United States Department of Agriculture

Animal and Plant Health Inspection Service

Cooperating State Departments of Agriculture

New Pest Response Guidelines

Tropical Terrestrial Gastropods

This document is not intended to be complete and exhaustive. It provides a foundation based upon available literature to assist in the development of appropriate and relevant regulatory activities. Some key publications were not available at the time of writing, and not all specialists and members of the research community were consulted in the preparation of this document.

References to commercial suppliers or products should not be construed as an endorsement of the company or product by the USDA.

All uses of pesticides must be registered or approved by appropriate Federal, State, and/or Tribal agencies before they can be applied. The information provided on pesticide labels may not reflect all of the actual information, including precautions and instructions for use, which you are required to follow in your specific State or locality. It is the responsibility of persons intending to use a pesticide to read and abide by the label, including labeling approved for the particular State or locality in which the chemical is to be used, and to comply with all Federal, State, Tribal, and local laws and regulations relating to the use of the pesticide. APHIS program staffs are responsible for their compliance with applicable environmental regulations.

CAUTION: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.

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Cover Image

Veronicella cubensis (Pfeiffer), David Robinson

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Tropical Terrestrial Gastropods

Introduction

Contents

Purpose

Use *New Pest Response Guidelines: Tropical Terrestrial Gastropods* as a guide when designing a program to detect, monitor, control, contain, or eradicate an infestation of tropical terrestrial gastropods in the United States and collaborating territories. Selected species in the gastropod families Ariophantidae and Veronicellidae are discussed here as these are currently of particular concern, but these guidelines are applicable for most tropical terrestrial gastropods (TRTG).

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

Any new detection may require the establishment of an Incident Command System to facilitate emergency management. This document is meant to provide the necessary information to launch a response to a detection of most tropical terrestrial gastropods.

If tropical terrestrial gastropods are 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 can be updated.

Users

The guidelines is intended as a field reference for the following users who have been assigned responsibilities for a plant health emergency for tropical terrestrial gastropods:

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

Pest Status

Tropical terrestrial gastropods:

- Cause damage by feeding on agricultural and horticultural crops as well as native plants, thereby lowering crop yield and quality
- Transmit pathogens to humans indirectly when humans consume vegetables and fruits contaminated by slugs and snails
- Transmit pathogens of livestock in their feces
- Displace native species of slugs and snails

The species included in the guidelines are just a few of the tropical terrestrial gastropods that have been introduced into the United States and collaborating Territories. Some of these species have established self-sustaining populations.

Although efforts have been made to eradicate or suppress these introduced species, there remains the possibility that they have been introduced further afield from known introduction sites and therefore represent a credible threat to agriculture and the environment.

Contacts

When an emergency program for tropical terrestrial gastropods has been implemented, its success depends on the cooperation, assistance, and understanding of other involved groups. The appropriate liaison and information officers should distribute news of program progress and developments to interested groups, including the following:

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

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 pests identity is confirmed by a national taxonomic authority recognized by USDA–APHIS–PPQ–National Identification System.
4. Existing *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 an NPAG, as follows:

- Take no action
- Regulate the pest
- Contain the pest
- Suppress the pest
- 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.
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.

Prevention

Federal and State regulatory officials must conduct inspections and apply prescribed measures to ensure that this pest does **not** spread within or between properties. Federal and State regulatory officials conducting inspections should follow the sanitation guidelines in ***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*
2. *Pest Information*
3. *Identification*
4. *Survey Procedures*
5. *Regulatory Procedures*
6. *Control Procedures*
7. *Environmental Regulations*
8. *Pathways*

The guidelines also includes appendixes, 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 and resources:

- 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
- National Environmental Policy Act
- *New Pest Response Guidelines: Temperate Terrestrial Gastropods*
- *New Pest Response Guidelines: Giant African Snails: Snail Pests in the Family Achatinidae*

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 concerning risk assessments, survey methods, control strategies, regulatory treatments, and other aspects of pest response programs. PPQ managers consult with State departments of agriculture in developing guidelines and policies for pest response programs.

Address	USDA–APHIS–PPQ–Center for Plant Health, Science, and Technology http://www.aphis.usda.gov/plant_health/cphst/index.shtml

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.

Address	Address indicates the person or agency to contact, along with their Web site address, email address, telephone number, or other means of contact.
Example	Example provides an example of the topic.
Source	Source indicates the location of information used for writing this section of the guidelines.
	IMPORTANT indicates helpful information.
	CAUTION indicates that people could possibly be endangered and slightly hurt.
	NOTICE indicates a possibly dangerous situation where goods might be damaged.

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.

2 Pest Information

Tropical Terrestrial Gastropods

Contents

Introduction

Use *Chapter 2 Pest Information* to learn more about the classification, history, host range, and biology of tropical terrestrial gastropods in the United States and collaborating territories. Selected species in the gastropod families Ariophantidae and Veronicellidae are discussed here as these are currently of particular concern, but the guidelines are applicable for most tropical terrestrial gastropods (TRTG).

Classification

Use ***Table 2-1*** and ***Table 2-2*** as aids to the classification of tropical terrestrial gastropods discussed in the guidelines.

Table 2-1 Tropical Terrestrial Gastropods in the Family Ariophantidae

Name	*Parmarion martensi* Simroth
Phylum	Mollusca
Class	Gastropoda
Subclass	Pulmonata
Order	Stylommatophora
Family	Ariophantidae

Table 2-2 Tropical Terrestrial Gastropods in the Family Veronicellidae

Names	*Belocaulus angustipes* (Heynemann), *Laevicaulis alte* (Férussac), *Sarasinula plebeia* (Fischer), *Veronicella cubensis* (Pfeiffer), *Veronicella sloanei* (Cuvier)
Phylum	Mollusca
Class	Gastropoda
Subclass	Pulmonata
Order	Systellommatophora
Families	Veronicellidae

Inclusion of species in the guidelines was based on input and suggestions from regulatory officials and Cooperative Agricultural Pest Survey (CAPS) members. Many of these tropical terrestrial gastropods are invasive, cause economic damage, and are considered pests elsewhere in the world. Many are included in the CAPS Analytic Hierarchy Process (AHP) Prioritized Pest List, a ranked list of pests that are expected to cause damage to agricultural and/or natural resources if introduced into the United States.

Distribution and Detections

Gastropods in the families Ariophantidae and Veronicellidae have a tropical and subtropical distribution. Many species within the two families have spread to other parts of the world where they have become pests of ornamental and

horticultural crops and gardens. Spread of these pests has most likely occurred through human activities, including the ornamental and horticultural trade. Use ***Table 2-3*** **on page 2-4** and as an aid to the classification, distribution, and detections, of tropical terrestrial gastropods discussed in the guidelines.

Ariophantidae

In the guidelines, the family Ariophantidae is represented by *Parmarion martensi* Simroth, the yellow-shelled semi-slug. This species has been neither introduced nor detected in the United States.

Veronicellidae

This family is widely distributed in tropical regions of South America, southern Asia, Africa, Madagascar and Indian Ocean Islands (Herbert and Kilburn, 2004). In the guidelines, the family Veronicellidae is represented by *Belocaulus angustipes* (Heynemann), *Laevicaulis alte* (Férussac), *Sarasinula plebeia* (Fischer), *Veronicella cubensis* (Pfeiffer), *Veronicella cubensis* (Pfeiffer), and *Veronicella sloanei* (Cuvier).

Belocaulus angustipes (Heynemann)—This species was first detected in the United States in 1960 at Mobile, Alabama and New Orleans, Louisiana. It has also been found in Florida since the early 1980s. Its current distribution is Florida, Alabama, Louisiana and Texas (Walls, 2009). It was introduced from South America (Rueda et al., 2002).

Laevicaulis alte (Férussac)— This species has been established in Hawaii since 1900 (Bishop Museum, 1999). It was also reported from Texas but may have died out (D. Robinson, personal comm., 2010). This species has been introduced and established in many tropical areas (Herbert and Kilburn, 2004).

Sarasinula plebeia (Fischer)—This pest is present in the United States, but its current distribution within the United States is unknown (D. Robinson, personal comm., 2009).

Veronicella cubensis (Pfeiffer)—This pest may have originated in Cuba. Interceptions have occurred in New Orleans and southern Florida. It was found in one California county, Santa Barbara (2006) (McDonnell et al., 2008; McDonnell et al., 2009).

Veronicella sloanei (Cuvier) —This species is suspected to be introduced to southern Florida based on photographic evidence only (D. Robinson, personal comm., 2010).

Table 2-3 Distribution and Detections of Tropical Terrestrial Gastropods in the Families Ariophantidae and Veronicellidae

Family	Species	Common Name	Known Distribution	Interceptions/ Detection
Ariophantidae	*Parmarion martensi* Simroth	yellow-shelled semi-slug	American Samoa, Cambodia, China, Indonesia, Japan, Malaysia, Singapore, Taiwan, Hawaii[1]	None
Veronicellidae	*Belocaulus angustipes (Heynemann)*	black-velvet leatherleaf or veronicellid slug	Argentina, Brazil, Paraguay and Columbia; introduced into Honduras[2]	1960 in both Mobile, AL and New Orleans, LA[3]
	Laevicaulis alte (Férussac)	tropical leatherleaf or lined leatherback slug	Australia, Bermuda Islands, China, Fiji, India, Indonesia, Malawi, Malaysia, Midway, New Guinea, New Caledonia, Philippines, South Africa, Sri Lanka, Taiwan, Tanzania, Torres Islands, Vanuatu, Western Samoa, Zaire[4]	1900 in HI[5]
	Sarasinula plebeia (Fischer)	Caribbean leatherleaf slug or bean slug	Australia, New South Wales, North Territory, Fiji, Hawaii, Toba, Indonesia, Guam, Saipan (Marianas), New Caledonia, Philippines, Salomon Islands, Tahiti, Tonga island, Tuamotu, Vanuatu, Western Samoa[6]	Unknown[7]
	Veronicella cubensis (Pfeiffer)	Cuban slug	Antigua, the Bahamas, Barbados, Dominica, Dominican Republic, Guam, Haiti, Hawaii, Rota, Jamaica, the Northern Mariana Islands, Olosega (Manu'a Islands), Pohnpei (Micronesia), Puerto Rico, St. Croix, St. Kitts and Nevis and Tutuila (American Samoa)[8]	New Orleans, LA; FL; 2006 in Santa Barbara County, CA[9]
	Veronicella sloanei (Cuvier)	pancake slug	Barbados, Bermuda, Dominica, Dominican Republic, Jamaica, St. Lucia and St. Vincent[10]	Suspected in FL[11]

1 Schall, 2006

2 Thompson, 2008

3 Walls, 2009

4 Gomes and Thomé, 2004

5 Bishop Museum, 1999

6 Gomes and Thomé, 2004; Robinson et al., 2009

7 D. Robinson, personal comm., 2010

8 McDonnell et al., 2009

9 McDonnell et al., 2008; McDonnell et al., 2009

10 Stange, 2006

11 Based on photographic evidence only; D. Robinson, personal comm., 2010

Potential Distribution

No risk documents exist for any of the tropical terrestrial gastropods that give potential distribution in the United States. Host material is unlikely to limit their distribution since they are all polyphagous, but these species are limited by climate. If introduced, the tropical terrestrial gastropods would most likely be limited to the southern part of the United States and possibly the West Coast where the climate is similar to native ranges. This is supported by interceptions and detections of these species which have all been in either the southern United States or West Coast.

Economic Importance and Impact

Ariophantidae

There are few literature references for *Parmarion martensi* Simroth and none mention financial loss due to damage. However, this species can cause plant damage and has the potential to damage the quality of flowers and vegetables cultivated in protected facilities (Liao and Wang, 1999). It can also cause damage to orchids (Liu et al., 1997). This species is also a major disease carrier with up to 70 percent of individuals from the established Hawaiian population infected with human and livestock pathogens (David Robinson, 2009, personal communication).

Veronicellidae

Several non-native species in the family Veronicellidae are present in Hawaii, including *Laevicaulis alte* (Férussac), *Sarasinula plebeia* (Fischer), and *Veronicella cubensis* (Pfeiffer). These pests serve as a potential threat to both the vegetable and floriculture industry in Hawaii valued at $104 million (Hata et al., 1997). Some communities have taken drastic measures to control these pests: In the Los Tuxtlas region in southern Veracruz, Mexico, many farmers have stopped growing beans altogether in an effort to control veronicellid slugs (Naranjo-Garcia et al., 2007).

In order to prevent the accidental introductions of these gastropods, some U.S. States have imposed strict quarantine regulations (Parrella et al., 1985). However, if these pests became established in the U.S. mainland, consequences could be severe. If introduced, the costs of labor and material associated with gastropod control would be great, local tourism could be affected by the degradation of habitat caused by feeding and feces, and nutrient cycles could be altered.

