. *Pesticide Science* 37(4):387-391.

Hill, D. S. 1987. Agricultural Insect Pests of Temperate Regions and Their Control. Cambridge University Press. 659 pp.

Hoebeke, E. R., J. A.G. Wheeler, and J. W. Brown. 2008. *Archips xylosteana*

(L.) (Lepidoptera: Tortricidae), a Palearctic leafroller new to North America. *Proceedings of the Entomological Society of Washington* 110(3):789-795.

Hoelscher, J. A., and B. A. Barrett. 2003. Effects of methoxyfenozide-treated surfaces on the attractiveness and responsiveness of adult leafrollers. *Entomologia Experimentalis et Applicata* 107(2):133-140.

Jakab, Z. S., I. Platon, and L. Gansca. 2009. Researches concerning the pheromonal control of summer fruit tortrix moth (Adoxophyes orana, Hb) using the biotechnique "Attract and kill". Bulletin of University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca. *Horticulture* 66(1):633-644.

Jonaitis, V. 2000. Fauna of the Metopiinae (Hymenoptera, Ichneumonidae). *Acta Zoologica Lituanica* 10(3):3-19.

Kara, K., and H.-P. Tschorsnig. 2003. Host catalogue for the Turkish Tachinidae (Diptera). *Journal of Applied Entomology* 127:465-467.

Kehrli, P., D. Pasquier, and P. A. Roux. 2009. Phenological variability and insecticide susceptibility of the summer fruit tortrix moth (Adoxophyes orana) in the Valais. *Revue Suisse de Viticulture, Arboriculture et Horticulture* 41(5):263-268.

Kienzle, J., C. P. W. Zebitz, S. Brass, and A. Athanassov. 1997. Abundance of different tortricid species and their parasitoid antagonists in ecological apple orchards in Southern Germany. *Biological Agriculture and Horticulture* 15(1):211-221.

Knight, A. L. 2010. Targeting Cydia pomonella (L.) (Lepidoptera: Tortricidae) adults with low volume applications of insecticides alone and in combination with sex pheromone. *Pest Management Science* 66(7):709-717.

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

Li, L.Y. 1994. Worldwide use of Trichogramma for biological control on different crops: A survey. Pages 37-54 in E. Wajnberg and S. A. Hassan, (eds.). Biological Control with Egg Parasitoids. CAB International, Oxon, England, 226 pp.

Meijerman, L., and S. A. Ulenberg. 2006. Arthropods of Economic Importance - Diaspididae of the World – Eurasian Tortricidae *Archips xylosteana*. Accessed January 12, 2006. http://wbd.etibioinformatics.nl

NASS. 2010. Census of Agriculture: Noncitrus Fruits and Nuts 2009 Summary, July 2010. United States Department of Agriculture, National Agricultural Statistics Service (NASS), Washington, D.C. 1-82 pp.

Oltean, I., L. GÃ¢ncaÌ†, T. Florian, H. Bunescu, I. BodisÌ§, and M. Varga. 2009. Fighting against Adoxophyes orana peel moth of fruits thru "attract and kill" method. *Research Journal of Agricultural Science* 41(1):271-276.

PestID. 2010. Pest Identification Database (PestID). United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine. Accessed XXXX. https://mokcs14.aphis.usda.gov/aqas/login.jsp

Pheronet. 2010. *Archips xylosteana* Linneaus. Alnarp, Sweden. Accessed October 27, 2010. Web site URL

Pluciennik, Z., and R. Olszak. 2010. The role of parasitoids in limiting the harmfulness of leafrollers in apple orchards. *Journal of Plant Protection Research* 50(1):1-8.

Pollini, A. 2009. Timely and targeted interventions against summer tortricid moths. *Informatore Agrario Supplemento* 65(26):10-11.

Razowski, J. 1977. Monograph of the genus *Archips* Hübner (Lepidoptera, Tortricidae). *Acta Zoologica Cracoviensia* 30(IX):55-206.

Riedl, H., and J. Avilla. 2007. Cherry Insects: Ecology and Control. Pages 1-10 in D. Pimentel, (ed.) Encyclopedia of Pest Management. CRC Press, Inc., 784 pp.

Schmid, A., J. P. Molen, W. Jucker, M. Baggiolini, and P. Antonin. 1978. The use of insect growth regulators, analogues of the juvenile hormone, against summer fruit tortrix moth, Adoxophyes orana and other pests. *Entomologia Experimentalis et Applicata* 24(1):65.

Schmidt, C. 2010. Re: *Archips xylosteana* survey. Personal communication to K. Maguylo on October 28, 2010, from Chris Schmidt.

Shiraki, T. 1952. Catalogue of injurious insects in Japan (exclusive of animal parasites) Volume III. General Headquarters Supreme Commander for the Allied Powers - Economic and Scientific Section Natural Resources Division, Tokyo, Japan. 166 pp.

Sial, A. A., and J. F. Brunner. 2010. Assessment of resistance risk in obliquebanded leafroller (Lepidoptera: Tortricidae) to the reduced-risk

insecticides chlorantraniliprole and spinetoram. *Journal of Economic Entomology* 103(4):1378-1385.

Sial, A. A., J. F. Brunner, and M. D. Doerr. (Article). 2010. Susceptibility of Choristoneura rosaceana (Lepidoptera: Tortricidae) to Two New Reduced-Risk Insecticides. *Journal of Economic Entomology* 103(1):140-146.

Smith, S. M. 1996. Biological control with Trichogramma: advances, successes, and potential of their use. *Annual Review of Entomology* 41:375-406.

Somsai, A. P., I. Oltean, L. Gansca, I. Oprean, P. Raica, and E. Harsan. 2009. Control of summer fruit tortrix moth, *Adoxophyes reticulana*, by an experimental "attract and kill" formulation. Bulletin of University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca. *Horticulture* 66(1):475-479.

Trematerra, P., and G. Baldizzone. 2004. Records of Lepidoptera Tortricidae from Krk Island (Croatia). *Entomologica Croatica* 8(1-2):25-44.

Trona, F., E. Ladurner, M. Baldessari, and G. Angeli. 2008. Two biological insecticides against the summer fruit tortrix moth of apple. *Informatore Agrario* 64(1):55-57.

Umeya, Y. 1950. Studies on embryonic hibernation and diapause in insects. *Proceedings of the Japan Academy* 26(6):1-9.

USDA–NRCS. 2010. The PLANTS Database. National Plant Data Center, Baton Rouge, LA. Accessed December 12, 2010. http://plants.usda.gov

United States Fish and Wildlife Service. 2011. Threatened and Endangered Species System (TESS). Accessed September 8 2011. http://ecos.fws.gov/tess_public/

van der Geest, L. P. S. 1971. Use of Bacillus thuringiensis for the Control of Orchard Pests. *Zeitschrift für Angewandte Entomologie* 69(1-4):263-266.

van der Geest, L. P. S. 1981. Mode of action of Bacillus thuringiensis on the summer fruit tree leafroller Adoxophyes orana (F. v. R.). *Zeitschrift für Angewandte Entomologie* 91(1-5):84-86.

van der Geest, L. P. S., and H. H. Evenhuis. 1991. Tortricid Pests: Their biology, natural enemies and control. Elsevier, Amsterdam, The Netherlands. 808 pp.

Velcheva, N. 2009. Lepidopteran fauna in new planted apple orchard in west Bulgaria. *Biotechnology and Biotechnological Equipment* 23(2):127-131.

Welch, R. C., and J. N. Greatorex-Davies. 1993. Colonization of two Nothofagus species by Lepidoptera in Southern Britain. *Forestry* 66(2):181-203.

Yasuda, T. 1972. The Tortricinae and Sparganothinae of Japan (Lepidoptera: Tortricidae) (Part I). Bulletin of the University of Osaka Prefecture, Series B 24:53-134.

Zwolfer, H., and M. Kraus. 1957. Biocoenotic studies on the parasites of two fir- and two oak tortricids. *Biocontrol* II(3):173-196.

Variegated Golden Tortrix

Glossary

Use this glossary to find the meaning of specialized words, abbreviations, acronyms, and terms used by PPQ–EDP. To locate where in the manual a given definition, term, or abbreviation is mentioned, refer to the Index.

Definitions, Terms, and Abbreviations

APHIS. USDA-Animal and Plant Health Inspection Service
ARS. USDA-Agricultural Research Service
attract and kill. IPM technique in which both pheromones and insecticides are applied to the upper canopy of an orchard, attracting male moths to the orchard where they are killed by the insecticide
blastokinesis. movement of the developing embryo into the yolk in insect eggs
CAPS. Cooperative Agricultural Pest Survey Program, a partnership between all 50 States and USDA to detect and monitor exotic pests of economic impact
CPB. U.S. Department of Homeland Security-Customs and Border Protection
CPHST. PPQ-Center for Plant Health Science and Technology
decontamination. application of approved chemical or other treatment to contaminated implements, material, or buildings, to kill a pest
detection survey. survey conducted in an environmentally favorable area a pest is not known to occur
disposal. method used to eliminate diseased plant material or material associated with infested plant material, usually at an approved landfill
EDP. PPQ-Emergency and Domestic Programs
EM. PPQ-Emergency Management
FIFRA. Federal Insecticide, Fungicide, and Rodenticide Act
ICS. Incident Command System
IPM. integrated pest management
low threshold pest. pest with a low threshold of tolerance for damage it causes
MOA. mode of action
monitoring survey. survey conducted at a site where a disease was found and where an eradication program is being performed; also known as evaluation survey
NEPA. National Environmental Policy Act
NIS. PPQ-National Identification Service
NPAG. PPQ New Pest Advisory Group
NPRG. New Pest Response Guidelines
non-native. immigrant
PERAL. Plant Epidemiology and Risk Analysis Laboratory
pest. includes insects, weeds, plant disease agents, and microorganisms
PIB. polyisobutylene
polyphagous. feeding on a wide range of hosts

PPQ. APHIS-Plant Protection and Quarantine
SEL. USDA–ARS-Systematic Entomology Laboratory
SPHD. State Plant Health Director
SPRO. State Plant Regulatory Official
traceback. to investigate the origin of infested plants through intermediate steps in commercial distribution channels to the origin
trace-forward. to investigate where infected plants may have been distributed from a source through steps in commercial distribution channels
TWG. Technical Working Group
umbricate. shingle-like; having regularly arranged, overlapping edges such as in roof tiles
univoltine. one generation per year
USDA. United States Department of Agriculture
zonobiome. ecosystem with the same average temperature and the same volume of rainfall

Appendix

A

Resources

Use *Appendix A Resources* to find the Web site addresses, street addresses, and telephone numbers of resources mentioned in the guidelines. To locate where in the guidelines a topic is mentioned, refer to the index.

