United States Department of Agriculture

Animal and Plant Health Inspection Service

Cooperating State Departments of Agriculture

New Pest Response Guidelines

Red Palm Weevil

Rhynchophorus ferrugineus

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.

First Edition Issued 2010

Red Palm Weevil

Credits

Writers

Christie Bertone, Entomologist, USDA–APHIS–PPQ–Center for Plant Health Science and Technology (CPHST)

Patricia S. Michalak, Writer/Editor, USDA–APHIS–PPQ–EDP

Amy Roda, Entomologist, USDA–APHIS–PPQ–CPHST

Contributors

Heather Coady, Regulatory Policy Specialist, USDA–APHIS–PPQ–Regulations, Permit, and Manuals (RPM)

Stephanie Dubon, Biological Science Technician, USDA–APHIS–PPQ–Center for Plant Health Science and Technology (CPHST)

Reviewers

Dr. Dan Gerling, Department of Zoology, Tel Aviv University, Ramat Aviv, Israel

Dr. Hassan Y. Alayied, Associate Professor, IPM Specialist, Natural Resources and Environment Research Institute for Scientific Affaires, King Abdulaziz City for Science and Technology, Riyadh, Saudi Arabia

Dr. Robin M. Giblin-Davis, Professor and Interim Associate Center Director, Fort Lauderdale Research and Education Center, University of Florida/IFAS, Davie, Florida

Images

Cover image courtesy of Amy Roda.

Red Palm Weevil

Contents

Figures

Red Palm Weevil

Tables

1

Red Palm Weevil

Introduction

Contents

Purpose

Use *New Pest Response Guidelines: Red Palm Weevil* as a guide when designing a program to detect, monitor, control, contain, or eradicate an infestation of *Rhynchophorus ferrugineus*, the red palm weevil (RPW). 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 the red palm weevil.

If the red palm weevil is detected, PPQ personnel will produce a site-specific action plan based on the guidelines. As the program develops and new information becomes available, the guidelines 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 red palm weevil:

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

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 the beginning of the Survey Procedures chapter before entering and upon leaving each property to prevent contamination. (See ***Survey Procedures*** on **page 4-1**.)

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:

- Plant Protection Act of 2000
- 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

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.

How to Use the Guidelines

The guidelines is a portable electronic document that is updated periodically. Download the current version of 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 below.

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.
Example	Example provides an example of the topic.
	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

Red Palm Weevil

Contents

Introduction

Use *Chapter 2 Pest Information* to learn more about the classification, history, host range, and biology of the red palm weevil, *Rhynchophorus ferrugineus* (RPW).

Classification

Table 2–1 Classification of Red Palm Weevil

Phylum	Arthropoda
Class	Insecta
Order	Coleoptera
Family	Curculionidae
Genus	*Rhynchophorus*
Full Name	*Rhynchophorus ferrugineus* (Olivier)
Preferred Common Name	red palm weevil
Synonyms	*Rhynchophorus signaticollis* Chevrolat, 1882, *Curculio ferrugineus* Olivier, 1790, *Calandra ferruginea* Fabricius, 1801 (CABI 2009), *R. vulneratus* (Panzer), 1798 (Hallett et al. 2004)
Other Common Names	Asian palm weevil, Indian palm weevil, red stripe weevil, coconut weevil, Asiatic palm weevil, picudo asiático de la palma (Spanish), charançon asiatique du palmier (French), Indomalaiischer Palmen-Ruessler (German)
Causes Similar Damage	palmetto weevil, *Rhynchophorus cruentatus* Fabricius

Historical Information

The red palm weevil, a serious pest of palms, is native to Southeast Asia and has spread through the Arabian Gulf. Among palm weevil species, the red palm weevil has spread to the greatest number of countries, probably due to its association with the date palm (*Phoenix dactylifera*), which is propagated by offshoots (Giblin-Davis 2001).

Economic Impact

The red palm weevil is a major economic pest of palms, including coconut, date, oil, and sago palms (Malumphy and Moran 2007). In 2007, coconut production in Puerto Rico was 424,300 nuts (NASS 2007c). In Florida, coconuts are successfully grown from Stuart on the east to Punta Gorda on the west, and south to the Florida Keys (Broschat and Crane 2005, Gilman and

Watson 1993); however, Floridian coconuts are primarily used in landscapes, so there are no production reports (Garrett, personal communication). In Puerto Rico, palm sales reached $7.1 million (NASS 2007c), while the gross sales for palms from nurseries in the United States was $203 million (NASS 2007b). Of the States reporting gross sales of palms from nurseries, Florida had $127 million, California had $70 million and Texas had $3 million (NASS 2007b). United States date palm production encompasses approximately 7891 acres, primarily in California and Arizona (NASS 2007a). The greatest potential economic impact to the United States if the red palm weevil became introduced would be the destruction of palms in the landscape areas, especially in tourist areas of the southern United States and the territories.

Ecological Range

The red palm weevil is not present in the United States, but was recently detected in the Dutch Antilles, which was the first report of this pest in the western hemisphere (Alhudaib 2009). In May of 2009, a weevil collected in Aruba was identified as *Rhynchophorus ferrugineus* (Borchert 2009).

Asia—Bangladesh, Cambodia, China (Guangdong, Taiwan), India, Indonesia, Japan, Laos, Malaysia (Sabah, Sarawak), Myanmar, Philippines, Singapore, Sri Lanka, Thailand, Vietnam (CABI 2009)

Africa—Algeria (Bozbuga and Hazir 2008), Egypt (Murphy and Briscoe 1999), Madagascar, Malta, Morocco, Palestinian Authority, Syria (Baldacchino 2007)

Middle East—Bahrain (CABI 2009), Georgia (Murphy and Briscoe 1999, Pelikh 2009), Iran (Murphy and Briscoe 1999), Iraq (CABI 2009), Israel (Soroker et al. 2005), Jordan (Soroker et al. 2005), Kuwait (CABI 2009), Oman (Murphy and Briscoe 1999), Pakistan, Qatar (CABI 2009), Saudi Arabia, United Arab Emirates (Murphy and Briscoe 1999)

Europe—Cyprus (EPPO 2007), France, Greece (Malumphy and Moran 2007), Italy, Spain (Soroker et al. 2005), Portugal (EPPO 2008), Turkey (Bozbuga and Hazir 2008)

Oceania—Australia, Papau New Guinea, Samoa, Solomon Islands (Murphy and Briscoe 1999)

North America—Aruba (Borchert 2009), Netherland Antilles (Alhudaib 2009)

Potential Distribution

From the reported global distribution of the red palm weevil, we estimate that this pest would potentially be able to establish in areas of the United States that are warmer than Plant Hardiness Zone 8. This Zone makes up approximately 25 per cent of the United States, including all of Hawaii and the Territories (***Figure 2-1***).