Damage to Host Plants

Tropical terrestrial gastropods:

- Cause damage by feeding on agricultural and horticultural crops as well as native plants, thereby lowering crop yield and quality;
- Transmit pathogens to humans indirectly by contaminating vegetables and fruits;
- Transmit pathogens of both plants and livestock through their feces; and
- Displace native species of gastropods.

Due to their apparent lack of host specificity, few reports as to specific damage caused by tropical and terrestrial gastropods to agriculture have been published in the malacological or agricultural literature. This section contains a summary of some of the damage attributed to tropical terrestrial gastropods.

Ariophantidae

Parmarion martensi Simroth— *Parmarion martensi* Simroth has damaged leaves, flowers and roots of orchid plants in Taiwan (Liu et al., 1997). Liao and Wang (1999) stated that this pest could negatively impact crop quality, while Godan (1983) stated that the genera is a harmful pest of legumes in Malaysia. Host families recorded include Liliaceae, Orchidaceae and Fabaceae. Like *Parmarion pupillaris*, this slug is probably polyphagous (Schall, 2006). *Parmarion martensi* Simroth has a tendency to climb on structures and leave behind feces (Hollingsworth et al., 2007). This species can infect humans with a disease. See ***Health Risks*** on **page 2-8** for additional information.

Veronicellidae

Belocaulus angustipes (Heynemann)—Walls (2009) stated that this slug has the potential to become a lawn pest. While it is not considered a serious agricultural pest, it is a disease carrier (Rueda et al., 2002). See ***Health Risks*** on **page 2-8** for additional information.

Laevicaulis alte (Férussac)—*Laevicaulis alte* (Férussac) is considered a serious agricultural pest in India where it is invasive (Herbert and Kilburn, 2004). Hosts include lettuce, spinach and coriander (Raut and Panigrahi, 1990) as well as tobacco (Godan, 1983). It is also an intermediate host to the larval stages of some nematode parasites of vertebrates (dog, cat, and rat lungworms) (Herbert and Kilburn, 2004). See ***Health Risks*** on **page 2-8** for additional information.

Sarasinula plebeia (Fischer)—In many Central American regions, *Sarasinula plebeia* (Fischer) is considered the most important pest of bean crops. It has also become a pest on sweet pepper and tomatoes in Panama, and cucurbits in Nicaragua (Rueda et al. 2002). It is considered a pest in Saipan where it causes feeding damage to white radish, red taro, Chinese cabbage, and pechay (Robinson and Hollingsworth, 2004). This species can become abundant and serve as a public nuisance in both urban and suburban areas (Cowie et al., 2009).

Veronicella cubensis (Pfeiffer)—In Hawaii, Rota, and Guam, *Veronicella cubensis* (Pfeiffer) is an agricultural and horticultural pest (McDonnell et al., 2009). *Veronicella cubensis* (Pfeiffer) can damage many ornamental and agricultural plants including banana, cabbage, cassava, citrus, coffee, eggplant, mango, noni, papaya, pepper, pumpkin, star fruit, sweet potato, taro, and yam (USDA, 2006). Like *Sarasinula plebeia* (Fischer), this species can become abundant and serve as a public nuisance in both urban and suburban areas (Cowie et al., 2009).

Veronicella sloanei (Cuvier)—In Barbados, *Veronicella sloanei* (Cuvier) is an important garden and nursery plant pest (Clarke and Fields, 2005). *Veronicella sloanei* (Cuvier) attacks many agricultural and horticultural crops including beans, peas, citrus, banana, broccoli, cabbage, cauliflower, carrot, dasheen, eddo, eggplant, hot and sweet peppers, lettuce, peanut, plantain, sweet potato, tannia, tomato, and yam (Stange, 2006). *Veronicella sloanei* (Cuvier) damages leaves and can also debark portions of plant stems on *Datura* and *Gardenia*; *Hibiscus* sp., and *Bougainvillea* sp. Orchids can also be attacked by this pest (Fields and Robinson, 2004; Godan, 1983). This slug is an important pest in the Caribbean (Fields and Robinson, 2004).

Health Risks

Some tropical terrestrial gastropods carry diseases that can be transmitted to humans or other mammals.

Ariophantidae

Parmarion martensi Simroth—*Parmarion cf. martensi* has a very high rate of infection of rat lungworm: 77.5 percent in one Hawaiian survey (Hollingsworth et al., 2007). Rat lungworm is an infection caused by the pathogen *Angiostrongylus cantonensis*. Although its final hosts are rats, it can infect humans through slug/snail vectors and cause human angiostrongyliasis. If humans accidentally ingest the pest or waste products (i.e. unwashed vegetables) they can become infected with the pathogen. This pest may also carry other diseases.

Veronicellidae

Belocaulus angustipes (Heynemann)—*Belocaulus angustipes* (Heynemann) is a disease carrier (Rueda et al., 2002). It serves as an intermediate host for the nematode *Angiostrongylus costaricensis*, a parasite that can be transmitted to humans. In the Gulf states where it is present, it can be found in greenhouses, nurseries and grassy fields (Deisler and Stange, 1984).

Laevicaulis alte (Férussac)—*Laevicaulis alte* (Férussac) is an intermediate host to the larval stages of some nematode parasites of vertebrates (dog, cat and rat lungworms) (Herbert and Kilburn, 2004).

Behavior and Reproduction

An understanding of the gastropod life cycle can be important in determining an appropriate course of action and its timing. Unfortunately, our understanding of the biology of many of these species is still in its infancy. Some studies have been conducted in the life histories of a few economically-important species, such as *Laevicaulis alte* in India (Nagabhushanam and Kulkarni, 1971a; b). Similar studies should be conducted in the United States. Tropical terrestrial gastropods are hermaphroditic, but most likely reproduce by outcrossing rather than self-fertilization.

Ariophantidae

Parmarion martensi Simroth—Liu et al. (1997) found that *Parmarion martensi* Simroth has an average lifespan of 84 to150 days. Egg production is from 22 to188 eggs with a hatch rate of 75 to 96 percent. Eggs take approximately 2 weeks to hatch, depending on temperature. Clutches include approximately 10 to 30 eggs (Hollingsworth et al., 2007). Eggs are **not** chained together like some other slug species (Ho, 2007). The time from hatching to egg laying was found to be between 66 and 86 days; this slug can reproduce through cross-fertilization or self-fertilization (Liu et al., 1997).

Veronicellidae

Belocaulus angustipes (Heynemann)—This slug has a subtropical native range in South America and prefers undisturbed, shaded habitats (Reuda et al., 2002). In the Gulf Coast States, *B. angustipes* can be common where St. Augustine grass is found (Walls, 2009). This slug is active mostly at night when temperatures are between 68 to 75ºF and can live for several years (Walls, 2009). This species becomes inactive at very low humidity and near freezing temperatures; during hot, dry summer conditions, it will disappear into the soil and aestivate until conditions become more favorable (Walls, 2009).

This slug is oviparous (Rueda et al., 2002). In the Gulf Coast area, egg-laying occurs two times each year, from March to June and September to mid-November (Dundee, 1977). According to Dundee (1977),

> the egg mass is coiled and the eggs are attached together by a gelatinous, fecal-containing strand. The slug deposits the strands while it is curled in the form of a circle.

Eggs are oval and 6 mm long by 3 mm wide; when newly hatched, slug weight was found to be 0.016 g (Dundee, 1977). Adults can lay one to five egg masses per breeding season, which they shallowly bury in the soil, with eggs hatching in 20 to 28 days depending on the temperature (Dundee, 1977; Walls, 2009).

Laevicaulis alte (Férussac)—*Laevicaulis alte* (Férussac) is thought to be of African origin (Cowie, 2000). *Laevicaulus alte* (Férussac) has shown two distinct feeding peaks, both in the early and late hours of the night (Raut and Panigrahi, 1990).

Herbert and Kilburn (2004) stated that *Laevicaulis alte* (Férussac) eggs are deposited in a hole or depression in the soil a few days after mating; the eggs are joined together by an interconnecting thread forming a string that the parent shapes into a ball-like mass. The parent then deposits special fecal

pellets on the top of the eggs that contain high concentrations of soil which help maintain high humidity levels. Eggs are oval and translucent, measuring 6 to 8 mm in length, and laid in batches of up to 100. Hatching occurs around 1 to 3 weeks with newborn slugs measuring around 7 to 8 mm in length. Maturity can be reached in as soon as 5 months, but breeding only occurs during favorable conditions. In India, *Laevicaulis alte* (Férussac) breeds during monsoon season, while South African populations breed in the warm, rainy summer months (Herbert and Kilburn, 2004).

Sarasinula plebeia (Fischer)—Rueda et al. (2002) stated that *Sarasinula plebeia* (Fischer) is a nocturnal slug that prefers disturbed habitats including backyards, gardens and cultivated areas. This slug is oviparous with clutches averaging 37 eggs. They lay one to two clutches per year but can have as many as four. In laboratory conditions, they become mature around 6 months. Self-fertilization is common in this slug. In a laboratory study, *Sarasinula plebeia* (Fischer) was found to copulate several times in the same night maturity was reached suggesting a sexual pheromone may be produced (Rueda et al., 2002).

Veronicella cubensis (Pfeiffer)—*Veronicella cubensis* (Pfeiffer) is nocturnal and usually found near water bodies or moist soil (von Ellenrieder, 2004). In Rota, Spain, this pest is found in almost all habitats ranging from undisturbed natural habitats to agricultural areas (Robinson and Hollingsworth, 2004).

Veronicella sloanei (Cuvier)—*Veronicella sloanei* (Cuvier) is nocturnal. In both lab and field conditions it mates in pairs, triplets or groups (Clarke and Fields, 2005).

3 Identification

Tropical Terrestrial Gastropods

In progress.

4

Tropical Terrestrial Gastropods

Survey Procedures

Contents

Introduction

Use *Chapter 4 Survey Procedures* as a guide when conducting a survey for tropical terrestrial gastropods. Selected species in the gastropod families Ariophantidae and Veronicellidae are discussed here as these are currently of particular concern, but these guidelines are applicable for most tropical terrestrial gastropods (TRTG).

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. Obtain permission from the landowner before entering a property.
2. Determine if there have been recent pesticide applications that would make it unsafe to inspect the survey site. Contact the landowner or manager and ask if there is a re-entry interval in effect due to pesticide application. Look for posted signs indicating recent pesticide applications, particularly at agricultural sites, but including residential or industrial sites.
3. Conduct the survey at the proper time. The schedule should be on a regular time interval that coincides with weather and temperature conditions most suitable for tropical terrestrial gastropods. For further information see ***Survey Season and Timing*** on **page 4-3**.
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 sites to conduct surveys or to take samples, everyone must take strict measures to prevent contamination by tropical terrestrial gastropods or other pests between properties during inspections.

   Before entering a new property, make certain that clothing and footwear are clean and free of pests and soil to avoid moving soilborne pests from one property to another.

Wash hands with an approved antimicrobial soap. If not using an antimicrobial soap, wash hands with regular soap and warm water to remove soil and debris. Then use an alcohol-based antimicrobial lotion, with an equivalent of 63 percent ethyl alcohol. If hands are free of soil or dirt, the lotion can be applied without washing. Unlike some antimicrobial soaps, antimicrobial lotions are less likely to irritate the hands and thereby improve compliance with hand hygiene recommendations.

6. Gather together all supplies. Confirm the equipment and tools are clean. When taking plant samples, disinfest tools with bleach to avoid spreading diseases or other pests. A brief spray or immersion of the cutting portion of the tool in a 5 percent solution of sodium hypochlorite (common household liquid bleach) is an effective way to inactivate bacterial and other diseases and prevent their spread. For further information on preparing a solution of liquid bleach, refer to the PPQ *Manual for Agricultural Clearance.*

Address	PPQ Manual for Agricultural Clearance http://www.aphis.usda.gov/import_export/plants/manuals/online_manuals.shtml

7. Mark the sampled location with flagging whenever possible, and draw a map of the immediate area and indicate 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 location so that the area or plant may be re-sampled if necessary.

8. Survey task forces should consist of an experienced survey specialist familiar with tropical terrestrial gastropods and the symptoms of their damage. For further information, see ***Training Survey Personnel*** on **page 4-18**.

Survey Season and Timing

This section provides information that will help surveyors to select the right survey time and location. Most species of tropical terrestrial gastropods are active during nocturnal hours, when environmental conditions are cool and wet. Some species may also be active during daylight, especially during overcast and rainy days in the spring and fall. During dry, hot periods, TRTGs will seek shelter in cool, moist places shaded from the sun.

Refuge preferences can differ between species. For example, because they lack a shell, tropical terrestrial slug species can be found in refuges such as cracks in mud, under rocks, in tree crevices, and under refuse. During extended periods of drought, tropical terrestrial slugs may move deep into the soil or refuge structure, too deep to be observed during a visual survey. If possible, conduct surveys during spring and summer, and during early morning and overcast days.