Table A-1 Resources for *Harpophora maydis*

Resource	Contact Information
Center for Plant Health, Science, and Technology (USDA–APHIS–PPQ–CPHST)	http://www.aphis.usda.gov/plant_health/cphst/index.shtml
Emergency and Domestic Programs, Emergency Management (USDA–APHIS–PPQ–EDP–EM)	http://www.aphis.usda.gov/plant_health/plant_pest_info/index.shtml
PPQ *Manual for Agricultural Clearance*	http://www.aphis.usda.gov/import_export/plants/manuals/online_manuals.shtml
PPQ *Treatment Manual*	http://www.aphis.usda.gov/import_export/plants/manuals/online_manuals.shtml
Host or Risk Maps	http://www.nappfast.org/caps_pests/CAPs_Top_50.htm
Plant, Organism, and Soil Permits (APHIS–PPQ	http://www.aphis.usda.gov/plant_health/permits/index.shtml
National Program Manager for Native American Program Delivery and Tribal Liaison (USDA–APHIS–PPQ)	14082 S. Poston Place Tucson, AZ 85736 Telephone: (520) 822-544
Biological Control Coordinator (USDA–APHIS–CPHST)	http://www.aphis.usda.gov/plant_health/cphst/projects/arthropod-pests.shtml
FIFRA Coordinator (USDA–APHIS–PPQ-EDP)	4700 River Road Riverdale, MD 20737 Telephone: (301) 734-5861
Environmental Compliance Coordinator (USDA–APHIS–PPQ-EDP)	4700 River Road Riverdale, MD 20737 Telephone: (301) 734-7175
PPQ Form 391	http://www.aphis.usda.gov/library/forms/
List of State Plant Health Directors (SPHD)	http://www.aphis.usda.gov/services/report_pest_disease/report_pest_disease.shtml
List of State Plant Regulatory Officials (SPRO)	http://nationalplantboard.org/member/index.html

Appendix

B

Forms

Use *Appendix B Forms* to learn how to complete the forms mentioned in the guidelines. To locate where in the guidelines a form is mentioned, refer to the index.

Contents

PPQ Form 391 Specimens For Determination

This report is authorized by law (7 U.S.C. 147a). While you are not required to respond your cooperation is needed to make an accurate record of plant pest conditions. *See reverse for additional OMB information.*

FORM APPROVED
OMB NO. 0579-0010

U.S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE

SPECIMENS FOR DETERMINATION

Instructions: Type or print information requested. Press hard and print legibly when handwritten. Item 1 - assign number for each collection beginning with year, followed by collector's initials and collector's number. Example (collector, John J. Dingle): 83-JJD-001.
Pest Data Section – Complete Items 14, 15 and 16 or 19 or 20 and 21 as applicable. Complete Items 17 and 18 if a trap was used.

FOR IIBIII USE
LOT NO.
PRIORITY

1. COLLECTION NUMBER
2. DATE — MO | DA | YR
3. SUBMITTING AGENCY — ☐ State Cooperator ☐ PPQ ☐ Other _____

SENDER AND ORIGIN

4. NAME OF SENDER
6. ADDRESS OF SENDER
ZIP

INTERCEPTION SITE

5. TYPE OF PROPERTY *(Farm, Feedmill, Nursery, etc.)*
7. NAME AND ADDRESS OF PROPERTY OR OWNER
COUNTRY/ COUNTY

PURPOSE

8. REASON FOR IDENTIFICATION *("x" ALL Applicable Items)*

A. ☐ Biological Control (Target Pest Name)	E. ☐ Livestock, Domestic Animal Pest
B. ☐ Damaging Crops/Plants	F. ☐ Possible Immigrant *(Explain in* REMARKS*)*
C. ☐ Suspected Pest of Regulatory Concern *(Explain in* REMARKS*)*	G. ☐ Survey *(Explain in* REMARKS*)*
D. ☐ Stored Product Pest	H. ☐ Other *(Explain in* REMARKS*)*

9. IF PROMPT OR URGENT IDENTIFICATION IS REQUESTED, PLEASE PROVIDE A BRIEF EXPLANATION UNDER "REMARKS".

HOST DATA

10. HOST INFORMATION
NAME OF HOST *(Scientific name when possible)*

11. QUANTITY OF HOST
NUMBER OF ACRES/PLANTS
PLANTS AFFECTED *(Insert figure and indicate* ☐ Number ☐ Percent*):*

12. PLANT DISTRIBUTION
☐ LIMITED
☐ SCATTERED
☐ WIDESPREAD

13. PLANT PARTS AFFECTED

☐ Leaves, Upper Surface	☐ Trunk/Bark	☐ Bulbs, Tubers, Corms	☐ Seeds
☐ Leaves, Lower Surface	☐ Branches	☐ Buds	
☐ Petiole	☐ Growing Tips	☐ Flowers	
☐ Stem	☐ Roots	☐ Fruits or Nuts	

PEST DATA

14. PEST DISTRIBUTION
☐ FEW
☐ COMMON
☐ ABUNDANT
☐ EXTREME

15. ☐ INSECTS ☐ NEMATODES ☐ MOLLUSKS

NUMBER SUBMITTED	LARVAE	PUPAE	ADULTS	CAST SKINS	EGGS	NYMPHS	JUVS.	CYSTS
ALIVE								
DEAD								

16. SAMPLING METHOD
17. TYPE OF TRAP AND LURE
18. TRAP NUMBER

19. PLANT PATHOLOGY – PLANT SYMPTOMS *("X" one and describe symptoms)*
☐ ISOLATED ☐ GENERAL

20. WEED DENSITY
☐ FEW ☐ SPOTTY ☐ GENERAL

21. WEED GROWTH STAGE
☐ SEEDLING ☐ VEGETATIVE ☐ FLOWERING/FRUITING ☐ MATURE

22. REMARKS

23. TENTATIVE DETERMINATION

24. DETERMINATION AND NOTES *(Not for Field Use)*

SIGNATURE
DATE

FOR IIBIII USE
DATE RECEIVED
NO.
LABEL
SORTED
PREPARED
DATE ACCEPTED
RR

PPQ FORM 391 *Previous editions are obsolete.*
(AUG 02)

This is a 6-Part form. Copies must be disseminated as follows:
☐ PART 1 – PPQ ☐ PART 2 – RETURN TO SUBMITTER AFTER IDENTIFICATION ☐ PART 3 – IIBIII OR FINAL IDENTIFIER
☐ PART 4 – INTERMEDIATE IDENTIFIER ☐ PART 5 – INTERMEDIATE IDENTIFIER ☐ PART 6 – RETAINED BY SUBMITTER

Figure B-1 Example of PPQ Form 391 Specimens For Determination, side 1

OMB Information
According to the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information collection is 0579-0010. The time required to complete this information collection is estimated to average .25 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

Instructions
Use PPQ Form 391, Specimens for Determination, for domestic collections (warehouse inspections, local and individual collecting, special survey programs, export certification).

BLOCK	INSTRUCTIONS
1	1. Assign a number for each collection beginning the year, followed by the collector's initials and collector's number **EXAMPLE** In 2001, Brian K. Long collected his first specimen for determination of the year. His first collection number is 01-BLK-001 2. Enter the collection number
2	Enter date
3	Check block to indicate Agency submitting specimens for identification
4	Enter name of sender
5	Enter type of property specimen obtained from (farm, nursery, feedmill, etc.)
6	Enter address
7	Enter name and address of property owner
8A-8L	Check all appropriate blocks
9	Leave Blank
10	Enter scientific name of host, if possible
11	Enter quantity of host and plants affected
12	Check block to indicate distribution of plant
13	Check appropriate blocks to indicate plant parts affected
14	Check block to indicate pest distribution
15	• Check appropriate block to indicate type of specimen • Enter number specimens submitted under appropriate column
16	Enter sampling method
17	Enter type of trap and lure
18	Enter trap number
19	Enter X in block to indicate isolated or general plant symptoms
20	Enter X in appropriate block for weed density
21	Enter X in appropriate block for weed growth stage
22	Provide a brief explanation if Prompt or URGENT identification is requested
23	Enter a tentative determination if you made one
24	Leave blank

Distribution of PPQ Form 391
Distribute PPQ Form 391 as follows:
1. Send Original along with the sample to your Area Identifier.
2. Retain and file a copy for your records.

Figure B-2 Example of PPQ Form 391 Specimens For Determination, side 2

Purpose

Submit PPQ Form 391, Specimens for Determination, along with specimens sent for positive or negative identification.

Instructions

Follow the instructions in *Table B-1* on page B-5. Inspectors must provide all relevant collection information with samples. This information should be shared within a State and with the regional office program contact. If a sample tracking database is available at the time of the detection, please enter collection information in the system as soon as possible.

Distribution

Distribute PPQ Form 391 as follows:

1. Send the original along with the sample to your area identifier
2. Keep and file a copy for your records

Table B-1 Instructions for Completing PPQ Form 391, Specimens for Determination

Block		Instructions
1	COLLECTION NUMBER	1. ASSIGN a collection number for each collection as follows: 2-letter State code–5-digit sample number (Survey Identification Number in Parentheses) Example: PA-1234 (04202010001) 2. CONTINUE consecutive numbering for each subsequent collection 3. ENTER the collection number
2	DATE	ENTER the date of the collection
3	SUBMITTING AGENCY	PLACE an X in the PPQ block
4	NAME OF SENDER	ENTER the sender's or collector's name
5	TYPE OF PROPERTY	ENTER the type of property where the specimen was collected (farm, feed mill, nursery, etc.)
6	ADDRESS OF SENDER	ENTER the sender's or collector's address
7	NAME AND ADDRESS OF PROPERTY OR OWNER	ENTER the name and address of the property where the specimen was collected
8A-8H	REASONS FOR IDENTIFICATION	PLACE an X in the correct block
9	IF PROMPT OR URGENT IDENTIFICATION IS REQUESTED, PLEASE GIVE A BRIEF EXPLANATION UNDER "REMARKS"	LEAVE blank; ENTER remarks in *Block 22*
10	HOST INFORMATION NAME OF HOST	If known, ENTER the scientific name of the host
11	QUANTITY OF HOST	If applicable, ENTER the number of acres planted with the host
12	PLANT DISTRIBUTION	PLACE an X in the applicable box
13	PLANT PARTS AFFECTED	PLACE an X in the applicable box
14	PEST DISTRIBUTION FEW/COMMON/ ABUNDANT/EXTREME	PLACE an X in the appropriate block
15	INSECTS/NEMATODES/ MOLLUSKS	PLACE an X in the applicable box to indicate type of specimen
	NUMBER SUBMITTED	ENTER the number of specimens submitted as ALIVE or DEAD under the appropriate stage
16	SAMPLING METHOD	ENTER the type of sample
17	TYPE OF TRAP AND LURE	ENTER the type of sample
18	TRAP NUMBER	ENTER the sample numbers
19	PLANT PATHOLOGY-PLANT SYMPTOMS	If applicable, check the appropriate box; otherwise LEAVE blank
20	WEED DENSITY	If applicable, check the appropriate box; otherwise LEAVE blank

Table B-1 Instructions for Completing PPQ Form 391, Specimens for Determination (continued)

Block		Instructions
21	WEED GROWTH STAGE	If applicable, check the appropriate box; otherwise LEAVE blank
22	REMARKS	ENTER the name of the office or diagnostic laboratory forwarding the sample; include a contact name, email address, phone number of the contact; also include the date forwarded to the State diagnostic laboratory or USDA–APHIS–NIS
23	TENTATIVE DETERMINATION	ENTER the preliminary diagnosis
24	DETERMINATION AND NOTES (**Not** for Field Use)	LEAVE blank; will be completed by the official identifier

PPQ 523 Emergency Action Notification

According to the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information is 0579-0102. The time required to complete this information collection is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

FORM APPROVED - OMB NO. 0579-0102

U.S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
PLANT PROTECTION AND QUARANTINE

EMERGENCY ACTION NOTIFICATION

SERIAL NO.

1. PPQ LOCATION | 2. DATE ISSUED

3. NAME AND QUANTITY OF ARTICLE(S)

4. LOCATION OF ARTICLES

5. DESTINATION OF ARTICLES

6. SHIPPER

7. NAME OF CARRIER

8. SHIPMENT ID NO.(S)

9. OWNER/CONSIGNEE OF ARTICLES

Name:

Address:

PHONE NO. | FAX NO.

SS NO. | TAX ID NO.