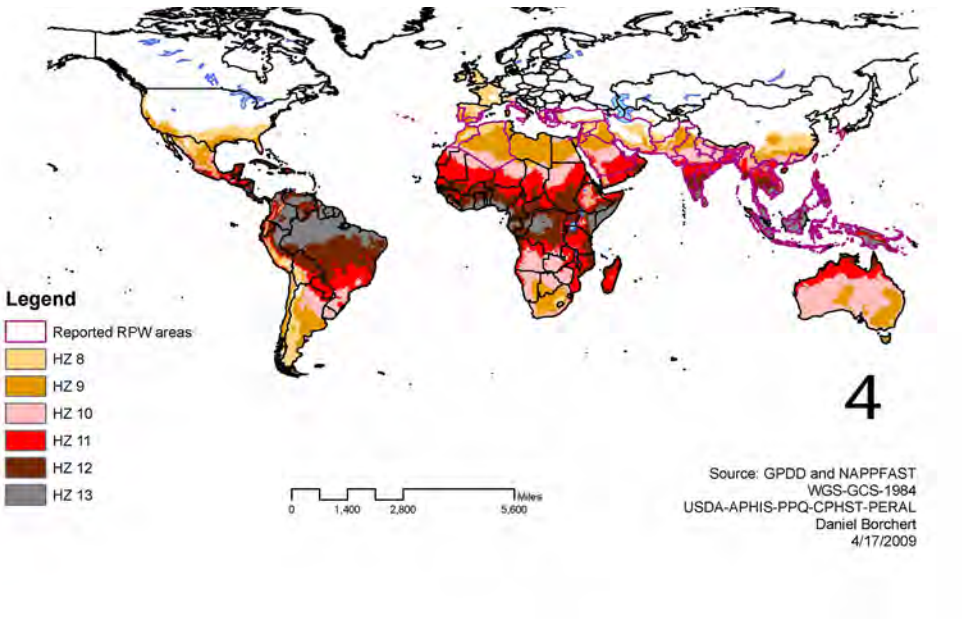

Figure 2-1 Current and Potential Distribution of Red Palm Weevil Based Upon Plant Hardiness Zone 8 and Above [Courtesy of Borchert 2009]

Hosts

The red palm weevil is primarily a pest of palms, but can be reared on sugarcane in laboratory studies (Rahalkar et al. 1972). See ***Table 2-2* on page 2-5** for a list of primary hosts of RPW. See ***Table 2-3* on page 2-5** for a list of secondary hosts.

Table 2-2 Primary Hosts of Red Palm Weevil[1]

Common Name	Scientific Name
betelnut palm	*Areca catechu*
queen palm	*Arecastrum romanzoffianum*
sugar palm	*Arenga pinnata*
toddy palm	*Borassus flabellifer*
palasan	*Calamus merrillii*
fishtail palm	*Caryota cumingii*
mountain fish tail palm	*Caryota maxima*
coconut	*Cocos nucifera*
gebang palm	*Corypha utan* (= *C. gebanga* and *C. elata*)
African oil palm	*Elaeis guineensis*
ribbon fan palm	*Livistona decipiens*
Chinese fan palm	*Livistona chinensis*
Chinese fan palm	*Livistona chinensis* var. *subglobosa*
sago palm	*Metroxylon sagu*
thorny palm	*Oncosperma horrida*
nibung palm	*Oncosperma tigillarium*
Cuban royal palm	*Roystonea regia*
Canary Island palm	*Phoenix canariensis*
date palm	*Phoenix dactylifera*
east Indian wine palm	*Phoenix sylvestris*
regal palm	*Roystonea regia*
Hispaniola palm	*Sabal blackburniana* (=*umbraculifera*)
Chinese windmill palm	*Trachycarpus fortunei*
Washington palms	*Washingtonia* sp.

1 EPPO 2008; Murphy and Briscoe 1999

Table 2-3 Secondary Hosts of Red Palm Weevil[1]

Common Name	Scientific Name
American agave	*Agave americana*
sugarcane	*Saccharum officinarum*

1 EPPO 2008; Murphy and Briscoe 1999

Life Cycle

Eggs

Females oviposit by boring with their rostrum into palm tissue, forming a hole into which they lay eggs. The eggs are light yellow, approximately 2.5 mm long, and are often laid near a tree wound. The female lays several eggs near each other and cements the hole closed. Females lay an average of 250 eggs, which take about three days to hatch (Murphy and Briscoe 1999).

Larvae

Upon hatching, larvae are whitish-yellow in color and begin to feed on surrounding palm tissue, moving toward the interior of the palm (***Figure C-2* on page C-2**). Larvae leave a tunnel behind them filled with frass and plant sap. The larval period requires an average of two months (Murphy and Briscoe 1999).

Pupae

Mature larvae pupate in an oval-shaped cocoon (about 80 x 35 mm) inside of the destroyed tissue of the tree (***Figure C-3* on page C-3**). The pupal stage requires an average of three weeks (Murphy and Briscoe 1999).

Adults

Adults are reddish-brown and about 35 x 12 mm in size (***Figure C-4* on page C-3**). After hatching into an adult, the weevil emerges from the pupal case, but remains in the cocoon for several days before exiting; during this time, entomologists believe that the weevil is completing sexual maturity. The adult then has a stage of one week outside the cocoon before beginning the oviposition period that lasts about 8 to 10 weeks. Adult weevils live for about 2 to 3 months, feeding on palms, mating multiple times, and laying eggs (Murphy and Briscoe 1999). The sex ratio found in a trapping study in the United Arab Emirates was 1 male: 1.5 females (Abbas et al. 2006), in Egypt, 1:2 (El-Garhy 1996), and in Israel, 1:2.5 (Soroker et al. 2005).