Some species of TRTG are difficult to identify in juvenile form. Mature adult specimens possess genitalic features that can help differentiate closely-related species. If possible, conduct survey activities during the time when adult life stages are present. If the phenology of the target species is unknown, surveys should be conducted in both spring and fall when environmental conditions are ideal. For further information, refer to ***Behavior and Reproduction*** on **page 2-8** and ***Visual Inspection*** on **page 4-11**.

Microhabitats

Tropical terrestrial gastropods may be found in cool refuges, near vegetation, under rocks, boards, and refuse. Some also climb into sheltered areas such as tree crevices and plant canopies.

During surveys, examine vegetation and the underside of a variety of structures, refuse, and litter, that is in contact with the ground. If the structure is safe to move, the item should be lifted and the underside examined for TRTG. Most TRTG require calcium for proper formation of the shell and/or for successful reproduction in creating new eggshells for their offspring; therefore, they can often be found near a source of calcium.

When planning the survey route for a particular site, examine the following microhabitats:

- Heavily vegetated areas, especially gardens and fields where plants have been damaged by feeding
- Spaces beneath rocks, asphalt, or cement pieces that are in loose contact with the ground surface
- Spaces beneath discarded wooden boards and planks, fallen trees, logs, branches and other debris
- Damp leaf litter (not wet or soggy), compost piles, and rubbish heaps
- Under flower pots, planters, rubber mats, tires and other items in contact with the soil
- Vegetation, fences, and other raised materials
- Standing rock walls, cement pilings, broken concrete, grave markers

While conducting a survey, look for clues that suggest the presence of tropical terrestrial gastropods. Evidence may include the following:

- Juveniles and adults
- Eggs
- Empty snail shells
- Mucus and slime trails
- Ribbon-like feces

Survey Types

Plant regulatory officials will conduct detection, delimiting, and monitoring surveys for tropical terrestrial gastropods. Conduct a detection survey to ascertain the presence or absence of tropical terrestrial gastropods in an area where they are **not** known to occur. After a new U.S. detection, 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 a pest.

Detection Survey

The purpose of a detection survey is to determine if a pest exists in an area in which it is not known to occur. Detection surveys increase the chance of early detection of new pest infestations. A detection survey may be initiated after a specific risk or a pest pathway has been identified. An ideal detection survey site is a single point identified to be a high-risk introduction of an exotic species. The site may be one property, or may include several property owners.

Procedure

Use ***Table 4-1*** **on page 4-6** to identify the appropriate survey tools when conducting a detection survey for tropical terrestrial gastropods.

Table 4-1 Survey Tools for Detection Surveys

If you need to:	Then use this survey tool:
Identify the most likely sources of introduction	***Pest Pathway Analysis*** on **page 4-6**
Develop a list of survey sites to target	***Targeting and Site Selection*** on **page 4-7**
Efficiently survey the same high-risk sites on a repeated basis at a fixed location	***Sentinel Survey Sites*** on **page 4-7**
Find most species of TRTGs in the field	***Visual Inspection*** on **page 4-11**
Supplement visual inspection and find species of TRTGs that may be more difficult to locate	***Trapping*** on **page 4-15**

Pest Pathway Analysis—Pest pathway analysis is a pre-survey tool used to identify likely sources of introduction and to help focus survey efforts on specific geographic sites. Survey managers can use this tool for an initial detection survey or to identify additional infested sites after detection is made.

1. Consult import pest interception records available in the Web-based USDA–APHIS–PPQ–Emergency Action Notification (EAN) System. (A user name and password are required to view or enter data in the database.)

Address USDA-APHIS-PPQ-Emergency Action Notification System
https://mokcs14.aphis.usda.gov/aqas/login.jsp

2. Search the records for local ports of entry, noting pest species, commonly-intercepted commodities, and countries of origin. Also query the EAN database and Automated Targeting System (ATS) databases for out-of-State ports of entry that may serve as entry points for high-risk shipments destined for the host state. Review the movement of containers, cargo, and equipment into and from a target site.
3. Use the ***Pre-Survey Interview*** on **page B-4** as a guide to interviewing importers to gather information on business import practices, and to identify pathways.

For further information refer to ***Pathways*** on **page 8-1**.

Targeting and Site Selection—New introductions of tropical terrestrial gastropods will likely be related to commerce and human-assisted movement.

1. Use the information gathered from the ***Pest Pathway Analysis*** on **page 4-6** to develop a list of survey sites to target. The habitat and land-use type of each survey site may be variable, ranging from agricultural land, to residential or industrial features.
2. Conduct on-site analysis of the survey area to determine any direct points of introduction, such as ports, rail yards, container yards, and cargo distribution centers.
3. Also consider habitats with features that TRTG prefer, such as vegetated areas. Most TRTG will thrive in moist vegetated areas, but preferences for microhabitats vary with species. Consult the biology of the target pests to identify any habitat or host preference information. For further information refer to ***Survey Season and Timing*** on **page 4-3**.
4. If no information is available, or multiple species are targeted, allow surveys to cover a number of diverse habitats. For further information, refer to ***Damage to Host Plants*** on **page 2-6**.
5. Once target sites are identified for survey, conduct a visual inspection of survey sites. For further information, refer to ***Visual Inspection*** on **page 4-11**.

Sentinel Survey Sites—A sentinel survey site is a fixed location for doing survey inspections on a repeated basis. This tool can be used to detect tropical terrestrial gastropods. Sentinel survey sites were described in Anonymous (2008). According to the source, if a particular area is considered at high risk for mollusk introduction based on pathway studies, surveyors can use their time efficiently by establishing sentinel survey sites in that area. The best sentinel survey sites within the high-risk area are chosen based on the biology and preferences of the TRTG. Examples of preferred sites include areas of dense vegetation or garbage piles. For further information refer to ***Survey Season and Timing*** on **page 4-3**.

1. Use Visual Sample Plan Software (VSP) to determine the number of potential sample sites needed (per sentinel site) to detect an infestation within the high risk area (for example, a large rail yard or seaport). Contact Edward (Ned) Jones, USDA–APHIS–PPQ–CPHST, for information on using VSP.

Address	Edward (Ned) Jones USDA–APHIS–PPQ–CPHST Raleigh, North Carolina Telephone: (919) 855-7433

2. Draw a grid around the areas chosen for sentinel site establishment.
3. Record the coordinates.
4. Establish and follow a schedule for inspecting the sentinel survey sites. The schedule should be on a regular time interval that coincides with weather and temperature conditions most suitable for TRTG activity. The total number of visits may vary depending on the sample area and the length of time it may take to arrive at the site.

Delimiting Survey

After tropical terrestrial gastropods are detected in an area, use a delimiting survey to establish the magnitude of the infestation. The results from the delimiting survey will be used to determine the type and extent of control measures to apply. First, establish a survey area by mapping the delimitation zone, based on the previous positive detection(s). The delimitation zone is the survey area where active delimitation sampling is focused.

Procedure

1. Identify the center of the infestation as the epicenter by marking the location of positive detections on a map.
2. Demarcate a circle with a 200-meter radius around each epicenter to define each delimitation zone (***Figure 4-1*** **on page 4-9**).
3. Combine any overlapping delimitation zones. The core infested area is the area included between adjacent detection points (***Figure 4-2*** **on page 4-9**).
4. Discard non-habitat areas such as paved areas or bodies of water.
5. Enlarge the delimitation zone to include commercial or residential properties where gastropods may have been introduced, as well as any environmental and structural features that create corridors that may encourage natural dispersal.
6. Conduct delimitation surveys in the delimitation zone. Deploy line sampling, plot sampling, and/or trapping, within the delimitation zone.

7. Interview property owners of infested areas to determine if any human activities may have contributed to the spread of the species to an adjacent or remote site. Conduct a detection survey at any of these remote sites. For further information refer to ***Detection Survey*** on **page 4-5**.

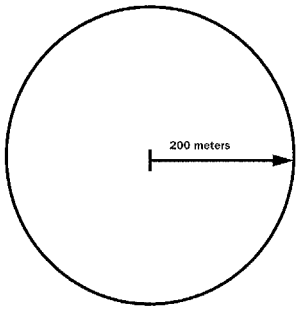

Figure 4-1 Circle Drawn Around the Epicenter

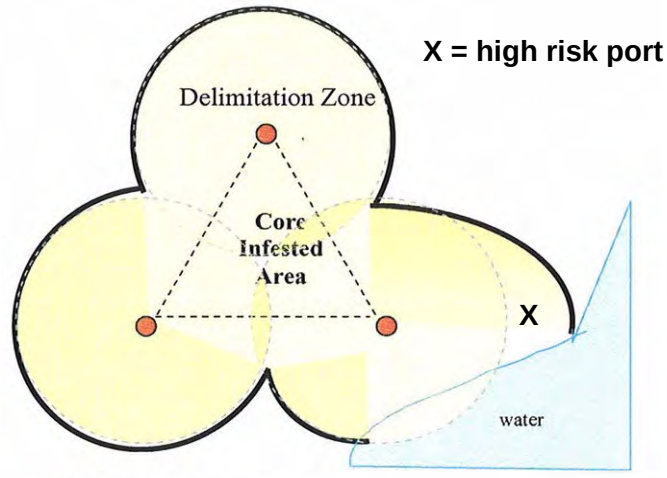

Figure 4-2 Example of a Delimitation Zone Including Three Epicenters

Monitoring Survey

Use a monitoring survey to gather population and activity information that will assist in planning a strategy for containment, suppression or eradication. The monitoring survey is also used to evaluate the effectiveness of an action taken to contain, suppress, or eradicate the pest.

Continue eradication measures for 2 to 4 years. After the termination of eradication or suppression measures, monitor the success of the program for 1 to 2 years. For further information on eradication measures see ***Control Procedures*** on **page 6-1**

Procedure

Use data from delimiting surveys to establish eradication and regulated zones. (See ***Delimiting Survey*** on **page 4-8**.) To plan control strategies and halt the natural and human-assisted spread of the infestation, divide the infested area into separate management zones. For further information refer to ***Regulatory Procedures*** on **page 5-1**.

Conduct a plot survey to determine the following:

- Density of tropical terrestrial gastropods
- Phenology and seasonal activity of TRTG
- Efficacy of treatment
- Behavioral or biological responses of TRTG to treatments

See ***Plot Survey*** on **page 4-12** for information on conducting plot surveys.

Traceback and Trace-Forward Survey

Use a traceback survey to locate the source of an introduction after tropical terrestrial gastropods have been detected. By identifying the source, other potential infestations may be identified through trace-forward investigations. Traceback investigations may also provide clues to the estimated time and exact location of a specific introduction. For interception on imported commodities, obtain all related documentation on shipping, origin, consignee, destination, and frequency of shipments.

Procedure

For interceptions within the United States, interview those involved to determine the source of the tropical terrestrial gastropods. If the source is unknown, continue questioning local residents, schools, and businesses. Investigate leads that may indicate further distribution. See ***Gastropod Detection Survey Data Sheet*** on **page B-2** and ***Pre-Survey Interview*** on **page B-4** for related assessment materials.

Visual Inspection

This section provides information that will help personnel find tropical terrestrial gastropods in the field. Visual inspection is the most effective survey tool for tropical terrestrial gastropods. The greatest challenge with using visual inspection is the risk of inconsistent sampling effort. Variability in surveyor experience and habitat type may result in different sampling effort between sites, and may affect the confidence in the results of a survey. To minimize this variability, a survey program should include surveyor field training in visual sampling techniques. Subjectivity of a visual survey can also be addressed through the use of plot sampling. For information on training personnel see ***Training Survey Personnel*** on **page 4-18**.

Procedure

Consumption of slugs and snails, or of vegetables and fruits contaminated by slugs and snails, may lead to infection by pathogens that are easily transmitted by these pests. Wear rubber or latex gloves when handling gastropods, as well as associated soil, excrement, and other materials that may have come in contact with them. Immediately after removing protective gloves, thoroughly wash hands with hot soapy water and rinse well. Consult a physician if, after handling slugs and snails, you experience symptoms resembling forms of meningitis, including headache, stiff neck, tingling or painful feelings in the skin, low-grade fever, nausea, and vomiting. These symptoms could indicate an infection by *Angiostrongylus cantonensis*, a parasite carried by snails and slugs. These pests may also carry other diseases.

Use the following survey criteria to standardize visual inspection techniques and increase the chance that tropical terrestrial gastropods will be detected:

1. Conduct visual inspections during the ideal sampling season, and in microhabitats attractive to TRTG. For further information see ***Targeting and Site Selection*** on **page 4-7**, ***Survey Season and Timing*** on **page 4-3**, and ***Microhabitats*** on **page 4-4**.

2. Use a global positioning device if available to determine the coordinates of the survey site or plot. Keep records on all plots surveyed, whether the results are positive or negative.
3. Collect and label any suspect TRTG and note the exact location of the find. Note the substrate, microhabitats and plant hosts on the ***Gastropod Detection Survey Data Sheet*** on **page B-2**. For further information on handling specimens see ***Collection and Preparation of Specimens*** on **page 4-17**.
4. Surveyors must be trained. See ***Training Survey Personnel*** on **page 4-18** for pertinent information.
5. Define survey protocols using time-based ***Line Survey*** on **page 4-12** or ***Plot Survey*** on **page 4-12**.