10. PORT OF LADING | 11. DATE OF ARRIVAL

12. ID OF PEST(S), NOXIOUS WEEDS, OR ARTICLE(S)

12a. PEST ID NO. | 12b. DATE INTERCEPTED

13. COUNTRY OF ORIGIN | 14. GROWER NO.

15. FOREIGN CERTIFICATE NO.

15a. PLACE ISSUED | 15b. DATE

Under Sections 411, 412, and 414 of the Plant Protection Act (7 USC 7711, 7712, and 7714) and Sections 10404 through 10407 of the Animal Health Protection Act (7 USC 8303 through 8306), you are hereby notified, as owner or agent of the owner of said carrier, premises, and/or articles, to apply remedial measures for the pest(s), noxious weeds, and or article(s) specified in Item 12, in a manner satisfactory to and under the supervision of an Agriculture Officer. Remedial measures shall be in accordance with the action specified in Item 16 and shall be completed within the time specified in Item 17.

AFTER RECEIPT OF THIS NOTIFICATION, ARTICLES AND/OR CARRIERS HEREIN DESIGNATED MUST NOT BE MOVED EXCEPT AS DIRECTED BY AN AGRICULTURE OFFICER. THE LOCAL OFFICER MAY BE CONTACTED AT:

16. ACTION REQUIRED

☐ TREATMENT:

☐ RE-EXPORTATION:

☐ DESTRUCTION:

☐ OTHER:

Should the owner or owner's agent fail to comply with this order within the time specified below, USDA is authorized to recover from the owner or agent cost of any care, handling, application of remedial measures, disposal, or other action incurred in connection with the remedial action, destruction, or removal.

17. AFTER RECEIPT OF THIS NOTIFICATION COMPLETE SPECIFIED ACTION WITHIN (Specify No. Hours or No. Days):

18. SIGNATURE OF OFFICER:

ACKNOWLEDGMENT OF RECEIPT OF EMERGENCY ACTION NOTIFICATION

I hereby acknowledge receipt of the foregoing notification.

SIGNATURE AND TITLE: | DATE AND TIME:

19. REVOCATION OF NOTIFICATION

ACTION TAKEN:

SIGNATURE OF OFFICER: | DATE:

PPQ FORM 523 (JULY 2002) Previous editions are obsolete.

Figure B-3 Example of PPQ 523 Emergency Action Notification

Purpose

Issue a PPQ 523, Emergency Action Notification (EAN), to hold all host plant material at facilities that have the suspected plant material directly or indirectly connected to positive confirmations. Once an investigation determines the plant material is not infested, or testing determines there is no risk, the material may be released and the release documented on the EAN.

The EAN may also be issued to hold plant material in fields pending positive identification of suspect samples. When a decision to destroy plants is made, or in the case of submitted samples, once positive confirmation is received, the same EAN which placed plants on hold also is used to document any actions taken, such as destruction and disinfection. More action may be warranted in the case of other fields testing positive for this pest.

Instructions

If plant lots or shipments are held as separate units, issue separate EAN's for each unit of suspected plant material and associated material held. EAN's are issued under the authority of the Plant Protection Act of 2000 (statute 7 USC 7701-7758). States are advised to issue their own hold orders parallel to the EAN to ensure that plant material cannot move intrastate.

When using EAN's to hold articles, it is most important that the EAN language clearly specify actions to be taken. An EAN issued for positive testing and positive-associated plant material must clearly state that the material must be disposed of, or destroyed, and areas disinfected. Include language that these actions will take place at the owner's expense and will be supervised by a regulatory official. If the EAN is used to issue a hold order for further investigations and testing of potentially infested material, then document on the same EAN, any disposal, destruction, and disinfection orders resulting from investigations or testing.

Find more instructions for completing, using, and distributing this form in the PPQ *Manual for Agricultural Clearance*.

Appendix

C

How to Submit Insect Specimens

Contents

Insects and Mites

Taxonomic support for insect surveys requires that samples be competently and consistently sorted, stored, screened in most cases, and submitted to the identifier. The following are submission requirements for insects.

1. Sorting Trap Samples

   Trapping initiative is most commonly associated with a pest survey program, such as Wood Boring and Bark Beetles (WBBB), see Bark Beetle Submission Protocol from the PPQ Eastern Region CAPS program for detailed procedures. As such, it is important to sort out the debris and non-target insect orders from the trap material. The taxonomic level of sorting will depend on the expertise available on hand and can be confirmed with the identifier.

2. Screening Trap Samples

   Consult the screening aids on the CAPS website for screening aids for particular groups. The use of these aids should be coupled with training from identifiers and/or experienced screeners before their use. These can be found at: http://pest.ceris.purdue.edu/caps/screening.php

3. Storing Samples

   Where appropriate, samples can be stored indefinitely in alcohol, however samples of dried insects such as those in sticky traps may decompose over time if not kept in a cool location such as a refrigerator or freezer. If insect samples have decomposed, do not submit them for identification.

4. Packaging and Shipping

   Ensure specimens are dead before shipping. This can be accomplished by placing them in a vial of alcohol or putting the dry specimens in the freezer for at least 1day. The following are a few tips on sorting, packaging and shipping liquids, sticky traps and dry samples.

Liquids

Factors such as arthropod group, their life-stage and the means they were collected determine the way the specimens are handled, preserved and shipped to the identifier. In general mites, insect larvae, soft-bodied and hard-bodied adult insects can be transferred to vials of 75-90 percent Ethanol (ETOH), or an equivalent such as isopropyl alcohol. At times, Lingren funnel trap samples may have rainwater in them. To prevent later decay, drain off all the liquid and replace with alcohol. Vials used to ship samples should contain samples from a single trap and a printed or hand-written label with the associated collection number that is also found in the top right corner of form 391. Please make sure to use a writing utensil that isn't alcohol soluble, such as a micron pen or a pencil. It is important not to mix samples from multiple traps in a single vial so as to preserve the locality association data. Vials can be returned to field personnel upon request.

If sending specimens in alcohol is an issue with the mail or freight forwarder, the majority of liquid can be decanted off from the vial and then sealed tightly in the container just before shipping. Tell the identifier that the vials will need to have alcohol added back to them as soon as they are received. During the brief time of shipping, the specimens should not dry out if the vial is properly sealed.

Sticky Trap Samples

Adult Lepidoptera, because of their fragile appendages, scales on wings, etc. require special handling and shipping techniques. Lepidoptera specimens in traps should not be manipulated or removed for preliminary screening unless expertise is available. Traps can be folded, with stickum-glue on the inside, but only without the sticky surfaces touching, and secured loosely with a rubber band for shipping. Inserting a few styrofoam peanuts on trap surfaces without insects will cushion and prevent the two sticky surfaces from sticking during shipment to taxonomists. Also DO NOT simply fold traps flat or cover traps with transparent wrap (or other material), as this will guarantee specimens will be seriously damaged or pulled apart – making identification difficult or impossible.

An alternative to this method is to cut out the area of the trap with the suspect pest and pin it securely to the foam bottom of a tray with a lid. Make sure there is some room around the specimen for pinning and future manipulation. For larger numbers of traps, placing several foam peanuts between sticky surfaces (arranged around suspect specimens) can prevent sticky surfaces from making contact when packing multiple folded-traps for shipment. DO NOT simply fold traps flat or cover traps with transparent wrap (or other material), as this will guarantee specimens will be seriously damaged or pulled apart – making identification difficult or impossible.

Dry Specimens

Some collecting methods produce dry material that is fragile. Dry samples can be shipped in vials or glassine envelopes, such as the ones that can be purchased here: http://www.bioquip.com/Search/default.asp. As with the alcohol samples, make sure the collection label is associated with the sample at all times. This method is usually used for larger insects and its downside is the higher chance of breakage during shipping. Additionally, dry samples are often covered in debris and sometimes difficult to identify.

Be sure that the samples are adequately packed for shipment to ensure safe transit to the identifier. If a soft envelope is used, wrap it in shipping bubble sheets; if a rigid cardboard box is used, pack it in such a way that the samples are restricted from moving in the container. Please include the accompanying documentation and tell the identifier before shipping. Remember to tell the identifier that samples are on the way, giving the approximate number and to include your contact information.

Documentation

Each trap sample/vial should have accompanying documentation along with it in the form of a completed PPQ form 391, Specimens for Determination. The form is fillable electronically and can be found here:

http://cals-cf.calsnet.arizona.edu/azpdn/labs/submission/PPQ_Form_391.pdf

It is good practice to keep a partially filled electronic copy of this form on your computer with your address and other information filled out in the interest of saving time. Indicate the name of the person making any tentative identification before sending to an identifier. Please make sure all fields that apply are filled out and the bottom field (block 24: Determination and Notes) is left blank to be completed by the identifier. Include the trap type, lure used, and trap number on the form. Also, include the phone number and/or e-mail

address of the submitter. Other documentation in the form of notes, images, etc. can be sent along with this if it useful to the determination. It is important that there be a way to cross-reference the sample/vial with the accompanying form. This can be done with a label with the “Collection Number” in the vial or written on the envelope, etc.

Appendix

D

Taxonomic Support for Surveys

Contents

Background

The National Identification Services (NIS) coordinates the identification of plant pests in support of USDA's regulatory programs. Accurate and timely identifications are the foundation of quarantine action decisions and are essential in the effort to safeguard the nation's agricultural and natural resources.

NIS employs and collaborates with scientists who specialize in various plant pest groups, including weeds, insects, mites, mollusks and plant diseases. These scientists are stationed at a variety of institutions around the country, including federal research laboratories, plant inspection stations, land-grant universities, and natural history museums. Additionally, the NIS Molecular Diagnostics Laboratory is responsible for providing biochemical testing services in support of the agency's pest monitoring programs.

On June 13, 2007, the PPQ Deputy Administrator issued PPQ Policy No. PPQ-DA-2007-02 which established the role of PPQ NIS as the point of contact for all domestically- detected, introduced plant pest confirmations and communications. A Domestic Diagnostics Coordinator (DDS) position was established to administer the policy and coordinate domestic diagnostic needs for NIS. This position was filled in October of 2007 by Joel Floyd (USDA, APHIS, PPQ-PSPI,NIS 4700 River Rd., Unit 52, Riverdale, MD 20737, phone (301) 734-4396, fax (301) 734-5276, e-mail: joel.p.floyd@aphis.usda.gov).

Taxonomic Support and Survey Activity

Taxonomic support for pest surveillance is basic to conducting quality surveys. A misidentification or incorrectly screened target pest can mean a missed opportunity for early detection when control strategies would be more viable and cost effective. The importance of good sorting, screening, and identifications in our domestic survey activity cannot be overemphasized.

Fortunately most states have, or have access to, good taxonomic support within their states. Taxonomic support should be accounted for in cooperative agreements as another cost of conducting surveys. Taxonomists and laboratories within the State often may require supplies, develop training materials, or need to hire technicians to meet the needs of screening and identification. As well, when considering whether to survey for a particular pest a given year, consider the challenges of taxonomic support.

Sorting and Screening

For survey activity, samples that are properly sorted and screened before being examined by an identifier will result in quicker turn around times for identification.

Sorting

Sorting is the first level of activity that assures samples submitted are of the correct target group of pests being surveyed, that is, after removal of debris, ensure that the correct order, or in some cases family, of insects is submitted; or for plant disease survey samples, select those that are symptomatic if appropriate. There should be a minimum level of sorting expected of surveyors depending on the target group, training, experience, or demonstrated ability.