Adult weevils are predominantly active during the day and are capable of long distance flight (> 900 meters) to locate hosts or breeding sites. Marked and released weevils migrated up to 7 km during a period of 3 to 5 days (Abbas et al. 2006).

Behavior

Adult weevils are attracted to dying or damaged palms, but can also attack undamaged palms (Murphy and Briscoe 1999). Male red palm weevils produce an aggregation pheromone, which attracts other adult weevils to their host; it is composed of ferrugineol (4-methyl-5-nonanol) and 4-methyl-5-nonanone (Murphy and Briscoe 1999). The larvae can bore into soft tissue, such as the tree crown, the upper portion of the trunk, or the base of the petioles in mature palms, or into the trunk of young palms, or the decaying tissue of dying palms (Murphy and Briscoe 1999). As palm trees mature, there is a reduction in areas suitable for infestation by the weevil larvae. In trees 5-years old or less, the bole, stem or crown may be infested, but in palm trees more than 15-years old the area is reduced to the crown, the stem 1 m below the crown, and in the bases of leaf petioles (EPPO 2008). For images of the damage the weevils cause, see ***Figure C-5*** and ***Figure C-6*** **on page C-4**

Symptoms of the red palm weevil are often difficult to detect because the entry sites are usually covered with offshoots and fibers. However, in Europe and the Caribbean older trees (30 to 50 years) are also killed by the weevil. Researchers in Europe have noticed that the location of attack can depend upon tree species (Gerling, personal communication). *Phoenix dactylifera* are often attacked at the base of the trunk while *canariensis* are attacked at the top. Infestation is typically noticed when the palm has been severely damaged; it may contain more than 80 larvae (Soroker et al. 2004). Careful inspection of infested palms may show holes in the crown or trunk, possibly along with oozing brown liquid and chewed-up fibers (Giblin-Davis 2001).

Environmental Impact of Red Palm Weevil Infestation

Roystonea elata and *Sabal miamiensis* are on the Threatened and Endangered Species System (TESS) list in Florida and 12 species of agave are on the TESS list in various areas of the southwest such as Arizona, Texas, California, Nevada and the Virgin Islands (USFWS 2009). These species are not reported as hosts, but they may be impacted by the red palm weevil if the host range of this pest expands. We estimate the environmental impacts to endangered or threatened species to be low, but the impact of the red palm weevil on host palms in the environment may be significant since infestation typically results in death of the plant.

3 Identification

Red Palm Weevil

Contents

Introduction

Use *Chapter 3 Identification* as a guide to recognizing red palm weevil, *Rhynchophorus ferrugineus* (RPW). Accurate identification of the pest is pivotal to assessing its potential risk, developing a survey strategy, and determining the level and manner of control.

Characteristics

For detailed information see ***Rhynchophorus ferrugineus and Rhynchophorus palmarum Diagnostics*** on **page D-1**.

Similar Species

This section describes the palmetto weevil, *Rhynchophorus cruentatus* Fabricius (***Figure C-1*** on **page C-2**). The palmetto weevil is native and is the only species of palm weevil in the continental United States. Damage caused by the palmetto weevil is similar to that caused by the red palm weevil.

Until recently, the palmetto weevil was considered a minor pest, attacking only severely wounded and dying trees, particularly the cabbage palmetto (*Sabal palmetto*) and the saw palmetto (*Serrenoa repens*), both native to the southeastern United States. However, the weevil is considered a pest of stressed nursery and transplanted palms. These include the Canary Island date palm (*Phoenix canariensis*), *Phoenix dactylifera, Pritchardia* sp.,

Washingtonia sp., royal palms (*Roystonea* sp.), *Latania* sp., coconut palm (*Cocos nucifera*), and *Caryota* sp. In undisturbed locations, palms are rarely observed with palmetto weevil infestations. Trees stuck by lightening have been observed with subsequent weevil infestations.

It is not known if the palmetto weevil is attracted to the red palm weevil trapping systems, nor if olfactory and acoustic detection techniques will be useful for the palmetto weevil.

4 Survey Procedures

Red Palm Weevil

Contents

Introduction

Use *Chapter 4 Survey Procedures* as a guide when conducting a survey for red palm weevil, *Rhynchophorus ferrugineus* (RPW).

Survey Types

Plant regulatory officials will conduct detection, delimiting, and monitoring surveys for red palm weevil. Conduct a detection survey to ascertain the presence or absence of red palm weevil in an area where it is **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.

Preparation, Sanitization, and Clean-up

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

1. Before starting a survey, determine if there have been recent pesticide applications that would make it unsafe to inspect the palm nursery, grove, or landscape planting. Contact the property owner or manager and ask if there is a re-entry period in effect due to pesticide application. Look for posted signs indicating recent pesticide applications, particularly in commercial fields or greenhouses.
2. Conduct the survey at the proper time. Studies have shown that the weevil is more active during warmer months, in areas that experience seasonal weather. Based upon the pests reported global distribution (Bozbuga and Hazir, 2008; CABI, 2009; EPPO, 2008a; Faleiro, 2006), scientists believe the RPW could establish in hardiness zones warmer than Zone 8 in the United States. General survey and trapping efforts should focus on months when host plants are growing.
3. Obtain permission from the landowner before entering a property.
4. Determine if quarantines for other pests, of palm or other crops, are in effect for the area being surveyed. Comply with any and all quarantine requirements.
5. When visiting the palm nursery, grove, or landscape planting to conduct surveys or to take samples, everyone must take strict measures to prevent contamination by red palm weevil or other palm 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 and arthropods 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.

   The EDP-National Survey Supply Coordinator will arrange for the procurement of all traps and lures. See Appendix A Resources on page A-1 for information on contacting the National Survey Supply Coordinator.

7. Mark the palm or 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 trap or infested palm tree location so that the area or plant may be re-sampled if necessary.

8. Survey task forces should consist of an experienced survey specialist or entomologist familiar with the red palm weevil and the symptoms of its damage.