Line Survey—A line survey is a transect across a target property that allows the surveyor the flexibility to choose inspection points likely to shelter tropical terrestrial gastropods. This flexibility is useful for detection surveys, when several target species and habitat types need to be sampled. Line sampling can be used alone when survey resources are low, or can be combined with a plot survey when more quantification is needed, as with delimitation and monitoring surveys.

To conduct a line survey, examine microhabitats that include vegetation, duff, and structures that might serve as diurnal or seasonal refuge sites for TRTG. Estimate the survey area, and coordinate line survey routes for each surveyor. Standardize survey efforts between sites by requiring a minimum survey time. Require a minimum of one survey hour per two-acre site. Each survey hour is the sum of active survey time spent by each surveyor.

Plot Survey—Use the plot survey method if further standardization and quantification is required. A plot is a small, defined area (for example, one square meter) that is used to conduct detailed, standardized subsampling throughout a target site. This method is effective for detecting immature and minute TRTG species. See ***Accuracy*** on **page 4-13** for a statistical application of this method.

Construct a plot template of any size that is easy to use. A template is a precisely measured, reusable tool used to define a plot sample. Use PVC tubing or wood to construct a lightweight template. A square template measuring one meter on each side is easy to use, but the size can be adjusted to fit the goals of the survey program.

To begin surveying, randomly toss the template into the habitat. Stand outside of the plot while examining rocks, boards, litter, vegetation and other structures within the plot that could serve as refuge for slugs and snails. Look under leaves, duff, and at the base of plants. Spend a standardized minimum amount of time surveying each plot. Repeat four times per acre of target property. Do not overlap plots in a survey site.

Accuracy—Using the plot survey method, the visual inspection tool can be statistically supported. For example, to report with 95 percent confidence that less than 1 percent of the delimitation zone is infested, a minimum of 330 negative plot samples need to be gathered within the delimitation zone. To standardize and quantify the survey, the following protocols are required:

- Surveyors must be trained in survey procedures (see ***Training Survey Personnel*** on **page 4-18**)
- Plot samples cannot overlap
- Plot samples must be searched for a minimum time of 5 minutes per plot
- Surveys must be conducted during the ideal sampling season (see ***Survey Season and Timing*** on **page 4-3**)

Combined Line and Plot Sampling for Detection Survey—If the target property is small (less than 1 acre), conduct 1 plot sample and then line survey the entire property.

Combined Line and Plot Sampling for Delimitation Survey—Use a combined line and plot sampling method to survey within the delimitation zone. See ***Targeting and Site Selection*** on **page 4-7** for information concerning site selection, environmental factors, and local conditions. One efficient method is to assign surveyors to a survey route.

Use the survey route method to ensure different areas of the delimitation zone are covered and not overlapping. While walking between plot sites, surveyors should use visual line sampling techniques. Use the following protocol:

1. Place a square meter template at least 25 meters apart, targeting likely habitat (i.e., vegetation, daily refuge areas, etc) (***Figure 4-3*** **on page 4-14**).
2. Examine the entire area within the square meter template for a minimum of 5 minutes. Inspect any surface substrate or vegetation, especially under leaves, rocks and in the whorl of plants.

3. Collect any suspect TRTG found. Place specimens in a sealed vial with water and label. Label should include the site name, transect number, plot number and date. Collect the same information on the survey report form. Note the exact location of the longitude/latitude for each plot with a GPS.
4. Records should be kept on each plot, even if no specimens were collected.
5. Learn the procedures in ***Collection and Preparation of Specimens*** on **page 4-17**. Laboratory screening will confirm the identification of gastropods and confirm their status. Other information will be gathered on address, ownership, and habitat type.
6. Conduct plot sampling survey within the delimitation zone until 330 plots have been taken with negative results (**no** target TRTG were found).

If:	Then:
No target TRTG were found	Continue sampling plots within the delimitation zone until 330 plots have been sampled
New positive collections of TRTG are found within this area	Add a new 200-meter radius circle to the existing delimitation zone and plot a new survey

Figure 4-3 Plot Survey Tool (left) and Platform Trap (right)

Trapping

Use platform and baited traps, trap crop stations and trash traps, to supplement visual inspection.

Procedure

Consumption of slugs and snails, or of vegetables and fruits contaminated by slugs and snails, may lead to infection by pathogens that are easily transmitted by these pests. Wear rubber or latex gloves when handling gastropods, as well as associated soil, excrement, and other materials that may have come in contact with them. Immediately after removing protective gloves, thoroughly wash hands with hot soapy water and rinse well. Consult a physician if, after handling slugs and snails, you experience symptoms resembling forms of meningitis, including headache, stiff neck, tingling or painful feelings in the skin, low-grade fever, nausea, and vomiting. These symptoms could indicate an infection by *Angiostrongylus cantonensis*, a parasite carried by snails and slugs. These pests may also carry other diseases.

Platform Traps—Use platform traps as artificial diurnal refuges for tropical terrestrial gastropods.

1. Construct square-shaped platform traps using square cardboard or wood sheets, placed directly on the ground.
2. If target species include large gastropods, the platform can be elevated 1 inch off the ground (***Figure 4-3* on page 4-14**). Platform traps may be used for repeat monitoring at high-risk sites, or where existing refuges are lacking (for example, open fields) and/or difficult to survey (brambles, dense grass).
3. Place traps the day before a survey and check daily thereafter. This method may **not** be effective for some target species.

Baited Traps—

Molluscicides are poisonous.

Baits are toxic to all slugs and snails and will attract non-target species. Bran-based baits are generally attractive to tropical terrestrial gastropods, but also attract mammals and arthropods.

1. Make a baited trap for tropical terrestrial gastropods by placing a food attractant inside a cup or bowl set into the ground. Place one of the following dry or wet feeding attractants inside the cup or bowl:

- Bran
- Molluscicide
- Beer
- Sugar water and yeast mixture
- Other preferred food sources

Dry molluscicide baits are commonly used to attract and kill TRTG in back yard environments. Unfortunately, TRTG that ingest the pesticide are **not** immediately killed, **nor** are they contained in the trap after feeding. Beer is generally effective at attracting and trapping many TRTG species.

2. Baited traps should be replenished every few days and should have deep, vertical sides to keep target pests from crawling out.

Trap Crop Stations—Construct trap crop stations by placing a preferred food source such as lettuce or fruit at a site and examining it daily.

Trash Traps—Trash traps are used in Central America to attract *Sarasinula plebeia* (Fischer) away from crops (Rueda et al., 2002). To use this technique,

1. Collect plant residues from crop weeding.
2. Use the plant residues to form hills of at least 30 cm x 30 cm x 30 cm. The hills serve as daytime refuges for the pest (Rueda et al., 2002).
3. Check the traps frequently; if not, the hills could serve as a breeding ground for these pests (Rueda et al., 2002).

Collection and Preparation of Specimens

Consumption of slugs and snails, or of vegetables and fruits contaminated by slugs and snails, may lead to infection by pathogens that are easily transmitted by these pests. Wear rubber or latex gloves when handling gastropods, as well as associated soil, excrement, and other materials that may have come in contact with them. Immediately after removing protective gloves, thoroughly wash hands with hot soapy water and rinse well. Consult a physician if, after handling slugs and snails, you experience symptoms resembling forms of meningitis, including headache, stiff neck, tingling or painful feelings in the skin, low-grade fever, nausea, and vomiting. These symptoms could indicate an infection by *Angiostrongylus cantonensis*, a parasite carried by snails and slugs. These pests may also carry other diseases.

Specimen Handling

When collecting live samples, specimens should be placed directly in water and sealed for 24 hours or until drowned, then transferred to 70 percent ethyl alcohol. Label the container with the appropriate information.

Labeling Samples

Collection information is vital and should be recorded immediately after a collection is made. Write directly on the collection container or on a paper label. Write the date, collector's name, and location, including any transect and plot numbers. If multiple vial samples are collected from a location, assign individual sample numbers. When transferring the specimens to alcohol, transfer the label with the sample.

Sample Submission Procedures

Submit suspect tropical terrestrial gastropod specimens according to sample handling guidelines. Collect all gastropods found and place in vials of water with a collection label. All collected specimens should be mailed or taken to an area malacologist for screening and identification. When submitting specimens for identification to PPQ, complete ***PPQ 391 Specimens For Determination*** on **page B-8** and include it with the specimen. If special preparations are necessary, the area malacologist will perform these techniques in consultation with the National malacologist.

Training Survey Personnel

Although visual inspection is very effective, the subjective nature of visual inspection, variability in habitat types, and differences in survey technician experience level, may cause a challenge with standardizing detection survey efforts between sites. To minimize this variability, a survey program should include training in the field in visual inspection techniques.

Due to the reliance on visual observation for a tropical terrestrial gastropod survey, standardized protocols should be used by all surveyors. Sufficient time should be allowed for training in survey methods. Use defined experience levels to stratify surveyor responsibilities (*Table 4-2* **on page 4-18**).

Table 4-2 Levels of Expertise for Survey Personnel

If:	And survey experience includes:	Then level is:
No prior training or survey experience with TRTG	→	Untrained
Trained	3 or more sites	Trained
	20 or more sites	Skilled
	100 or more sites over multiple seasons and in variable habitats	Expert

New surveyors who lack training and survey experience should only survey in tandem with another surveyor. Only after a surveyor has been trained should they be authorized to survey independently. Conduct in-field training when possible to encourage standardized survey techniques. Training should address the biology, life history, and behavior of TRTG. Discuss details of site selection, habitat selection, identification, specimen handling, data collection and sample submission procedures. Adequate training on the various survey techniques, sampling procedures, and data management will likely require two to three working days. Some of the topics to cover in a training session include the following:

- Slug and snail biology
- Target species
- Survey methods
- Specimen labeling
- Specimen submission
- Data collection procedures
- Safety issues and concerns

- TRTG identification (if taxonomic screening)
- Personnel requirements (time records, travel vouchers, etc.)
- Equipment assignment

Equipment

Surveyors will require the following equipment:

- Forceps (soft)
- Large permanent marker
- Collecting vials with water-tight caps
- Water
- Blank collection labels
- Survey forms
- GPS unit
- Disposable vinyl gloves
- Plot sampler (PVC for square-meter samplers)
- Resealable bags
- Platform traps
- Boots
- Magnifying lens
- Resealable freezer bags
- Pocket notebook
- Scoopula spatula
- Rain clothing

Survey Records

Records should be kept for each survey site. Negative survey data must be recorded even if no tropical terrestrial gastropods are found or no samples are collected at a surveyed site. Survey records and data-recording formats should be consistent, to allow for standardized collection of information. If automated collection devices are used, such as the Integrated Survey Information System (ISIS), ensure that all surveyors are trained in the technology before beginning

a survey. Use the appropriate ISIS templates for the survey type. To reduce the burden on data collectors in the field, pre-enter any known contact or address information into the database and hand-held data recorders. At the end of the survey, all survey data should be entered into a designated State or National pest database. For specific directions on how to access the ISIS template for TRTG, contact ISIS Customer Support.

Address	USDA–APHIS–Integrated Survey Information System http://ppqcoop.aphis.usda.gov/web/Default.aspx?alias=ppqcoop.aphis.usda.gov/web/isis

5

Tropical Terrestrial Gastropods

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 tropical terrestrial gastropods. Selected species in the gastropod families Ariophantidae and Veronicellidae are discussed here as these are currently of particular concern, but these guidelines are applicable for most tropical terrestrial gastropods (TRTG).

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 persons interested in moving articles affected by the quarantine and regulations. Only authorized treatments can be used in accordance with labeling restrictions. During all field visits, please 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 for 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 in the absence of 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.

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 current 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 additional information, contact PPQ's Tribal Liaison.

Address	Christina Jewett, National Program Manager for Native American Program Delivery and Tribal Liaison USDA–APHIS–PPQ 14082 S. Poston Place Tucson, AZ 85736 Telephone: (520) 822-5440

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.

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. (See ***PPQ 523 Emergency Action Notification*** on **page B-7**.) Immediately place a hold on the property to prevent the removal of any host plants of tropical terrestrial gastropods.

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 prescribed.

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, weevil cultural control measures, or plant waste material disposal.

Any regulatory treatments used to control tropical terrestrial gastropods 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 database(s) 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 application instructions. For further information refer to ***Control Procedures*** on **page 6-1**. Concurrence by PPQ is necessary before using any chemical or procedure for regulatory purposes. No chemical can be recommended that is not specifically labeled for tropical terrestrial gastropods.