Screening

Screening is a higher level of discrimination of samples such that the suspect target pests are separated from the known non-target, or native species of similar taxa. For example, only the suspect target species or those that appear similar to the target species are forwarded to an identifier for confirmation. There can be first level screening and second level depending on the difficulty and complexity of the group. Again, the degree of screening appropriate is dependent on the target group, training, experience, and demonstrated ability of the screener.

Check individual survey protocols to determine if samples should be sorted, screened or sent entire (raw) before submitting for identification. If not specified in the protocol, assume that samples should be sorted at some level.

Resources for Sorting, Screening, and Identification

Sorting, screening, and identification resources and aids useful to CAPS and PPQ surveys are best developed by taxonomists who are knowledgeable of the taxa that includes the target pests and the established or native organisms in the same group that are likely to be in samples and can be confused with the target. Many times these aids can be regionally based. They can be in the form of dichotomous keys, picture guides, or reference collections. NIS encourages the development of these resources, and when aids are complete, post them in the CAPS Web site so others can benefit. If local screening aids are developed,

please notify Joel Floyd, the Domestic Diagnostics Coordinator, as to their availability. Please see the following for some screening aids available: http://pest.ceris.purdue.edu/caps/screening.php

Other Entities for Taxonomic Assistance in Surveys

When taxonomic support within a state is not adequate for a particular survey, in some cases other entities may assist including PPQ identifiers, universities and state departments of agriculture in other states, and independent institutions. Check with the PPQ regional CAPS coordinators about the availability of taxonomic assistance.

Universities and State Departments of Agriculture

Depending on the taxonomic group, there are a few cases where these two entities are interested in receiving samples from other states. Arrangements for payment, if required for these taxonomic services, can be made through cooperative agreements. The National Plant Diagnostic Network (NPDN) also has five hubs that can provide service identifications of plant diseases in their respective regions.

Independent Institutions

The Eastern Region PPQ office has set up multi-state arrangements for Carnegie Museum of Natural History to identify insects from trap samples. They prefer to receive unscreened material and work on a fee basis per sample.

PPQ Port Identifiers

There are over 70 identifiers in PPQ that are stationed at ports of entry who primarily identify pests encountered in international commerce including conveyances, imported cargo, passenger baggage, and propagative material. In some cases, these identifiers process survey samples generated in PPQ conducted surveys, and occasionally from CAPS surveys. They can also enter into our Pest ID database the PPQ form 391 for suspect CAPS target or other suspect new pests, prior to being forwarded for confirmation by an NIS recognized authority.

PPQ Domestic Identifiers

PPQ also has a limited number of domestic identifiers (three entomologists and two plant pathologists) normally stationed at universities who are primarily responsible for survey samples. Domestic identifiers can be used to handle unscreened, or partially screened samples, with prior arrangement through the PPQ regional survey coordinator. They can also as an intermediary alternative to sending an unknown suspect to, for example, the ARS Systematic Entomology Lab (SEL), depending on their specialty and area of coverage.

They can also enter into our Pest ID database the PPQ form 391 for suspect CAPS target or other suspect new pests, prior to being forwarded for confirmation by an NIS recognized authority.

PPQ Domestic Identifiers
Bobby Brown
Domestic Entomology Identifier
Specialty: forest pests (coleopteran, hymenoptera)
Area of coverage: primarily Eastern Region

USDA, APHIS, PPQ
901 W. State Street
Smith Hall, Purdue University
Lafayette, IN 47907-2089
Phone: 765-496-9673
Fax: 765-494-0420
e-mail: robert.c.brown@aphis.usda.gov

Julieta Brambila
Domestic Entomology Identifier
Specialty: adult Lepidoptera, Hemiptera
Area of Coverage: primarily Eastern Region
USDA APHIS PPQ
P.O. Box 147100
Gainesville, FL 32614-7100
Office phone: 352- 372-3505 ext. 438, 182
Fax: 352-334-1729
e-mail: julieta.bramila@aphis.usda.gov

Kira Zhaurova
Domestic Entomology Identifier
Specialty: to be determine
Area of Coverage: primarily Western Region
USDA, APHIS, PPQ
Minnie Belle Heep 216D
2475 TAMU
College Station, TX 77843
Phone: 979-450-5492
e-mail: kira.zhaurova@aphis.usda.gov

Grace O'Keefe
Domestic Plant Pathology Identifier
Specialty: Molecular diagnostics (citrus greening, P. ramorum, bacteriology, cyst nematode screening)
Area of Coverage: primarily Eastern Region

USDA, APHIS, PPQ
105 Buckhout Lab
Penn State University
University Park, PA 16802
Lab: 814 - 865 - 9896
Cell: 814 – 450- 7186
Fax: 814 - 863 – 8265
e-mail: grace.okeefe@aphis.usda.gov

Craig A. Webb, Ph.D.
Domestic Plant Pathology Identifier
Specialty: Molecular diagnostics (citrus greening, P. ramorum, cyst nematode screening)
Area of Coverage: primarily Western Region
USDA, APHIS, PPQ
Department of Plant Pathology
Kansas State University
4024 Throckmorton Plant Sciences
Manhattan, KS 66506-5502
Cell (785) 633-9117
Office (785) 532-1349
Fax: 785-532-5692
e-mail: craig.a.webb@aphis.usda.gov

Final Confirmations

If identifiers or laboratories at the state, university, or institution level suspect they have detected a CAPS target, a plant pest new to the United States, or a quarantine pest of limited distribution in a new state, the specimens should be forwarded to an NIS recognized taxonomic authority for final confirmation. State cooperator and university taxonomists can go through a PPQ area identifier or the appropriate domestic identifier that covers their area to get the specimen in the PPQ system (for those identifiers, see table G-1-1 in the Agriculture Clearance Manual, Appendix G link below). They will then send it to the NIS recognized authority for that taxonomic group.

State level taxonomists, who are reasonably sure they have a new United States. record, CAPS target, or new federal quarantine pest, can send the specimen directly to the NIS recognized authority, but must notify their State Survey Coordinator (SSC), PPQ Pest Survey Specialist (PSS), State Plant Health Director (SPHD), and State Plant Regulatory Official (SPRO).

Before forwarding these suspect specimens to identifiers or for confirmation by the NIS recognized authority, please complete a PPQ form 391 with the tentative determination. Also fax a copy of the completed PPQ Form 391 to

"Attention: Domestic Diagnostics Coordinator" at 301-734-5276, or send a PDF file in an e-mail to mailto:nis.urgents@aphis.usda.govwith the overnight carrier tracking number.

The addresses of NIS recognized authorities of where suspect specimens are to be sent can be found in The Agriculture Clearance Manual, Appendix G, tables G-1-4 and G-1-5: http://www.aphis.usda.gov/import_export/plants/manuals/ports/downloads/mac_pdf/g_app_identifiers.pdf

Only use Table G-1-4, the "Urgent" listings, for suspected new United States records, or state record of a significant pest, and Table G-1-5, the "Prompt" listings, for all others.

When the specimen is being forwarded to a specialist for NIS confirmation, use an overnight carrier, insure it is properly and securely packaged, and include the hard copy of the PPQ form 391 marked "Urgent" if it is a suspect new pest, or "Prompt" as above.

Please contact Joel Floyd, the Domestic Diagnostics Coordinator if you have questions about a particular sample routing, at phone number: 301-734-5276, or e-mail: joel.p.floyd@aphis.usda.gov

Digital Images for Confirmation of Domestic Detections

For the above confirmations, do not send digital images for confirmation. Send specimens in these instances. For entry into NAPIS, digital imaging confirmations can be used for new county records for widespread pests by state taxonomists or identifiers if they approve it first. They always have the prerogative to request the specimens be sent.

Communications of Results

If no suspect CAPS target, program pests, or new detections are found, communication of these identification results can be made by domestic identifiers or taxonomists at other institutions directly back to the submitter. They can be in spread sheet form, on hard copy PPQ form 391's, or other informal means with the species found, or "no CAPS target or new suspect pest species found". Good record keeping by the intermediate taxonomists performing these identifications is essential.

All confirmations received from NIS recognized authorities, positive or negative, are communicated by NIS to the PPQ Emergency and Domestic Programs (EDP) staff in PPQ headquarters. EDP then notifies the appropriate PPQ program managers and the SPHD and SPRO simultaneously. One of these contacts should forward the results to the originating laboratory, diagnostician, or identifier.

Data Entry

Cooperative Agricultural Pest Survey (CAPS)

For survey data entered into NAPIS, new country and state records should be confirmed by an NIS recognized authority, while for others that are more widespread, use the identifications from PPQ identifiers or state taxonomists.

Appendix

E

Distribution of Hosts

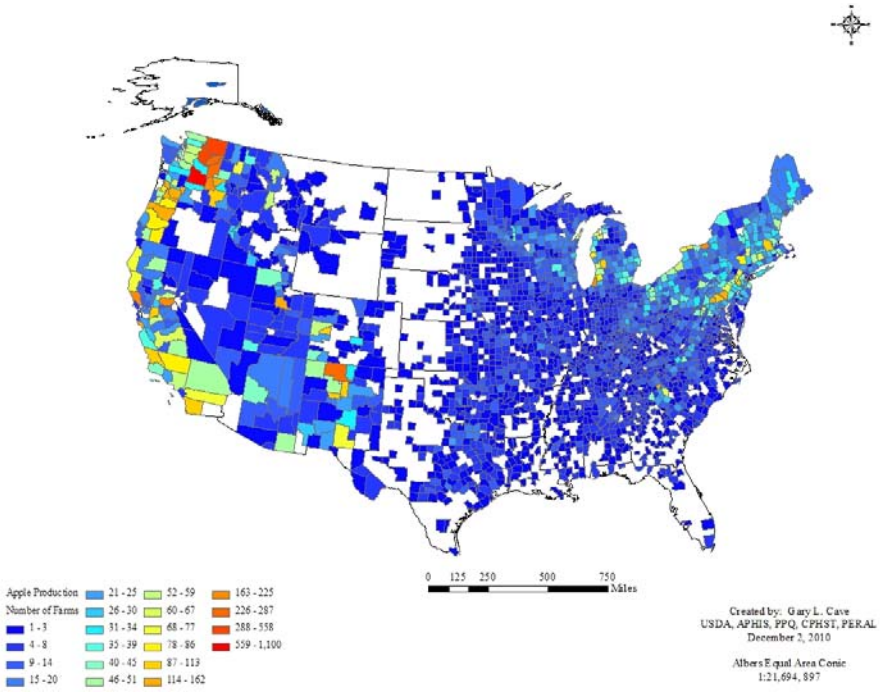

Figure E-1 Counties in the United States Containing Commercial Apple Farms (NASS, 2007)

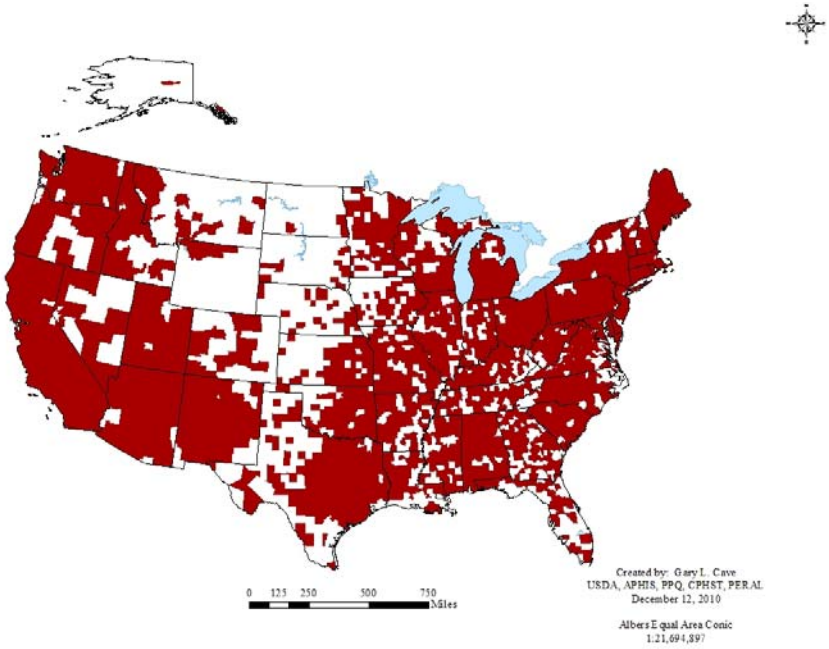

Figure E-2 Counties in the United States Containing *Prunus* species (USDA-NRCS, 2010)