Detection Survey

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

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

Procedure

Use the following tools singly or in any combination to detect the red palm weevil:

1. Focus on palm nurseries associated with high risk pathways. See ***Targeted Surveys*** on **page 4-6** for further information.
2. Establish regular sites to inspect along your normal surveying route. See ***Sentinel Sites*** on **page 4-6** for further information.
3. Check plants for pest damage. See ***Visual Inspection*** on **page 4-7** for further information.
4. Employ traps baited with lures and food that are attractive to the weevil. See ***Pheromone Traps*** on **page 4-9** for further information.
5. If the technology becomes available in the United States, use trained dogs to detect the characteristic odor of plant damage caused by the weevils. See ***Odors and Sounds*** on **page 4-11** for further information.
6. If the technology becomes available in the United States, use acoustic devices to detect sounds caused by the feeding larvae. See ***Odors and Sounds*** on **page 4-11** for further information.

Delimiting Survey After Initial U.S. Detection

If the red palm weevil is detected in the United States, surveys will be conducted in the area to determine the distribution of the pest. In large areas, locating the source of a weevil infestation could be difficult if it is based on weevil captures by pheromone traps. Studies in date palm plantations indicated that red palm weevils tend to aggregate and infestations occur in clusters (Faleiro et al. 2002) and tend to prefer areas that are under heavy irrigation (Aldryhim and Al-Bukiri 2003, Aldryhim and Khalil 2003). However, adults are capable of long distance flight to locate hosts or breeding sites. In a mark-and-release study, a small portion of the weevils were capable of migrating up to 7 km within 3 to 5 days, from the plantations in which they were released.

Procedure

Follow the same procedure used for detection surveys in ***Detection Survey*** on **page 4-3**. Once red palm weevils have been confirmed from a pheromone trap, an additional 4 to 5 traps should be placed 200 m around the original find to locate infested palms. Traps with higher number of weevils indicate closer proximity to an infested area.

Surveys should be most intensive around the known positive detections and any discovered through traceback and trace-forward investigations.

Traceback and Trace-Forward Investigations

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

Infestations of red palm weevil usually remain undetected because the pest conceals itself within the stems of the host plant and this characteristic makes detection difficult, especially in the absence of symptoms.

Infested palm nursery stock is a potential pathway that red palm weevil could have used to enter the Caribbean area. Due to the risk of the weevil spreading through infested palms, USDA–APHIS–PPQ has prohibited the importation of plants for planting of the listed host genera, with the exception of seed, until a pest risk analysis has been completed and appropriate effective mitigation measures have been established. However, the weevil may enter through the illegal importation of nursery stock. Refer to the APHIS Federal Import Orders Web site for further information.

Address	**USDA–APHIS–Plant Import** **http://www.aphis.usda.gov/import_export/plants/plant_imports/federal_order/**

For nursery stock, a list of facilities associated with infected nursery stock from those testing positive for red palm weevil will be compiled. These lists will be distributed by the State to the field offices, and are **not** to be shared with individuals outside USDA–APHIS–PPQ regulatory cooperators.

Important

Grower names and field locations on these lists are strictly confidential, and any distribution of lists beyond appropriate regulatory agency contacts is prohibited.

Each State is only authorized to see locations within their State and sharing of confidential business information may be restricted between State and Federal entities. Check the privacy laws with the State Plant Health Director for the State.

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

Monitoring Survey

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

Targeted Surveys

Conduct targeted surveys at palm nurseries associated with high risk pathways. Lights of open cargo holes on ships and airplanes may attract flying adult beetles. Because importing host plants is prohibited, targeted surveys should focus on areas where adults may enter the country particularly as hitch-hikers that may fly into the open cargo holes of ships or airplanes.

Sentinel Sites

Sentinel sites are locations that are regularly inspected along the surveyors normal route. The sites can be established using a known host palm such as date palms or coconuts. Sable palms and saw palmettos should be avoided because these are attacked by the native palmetto weevil. Observations in Curacao and Aruba indicate that date palms exhibit visual symptoms and die, while cabbage palms (*Sabal palmetto*) native to the United States appear un-infested. Select younger trees (less than 15-years old and less than 3 meters tall) with accessible crowns and fronds.

The palm used as a sentinel site should be inspected for visual signs of damage; if available, test the palm using a portable acoustic devise. Refer to ***Odors and Sounds*** on **page 4-11** for further information. Use GPS to record the location of the palms, and draw a map of the immediate area that includes reference points so that the area can be found by others if necessary. Once the sentinel site is established the surveyor should re-inspect the site on a regular basis (bimonthly or monthly) as permitted by the persons regular survey schedule. Any larvae, pupae, or adults, should be processed as described above. GIS can be use to map the sentinel site locations to help visualize an even coverage, particularly high risk areas.

Visual Inspection

This section contains instructions for inspecting plants for red palm weevil damage and determining where to deploy traps.

Finding a palm with a distorted or dead crown does not necessarily signify the presence of the weevil. Other factors such as native insects, diseases, nutritional deficiencies, or damage caused by storms, can lead to similar damage. However, palms with symptoms should be inspected thoroughly and traps deployed in the area particularly if the palm is in a high-risk area.

1. Inspect palm trees thoroughly for the signs of red palm weevil damage described in this section. Review the images of RPW damage in ***Images*** on **page C-1**.
2. Deploy traps where damaged palms are found, and in areas determined to be at high risk. Follow the instructions for trapping in ***Pheromone Traps*** on **page 4-9**.
3. Collect samples of larvae, pupae, and adults, while inspecting plants and trapping. If only larvae are found, continue sampling until a pupa or adult is found. Review the images of larvae, pupae, and adults, in ***Images*** on **page C-1**.
4. Follow the instructions described in ***Processing Samples*** on **page 4-13** when preparing specimens. Submit specimens and plant material to the proper authority.
5. If the RPW is detected in an area, a Technical Working Group for this pest will be assembled; the group will provide further guidance concerning additional surveys.

What To Look For

The concealed nature of the weevil and its wide host range make detection of infested palms difficult. Red palm weevil is known to attack and kill over 17 palm species. See ***Hosts*** on **page 2-5** for lists of plant hosts.

Larvae, pupae, pupal cases, and adults, can be found in the dead or dying crown of the palm or infested fronds. In heavily infested palms fallen empty pupal cases and dead adults may be found around the base of the palm.

Early infestations or low numbers of the red palm weevil in plants are very difficult to detect. The older leaves of a palm begin to droop during the early stages of infestation but quickly collapse. Later stages or high infestations cause a decreased size and yellowing of the frond, particularly the new fronds as the larvae destroy the growing point of the palm. Eventually the frond canopy becomes very small relative to trunk and distorted.