6

Tropical Terrestrial Gastropods

Control Procedures

Contents

Introduction

Use *Chapter 6 Control* to eradicate, contain, or suppress, an infestation of tropical terrestrial gastropods in the United States and collaborating territories. Selected species in the gastropod families Ariophantidae and Veronicellidae are discussed here as these are currently of particular concern, but these guidelines are applicable for most tropical terrestrial gastropods (TRTG).

Overview of Emergency Programs

APHIS-PPQ develops and makes control measures available to involved States. Environmental Protection Agency-approved treatments will be recommended when available. If selected treatments are not labeled for use against the organism 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 expedite approval of a product that may not be registered in the United States or to obtain labeling for a new use-site. The PPQ FIFRA Coordinator is available for guidance pertaining to pesticide use and registration. For contact information, refer to ***Resources*** on **page A-1**.

Treatment Options

Consider the treatment options described within this chapter when taking action to eradicate, contain, or suppress tropical terrestrial gastropods.

All treatments listed in the guidelines should only be used as a reference to assist in the regulatory decision making 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 that the chemical is approved by EPA for use in the United States prior to application.

Treatments may include the following:

- Molluscicides—Several products and formulations are effective. See ***Molluscicides*** on **page 6-7** for more information.
- Cultural Control—Cultural control methods used in combination with chemical control is the most effective treatment regime against this group of snail pests. See ***Cultural Controls*** on **page 6-10** for more information
- Biological Control—Currently, there are no effective, specific non-invasive biological control methods available for control of TRTG.

Eradication of TRTGs may be most feasible in port or nursery environments. If adjoining neighborhoods or natural areas are generally infested, it may only be possible to maintain suppression or local eradication in these situations. A TRTG eradication program in residential or natural areas must be seriously considered because of the public outreach necessary to gain cooperation, the resources required to be successful, and the impacts of pesticides applied in these environments. The risk of the particular species spreading to agricultural areas of causing significant damage in residential and natural area must be balanced with the risk of control activities.

Formulate a treatment plan addressing specific issues based on the site classification and types of resources needed to complete the treatment. Consider the following:

- All activity in infested area
- Available resources and contacts
- Need for counter measures
- Cooperation of property owner

Widespread or random infestations may warrant the use of Treatment Zones. For further information refer to ***Treatment Zones*** on **page 6-7**.

Efficacy of Treatment

Continue eradication measures for 2 to 4 years. After the termination of eradication or suppression measures, monitor the success of the program for one to two years. For further information see ***Monitoring Survey*** on **page 4-10**.

Site Assessment

Site assessment is the foundation of tropical terrestrial gastropod control. Consult survey records prior to treatment. Interview all persons for relevant information on site history and property ownership. Information gained from the property owner may help to locate the source of infestation, or other sites where TRTG remain undetected. Contact the area identifier to learn more about identification and characters of similar appearing species.

Assessment for modes of artificial and natural movement from a site is important during this stage. Review ***Pest Information*** on **page 2-1** as well as recent research findings to learn more about behavior, life cycle and other information that may be useful in the control process. Refer to ***Gastropod Detection Survey Data Sheet*** on **page B-2** and ***Pre-Survey Interview*** on **page B-4** for assessment job aides.

Site Visit

Communicate frequently with the person responsible for the site. Keep a log of your observations at the site. Use flags or ribbons to mark areas with invasive species; record GPS readings or use other electronic devices. Record the names of the property owners. In many cases more than one property owner is involved and research must be performed to gain this information. Much of this information may have already been recorded during survey investigations.

Use the answers to the following questions to prepare a status report:

1. Is the terrain sloped or flat?
2. Is there a source of calcium carbonate?
3. Are water sources located nearby?
4. How is the property used?
5. Is the area secure?
6. Does the area contain debris, trash or other obstacles?
7. Does the area contain an overgrowth of weeds and brush?
8. Are any hot zones located close to other properties (for example, intermodal container yard or freight forwarding business)?
9. What is the general condition of the property?
10. Are TRTGs climbing weeds, high brush, or trees?
11. Are there modes for artificial movement at the site that need to be addressed to prevent movement?
12. Are sensitive flora and fauna present at the site?

Classification

Development of a control plan depends on the type of property infested. Site access, security, containment, and ownership type may dictate a particular direction in eradication options. Prepare a concise overview of the infested area. This means recording information about the infested property, including the following:

- Location
- Type of property ownership (government, private, tribal, commercial, residential or agricultural)
- Current and past property uses
- Snail distribution
- Status of security and containment
- Modes of artificial movement

Mapping

Prepare a detailed map of the infested site, pinpointing the location and severity of infestations of TRTG. The map should include as much information as possible, such as acreage, roads, tree lines, water sources, property uses, and GPS coordinates. Map the property lines to indicate different property owners.

The use of aerial maps can save time. Many resources are available, such as Google Earth™. Aerial maps can be used in a graphics computer program to indicate details. ArcMap® can be used to produce excellent detailed maps. If possible, consult your regional GIS personnel. They can produce detailed maps.

See an example of a site map in ***Figure 6-1*** **on page 6-6**.

Figure 6-1 Example of a Map using Grids to Divide Infestations into Manageable Units

Safeguarding Against Artificial Movement

Artificial movement occurs when pests are moved by cargo, conveyances, or passengers. Snails and slugs can hitchhike on many objects ranging from intermodal containers to nursery stock. When new infestations are found, search the site for items that might serve as carriers. After risks have been identified, immediately implement plans to prevent future spread. These risks need to be reviewed and some traceback work performed to insure movement has not occurred prior to the discovery of the infestation.

All objects of risks in an infested area become a regulated item and steps need to be taken to eliminate the TRTG. An Emergency Action Notification may need to be issued to insure compliance and remove risk. By safeguarding risks the focus then can be on treatment plans and zones. See ***Issuing an Emergency Action Notification*** on **page 5-5** for related information.

Treatment Zones

Zones or grid areas can be implemented for containment strategies. The use of zones can be done for the total infested area or broken down to the level of property owner. The cost of a quarantine as well as the size of the infestation could require prioritizing treatment zones. Site zoning can be designed to meet the need specifically.

Primary Inner

The primary inner zone is the point of introduction and is also known as the core area. It is a source of information on introduction and possible spread where the TRTG population is most heavily concentrated.

Primary Outer

The primary outer zone is characterized by a random distribution of TRTG.

Secondary

The secondary area (also known as the barrier area) is crucial for containment and should be addressed first. Treat the outside of the infestation and then work inward.

Tertiary

The tertiary zone is characterized by the absence of TRTG.

Molluscicides

At the initiation of an eradication or suppression program, evaluate all available molluscicides. Select a molluscicide after considering local conditions, survey results and efficacy of available products.

The labels for several products have been amended by their manufacturer to include non-crop areas such as rail yards, ports, and right-of-ways. Check also for registrations to assure the compound you have chosen is registered for use in the State where applications are taking place.

Use the highest rate allowed by the label in first time treated areas. Depending on the population levels, several repeated applications may be necessary in a particular area within a season or over the course of years in order to achieve effective eradication or suppression. Monitoring for snail mortality and

population resurgence is an important consideration when deciding to make additional applications. See ***Monitoring Survey*** on **page 4-10** for related information.

Prepare a Categorical Exclusions for National Environmental Policy Act (NEPA) compliance for each site or property owner where treatments will be performed.

Application

Strategy in control approaches must be flexible since infested sites and setting can vary greatly. Types of infested conditions could limit or preclude options utilized for one site while accommodating multiple chemical formulations for another. A multifaceted strategy will be needed to manage invasive TRTG outbreaks.

Spread baits evenly. Reverse the pattern of application on repeat treatments, since spots may be missed during ground application. Pellets are usually colored and easy to see. Use a granular product if visible bait is undesirable. Schedule treatments before or after rains, since snails are active at this time and more likely to encounter bait. If this cannot be done, the area can be irrigated beforehand to help promote slug and snail activity (Flint and Wilen, 2009). Bait treatments are much more effective with moisture and should be applied in either late afternoon or evening.

Metaldehyde pellets are one of the most utilized form of bait. It is applied and used in a wide array of conditions. Granular metaldehyde formulations such as Durham® granules may be more appropriate in settings where pellets may be unsightly or pose a potential focus of curiosity.

Liquid applications may be effective when bait formulas cannot reach target snails. Metaldehyde spray formulations provide another application format that has potential to accommodate snail control needs alone or in concert with other approaches.

Difficult terrain areas which present problems in applying baits could indicate the need for a spray or even a more specialized form of application equipment such as bait blower. Baits are toxic to all slugs and snails, not just target species.

Metaldehyde

Metaldehyde is the most widely used chemical snail bait treatment. It comes in many formulations with various attractant systems. Metaldehyde baits containing 4 percent metaldehyde are significantly more effective than those products containing only 2 percent metaldehyde. Some metaldehyde products are formulated with carbaryl, partly to increase the spectrum of pests

controlled to include soil and debris-dwelling insects, spiders, and sow bugs. However, carbaryl is toxic to soil-inhabiting beneficial organisms, such as ground beetles and earthworms, and should be avoided if snail and slug management is all that is required.

Deadline® M-Ps™ and Metarex are bait treatments that have been very effective in recent years for invasive snail eradication. Deadline® 40 and Slugfest are liquid formulations of metaldehyde. Metarex is a smaller bait pellet and has more bait points per given area applied at label rates. This bait also produces less dust and breaks down slower in moist conditions as compared to Deadline®.

Baits with only metaldehyde work well with warm temperatures or during low humidity periods. Watering after placement will reduce the effectiveness of the bait. Sunlight and high irrigation can lead to rapid breakdown of the bait, but using bullet or paste formulations will help reduce this (Flint and Wilen, 2009).

Metaldehyde baits are poisonous to other animals as well, including dogs, cats and other wildlife. These baits should not be sprayed or applied to plants, especially vegetables (Flint and Wilen, 2009).

Methiocarb

Methiocarb is an organophosphate chemical. Most formulations of methiocarb are classified as Restricted Use Pesticides. Restricted use products may only be applied by a certified pesticide applicator or under the direct supervision of a certified applicator. According to some researchers, methiocarb produces better kill than metaldehyde under wet conditions. Mesurol 75-W® is formulated as a wettable powder with 75 percent active ingredient. Mesurol Pro® is a food bait with 2 percent active ingredient.

Iron Phosphate

Iron phosphate is a relatively new active ingredient for slug and snail food baits. Iron phosphate baits are considered generally safe for the environment. Unlike metaldehyde and methiocarb products, baits containing iron phosphate are thought to be safe for pets and other non-target animals. After feeding on baits containing iron phosphate, slugs and snails will cease feeding but will not die until 3 to 6 days later. For some slug and snail species, there is evidence that iron phosphate baits are less effective than those containing metaldehyde or methiocarb. Indications are that iron phosphate, while not as effective as metaldehyde and methiocarb, has potential in chemically sensitive areas due to its low toxicity.

Iron phosphate pellet formulations can assist in filling a treatment void in cases in which a home or landowner's may have reservations of chemical control options. Iron phosphate may be impractical on large scale eradication but allow for treatment in smaller or sensitive areas.

Sluggo® is granular bait containing 1 percent iron phosphate. This bait can be used in areas that have public access or other areas of concern in place of metaldehyde use.

Caffeine

Hollingsworth et al. (2002) found that caffeine served as a neurotoxin to TRTGs when applied to foliage or plant growing media. Both 0.5 and 2 percent caffeine concentrations killed the majority of *Veronicella cubensis* (Pfeiffer) over a 48 hour period. In preliminary trials, the 2 percent solution caused leaf yellowing on ferns, bromeliads and lettuce, but this problem may be alleviated if mixed with an appropriate agricultural polymer. In the future, this method may be approved and recognized as an environmentally acceptable toxicant for slug and snail control for food crops.

Cultural Controls

Altering environmental conditions can be an effective control technique for slugs and snails. Rely on a combination of cultural methods in non-emergency situations. Cultural controls can also be used in combination with other treatments. Some cultural controls, such as draining wetlands, may be subject to obtaining environmental documentation under the National Environmental Policy Act (NEPA) and the Endangered Species Act (ESA). Check with the program manager to make sure documentation is in order. See ***National Environmental Policy Act*** on **page 7-2** for related information. See also ***Microhabitats*** on **page 4-4** and ***Visual Inspection*** on **page 4-11** for related information concerning environments that TRTG seem to prefer.

Alteration of Habitat

In order to increase the efficacy of treatments, habitat modification or alteration is needed. Modification can range from extensive alteration of the landscape by removing vegetation and grading the site, to very basic alteration that includes keeping vegetation mowed in order to keep the snails closer to ground level for easy access to bait/treatments when treatments are applied. The least amount of modification at a site should be keeping the area clean and clear along with mowing vegetation. Treatments and site modification are best applied in concert with each other, as any one of them alone has limited impact.

The most cost effective approach is to gain the cooperation of property owners. Prior to treatments, assess the different properties in order to come up with a habitat modification site plan for each property. After the assessments, discuss with the property owners what they can do to help with site modifications.