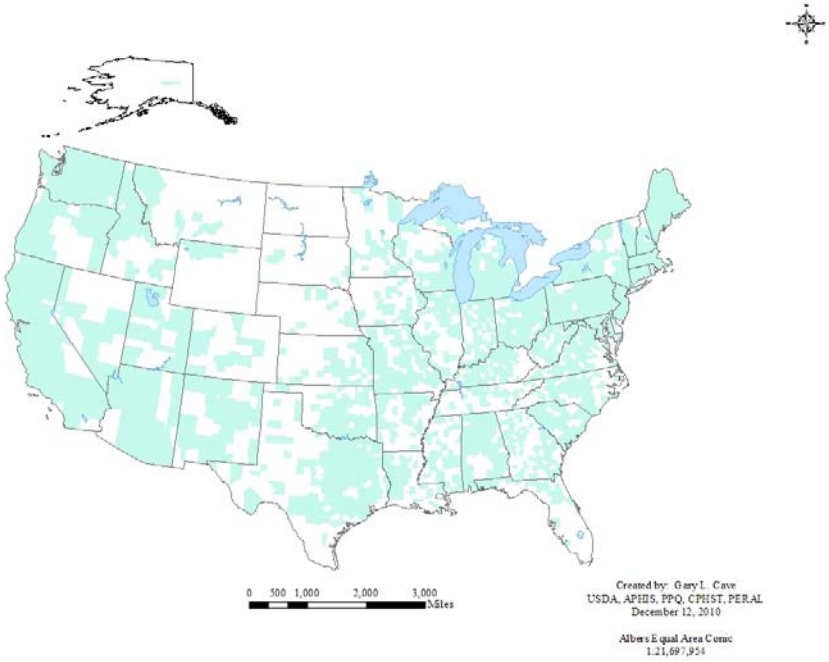

Figure E-3 Counties in the United States Containing Commercial Farms with *Pyrus* species (NASS, 2007)

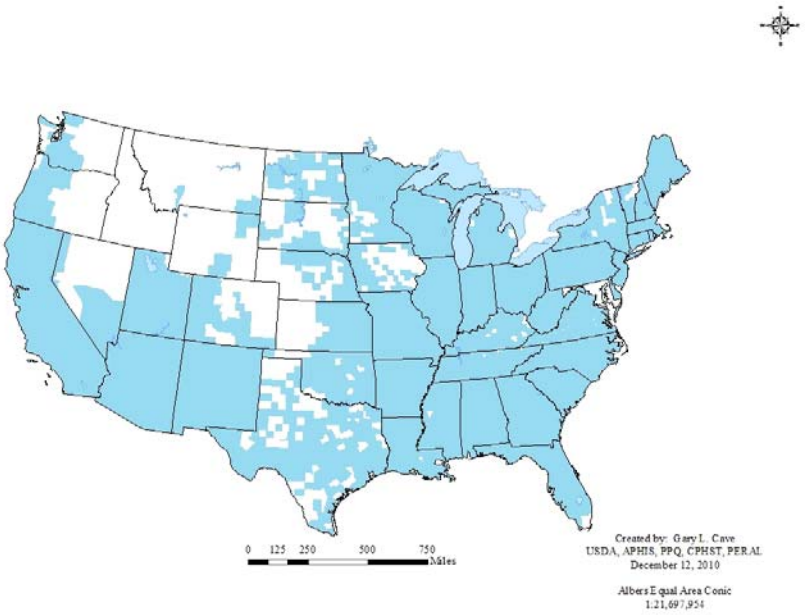

Figure E-4 Counties in the United States Containing *Quercus* Species (USDA–NRCS, 2010)

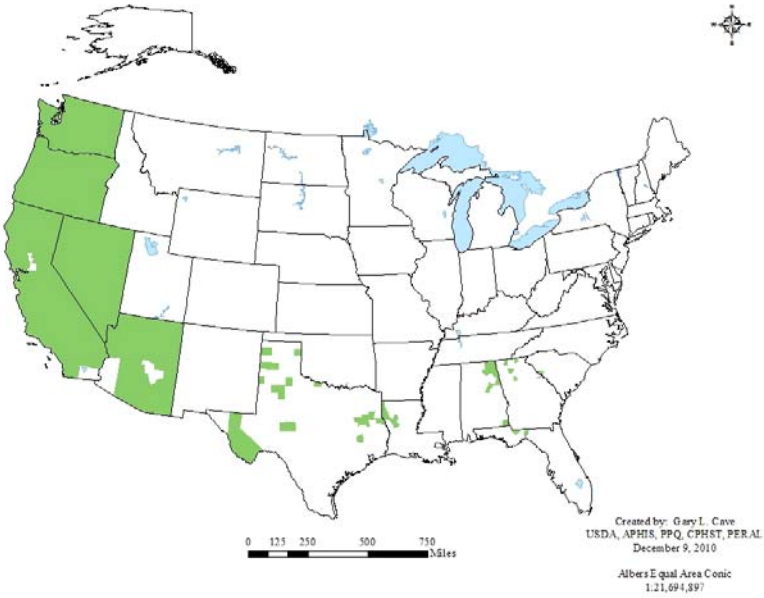

Figure E-5 Counties in the United States Containing *Ribes* Species (USDA–NRCS, 2010)

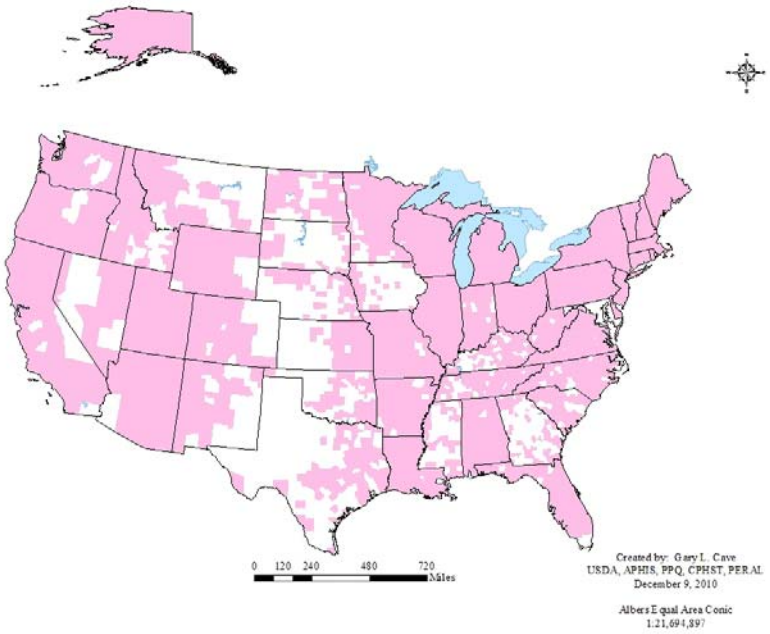

Figure E-6 Counties in the United States Containing *Rubus* Species (USDA–NRCS, 2010)

Appendix

F

Tortricidae Molecular Protocols

Contents

Tortricidae Molecular Protocol

T. M. Gilligan
Colorado State University
June 2010

DNA extraction using Qiagen DNeasy Blood & Tissue Kit:

1. Place 2-3 legs dry legs from moth in 1.5 ml tube
2. Crush legs with pestle
3. Add 180 µl Buffer ATL while washing off pestle
4. Add 20 µl proteinase K
5. Vortex and briefly spin down
6. Incubate at 56°C for 12-24 hours (overnight)

Note: following day

7. Vortex for 15 sec.
8. Add 200 µl Buffer AL, vortex
9. Add 200 µl 100% EtOH, vortex
10. Pipet mixture into spin column (650 µl)
11. Spin at 8000 RPM for 1 minute
12. Discard collection tube and flow through
13. Place column in new tube, add 500 µl Buffer AW1
14. Spin at 8000 RPM for 1 minute
15. Discard collection tube and flow through
16. Place column in new tube, add 500 µl Buffer AW2
17. Spin at 14,000 RPM for 3 minutes
18. Discard collection tube and flow through
19. Place column in clean 1.5 ml tube labeled “high”
20. Elute DNA with 100 µl Buffer AE, incubate for at least 1 minute
21. Spin at 8000 RPM for 1 minute
22. Place column in clean 1.5 ml tube labeled “low”
23. Elute DNA again with 100 µl Buffer AE, incubate for at least 1 minute
24. Spin at 8000 RPM for 1 minute

This protocol results in two extracts per sample (100 µl each): a “high” concentration tube and “low” concentration tube. The “low” concentration extract is stored in -80°C as a back up and the “high” concentration extract is used for PCR.

At this point samples are ready for PCR.

Tortricidae Molecular Protocol

T. M. Gilligan
Colorado State University
June 2010

Gene: Cytochrome oxidase I (COI)

Length: Approximately 700 bp

Primers: 25 nmole DNA Oligo (IDT)

LCO-1490	GGT CAA CAA ATC ATA AAG ATA TTG G
HCO-2198	TAA ACT TCA GGG TGA CCA AAA AAT CA

PCR mix: TaKaRa Ex Taq Hot Start (RR006A)

PCR protocol:

1. Create master mix containing:

37.75 µl	Water
5.00 µl	10X buffer
4.00 µl	dNTPs
1.00 µl	Primer LCO-1490
1.00 µl	Primer HCO-2198
0.25 µl	Taq

2. Add 49 µl of master mix to each PCR tube
3. Add 1 µl DNA template for total of 50 µl per PCR reaction

PCR program:

T50/C39 (TODDCOI) – approximately 1 ½ hours

1. 94°C / 3 min.
2. 39 cycles of:
    a. 94°C / 20 sec.
    b. 50°C / 20 sec.
    c. 72°C / 30 sec.
3. 72°C / 5 min.
4. Hold at 4°C

Run PCR product on normal gel (9 µl DNA + 2 µl dye) and note band intensity.

Clean successful amplifications using standard PCR cleanup protocols.

Samples are now ready for sequencing.

Tortricidae Molecular Protocol

T. M. Gilligan
Colorado State University
June 2010

Gene: Elongation factor 1 alpha (EF-1a)

Length: 516 bp

Primers: 25 nmole DNA Oligo (IDT)

M13REV_M51.9tort (BJ)	CAG GAA ACA GCT ATG ACC CAR GAY GTN TAC AAA ATC GG
M13_rcM4 (Tweeky)	TGT AAA ACG ACG GCC AGT ACA GCV ACK GTY TGY CTC ATR TC

PCR mix: TaKaRa Ex Taq Hot Start (RR006A)

PCR protocol:

1. Create master mix containing:

37.75 µl	Water
5.00 µl	10X buffer
4.00 µl	dNTPs
1.00 µl	M13REV_M51.9tort
1.00 µl	M13_rcM4
0.25 µl	Taq

2. Add 49 µl of master mix to each PCR tube
3. Add 1 µl DNA template for total of 50 µl per PCR reaction

PCR program:

cadtd352 (TODD1) – approximately 3 ½ hours

1. 94°C / 4 min.
2. 5 cycles of:
    a. 94°C / 30 sec.
    b. 52°C / 30 sec.
    c. 72°C / 1 min.
3. 7 cycles of:
    a. 94°C / 30 sec.
    b. 51°C / 1 min.
    c. 72°C / 1 min.
4. 36 cycles of:
    a. 94°C / 30 sec.
    b. 45°C / 20 sec.
    c. 72°C / 1 min. 30 sec.
5. 72°C / 3 min.
6. Hold at 4°C

Run PCR product on normal gel (9 µl DNA + 2 µl dye) and note band intensity.