With the pests recent introduction into the Caribbean, popular landscape palms such as the Bismarck palm (*Bismarckia nobilis*), Washington palm (*Washingtonia robusta*), Fiji fan palm (*Pritchardia pacifica*) and hurricane palm (*Dictyosperma album*) are now reported to be attacked by red palm weevil. The large numbers of palm species attacked along with the expanding host range will make visual surveys for the pest difficult. Despite the difficulties, surveyors should be aware of visual signs of infected palms usually signifying advanced levels of infestation.

Red palm weevil preferentially attacks young palm (under 20 years) trees (Falerio 2006); however, in Europe and the Caribbean, old trees (30 to 50 years old) are also killed by the weevil. Researchers found that during the early invasion stage of the pest in Curacao and Aruba, date palms (*Phoenix canariensis, P. dactylifera* and *P. sylvestris*) were the first palms to display symptoms and die. The female lays eggs in wounds particularly those caused by pruning fronds, the base of frond petioles/axils near the crown of the plant. These areas should be the focus of visual inspections.

Popped Neck—As the infestation progresses, the larval feeding damage and associated rot is so severe that the integrity of the crown is compromised and the top of the palm falls over. This condition is known as popped neck. If the palm is pulled apart at this stage, larvae, cocoons, and even adults may be found within the crown region.

Tunnels with Brown Fluid—Highly infested trees may have tunnels in the trunk and base of the frond petiole, and a thick brown fluid can be seen oozing from the tunnels. In date palms, infested offshoots become dry.

Wilting and Yellowing of Fronds—When infestation is in the coconut crown, wilting or yellowing of the inner fronds may occur.

Fronds with Tunnels—The weevil is known to infest the base of fronds. Tunnels may be visible.

Pheromone Traps

Chemical Lures

Volatile odors emanating from dying palms are attractive to red palm weevil adults. In addition, aggregation pheromones (4-methyl-5-nonanol and 4-methyl-5-nonanone) produced and released by male weevils attract other male and female weevils to a palm. Neither the palm stress compound nor the aggregation pheromones are very attractive by themselves, but when put together they are synergistic, attracting many adult weevils. These attractants are commercially available and are used for detection, delimiting an infestation, monitoring populations changes, and for mass trapping.

The EDP-National Survey Supply Coordinator will arrange for the procurement of all traps and lures. See ***Resources*** on **page A-1** for information on contacting the National Survey Supply Coordinator.

Trap Construction and Set-up

Many of the traps used to capture red palm weevils are variations of a bucket design with a tight-sealing lid. Surveyors can alter the design of the trap to suit the materials that are available. See examples of traps in ***Images*** on **page C-1**. Regardless of the materials, construct the traps so they include the following features:

- Rough texture on the outside of the bucket to allow weevils to crawl up the outer surface (attach burlap, ground cloth, or some other material, to the outside of the container)
- Holes large enough (approximately 3 cm) to permit weevil entry in the side of the bucket, cut near the rim
- Sufficient space at the bottom for a liquid mixture that is used to trap and kill the weevils that enter the trap
- Trap lid to prevent contamination of the trap contents
- Trap lid with a loop for hanging the trap in trees

Use the following instructions to set-up the traps:

1. Assign an identification number to each trap.
2. Use a wire to attach the lure to the trap lid, allowing the lure to suspend about one-half inch above the liquid. Replace the lures every 3 months or when the liquid is no longer visible in the lure.
3. Prepare a 50 to 50 solution of propylene glycol and water (anti-freeze/ coolant) and place it in the bottom of the inside of the bucket. Enough water and propylene glycol should be added to cover 75 percent of the food bait. The solution will extend the life of the food baits, as well as decrease the rate of evaporation. Replace the food baits every 4 to 6 weeks.
4. Add food baits to the trap liquid to greatly increase the attractiveness of the trap. Food baits can include sugarcane, apples, palm stems (chopped into 3 to 4 cm pieces) or 10 percent molasses containing 1 teaspoon of bakers yeast. Food baits should be replaced every 2 to 3 weeks.
5. Service the trap at least once each week.
6. Keep a record of the dates on which lures, liquids, or foods, were replaced; or, when data was collected.

In the past, the pesticides Lannate, Furadan, or Sevin were often added to the liquid in the bottom of the trap. It is not known whether pesticides can continue to be used in traps in this manner. If so, the inclusion of pesticides in traps will likely depend on the environment in which the traps are located. Surveyors should check with the National Program Manager, or FIFRA Coordinator, for further guidance. For contact information see ***Resources*** on **page A-1**.

Servicing Traps—The number of weevils captured should be recorded each week. Replace the lures every 3 months or when the liquid is no longer visible in the lure. Replace the food baits every 2 to 3 weeks unless antifreeze solution is used. If antifreeze solution is added to the liquid, food baits should remain attractive to the weevils for 4 to 6 weeks, at which time they should be replaced. If a longer interval between servicing is required, make sure sufficient trap liquid is present so that the traps always contain several inches of liquid.

Red palm weevils can easily fly or walk out of a dry trap, resulting in errors in data. Make sure sufficient liquid is present so that the traps always contain several inches of liquid.

Red palm weevils can infest host trees located near the trap. Carefully monitor the host trees for signs of damage and immediately control any infestations.

Trap Placement

Hang the traps from trees, or place them partially buried next to host trees. Traps buried next to host palm trees were found to capture more beetles than those placed in trees. Buried traps should be placed so that the entry holes are near ground level to allow weevils to easily crawl inside, as in ***Figure C-8***, ***Figure C-9***, and ***Figure C-10*** **on page C-6**. Traps placed in shade retain the trap liquid longer.

When deciding whether to hang or bury traps, consider the environment in which it will be used. In public areas, traps should be suspended from trees or poles out of the reach of curious people and pets. Consider also that adults attracted to the pheromone trap will likely attack the palm if it is a host plant. Carefully monitor host palms for signs of damage and immediately treat or remove an infested palm.

Traps can be placed in sections of hollowed out palm, however there is a risk that the dead palm material may carry pests. The traps can be placed on a grid, but it is more appropriate to place them near host material, and palms in urban settings tend to be planted in long rows. Traps should be located 1 km apart to monitor for weevils in an area (Oehlschlager 1994).