If the property is overgrown with various types of vegetation, have the site mowed or otherwise maintained. Without modification, the snails will be difficult to control in overgrown areas. Perform extensive modification by removing small trees, brush, and other vegetation. When removing large areas of trees and brush, it should be chipped on-site to prevent artificial movement of snails and slugs. Inspect equipment before it leaves the site to prevent artificial spread.

After vegetation removal, manage the property by keeping regrowth mowed. The site can also be plowed and disked, or an herbicide can be applied. The property should be safeguarded by treatment around the border to prevent reintroduction of snails to the modified area if infestations occur outside of the modified area. If snails still exist in the altered area, a treatment plan should be used. This aggressive alteration should drastically reduce population numbers of the snails in this area. Survey work is needed in this area in the following years to confirm this and treatments applied when detected.

Removal of trash, litter or debris must be done in such a way as to prevent the spread of an infestation. Equipment used for maintenance, roadwork, etc., should not be parked, stored or left idle in snail infested areas, but cleaned and returned to storage at the end of each work day. Idle equipment should be removed from the infested area, unless protected by barriers or stored inside buildings kept clear of any infestation.

Good watering techniques can also have an effect on slug populations. Avoid watering plants later in the day as this provides suitable habitat in the evening when slugs emerge from their refuge. Water early in the morning and use drip irrigation to avoid providing a moist environment needed for slug survival.

The habitat can also be altered in a way that encourages predators such as mammals and birds. This can be done by planting hedges for shelter, shrubs with berries for food and adding a pond or bird bath for water (Weisenhorn, 2001).

Barriers

Copper Foil—Install strips of copper foil to repel snails and prevent their access to tree foliage or planting beds for several years. Snails will not cross the copper foil. Snail Barr® is a copper foil product widely available from suppliers of agricultural products.

Salt— Salt is an effective barrier for snails to safeguard items of risk or concern.

Soil—Snails limit their movement on bare soil. Consequently, a strip of bare earth about 1.5 meters wide around cultivated areas will give some protection. This form of control is made more effective if combined with chemical means of control and regular hand collection of snails.

Abrasives—Heaping dry ash or other abrasives in a band 1 inch high and 3 inches wide is an effective barrier. However, these are hard to maintain due to loss of effectiveness when damp or wet.

Bordeaux Mixture

Brush copper sulfate or Bordeaux mixture (10 pounds of copper sulfate, 10 pounds of lime, and 100 gallons of water) on tree trunks to repel snails. Bordeaux mixture will withstand rainy weather better than copper sulfate alone.

Hand-Collecting

Consumption of slugs and snails, or of vegetables and fruits contaminated by slugs and snails, may lead to infection by pathogens that are easily transmitted by these pests. Wear rubber or latex gloves when handling gastropods, as well as associated soil, excrement, and other materials that may have come in contact with them. Immediately after removing protective gloves, thoroughly wash hands with hot soapy water and rinse well. Consult a physician if, after handling slugs and snails, you experience symptoms resembling forms of meningitis, including headache, stiff neck, tingling or painful feelings in the skin, low-grade fever, nausea, and vomiting. These symptoms could indicate an infection by Angiostrongylus cantonensis, a parasite carried by snails and slugs. These pests may also carry other diseases.

Collecting gastropods by hand is the simplest and most environmentally-friendly control methods available. Look for slugs and snails in areas where refuge is present (under rocks, vegetation, planks, etc.). Regular and extensive collection of slugs and snails should be carried out in tandem with other control methods or when performing survey work. Community cooperation can help to reduce slug snail numbers significantly, particularly in newly infested areas.

Use the following methods to dispose of slugs and snails:

- Freeze at –10 °C for 3 days
- Immerse in boiling water, rubbing alcohol, ethanol, seawater
- Incinerate

Disturbing Soil

In open fields, plowing the soil twice yearly will reduce small populations of TRTG by exposing them to predators. Disking and cultipacking will help to reduce slug and snail populations in areas of thin topsoil or where erosion is a problem.

Sanitation

Sanitation is a continual process. Destroy snail habitats by clearing underbrush, eliminating refuse piles and loose boards, and checking underneath stones. All infested properties must be cleaned thoroughly to facilitate survey operations and to improve the effectiveness of control treatments. Plant soil can be sterilized to kill eggs.

Trapping

Traps have limited use and are not effective on a large scale or site. This method is time-consuming and should be used on small sites in concert with hand collecting. This method is most effective during active periods of the pests. Trap TRTG under boards or flower pots positioned throughout the landscape. Inverted melon rinds also make good traps. See ***Trapping*** on **page 4-15** for other methods of trapping.

Burning

Collect, pile and burn host material if local ordinances and fire officials permit.

Controlled burning as a management tool might reduce or eradicate gastropod populations. It will remove food sources and destroy gastropod habitat. There is a need for research and documentation to review the possibility of this management tool.

Application of Herbicides

Using herbicides to control wild and cultivated hosts has proven to be effective by removing food sources and habitat. If baits are also being used as a control tool, apply them after vegetation dies back. The bait then becomes the new and only food source. Without baiting, in an area in which herbicides were used to clear the vegetation the snails will migrate to new areas to find a new food source and habitat. See ***Molluscicides*** on **page 6-7** for more information on using baits.

Control in Commercial Nurseries

Tropical terrestrial gastropods can be easily spread to multiple environments through the sale and movement of plant material. Before addressing potential invasive TRTG issues in the commercial environment, confirm the official position of PPQ for the particular outbreak through your SPHD. Clarity on the agency position, pest risk potential, site information and clear communication will be paramount.

Nursery Assessment and Considerations

After initial assessment and classification has been conducted, further control and safeguard issues for the commercial environment must be addressed. See ***Gastropod Detection Survey Data Sheet*** on **page B-2** and ***Pre-Survey Interview*** on **page B-4** for related assessment materials.

General Nursery Assessment—Determine the type of nursery, type of infestation, and type of material sold such as cuttings, potted material or shrubbery. Determine if the property includes both greenhouse and field locations.

Use the following checklist when assessing the structures and environment:

1. Are greenhouses isolated?
2. What is the construction type (plastic, glass, type of entry)?
3. Are the greenhouses automated?
4. Do the greenhouses contain multiple types of plant material?
5. What is the general state of hygiene of the greenhouses?
6. What is the type of floor (dirt, gravel, marl, concrete, asphalt)?
7. What is the type of planting system (raised or floor)?
8. What is the type and height of rack system?
9. What type of material are the racks and their stands made of (metal, wood, concrete, plastic)?
10. How are greenhouse debris and trash handled?
11. Is an area designated for debris and waste media?

Nursery Field Assessment—Determine the type of growing system used (for example block plantings, varied, mixed species), and identify general types of soil and terrain.

Use the following checklist when assessing the nursery field:

1. Are calcium carbonate sources present?
2. What is the overall condition of the field area?
3. Are the field areas clean and free of grass, weeds and other host materials?
4. Are waste or debris piles in or near planting field areas?
5. How is debris and plant waste material handled in field areas?

Pest Management—Obtain information on the type of pest management system used by the nursery. Use the following checklist when assessing the pest management at the nursery:

1. Does the nursery already treat for TRTG pests?
2. Does the nursery use pesticides?
3. Which TRTG control strategies are used?
4. What types of pests are targeted?
5. Are herbicides used?
6. Are pesticide dips or treatments used for plants being shipped?
7. Are insecticidal soaps or washes used for plants being shipped?

7

Tropical Terrestrial Gastropods

Environmental Compliance

Content

Introduction

Use *Chapter 7 Environmental Compliance* as a guide to environmental regulations when conducting a program against tropical terrestrial gastropods. Selected species in the gastropod families Ariophantidae and Veronicellidae are discussed here as these are currently of particular concern, but these guidelines are applicable for most tropical terrestrial gastropods (TRTG).

Overview

A key element in designing a program or an emergency response is consultation with Environmental Services (ES), a unit of APHIS' Policy and Program Development Staff (PPD). ES prepares environmental documentation such as Environmental Impact Statements (EIS) and Environmental Assessments (EA) to aid in program operational decisions, as well as endangered species consultation. ES also coordinates pesticide registration and approvals for APHIS pest control and eradication programs, ensuring that registrations and approvals meet program needs and conform to pesticide use requirements.

National Environmental Policy Act

Agencies should prepare an Environmental Assessment (EA) or Environmental Impact Statement (EIS) concurrently and integrated with environmental impact analyses, surveys, and studies required by the Fish and Wildlife Coordination Act, National Historic Preservation Act of 1966, Endangered Species Act, and other laws and executive orders. Environmental documents prepared to comply with other Acts also may be incorporated into National Environmental Policy Act (NEPA) documents as part of the NEPA process.

Categorical Exclusion

Categorical Exclusions (CE) are categories 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 generally required.

USDA–APHIS managers are encouraged to use categorical exclusions where appropriate to reduce paperwork and speed up decision making. Proposed actions are subject to sufficient environmental review to determine whether they fall within the broadly defined categories. Each time a specific categorical exclusion is used, the required review must be done. An EA may be prepared for proposed actions otherwise excluded when the manager determines that the action may have potential to significantly affect the environment or an EA would be helpful in planning or decision-making.

Environmental Impact Statement

An Environmental Impact Statement (EIS) is a detailed statement that must be included in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment. The primary purpose of an EIS is to serve as an action-forcing device to ensure that the policies and goals defined in the National Environmental Policy Act (NEPA) are infused into the ongoing programs and actions of the Federal government. Generally, EISs are prepared when Federal

agencies recognize that their actions have the potential for significant environmental effects (adverse or beneficial), or when an Environmental Assessment leads to a finding of potentially significant impact.

APHIS prepares EISs for administrative proceedings that establish broad scale significant impact-generating strategies, methods, or techniques such as large-scale aerial pesticide applications. This can include contingency or emergency strategies that are comprehensive in scope or long-range plans with potential for significant environmental impact. APHIS also prepares programmatic EISs to examine strategies and options for dealing with issues with important implications for the maintenance and enhancement of environmental quality.

Environmental Assessment

An Environmental Assessment (EA) is a concise public document that briefly provides sufficient evidence and analysis for determining whether to prepare an Environmental Impact Statement (EIS) or a finding of no significant impact (FONSI). An EA aids an agency's compliance with the National Environmental Policy Act (NEPA) when no EIS is necessary and facilitates the preparation of an EIS when necessary. Generally, an EA leads to a FONSI or an EIS, but it could also lead to abandonment of a proposed action.

The content of an EA must include brief discussions of the need, alternatives, and potential environmental impacts of the proposal, and a list of agencies and persons consulted.

Environmental Monitoring

APHIS–PPQ requests assistance from Environmental Services (ES) before PPQ personnel or funding are used for control operations. Additionally, program staff should consult with PPQ–EDP– Environmental Monitoring staff to determine if an environmental monitoring plan is required for the operation. State, regional, and national program managers determine counties where treatments may be needed.

Program personnel should evaluate the need for and success of biological control agents and herbicide treatments used in eradication or suppression of the target foreign noxious weed or host weeds and avoid damage to non-target plants.

Biological Assessment

A biological assessment is an analysis of the effects that a Federal agency action may have on listed or proposed endangered or threatened species and designated critical habitat. The Endangered Species Act (ESA) requires this analysis if the proposed action may affect a listed species. In such a case, consultation with the U.S. Fish and Wildlife Service (FWS) or the National Marine Fisheries Service (NMFS) is required. Federal agencies are required to insure that any action authorized, funded, or carried out is not likely to jeopardize listed species or result in adverse modification of designated critical habitat.

8

Tropical Terrestrial Gastropods

Pathways

Contents

Introduction

Use *Chapter 8 Pathways* to learn more about interceptions of tropical terrestrial gastropods in the United States and collaborating territories. Selected species in the gastropod families Ariophantidae and Veronicellidae are discussed here as these are currently of particular concern, but these guidelines are applicable for most tropical terrestrial gastropods (TRTG).

Interceptions

Interceptions of the following tropical terrestrial gastropod species occurred approximately 190 times during the period 1985-2009 (***Table 8-1* on page 8-3**). The species were detected on 57 genera of plants; containers; and soil (AQAS, 2010):

- *Belocaulus angustipes* (Heynemann)
- *Laevicaulis alte* (Férussac)
- *Parmarion martensi* Simroth
- *Sarasinula plebeia* (Fischer)
- *Veronicella cubensis* (Pfeiffer)
- *Veronicella sloanei* (Cuvier)

Travel

Currently, the six species have not been intercepted in passenger baggage (AQAS, 2010). Although some tropical species such as giant African snail and channeled apple snail are popular in the pet trade and with traders of live mollusks, the six species in the guidelines do **not** seem to be as desirable.

Natural

Natural spread of any of the six species to the United States is **not** expected unless they become established elsewhere on the North American continent and move over land. Natural spread over water is unlikely.

Commerce

Approximately 46 percent of the interceptions of the species were via airport. Other interceptions occurred at inspection stations (24 percent), pre-departure stations (12 percent), maritime stations (10 percent), and land borders (8 percent).