Clean successful amplifications using standard PCR cleanup protocols.

Samples are now ready for sequencing.

Tortricidae Molecular Protocol

T. M. Gilligan
Colorado State University
June 2010

Gene: Carbamoyl-phosphate synthetase 2, aspartate transcarbamylase, and dihydroorotase (CAD)

This gene is very difficult to obtain. The following primer combination amplified CAD across several genera in several tribes in both the Olethreutinae and Tortricinae. These primers are a mix from different labs and have different universal primer tails (M13 for the forward and T3 for the reverse). In theory they would work without the tails (or both with a M13 or T3/T7 combo), but this has not been tested and I have no desire to mess with this working protocol. So they are included below with the tails attached.

This primer combination results in multiple bands for most taxa, necessitating gel isolation after the initial PCR. Direct sequencing of the initial PCR product does not work. Some samples that show very faint bands may be reamplified after the gel isolation. Reamplification of samples that failed the initial PCR (no detectable band in the gel isolation process) did not result in PCR product after the reamp, thus reamping completely failed PCRs is not recommended.

Protocols for the entire process are included here and follow these general steps:

1. Initial PCR
2. Gel isolation and purification of PCR products
3. Reamplification of faint bands detected during step 2

Length: Approximately 800 bp

Primers: 25 nmole DNA Oligo (IDT)

M13r-791F	CAG GAA ACA GCT ATG ACC TTY GAR GAR GCN TTY CAR AAR GC
T3-CAD1028R	ATT AAC CCT CAC TAA AGT TRT TNG GNA RYT GNC CNC CCA T

PCR mix: TaKaRa Ex Taq Hot Start (RR006A)

STEP 1: Initial PCR

PCR protocol:

1. Create master mix containing:

37.75 µl	Water
5.00 µl	10X buffer
4.00 µl	dNTPs
1.00 µl	M13r-791F
1.00 µl	T3-CAD1028R
0.25 µl	Taq

2. Add 49 µl of master mix to each PCR tube
3. Add 1 µl DNA template for total of 50 µl per PCR reaction

PCR program:

cadtd352 (TODD1) – approximately 3 ½ hours

1. 94°C / 4 min.
2. 5 cycles of:
    a. 94°C / 30 sec.
    b. 52°C / 30 sec.
    c. 72°C / 1 min.
3. 7 cycles of:
    a. 94°C / 30 sec.
    b. 51°C / 1 min.
    c. 72°C / 1 min.
4. 36 cycles of:
    a. 94°C / 30 sec.
    b. 45°C / 20 sec.
    c. 72°C / 1 min. 30 sec.
5. 72°C / 3 min.
6. Hold at 4°C

Run PCR product on normal gel (9 µl DNA + 2 µl dye) and note band intensity.

STEP 2: Gel Isolation

Gel isolation and extraction of PCR product using Qiagen QIAquick Gel Extraction Kit:

1. Load entire PCR product (~40 µl + 6 µl loading dye = 45 µl product) onto a 1.5% low-melt gel
2. Run gel at 50V for approximately 3 hours
3. Visualize band intensity and note faint bands to reamplify
    a. Note that completely absent bands are not likely to reamp
4. Cut visible bands from gel and place into 1.5 ml tubes
5. Dissolve gel in 500 µl Buffer QC (vortexing often – usually heating is not necessary)
6. Once completely dissolved, pipette solution into spin column (750 µl total)
7. Spin at 15,000 RPM for 1 minute
8. Discard flow through, dry tube
9. Add 750 µl Buffer PE
10. Spin at 15,000 RPM for 1 minute
11. Discard flow through, dry tube
12. Spin at 15,000 RPM for 1 minute, discard flow through and tube
13. Place in clean, labeled 1.5 ml tube
14. Elute DNA with 35 µl Buffer EB, spin at 15,000 RPM for 1 minute

At this point samples not being reamplified are ready for sequencing.

Proceed to Step 3 with samples that showed faint bands in #3 above.

STEP 3: Reamplification PCR

Dilute extracted/cleaned PCR product from Step 2:

Dilute 1 µl of PCR product into 10 µl of water; use this diluted DNA as the PCR template below

PCR protocol:

1. Create master mix containing:

37.75 µl	Water
5.00 µl	10X buffer
4.00 µl	dNTPs
1.00 µl	M13r-791F
1.00 µl	T3-CAD1028R
0.25 µl	Taq

2. Add 49 µl of master mix to each PCR tube
3. Add 1 µl DNA template for total of 50 µl per PCR reaction

PCR program:

T55/C34 – approximately 1 ¼ hours

1. 94°C / 3 min.
2. 34 cycles of:
    a. 94°C / 20 sec.
    b. 55°C / 20 sec.
    c. 72°C / 30 sec.
3. 72°C / 5 min.
4. Hold at 4°C

Run PCR product on normal gel (9 µl DNA + 2 µl dye) and note band intensity.

Clean successful reamps using standard PCR cleanup protocols.

Reamplified samples are now ready for sequencing.

Appendix

G

Dissection Technique for Moths from Sticky Traps

Contents

Materials

- Brushes (two synthetic, No. 0, 00)
- Forceps (two pair, Dumont #5)
- Stains (optional)
- Watch glasses, Syracuse
- Potassium hydroxide (KOH, 10%, or pellets)
- Petri dishes (glass)
- Histoclear (citrus oil)
- Genitalia vials
- Ethanol (95%, optional)
- Dry bath heat block (optional)
- Soapy water solution
- Slide making materials (optional)
- Dissecting microscope
- Glycerin

Technique

1. Create temporary labels to track specimen throughout process
2. Cut piece of sticky trap containing specimen or remove abdomen from specimen
3. Immerse sticky trap piece or abdomen in citrus oil until specimen is free of PIB
4. Put abdomen in 10% KOH:
   - **A.** 12 to 24 hours at room temperature, or
   - **B.** 45 minutes to 2 hours at 50° C (in dry bath)
5. Clean abdomen in water:

- **A.** Clean in Syracuse watch glass
- **B.** Use a drop of soapy water to break surface tension
- **C.** Remove scales, fat, and other debris using brushes and forceps
- **D.** Change water and watch glasses as necessary

6. Dissect specimen:
   - **A.** Males
     - **i.** Remove genital capsule by brushing or with forceps
     - **ii.** Clean debris from genital capsule and remaining debris from pelt
     - **iii.** More dissection will be taxon dependent
   - **B.** Females
     - **i.** Separate female genitalia from pelt
     - **ii.** Carefully pull bursae copulatrix from pelt
     - **iii.** Clean debris from genital capsule and pelt
     - **iv.** More dissection will be taxon dependent
7. Stain specimen (optional):
   - **A.** Common stains: mercurochrome, chlorazol black, eosin (Y or B), others
   - **B.** Staining times and procedures depend on particular stain
   - **C.** Do not stain too heavily; light or no stain is better than too much stain
8. Mount and store specimen:
   - **A.** Genitalia vial
     - **i.** Put genitalia in vial filled with glycerin
     - **ii.** Pin vial below specimen with appropriate labels
   - **B.** Microscope slide
     - **i.** Dehydrate specimen in appropriate position with 95% ethanol
     - **ii.** Follow mounting procedures in Robinson (1976)
     - **iii.** Label slide with appropriate information

References

Clarke, J. F. G. 1941. The preparation of slides of the genitalia of Lepidoptera. *Bulletin of the Brooklyn Entomological Society* 36:149-161.

Miller, R. S., S. Passoa, R. D. Waltz & V. Mastro. 1993. Insect removal from sticky traps using a citrus oil solvent. *Entomological News* 104(4): 209-213.

Robinson, G. S. 1976. The preparation of slides of Lepidoptera genitalia with special reference to the Microlepidoptera. *Entomologist's Gazette* 27:127-132.

Winter, W. D. 2000. Basic techniques for observing and studying moths and butterflies. *Memoirs of the Lepidopterists' Society* No. 5:1-444.

Appendix

H

Supporting Publication

Contents

PROC. ENTOMOL. SOC. WASH.
110(3), 2008, pp. 789–795

ARCHIPS XYLOSTEANA (L.) (LEPIDOPTERA: TORTRICIDAE), A PALEARCTIC LEAFROLLER NEW TO NORTH AMERICA

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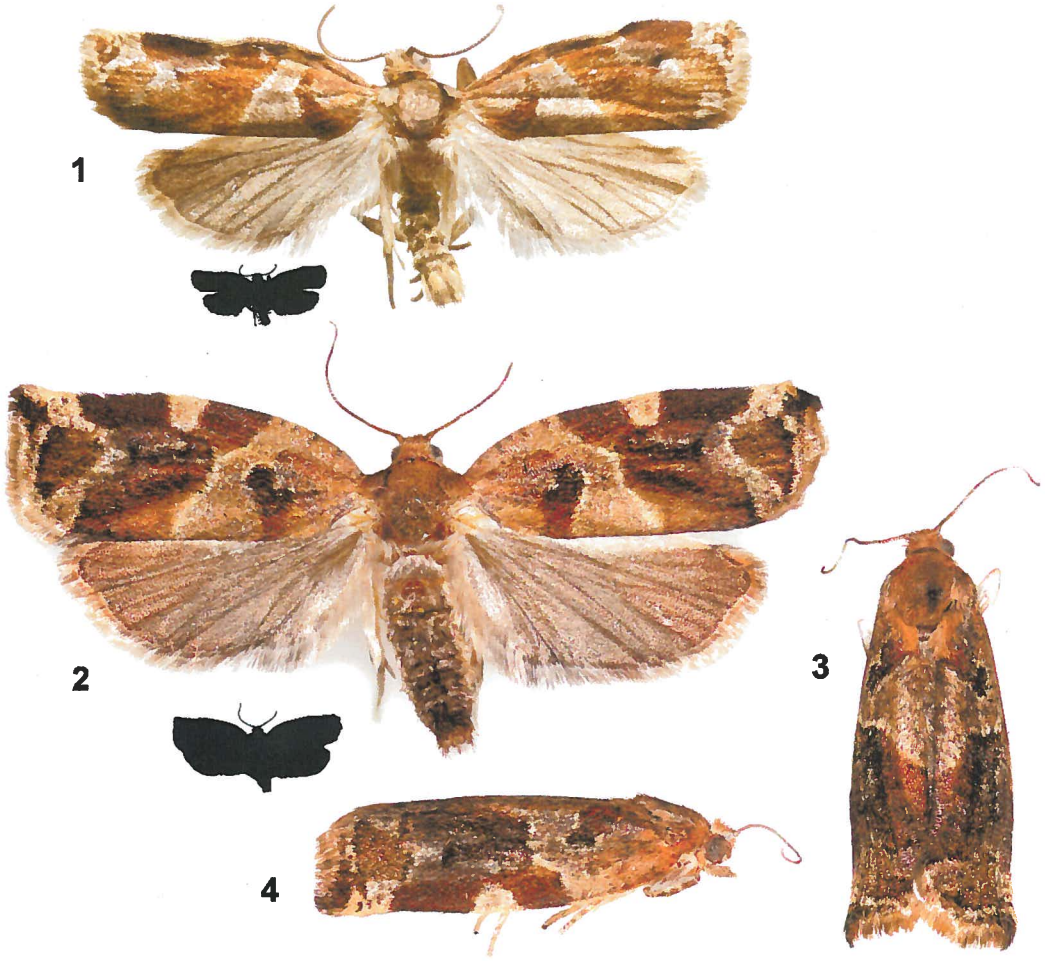
Abstract.—*Archips xylosteana* (L.), a widespread Palearctic tortricid moth, is reported from four localities in St. John's, Newfoundland, the first records of this species in North America. Adults were found on a variety of ornamental trees and shrubs on the campus of Memorial University in August 2005 and 2006. This immigrant tortricid, a minor pest of rosaceous fruit trees and shrubs, is redescribed and diagnosed. Photographs of the adult male and female are provided to facilitate its recognition. Its worldwide distribution and biology are summarized.