Odors and Sounds

Pest surveyors outside the United States sometimes use olfactory and acoustic clues to find the red palm weevil. These techniques can be evaluated if the red palm weevil is detected within the States. Damaged palms and fronds emit a fermented odor particularly around tunnel openings and other damaged areas (Abraham et al. 1998). Dogs have been trained to detect the odor of red palm weevils in palm in the field (Nakash et al. 2000), but the training must be reinforced regularly. Training requires a supply of palm that is infested with red palm weevils. When scientists are able to identify the chemical signature, a synthetic version of the odor could be manufactured to aid in the training.

The gnawing sound due to feeding by grubs also has been used to detect infested palms (Abraham et al. 1998, Soroker et al. 2004, Hamad Saad Al-Saad and Mahdi 2004, Mankin et al. 2008). The sounds can be detected by trained individuals using endoscopes and acoustic devices to amplify RPW larval sounds inside tree trunks. This technique could replace inspection for visible symptoms, which normally appear in the tree only following severe infestations when it is too late to prevent the spread of the problem. However,

detection by the human ear is often hampered by extraneous sounds such as those emitted by other tree inhabitants and by external sounds which interfere with determination of larval presence.

Recent advances using software to select frequencies specific to red palm weevil have shown promising results in the laboratory (Pinhas et al. 2008) and the field (Siriwardena et al. 2010). The acoustic device consists of a sensor to acquire the sound signals from an infested palm; a signal processing unit to capture and amplify the sound acquired by the sensor while filtering out the environmental noise; and an output device that allows the user to determine whether the palm is infested. In field trials on coconut the unit detected infested palms with over 97 percent accuracy, while the probability of **not** detecting unifested palms was over 92 percent in the field (Siriwardena et al. 2010).

Although the components for this detection system are commercially available, the system needs to be assembled and the signal-processing units programmed to red palm weevil specific activity. It is not known if the sound signals produced by red palm weevil larvae vary depending on the palm host.

Processing Samples

This section contains instructions for preparing and shipping insect and plant specimens.

Preparing Samples

Live adult red palm weevils can easily chew through plastic bags and paper. Living specimens cannot be shipped by the U. S. Postal Service.

Alcohol can dissolve and remove permanent marker ink. Make sure the vials are tightly sealed and use pencil to write information on sample labels to avoid the loss of important information.

Table 4-1 Preparation of Samples

If this stage is found:	Then:	And
Larvae	Continue sampling to locate an adult. This weevil must be identified in the adult stage.	Label samples with any trap identification codes and the necessary collection and contact information
Pupae	Carefully remove the pupae from the frond without damaging them. Gently wrap the live pupae in paper towels, place them in a screw cap vile, and send them overnight to your designated identifier. The live pupae will be held until adults emerge, or else they will be dissected.	Label samples with any trap identification codes and the necessary collection and contact information
Adults	Place adults in vials containing 70 percent ethyl alcohol	Label samples with any trap identification codes and the necessary collection and contact information

Shipping Samples

Call the laboratory prior to shipping the samples via overnight delivery service. Instructions and contact information are located in ***Submitting Survey Samples to Domestic and Other Identifiers*** on **page D-1** and ***Taxonomic Support for Surveys*** on **page F-1**.

Data Collection

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

Data collected during surveys should include the following:

- Date of trap service
- Trap identification number from predetermined numbering system
- Collector's name and affiliation
- Full name of business, institution, or agency
- Full mailing address including county
- Type of property (commercial nursery, hotel, residence)
- GPS coordinates of the host plant and property
- Host species and variety
- Date of lure replacement
- Date of trap liquid replacement
- General conditions or any other relevant information
- Positive or negative results from specimen collection

Cooperation With Other Surveys

Surveyors that are regularly sent to the field should be trained to recognize the red palm weevil and its visual symptoms.

5

Red Palm Weevil

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 red palm weevil, *Rhynchophorus ferrugineus* (RPW).

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, ensure that proper sanitation procedures are followed as outlined in ***Survey Procedures*** on **page 4-1** .

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

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 government and Tribal government. 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 RPW host plants.

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 is 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 Emergency Action Notification (***PPQ 523 Emergency Action Notification*** on **page B-7**) 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 (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.

Regulated Area Requirements Under Regulatory Control

Depending upon decisions made by Federal and State regulatory officials in consultation with the RPW 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 RPW 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 EANs 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 other chemical or procedure for regulatory purposes. No chemical can be recommended that is not specifically labeled for red palm weevil.

6 Control Procedures

Red Palm Weevil

Contents

Introduction

Use *Chapter 6 Control* as a guide to control the red palm weevil, *Rhynchophorus ferrugineus* (RPW).

Overview of Emergency Programs

Plant Protection and Quarantine develops and makes control measures available to involved States. Environmental Protection Agency (EPA)-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 U.S. or to obtain labeling for a new use-site. The PPQ FIFRA Coordinator is available for guidance pertaining to pesticide use and registration.

Treatment Options

Because the red palm weevil is a concealed tissue borer and difficult to eradicate, early detection is essential for an effective eradication or management program. If a population of red palm weevil becomes established, efforts must be put into an integrated pest management (IPM) system.

Consider the treatment options described within this chapter when taking action to eradicate, contain, or suppress the red palm weevil. A review of the current literature has yielded many promising tools. When this guideline was written, red palm weevil was not present within the United States.

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 can include any combination of the following options:

- ***Sanitation*** on **page 6-4**
- ***Insecticides*** on **page 6-5**
- ***Mass Trapping*** on **page 6-7**
- ***Biological Control*** on **page 6-8**
- ***Other Cultural Controls*** on **page 6-10**

Eradication

Eradication, the elimination of a pest from an area through phytosanitary measures, is the first priority to consider with the introduction of a new pest. Eradication is feasible when the following conditions exist:

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

Suppression

Pest management includes steps taken to either contain or suppress a pest population. Red palm weevil is most effectively managed with the cultural controls described in this chapter:

- ***Mass Trapping*** on **page 6-7**
- ***Biological Control*** on **page 6-8**
- ***Other Cultural Controls*** on **page 6-10**

Treatment Area

At the time of writing, there was no research to define the treatment area for the red palm weevil.