Many of these interceptions originated from tropical areas including 30 percent from Costa Rica and 23 percent from Hawaii (AQAS, 2010). All pre-departures were intercepted in Hawaii, illustrating that the pre-clearance programs in Hawaii stop many potential stow-aways.

Cowie (1998) stated that semi-slugs can move with potted plants. Considering *Parmarion martensi* Simroth has been intercepted in this fashion, this pathway should be monitored closely (AQAS, 2010).

Dundee (1977) stated that soil infested with eggs of *Belocaulus angustipes* (Heynemann) is the most likely means of transportation of this species in nurseries. This was most likely the case for other tropical terrestrial gastropods considering the small size of eggs compared to other life stages. Currently, most allowable nursery stock is shipped without soil under current regulations, helping to provide considerable mitigation against such risks. However, plants continue to be smuggled, sometimes with soil.

Table 8-1 Interceptions of Six Species of Invasive Tropical Terrestrial Snails at U. S. Ports of Entry 1985 to 2009 (AQAS, 2010; Robinson, 2006)

	Host Genera		Interceptions		Countries of Origin		
Species	**Number**	**Top Ranked**	**Number**	**Top Ranked[2]**	**Number**	**Top Ranked**	**NOD[1]**
Belocaulus angustipes (Heynemann)	N/A[3]	N/A	1	N/A	1	France	1
Laevicaulis alte (Férussac)	2	*Alyxia*	4	P	3	Fiji	3
Parmarion martensi Simroth	4	1 each of various	4	P	2	Hawaii	4
Sarasinula plebeia (Fischer)	37	*Dracaena* *Chamaedorea* *Ananas*	110	P, C, QP	14	Costa Rica Mexico Guatemala	14
Veronicella cubensis (Pfeiffer)	25	*Eryngium* *Heckeria* *Limnophila*	56	P	3	Hawaii Puerto Rico Dominica	13
Veronicella sloanei (Cuvier)	10	*Amaranthus* *Momordica*	15	P, QP	5	Jamaica St. Lucia	6

1 Number of Destinations.

2 P = Plants; C = Containers; QP = Quarantine Products; M = Mushrooms.

3 Does not apply.

Countries of Origin

During the period 1985-2009, interceptions of the six species of tropical terrestrial gastropods originated in 19 countries and Territories around the globe. The majority of interceptions originated in Costa Rica and Hawaii (AQAS, 2010; Robinson and Tang, 2003).

Destinations

When an actionable pest is intercepted, officers ask for the intended final destination of the conveyance. During the period 1985-2009, interceptions of the six tropical terrestrial gastropod species were bound for 23 States or U. S. Territories, some of them to areas where establishment could or has already occurred (for example, Miami) (AQAS, 2010).

Risk

The six species of tropical terrestrial gastropods treated herein pose considerable establishment and environmental risks to the United States because:

- Some have been found in the United States in isolated populations (Dundee, 1977)
- All have been associated with at least 57 genera of plants (AQAS, 2010)
- Some carry parasites that can infect humans
- Some carry parasites that can infest U.S. cattle and sheep (Godan, 1983).

Prevention

The six species of tropical terrestrial gastropods treated herein should be prevented from re-establishing. Species of tropical terrestrial gastropods that are already established should be eradicated. All pathways that serve to provide entry of TRTG should be thoroughly inspected.

Agricultural and horticultural products are two of the main pathways known to spread these pests (AQAS, 2010) and particular care should be taken to ensure that these pathways are effectively monitored.

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.

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Glossary

Use the *Glossary* to find the meaning of specialized words, abbreviations, acronyms, and terms used by USDA–APHIS–PPQ–Emergency and Domestic Programs.

APHIS. Animal and Plant Health Inspection Service
apex. tip of the spire of a snail shell, at the opposite end from the aperture
aperture. mouth or principal opening of the shell, through which the body of the gastropod passes out of the shell
artificial movement. movement of pests by cargo, conveyances, or passengers
AQAS. Agricultural Quarantine Activity System, a Web database accessible from any USDA–APHIS computer
attractant trap. trap employing a lure which incites the target snail to come to it and be caught
ATS. Automated Targeting System
barrier. natural or artificial obstacle to movement**.**
biometric survey. survey succeeding the delimiting survey, in which properties are number- and letter-coded for survey purposes on a rotational basis
body whorl. last whorl of a snail shell, from the aperture to the line directly above the aperture on the previous whorl; normally the largest portion of the shell; partially encloses the rest of the shell
buffer zone. area extending 75 meters beyond the core zone
cf. (confer) compare or see
columella. central column of the shell, around which the shell whorls coil
commercial production area. area in which host material is grown for sale
confirmed detection. positive laboratory identification of a submitted specimen
core zone. minimum distance of 25 meters in all directions of any confirmed target snail infestation
core infested area. known edges of infestation, defined by the area between several adjacent positive points; may include multiple positive points, and multiple properties; boundaries are established where positive species have been found
delimiting survey. survey to determine the extent of the infestation in an area after the target snail has been detected
detection. collection of any life stage of the target snail
detection survey. survey conducted in a susceptible area not known to be infested with the target snail
dry heat. use of high temperatures as a treatment
egg survey. collection and holding of suspect eggs when no hatched snails are available to determine the extent and nature of an infestation

epicenter. initial site of an infestation
epiphragm. hardened mucous barrier that seals the aperture in most land snails and prevents desiccation during dry spells
eradication zones. areas or properties slated for eradication measures
FONSI. Finding Of No Significant Impact
fumigation. application of an approved fumigant, such as methyl bromide, as a treatment
generation. period of time for the pest to complete all stages of development predicated on the basis of biological information
GPS. Global Positioning System
ground spray. using ground spray equipment to apply molluscicide to the ground, selected resting places, or host vegetation in a target snail infested area
host. plant species, substrate, debris, or other food reproduction of the target snail
infestation. collection of one or more target snails from an area
infested area. infested properties or core areas of no less than 25 meters on a side each, unless biological factors indicate the need for more or less area
ISIS. Integrated Survey Information System
lip. flared margin surrounding the aperture of a shell
mantle. sheet of epithelial tissue that covers the viscera and secretes the shell
monitoring. using interdependent visual and/or trapping surveys in an area where treatment has been applied to evaluate the effectiveness of the application; also known as evaluation survey
natural movement. dispersal of pests without assistance from man or other means
PPQ. Plant Protection and Quarantine
pathway. means by which plant pests are introduced
parietal callus. layer of shell secreted over the parietal area
PestID. database containing all the information recorded from the PPQ Form 309 Pest Interception Record
positive point. single point where a specimen of the target species was detected
regulated zone. zone that extends at least 100 meters in any direction from an infested property; may be extended to include any other nearby regulated areas as seems practical or within 1 kilometer
regulatory inspection. visual examination of host material, containers, and transport
semi-slug. taxonomic intermediate between a slug and snail
SPHD. State Plant Health Director
steam sterilization. use of live steam as a treatment on selected regulated items
suture. line of contact or fusion between one shell whorl and the next
target snail. exotic species of snail found to be established in a given area of the United States against which it has been determined to conduct eradication and/or regulatory action

trap survey. determining the presence or absence of a pest by the use of traps placed in a predetermined pattern and serviced on a given schedule
TRTG. tropical terrestrial gastropods; used in the guidelines to refer to tropical terrestrial gastropods in the United States and collaborating territories; includes selected species in the families Ariophantidae and Veronicellidae
TTG. temperate terrestrial gastropods
urban area. noncommercial crop production area containing multiple or single-family dwellings; Also known as residential area
USDA. United States Department of Agriculture
visual survey. examining hosts, substrate, or hiding places for eggs, adults, or visible damage; either in the field, in regulated establishments, or in monitoring the movement of regulated articles
whorl. turn on a spiral shell

Appendix A

Resources

Use *Appendix A Resources* to find the contacts and products mentioned in the guidelines. To locate where in the guidelines a product is mentioned, refer to the Index.

Table A-1 Tropical Terrestrial Gastropods Resources

Function	Contact Information
Mesurol® Products	Gowan Company P.O. Box 5569 Yuma, Arizona 85366-5569 Telephone: (800) 883-1844 X 2 http://www.gowanco.com
Deadline® Products	Pace International 1011 Western Ave., Suite 505 Seattle, Washington 98104 Telephone: (800) 936-6750 http://www.paceint.com
First Choice® Sluggo Slug and Snail Bait	Western Farm Service, Inc. P.O. Box 1168 Fresno, California 93711 Telephone: (559) 436-2800 http://www.westernfarmservice.com
Copper Sulfate and Bordeaux Mixture	CR Chemical Corp. 4450 Trade Center Blvd., ITC Park Laredo, Texas 78045 Telephone: (956) 753-0175 http://www.crchemical.com Statewide IPM Program Agriculture and Natural Resources University of California Pests in Landscapes and Gardens Bordeaux Mixture http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn7481.html
PPQ FIFRA Coordinator	USDA–APHIS–PPQ–Emergency and Domestic Programs 4700 River Road Riverdale, MD 20737 Telephone: (301) 734-5861
Predicting Pest Development	Univ. of CA Integrated Pest Mgt. Prgm. http://www.ipm.ucdavis.edu/WEATHER National Oceanic and Atmospheric Administration http://www.noaa.gov/ NAPPFAST (North Carolina State University, APHIS, Plant Pest Forecasting System) http://www.nappfast.org/index.htm) U.S. Department of Commerce Local Cooperative Extension Service Private, State, university, or industry sources

Table A-1 Tropical Terrestrial Gastropods Resources (continued)

Function	Contact Information
Pest Management Supplies	BioQuip Products, Inc. 2321 Gladwick Street Rancho Dominguez, CA 90220 Telephone: (310) 667-8800 http://www.bioquip.com/ Wards Natural Science P.O. Box 92912 Rochester, NY 14692-9012 Telephone: 800-962-2660 http://www.wardsci.com/ Carolina Biological Supply Co. 2700 York Road Burlington, NC 27215-3398 Telephone: (800)334-5551 http://www.carolina.com/ Hercon Environmental Corporation P.O. Box 467 Aberdeen Road Emigsville, PA 17318-0467 USA Telephone: (717) 764-1191 Fax: (717) 767-1016 http://www.herconenviron.com/ Cooper Mill Ltd R.R. 3 Madoc, Ontario K0K 2K0 CANADA Telephone: (613) 473-4847 Fax: (613) 473-5080 http://www.coopermill.com ISCA Technologies, Inc. P.O. Box 5266 Riverside, CA, 92521 Telephone: (909) 686-5008 Fax: (815) 346-1722 http://www.iscatech.com/exec/index.htm Great Lakes IPM, Inc. 10220 Church Road Vestaburg, Mi 48891-9746 Telephone: (989) 268-5693 or (989) 268-5911 Fax: (989) 268-5311 http://www.greatlakesipm.com/

B

Tropical Terrestrial Gastropods

Appendix B

Forms

Contents

Gastropod Detection Survey Data Sheet

Survey
Number:
Date:

Surveyor Information

Name

Code | Affiliation

Client Information

Name(s) of resident(s) or landowner(s)

Business name | Name of contact

Street address | City, State, Zip Code

Telephone (office, home, or cell)

Site Information

Location or landmarks

Usage (farm, residence, nursery, etc.) | Size (acres)

Longitude | Latitude

Description of vegetation or habitat

Name of host plants exhibiting damage

Other observations

Sketch of site, route, or collections

Code	Description	Species	Identifier	Number of Molluscs			
				A[1]	E[2]	I[3]	T[4]
A							
B							
C							
D							
E							
F							

1 Adults

2 Eggs

3 Immatures

4 Total

Pre-Survey Interview

Business Information

Name

Address, City, State, Zip Code

Name of contact person

Telephone FAX Email address

Latitude Longitude

Type	Description
❑ Maritime port	
❑ Rail yard	
❑ Container yard	
❑ Tile importer	

Questions

1. Do you import directly to this facility?

If your answer is:	Then:
❑ Yes	Use the following table to indicate how often you receive imported products from this location, and then go to the next question.
❑ No	Which distributor do you receive your products from? Write your answer here, and then go to the next question.

Code	Product or material	Country of Origin	Frequency	Volume
A				
B				
C				
D				
E				

2. For how long have you received products or materials from overseas?_____

3. Is the product stored at another location or warehouse?

If your answer is:	Then:
❑ Yes	What is the location? Write your answer here, and then go to the next question.
❑ No	Go to the next question.