Key Words: Lepidoptera, Tortricidae, *Archips xylosteana*, new records, adventive species, Atlantic Canada

Since 1993, we (E.R.H. and A.G.W.) have made 11 survey collecting trips to the Atlantic Provinces of Canada, with the goal of detecting non-native insects not recorded previously from North America. We collected mainly in and around Halifax, Nova Scotia, and St. John's, Newfoundland, both considered high-risk areas for the unintentional introduction of Palearctic insects. In August 2005 and 2006, numerous adults of the Eurasian tortricid *Archips xylosteana* (L.) were taken at several locations in St. John's, Newfoundland (by E.R.H. and A.G.W.). Here, we list the first North American records for this newly detected immigrant; provide a diagnosis, description, and photographs of the moth to facilitate its recognition; and review its Old World distribution, biology, damage, and hosts.

The genus *Archips* Hübner is widely distributed in the Holarctic Region, especially in the Asian part of the Palearctic (Kruse and Sperling 2002). In the Nearctic Region, the genus is represented by at least 24 species (Razowski 1977, Powell 1983, Brown 2005). *Archips rosana* (L.) was introduced accidentally to North America prior to 1890 (Comstock and Slingerland 1890) and is well established in the western and eastern portions of the continent, with fewer records from the middle. *Archips fuscocupreana* Walsingham has been in the northeastern United States since at least 1982 (Maier and Mastro 1998, Maier 2003), and in the Northwest since at least 1995 (LaGasa et al. 1997). *Archips podana* (Scopoli) was first introduced into North America in British Columbia, Canada, earlier this century, and was not



Figs. 1–4. *Archips xylosteana*. 1, Adult male, dorsal aspect, wings spread. 2, Adult female, dorsal aspect, wings spread. 3, Adult female, dorsal aspect, natural repose. 4, Adult female, lateral aspect, natural repose. Actual size indicated by accompanying silhouettes.

discovered in the United States until 2000 in northwestern Whatcom County, Washington (LaGasa et al. 2003). With the addition of *A. xylosteana* to the fauna, the number of Palearctic species of *Archips* in North America now stands at four.

Diagnosis and Description

Archips xylosteana (L.)

(Figs. 1–6)

Diagnosis.—*Archips xylosteana* (Figs. 1–4) is similar to many other Archipini in size, wing shape, and color pattern. It is most similar to the European *A. crataegana* (Hübner) but differs in its more variegated forewing maculation and its smaller size (Bradley et al. 1973, Alford 1984). Some strongly patterned individuals of the Holarctic *A. rosana* also are similar to *A. xylosteana*, but the latter can be distinguished by the sacculus being narrower medially (Razowski 2002). The extremely long cestum of the female genitalia, as long as the ductus bursae, also distinguishes *A. xylosteana* from similar-appearing congeners.

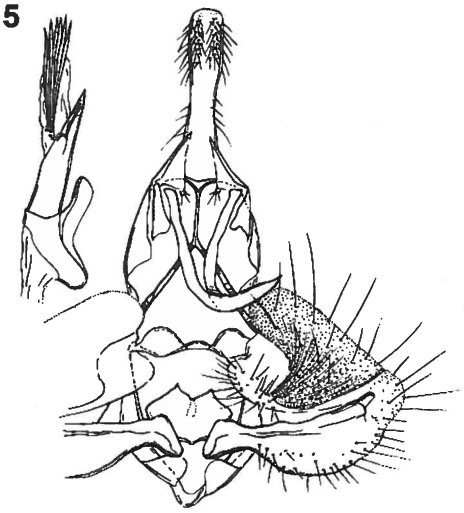


Fig. 5. Male genitalia of *Archips xylosteana* (after Razowski 2001).

Description (after Bradley et al. 1973; Razowski 1977, 2002; Meijerman and Ulenberg 2004).—Adult. Male (Fig. 1). *Head:* Vertex and frons pale brownish cream, often mixed with rust; labial palpus concolorous with head. *Thorax:* Dorsum pale brownish cream; legs unmodified. Forewing length 7–10 mm; costal fold occupying basal two-thirds of wing, with patch of featherlike scales near its distal end; forewing ground color whitish ochreous with variable gray, slightly refractive suffusion; markings reddish brown, thinly edged with ground color; basal blotch variably developed, usually a thumb-shaped patch extending subbasally from dorsum; median fascia slender in costal one-fourth, broadened toward tornus, inner margin sinuate; small black-brown dot at end of discal cell; subapical spot semi-ovate, usually contiguous with paler pistol-shaped subterminal marking; a reddish-brown spot or elongate marking at apex or in apical part of termen. Cilia concolorous with ground color of distal portion of wing, gray-brown at tornus, mixed rust at apex. Hindwing grayish brown, mixed ferruginous in apical area. Cilia pale ochreous-cream or cream, brownish in

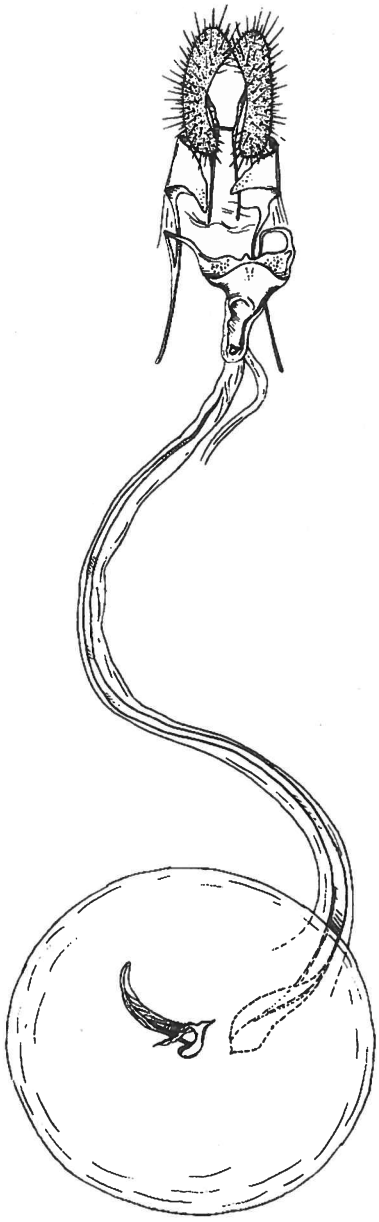


Fig. 6. Female genitalia of *Archips xylosteana* (after Razowski 2001).

caudal part of wing, with brown basal line. *Abdomen:* Pale brownish cream. Genitalia (Fig. 5) with uncus parallel-sided, slightly broader in distal half, with truncate tip; socius vestigial; gnathos large with long, pointed terminal plate; valva rounded-obovate, sacculus with short free termination. Aedeagus short,

tapering apically, pointed ventro-apically, with slender subapical lateral process; vesica usually with 6 deciduous cornuti.

Female (Figs. 2–4). *Head:* Essentially as described for male. *Thorax:* Dorsum pale brownish cream. Forewing length 9–11 mm; forewing broad; costa curved in basal one-third, slightly concave before apex; apex longer than in male; termen sinuate, convex and rounded postmedially; forewing pattern and maculation as in male, or markings darker, less reddish. Hindwing gray, apical area sometimes tinged with yellow or cupreous. *Abdomen:* Genitalia (Fig. 6) with sterigma weakly sclerotized with short caudal portion and small median process; anterior cup-shaped portion well developed, broad posteriorly, tapering anteriorly, partially fused with sclerite of antrum; cestum reaching almost to the anterior end of ductus bursae; corpus bursae round, signum with well-developed capitulum.

Sexual dimorphism and color variation.—Male with distinct costal fold and long antennal setae; female without costal fold, apex slightly produced, slightly greater forewing length, and antenna filiform, lacking conspicuous setae (Bradley et al. 1973). Considerable variation in forewing markings; inner margin of median fascia often shallowly sinuous or nearly angulate at middle; terminal markings often reduced to small irregularly shaped spot; ground color and markings in some specimens very pale, exceptionally dark in others (Bradley et al. 1973). For illustrations of adults see Bradley and Martin (1956), Bradley et al. (1973), Razowski (2002), and Meijerman and Ulenberg (2004). For illustrations of male and female genitalia see Razowski (1977, 2002).

Immature stages.—Egg: Ovoid, flattened, laid in a rounded imbricate mass, covered by a purplish-brown colleterial secretion. Larva: Last instar 16–22 mm long; whitish gray, sometimes gray or dark bluish gray, with paler sides; head shiny black; prothoracic shield black or dark brown, with a whitish midline and collar; anal comb present. Chaetotaxy as described by Swatschek (1958). Pupa: About 10–15 mm long; reddish brown to dark brown or black; cremaster elongate; abdominal segments 2 and 3 with transverse folds dorsally, front margin of transverse fold reaching far behind, especially in segment 2, hind margin of the fold distinctly undulate; abdominal segments with some conspicuous hairs, dorsal pits absent; abdominal segments 3–8 with characteristic double row of spines.

Distribution

Archips xylosteana is native to most of Europe (Bulgaria, France, Germany, Lithuania, Poland, Portugal, Romania, Spain, Sweden, United Kingdom, Ukraine) (Bradley et al. 1973, Zhang 1994, Leraut and Luquet 1995, Razowski 2002), eastern and central Asia (China, Iran, Japan, Kazakhstan, Korea, far eastern Russia, Siberia, Turkey, Turkmenia) (Shiraki 1952, Bradley et al. 1973, Kuznetzov 1978, Zhang 1994, Byun et al. 1998), and northern Africa (Algeria) (Leraut and Luquet 1995).

New North American records (based on specimens examined).—CANADA: Newfoundland: St. John's, Memorial University campus, N43°34.407, W52°43.856, 5 August 2005 (3 males, 1 female), 5–8 August 2006 (13 males, 25 females); St. John's, Bowring Park, N47°31.680, W52°45.016, 6–8 August 2006 (3 males, 15 females); St. John's, Southside Road, N47°32.531, W52°43.460, 5–8 August 2006 (2 males, 1 female); St. John's, Thorburn Road, N47°33.909, W52°45.758, 6 August 2006 (1 male, 1 female). Based on our collecting, *Archips xylosteana* appears to be established in the St. John's area of the Avalon Peninsula.

Voucher specimens of *A. xylosteana* are deposited in the Canadian National

Collection of Insects, Ottawa, Ontario; Cornell University Insect Collection, Ithaca, NY; and National Museum of Natural History, Smithsonian Institution, Washington, DC.