Sanitation

Carry out sanitation in nurseries, gardens, landscapes, and other establishments where hosts are present within the core and buffer areas. Depending on the circumstances and equipment available, use the following techniques:

- Cut into small pieces and burn
- Prune foliage 120 cm from base
- Treat injuries with an insecticide
- Encourage ground covers
- Treat for any diseases

Burning

Destroy palms at the first sign of larval weevil infestations by cutting down, shredding into small pieces, and burning, all infested palms. This practice will prevent larvae from hatching and reinfesting an area (Alhudaib 2009b; Giblin-Davis 2001). Burning the top of the tree alone does not kill the stages in the middle of the trunk, so heavily infested trees should be uprooted, split open to expose the different stages of the pest inside, and burned (Alhudaib 2009b; Soroker et al. 2005).

Pruning

When green leaves are trimmed, they should be cut 120 cm from the base (Alhudaib 2009b).

Treating Palm Injuries

All injuries to palms must be treated immediately with an insecticide because female weevils will lay eggs in any opening (Alhudaib 2009b). If sealant is available, wounds should be quickly covered to stop the release of kairomones, which attract the weevils.

Encouraging Ground Covers

Encourage ground covers around areas with high palm populations because this promotes higher levels of natural enemies and fewer pest problems (Murphy and Briscoe 1999).

Treating Diseases

Any palms infested with leaf or bud rot should first be treated with fungicide and then treated with insecticide because they are more attractive to weevils for laying their eggs (Alhudaib 2009b).

Insecticides

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.

Options for insecticide applications to control the red palm weevil include the following:

- Dust the leaf axils after pruning (Murphy and Briscoe 1999)
- Seal slow-release aluminum phosphide tablets inside the tree (El Ezaby et al. 1998; Kaakeh 2006; Murphy and Briscoe 1999)
- Spray or soak the tree trunk (Giblin-Davis 2001; Murphy and Briscoe 1999)
- Inject directly into the trunk (Kaakeh 2006; Murphy and Briscoe 1999)
- Apply systemic insecticide through irrigation water (Kaakeh 2006)

All cuts and injuries must be treated immediately with insecticides (Alhudaib 2009b). For further information see ***Treating Palm Injuries*** on **page 6-4**.

After detection of RPW, insecticides should be used even in areas that do not show signs of infestation. For these prophylactic treatments, spraying should be done during times when weevils disperse using a foliar insecticide (Faleiro, 2006).

Insecticides that are currently used to control red palm weevil include carbaryl, chlorpyrifos, diazinon, endosulfan, fipronil, imidacloprid or malathion (***Table 6-1*** **on page 6-6**). Pesticide applications should be repeated to avoid an increase in RPW population density (Conti et al. 2008).

Systemic insecticides such as imidacloprid are favored over organophosphate and carbamate insecticides for control of the red palm weevil (Kaakeh 2006). Imidacloprid can be applied through soil-drench irrigation (Kaakeh 2006) and can be detected for up to 4 months in the foliage (Dembilio et al. 2009b).

Kaakeh (2006) tested the efficacy of a commercial formulation of imidacloprid (Confidor® SL) in both field and semi-field conditions. Soroker et al. (2005) carried out an intensive and effective pesticide spray program in Israel from May 2000 through August 2002 as both preventive and curative treatments.

Prophylactic methods included trunk sprays of azinphos-methyl, diazinon, or chlorpyriphos, and curative methods for RPW-infested trees included stem infusion with dichlorvos, or soil application of imidacloprid (Soroker et al. 2005).

An integrated pest management program was started in 1990 in the United Arab Emirates where one of the following insecticides was used on over 10,000 date palms: carbosulfan 25 percent EC, primiphos ethyl 50 percent EC, or dimethoate 41 percent + phenthoate 11 percent EC (El Ezaby et al. 1998). Starting in 1994, the researchers also used endosulfan 40 percent + dimethoate 18 percent EC (El Ezaby et al. 1998).

Table 6-1 Insecticides Registered for use Against Red Palm Weevil on Palms

Acephate (O,S-Dimethyl acetylphosphoramidothioate)	Beevi et al. 2004
Azinphos-methyl (O,O-Dimethyl-S-4-oxo-1,2,3-benzotriazin-3(4 H)-ylmethyl phosphorodithioate	Soroker et al. 2005
Carbaryl (1-naphthyl n-methylcarbamate)	El Ezaby et al. 1998; Murphy and Briscoe 1999
Chlorpyriphos (diethyl O-(3,5,6-trichloro-2-pyridyl)phosphorothioate)	(Abraham et al. 2000; Beevi et al. 2004; Ferry and Gómez 2002; Murphy and Briscoe 1999; Soroker et al. 2005)[1], Giblin-Davis 2001; Murphy and Briscoe 1999
Diazinon (O,O-Diethyl O-(2-isopropyl-6-methyl-4-pyrimidinyl) Phosphorothioate	Ferry and Gómez 2002; Soroker et al. 2005
Endosulfan (1,2,3,4,7,7-Hexachlorobicyclo (2.2.1)Hepten-5,6-Bioxymethylenesulfite)	(Abraham et al. 2000; Murphy and Briscoe 1999)[1], Murphy and Briscoe1999
Imidacloprid (1-((6-chloro-3-pyridinyl)methyl)-4,5-dihydro-N-nitro-1H-imidazol-2-amine)	Beevi et al. 2004; Kaakeh 2006; Soroker et al. 2005
Malathion (Dicarboethoxyethyl O,O-Dimethyl Phosphorodithioate)	El Ezaby et al. 1998
Methidathion (O,O-dimethyl-s-(2-methoxy-1,3,4-thiadiazol-5(4H)-onyl-(4)-methyl)phosphorodithioate)	Abraham et al. 2000; Ferry and Gómez 2002
Dimethoate (O,O-Dimethyl S-(N-Methyl-carbamoylmethyl Dithiophosphate)	El Ezaby et al. 1998; Murphy and Briscoe 1999
Trichlorfon ((1-Hydroxy-2,2,2-trichloroethyl) phosphonic acid, dimethyl ester)	El Ezaby et al. 1998; Murphy and Briscoe 1999

1 Sprayed and soaked on the tree, the absorption of the insecticide by the matted fiber on tree gives protection to the cracks and crevices favored by the red palm weevil for egg laying.

Mass Trapping

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.

The EDP-National Survey Supply Coordinator will arrange for the procurement of all traps and lures. See ***Resources*** on **page A-1** for information on contacting the National Survey Supply Coordinator.