4. Have you noticed snails, insects or other pests in any imported materials?

If your answer is:	Then:
❑ I don't know	Go to the next question.
❑ No	Go to the next question.
❑ Yes	Explain here, and then go to the next question. Include approximate frequency, types, locations:

5. Have you noticed snails or slugs around your property or neighboring properties?

If your answer is:	Then:
❑ No	Go to the next question.
❑ Yes	Explain here, and then go to the next question. Include locations:

6. What type of solid wood packing material (SWPM) is received with this product?

❑ none ❑ crates ❑ pallets ❑ spools ❑ dunnage
❑ spacers ❑ skidders ❑ chips ❑ shavings ❑ other

7. What is the quality of the solid wood packing material (SWPM) when it is received?

❑ bark ❑ dimensional lumber ❑ other:

8. Is foreign-origin tile or solid wood packing material (SWPM) forwarded from here to other locations?

If your answer is:	Then:
❑ No	Go to the next question.
❑ Yes	Explain here, and then go to the next question.

9. How is solid wood packing material (SWPM) normally handled and disposed of?

If SWPM is:	Then explain how, location, or frequency:
❑ Stored inside	
❑ Stored outside ❑ On-site ❑ Off-site	
❑ Reused as SWPM ❑ On-site ❑ Off-site ❑ Another way	
❑ Recycled into other wood products[1] ❑ Drop box ❑ On-site ❑ Off-site ❑ Other	
❑ Given away ❑ Free Wood sign ❑ Employees ❑ On-site ❑ Off-site	
❑ Burned ❑ On-site ❑ Off-site	
❑ Other ❑ On-site ❑ Off-site	

1 Include the name of the recycling company or site.

10. Have you noticed any damaged, dead or dying trees or shrubs on your property or nearby?

❑ Yes ❑ No ❑ Do not know

❑ Comments:

11. Are you aware of other businesses that regularly import products or materials from overseas?

❑ Yes ❑ No ❑ Do not know

❑ Comments:

Interviewer Date

PPQ 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)
B. ☐ Damaging Crops/Plants
C. ☐ Suspected Pest of Regulatory Concern *(Explain in* REMARKS*)*
D. ☐ Stored Product Pest
E. ☐ Livestock, Domestic Animal Pest
F. ☐ Possible Immigrant *(Explain in* REMARKS*)*
G. ☐ Survey *(Explain in* REMARKS*)*
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 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 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-11**. Inspectors must provide all relevant collection information with samples. This information should be communicated 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.

Address	Fillable PPQ Form 391 http://cals-cf.calsnet.arizona.edu/azpdn/labs/submission/PPQ_Form_391.pdf

Distribution

Distribute PPQ Form 391 as follows:

1. Send the original along with the sample to your area identifier.
2. Retain 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 PROVIDE 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 HOS	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

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

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. Additional action may be warranted in the case of other fields or greenhouses testing positive for red palm weevil.

Instructions

If plant lots or shipments are held as separate units, issue separate EANs for each unit of suspected plant material and associated material held. EANs 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 EANs 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.

Follow the instructions in ***Table B-2*** **on page B-15** when completing PPQ 523 for the red palm weevil. Find additional instructions for completing, using, and distributing the form in the PPQ *Manual for Agricultural Clearance*.

Address	**PPQ *Manual for Agricultural Clearance*** **http://www.aphis.usda.gov/import_export/plants/manuals/online_manuals.shtml**

Table B-2 Instructions for Completing PPQ Form 523, Emergency Action Notification

Block		Instructions
1	COLLECTION NUMBER	ENTER the name and location of the nearest PPQ office
2	DATE	ENTER the date of the collection
3	PPQ LOCATION	ENTER the host scientific name and cultivar
4	LOCATION OF ARTICLES	ENTER the location of the article (premise location, pier, dock, container yard, hold space, etc.)
6	SHIPPER	ENTER the plant material source if known
7	NAME OF CARRIER	LEAVE blank unless that information is known
8	SHIPMENT ID NO.	LEAVE blank unless that information is known
12	ID OF PEST	To place plant material on a property on “Hold”, enter “suspect red palm weevil, *Rhynchophorus ferrugineus*”; the authority under which actions are taken is The Plant Protection Act of 2000, Statute 7 USC 7701-7758
16	ACTION REQUIRED	ENTER the following text: “All host plants of the red palm weevil, *Rhynchophorus ferrugineus*, are prohibited from movement from the property pending further notification by USDA–APHIS–PPQ and/or the State department of agriculture. No other plant material may leave the property until further evaluations can be made. After further investigations are conducted on the listed plants and other host material, if a positive detection is confirmed on the property, plant material will be treated/destroyed under supervision, with approved methods in accordance with USDA and State policies. Any additional hosts of red palm weevil on the property are subject to Federal and State quarantine requirements prior to movement from the property.”

C

Tropical Terrestrial Gastropods

Appendix C

Submitting Survey Samples to Domestic and Other Identifiers

Procedures for Submitting Survey Samples to Domestic and Other Identifiers

A. 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.

Submission requirements for insects are:

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 prior to shipping. This can be accomplished by placing them in a vial of alcohol or place 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% 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 very 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 prior to shipping. Notify 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.

Figure C-1 Procedures for Submitting Survey Samples to Domestic and Other Identifiers, page 1

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. 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 very 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, it should be wrapped 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 notify the identifier prior to shipping. Remember to inform the identifier that samples are on the way, giving the approximate number and to include your contact information.

5. ***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 identifications prior to 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.

Figure C-2 Procedures for Submitting Survey Samples to Domestic and Other Identifiers, page 2

B. PLANT SAMPLES FOR PLANT PATHOLOGY ANALYSIS

1. Sampling

Please submit adequate amounts of suspect leaf material when possible. This helps ensure that there is sufficient material if downstream diagnostic techniques are required. Twelve or more leaves per sample are desired.

2. Storing

Refrigerate samples while awaiting shipment to the diagnostic laboratory. Place leaves **without paper towel** in a sealed and labeled ziplock bag.

3. Documentation

Each **sample** should be documented on, and accompanied by its own completed PPQ Form 391 '*Specimens for Determination*'. 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. 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 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 with the accompanying form. For example, write the "Collection Number" both on the Form 391 and on the sample bag.

4. Packing

To provide extra insurance against accidental release during shipping, specimens should be double-bagged – i.e. first place the specimen in a self-locking plastic bag and then place that bag within a second self-locking plastic bag. **The Form 391 should not be placed in the bag holding the sample! Rather, it should be placed inside the outer bag**

Place double-bagged samples in a sturdy cardboard box or heavy styrofoam container so that the samples are not damaged during shipping and handling. Ideally, samples should be packed with freezer blocks or wet ice to maintain their integrity during the shipping process. Thoroughly seal all seams on the container with shipping tape.

5. Shipping

The Identifier Laboratory should be contacted prior to forwarding samples. It is helpful to know how many samples are being forwarded, what types of samples they are (e.g. SOD-suspect Camellia leaves), when the samples will be shipped, and the package tracking number.

Label the shipping box as 'URGENT' and send via overnight express courier (FedEx, UPS, Airborne, DHL, etc) to the appropriate Identifier.

Figure C-3 Procedures for Submitting Survey Samples to Domestic and Other Identifiers, page 3

C. MOLLUSKS

1. **Specimen Handling**

When collecting live samples, specimens should be placed directly into water making sure that no air bubble remains inside. Seal for 24 hours or until drowned, then transfer to 70 percent ethyl alcohol. Replace the water with a 70-80 percent alcohol solution after the snail has extended from the shell or when the slug is fully extended. Label the container with the appropriate information. After handling slug samples, hands should be washed in hot soapy water, and rinsed in alcohol or a standard disinfectant.

2. **Labeling & Documenting Samples**

Collection information is vital and should be completed immediately after a collection is made. Write directly on the collection container or on a paper label placed inside the vial using a pencil or with alcohol-proof ink. Complete PPQ form 391, *Specimens for Determination*. Write the date, collector's name, collector's contact information, and location including any transect and plot numbers. If multiple vial samples are collected from a location, assign individual sample numbers. When transferring the specimens to alcohol, ensure the label accompanies the sample.

3. **Sample Submission Procedures**

Sort samples:
As such, it is important to sort out the debris and non-target pests. The taxonomic level of sorting will depend on the expertise available on hand and can be confirmed with the identifier.

Screen Target Pests:
Utilize local resources. Some states may have taxonomic support, access local training aids or identification guides.

Packaging and Shipping:
Ensure specimens are dead prior to shipping. Use a sturdy cardboard box or heavy styrofoam container so that the samples are not damaged during shipping and handling. When shipping large vials, carefully wrap vials with adequate packing material so that if breakage occurs during transit, the alcohol will not leak outside the shipping box. It is recommended that vials be wrapped in zip-type bags.

4. **Identification**

The Identifier should be contacted prior to forwarding samples. It is helpful to know how many samples are being forwarded and when the samples will be shipped.

Reporting results are "positive" or "negative." Identifications usually take 2-3 weeks. However, identification time may take longer based on identifier's current workload or the volume of samples submit.

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Figure C-4 Procedures for Submitting Survey Samples to Domestic and Other Identifiers, page 4

D

Tropical Terrestrial Gastropods

Appendix D

Taxonomic Support for Surveys

Background

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

National Identification Services employs and collaborates with scientists who specialize in 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 domestic plant pest confirmations and communications. A Domestic Diagnostics Coordinator position was established to administer the policy and coordinate domestic diagnostic needs for NIS. This position was filled in October 2007.

Address

Joel Floyd, Domestic Diagnostics Coordinator
USDA–APHIS–PPQ–PSPI–NIS
4700 River Rd., Unit 52
Riverdale, MD 20737
Telephone: (301) 734-4396
Fax: (301) 734-5276
Email: 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 access to good taxonomic support within their borders. 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. Moreover, when considering whether to survey for a particular pest it is advisable to consider the challenges of taxonomic support.

Sorting and Screening

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

Sorting is the first level of activity that assures samples submitted are of the correct target group of pests being surveyed. After removing debris, ensure that the correct order or 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 is a higher level of discrimination of samples. 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. The degree of appropriate screening is dependent on the target group, and the training, experience, and demonstrated ability, of the screener.

Check individual survey protocols to determine if samples should be sorted, screened 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 the USDA–Cooperative Agricultural Pest Survey (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, posts them on the CAPS Web site. If local screening aids are developed, please notify the Domestic Diagnostics Coordinator. Visit the CAPS Website to view the screening aids available.

Address	Joel Floyd, Domestic Diagnostics Coordinator USDA–APHIS–PPQ–PSPI–NIS 4700 River Rd., Unit 52 Riverdale, MD 20737 Phone: 301-734-4396 Fax: 301-734-5276 Email: joel.p.floyd@aphis.usda.gov
Address	CAPS Screening Aids Web site: 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 other entities may assist, including PPQ identifiers, universities, State departments of agriculture, 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 the 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 PPQ Eastern Region 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 access our PestID database, and 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 PestID 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.

Table D-1 PPQ Domestic Identifiers

Specialty	Area of Coverage	Identifier's Name/Address	Telephone/Fax/Email
forest pests (Coleoptera, Hymenoptera)	Eastern Region	Robert Brown Domestic Entomology Identifier USDA–APHIS–PPQ 901 W. State Street Smith Hall Purdue University West Lafayette, IN 47907-2089	Phone: 765-496-9673 Fax: 765-494-0420 robert.c.brown@aphis.usda.gov
adult Lepidoptera, Hemiptera	Eastern Region	Julieta Brambila Domestic Entomology Identifier USDA–APHIS–PPQ P.O. Box 147100 Gainesville, FL 32614-7100	Phone: 352-372-3505 ext. 438, 182 Fax: 352-334-1729 julieta.bramila@aphis.usda.gov
To be determined	Western Region	Kira Zhaurova Domestic Entomology Identifier USDA–APHIS–PPQ Minnie Belle Heep 216D 2475 TAMU College Station, TX 77843	Phone: 979-450-5492 kira.zhaurova@aphis.usda.gov
molecular diagnostics (citrus greening, *Phytophthora ramorum*, bacteriology, cyst nematode screening)	Eastern Region	Grace O'Keefe Domestic Plant Pathology Identifier USDA–APHIS–PPQ 105 Buckhout Lab The Pennsylvania State University University Park, PA 16802	Phone: 814-865-9896 Cell: 814-450-7186 Fax: 814-863-8265 grace.okeefe@aphis.usda.gov
molecular diagnostics (citrus greening, *Phytophthora ramorum*, cyst nematode screening)	Western Region	Craig A. Webb, Ph.D. Domestic Plant Pathology Identifier USDA–APHIS–PPQ Department of Plant Pathology Kansas State University 4024 Throckmorton Plant Sciences Manhattan, KS 66506-5502	Cell: 785-633-9117 Phone: 785-532-1349 Fax: 785-532-5692 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. See the Manual for Agricultural Clearance, Appendix G, Table G-1-1 for those identifiers. They will then send it to the NIS-recognized authority for that taxonomic group.

Address	Manual for Agricultural Clearance Appendix G: Table G-1-1 http://www.aphis.usda.gov/import_export/plants/manuals/ports/mac.shtml

State level taxonomists, who are reasonably sure they have a new U.S. 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 U.S. 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.

Communication 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.

Tropical Terrestrial Gastropods

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