Biology and Damage

Known in the Palearctic Region as the variegated golden tortrix (Carter 1984, Zhang 1994), apple leaf roller (Shiraki 1952), and brown oak tortrix (Alford 1984, 1995, 2007; Dickler 1991), *A. xylosteana* is a polyphagous minor pest of fruit trees such as apple, pear, plum, and cherry (Balachowsky 1966, Razowski 1977, Kuznetzov 1978, Dickler 1991, Alford 2007). In the United Kingdom, it occurs in woodlands and gardens (Bradley et al. 1973), whereas in the former USSR and adjacent countries it can be found in forest nurseries and plantations (Kryzhanovskii 1988). Dickler (1991) recognized *A. xylosteana*, along with *A. rosana* and *A. crataegana*, as important "bud-attacking" species.

This species is univoltine in Eurasia (Bradley et al. 1973, Carter 1984, Dickler 1991). Adults are most numerous in July in the United Kingdom (Bradley et al. 1973, Alford 2007), from the end of June to mid-August in parts of Europe and Japan (Razowski 1977), and from early July to mid-August in far eastern Russia (Razowski 1977). Eggs are present from July through April (Carter 1984). Overwintering eggs are laid on branches or trunks in small masses, then coated with a brownish secretion that camouflages them on the bark (Alfaro 1950, Balachowsky 1966, Razowski 1977, Carter 1984, Dickler 1991, Alford 2007). Eggs hatch in late March, April, or early May in Europe (Alford 2007); neonates start to feed at the green-tip stage of host development (pome and stone fruits) (Dickler 1991) and begin feeding on the underside of the leaves. Early instars chew through vegetation and flower buds, whereas later instars feed inside a tightly rolled leaf edge, usually on fully expanded foliage at the shoot tips, and skeletonize the leaf (Kryzhanovskii 1988, Meijerman and Ulenberg 2004, Alford 2007). Larvae continue to feed until early June, usually requiring 30–40 d to reach maturity. Larvae also will feed on young fruitlets, resulting in the development of corky blemishes on the skin. In May or June, pupation takes place in a transversely rolled leaf or between two spun leaves (Alford 1995). The pupal stage typically lasts 9–12 d (Razowski 1977). Larval shelters may disfigure host plants and cause concern, but feeding is confined mainly to fully expanded leaves and therefore has little or no significance (Alford 1995).

Hosts.—Host plants documented in the literature include *Acer* spp. (Aceraceae); *Alnus* sp., *Betula* sp., and *Corylus avellana* L. (Betulaceae); *Lonicera* sp. (Caprifoliaceae); *Cornus controversa* Hemsley (Cornaceae); *Rhododendron* sp. (Ericaceae); *Castanea* sp., *Quercus acutissima* Carruthers, *Q. cerris* L., *Q. dentata* Thunberg, *Q. robur* L., *Fagus* sp. (Fagaceae); *Hypericum* sp. (Hypericaceae); *Fraxinus excelsior* L. (Oleaceae); *Abies* sp. (Pinaceae); *Crataegus* sp., *Malus pumila* Miller, *Prunus apetala* (Siebold & Zuccarini) Franchet and Savatier, *P. armeniaca* L., *P. avium* (L.) L., *P. serrulata* Lindley var. *spontanea* (Maximowicz) E. H. Wilson, *Pyrus pyrifolia* (Burman) Nakai, *P. ussuriensis* Maximowicz, *Rubus* sp., and *Sorbus aucuparia* L. (Rosaceae); *Citrus* sp. (Rutaceae); *Salix cinerea* L., *Salix* sp., *Populus* sp. (Salicaceae); *Tilia* sp. (Tiliaceae); and *Ulmus davidiana* Planchon var. *japonica* (Rehder) Nakai (Ulmaceae) (Disque 1908; Shiraki 1952; Wilson and Becker 1960; Bradley et al. 1973; Yasuda 1975; Razowski 1977; Kuznetzov 1978; Park 1983; Carter 1984; Zhang 1994; Alford 1995, 2007; Teramoto 1996; Byun et al. 1998; Jaros and Spitzer 2002;

Meijerman and Ulenberg 2004; Konno 2005).

The majority of specimens collected on the campus of Memorial University and Bowring Park were beaten from foliage of various ornamental trees and shrubs, namely European ash (*F. excelsior*) (Oleaceae); crabapple (*Malus* sp.), mountain-ash (*Sorbus* sp.), chokeberry (*Aronia* sp.) (Rosaceae); English oak (*Q. robur*) (Fagaceae); linden (*Tilia* sp.) (Tiliaceae); and cranberry-bush (*Viburnum* sp.) (Caprifoliaceae).

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Literature Cited

Alfaro, A. 1950. Orugas de *Archips* en el arbolado frutal de la Ribera del Jalon. Boletin de Potologia Vegtal y Entomologia Agricola 17: 37–59.

Alford, D. V. 1984. A Colour Atlas of Fruit Pests; their Recognition, Biology and Control. Wolfe Publishing Ltd., London, 320 pp.

———. 1995. A Color Atlas of Pests of Ornamental Trees, Shrubs and Flowers. Halsted Press, New York, 448 pp.

———. 2007. Pests of Fruit Crops – A Colour Handbook. Manson Publishing Ltd., London, 461 pp.

Balachowsky, A. S. 1966. Entomologie appliqué a la agriculture. Lepidopteres 2(1): 1–1057. Mason & Cie, Paris.

Bradley, J. D. and E. L. Martin. 1956. An illustrated list of the British Tortricidae. Part I: Tortricinae and Sparganothinae. Entomologist's Gazette 7: 151–156, plate 1–10.

Bradley, J. D., W. G. Tremewan, and A. Smith. 1973. British Tortricoid Moths. Cochylidae and Tortricidae: Tortricinae. The Ray Society, London, 251 pp.

Brown, J. W. 2005. World Catalogue of Insects. Volume 5. Tortricidae (Lepidoptera). Apollo Books, Stenstrup, Denmark, 741 pp.

Byun, B. K., Y. S. Bae, and K. T. Park. 1998. Illustrated catalogue of Tortricidae of Korea (Lepidoptera). *In* Park, K.-T., ed. Insects of Korea, 2. Korea Research Institute of Bioscience and Biotechnology and Center for Insect Systematics, Korea, 317 pp.

Carter, D. J. 1984. Pest Lepidoptera of Europe: With Special Reference to the British Isles. W. Junk Publishers, Dordrecht and Boston, 431 pp.

Comstock, J. H. and M. V. Slingerland. 1890. A leaf roller on currant, *Cacoecia rosana* (Order Lepidoptera; Family Tortricidae). Cornell University Agricultural Experiment Station Bulletin 23: 119–121.

Dickler, E. 1991. Tortricid pests of pome and stone fruits, Eurasian species, pp. 435–452. *In* van der Geest, L. P. S. and H. H. Evenhuis, eds. Tortricid Pests; their Biology, Natural Enemies and Control. Elsevier Press, Amsterdam and New York.

Disque, H. 1908. Versuch einer microlepidopterologischen Botanik. Deutsche Entomologische Zeitschrift "Iris" 21: 34–147.

Jaros, J. and K. Spitzer. 2002. Food plants of Lepidoptera associated with an alder carr forest in South Bohemia (Central Europe). Zoological Studies in the Vrbenske Rybniky Reserve (South Bohemia, CZ). Rocnik 42(Supplement): 5–60.

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

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 the morphological and mitochondrial DNA data sets. Annals of the Entomological Society of America 95: 288–301.

Kryzhanovskii, O. L. 1988. Lepidoptera fauna of the USSR and adjacent countries: A collection of papers dedicated to professor Alexsander Sergeevich Danailevskiii. Smithsonian Institution Libraries, Washington, DC. 405 pp.

Kuznetzov, V. I. 1978. Chapter 21. Family Tortricidae (Olethreutidae, Cochylidae) - Tortricid Moths, pp. 279–956. *In* Medvedev, G. S., ed. Keys to the Insects of the European Part of the USSR. Volume IV (Lepidoptera), Part 1. Nauka Publishers, Leningrad.

LaGasa, E. H., D. Hartley, and M. Allen. 1997. Biology and distribution of the apple tortrix – *Archips fuscocupreanus* (Lepidoptera: Tortricidae) in Washington State, a polyphagous leafroller pest new to North America. 1996 Entomology Project Report – Washington State Department of Agriculture. February 3, 1997.

LaGasa, E. H., P. Hertzog, D. Bowden, and B. Fair. 2003. *Archips podana* (Scopoli) (Lepidoptera: Tortricidae) host survey 2002 – Northwest Washington occurrence of an Old World tree-fruit pest new to the United States. 2001 Entomology Project Report – WSDA Pub 080 (N/02/03), 7 pp.

Leraut, P. and G. Luquet. 1995(1996). *Archips xylosteana sabrinae* ssp. nov en France méridionale (Lepidoptera: Tortricidae). Alexanor 19: 249–251.

Maier, C. T. 2003. Distribution, hosts, abundance, and seasonal flight activity of the exotic leafroller, *Archips fuscocupreanus* Walsingham (Lepidoptera: Tortricidae), in the northeastern United States. Annals of the Entomological Society of America 96: 660–666.

Maier, C. T. and V. C. Mastro. 1998. Discovery, abundance, and distribution of the exotic apple tortrix, *Archips fuscocupreanus* Walsingham (Lepidoptera: Tortricidae), in the northeastern United States. Proceedings of the Entomological Society of Washington 100: 545–552.

Meijerman, L. and S. A. Ulenberg. 2004. Arthropods of Economic Importance: Eurasian Tortricidae. http://ip30.eti.uva.nl/bis/tortricidae.php?menuentry=soorten&id=132. (Accessed March 25, 2008)

Park, K.-T. 1983. Microlepidoptera of Korea. Insecta Koreana 3: 8–24.

Powell, J. A. 1983. Tortricoidea, pp. 31–42. *In* Hodges, R. W., ed. Check List of the Lepidoptera of America north of Mexico. E. W. Classey Ltd. and Wedge Entomological Research Foundation, London.

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

———. 2001. Die Tortriciden (Lepidoptera, Tortricidae) Mitteleuropas: Bestimmung, Verbreitung, Flugstandort, Lebensweise der Raupen. Frantisek Slamka, Bratislava, 319 pp.

———. 2002. Tortricidae of Europe. Vol. 1, 247 pp. Tortricinae and Chlidanotinae. Frantisek Slamka, Bratislava.

Shiraki, T. 1952. Catalogue of injurious insects in Japan (exclusive of animal parasites). Vol. III (Systematic List of Injurious Insects). General Headquarters, Supreme Commander for the Allied Powers, Tokyo, pp. 3–162.

Swatschek, B. 1958. Die Larvalsystematik der Wickler (Tortricidae und Carposinidae) aus dem Zoologischen Institut der Universität Erlangen. Akademie-Verlag, Berlin, 269 pp. [Abhandlungen zur Larvalsystematik Insekten 3.]

Teramoto, N. 1996. Studies on lepidopterous insect fauna on fabaceous plants, as the food plants of the wild silk moth, *Antheraea yamamai*. Bulletin of the Shiga Prefectural Agricultural Experiment Station 19: 1–216.

Wilson, G. F. and P. Becker. 1960. Horticultural Pests, Detection and Control. Crosby Lockwood, London, 240 pp.

Yasuda, T. 1975. The Tortricinae and Sparganothinae of Japan (Lepidoptera: Tortricidae) (Part II). Bulletin of the University of Osaka Prefecture (Series B) 27: 79–251.

Zhang, B.-C. 1994. Index of Economically Important Lepidoptera. CAB International, Wallingford, UK, 599 pp.

Variegated Golden Tortrix

Index

T