Mass trapping uses a mixture of materials including a trap, food material, and a pheromone; these materials are available to all level of growers. Adult weevils are highly attracted to the combination of aggregation pheromone (such as Ferrugineol) and the volatiles secreted by the palm trees, which can be natural or synthetic (Murphy and Briscoe 1999; Soroker et al. 2005). Food bait should be used along with the synthetic pheromone lure to maintain the overall efficiency of the trapping system (Faleiro and Satarkar 2003). The pheromone-food bait is often supplemented with pesticides to prevent weevils from escaping (Soroker et al. 2005).

Faleiro and Satarkar tested various synthetic pheromone lures and found Pherobank RHFE 400 mg (Plant Research International B.V. The Netherlands) to be the most effective attractant (2003). The traps used in the experiment were standard 5-L capacity bucket traps with four openings and were hung 1 meter from the ground. They included the pheromone lure that hung on the inner side of the bucket lid, 200 g of kairomone-releasing food bait (coconut petiole) mixed with 1 L of water and 10 g of carbofuran granules (3G). All traps were serviced once per week to record the number of weevil captures, and to refresh the food bait and insecticide.

In the past, some pesticides were added to the lure in the trap. It is not known whether pesticides can continue to be used in traps in this manner. If so, the inclusion of pesticides in traps will likely depend on the environment in which the traps are located. Surveyors should check with the National Program Manager, or FIFRA Coordinator, for further guidance. For contact information see ***Resources*** on **page A-1**.

Mass trapping as a part of an integrated pest management program not only reduces the pest population, but also assists in the detection of newly infested trees (Soroker et al. 2005). Additionally, El Ezaby et al. found that when

insecticide spray was used in combination with pheromone traps, there was a 30 percent reduction in the red palm weevil population when compared with insecticide spray alone (1998).

In Al-Hassa, Saudi Arabia, pheromone traps were used for mass trapping red palm weevil from June 1994 through December 1997 (Abraham et al. 2000). The traps consisted of 5l plastic buckets with a synthetic pheromone, a food bait (date palm stem bits and dates), and an insecticide. The synthetic pheromone used was Ferrolure, the commercial formulation of the male-produced aggregation pheromone Ferrugineol (4-Methyl-5 nonanol) (ChemTica International, San José, Costa Rica). The traps were hung 1.5 meters off the ground on old palms at a distance of 100 meters apart. All traps were serviced (cleaned, food/insecticide changed, and weevil captures recorded) once per week.

Mass trapping in Israel from August 1999 through September 2002 consisted of 5,000 traps at a density of 10 traps per ha (Soroker et al. 2005). Traps, which were set on the ground next to trees, were made from 10-L buckets containing the male aggregation pheromone Ferrolure, ethyl acetate, and a fermenting mixture of dates and sugarcane molasses. Traps were checked once per week during high temperatures (April to November) and once per two weeks during cool temperatures (December to March).

Biological Control

Biological control agents are useful for suppressing pest populations, but rarely eradicate them. Even when effective under laboratory conditions, many biological control agents do not provide adequate control of red palm weevil in the field (Abbas et al. 2001; Salama et al. 2004, Faleiro 2006; Gindin et al. 2006; Murphy and Briscoe 1999).

Use ***Table 6-2*** **on page 6-9** as a guide when investigating biological control agents against the red palm weevil. The timing of application is critical for biological control agents to reach the pest when temperatures are optimal and when RPW populations peak. While none of these biological control agents are successfully in use (Alhudaib 2009b), recent studies have found positive results for the control of RPW using entomopathogenic nematodes.

Table 6-2 Biological Control Agents that may be Useful for the Control of Red Palm Weevil[1]

Taxon	Species
Bacteria: Pseudomonadacae	*Pseudomonas aeruginosa*
Bacteria: Flexibacteraceae (Alfazariy et al. 2003; Alfazariy 2004; Salama et al. 2004)	*Bacillus laterosporus*
	Bacillus megaterium
	Bacillus sphaericus
	Bacillus thuringiensis
Fungi	*Beauveria bassiana* (Ghazavi and Avand-Faghih 2002)
	Metarhizium anisopliae
Hymenoptera: Forficulidae	*Chelisoches morio*
Hymenoptera: Scoliidae	*Scolia erratica*
Diptera: Sarcophagidae	*Sarcophaga fuscicauda*
Diptera: Tachinidae	*Paratheresia menezesi*
	Paratheresia rhynchophorae
Mites: Laelapidae	*Hypoaspis* sp.
Mites: Pymotidae	*Tetrapolypus rhynchophori*
Nematodes: Entaphelenchidae	*Praecocilenchus ferruginophorus*
	Praecocilenchus rhaphidophorus
Nematodes: Rhabditidae (Abbas et al. 2001)	*Heterorhapditis* sp.
	Steinernema abbasi
	Steinernema riobravae
	Steinernema feltiae
	Steinernema glaseri
	Steinernema anomali
	Steinernema carpocapsae
Virus	Cytoplasmic polyhedrosis virus

1 Murphy and Briscoe 1999.

An entomopathogenic nematode does not remain outside of palms awaiting hosts, but as the infective third juvenile stage (dauer juvenile or DJ) actually penetrates palm crowns actively searching for and infecting all stages of red palm weevil (Elawad et al. 2007; Llácer et al. 2009). After entering the weevil through an opening (mouth, anus, spiracles), the DJ grows into the parasitic stage.

In the United Arab Emirates, Elawad et al. applied a local nematode isolate *Heterorhabditis indicus* in a suspension to infected date palm trunks and surrounding soil, adjusted to contain 4 million infective dauer juveniles (2007). The first application was at the first peak of the weevil population (mid-March

in Saudi Arabia) and the second application was one month later (mid-April). The researchers found that two successive applications of the nematodes caused a substantial decline in the RPW population.

The nematode *Steinernema carpocapsae*, in the commercial formulation Biorend R®, provided excellent control of all stages of RPW in Spain (Llácer et al. 2009). The product was applied with a manual backpack sprayer to the trunk and base of the fronds on each palm until run-off. Efficacies were about 80 percent for the curative treatment and up to 98 percent for the preventive treatment (Llácer et al. 2009). Because this formulation of *S. carpocapsae* survived in the palm for a minimum of 2 weeks, applications could be repeated every 2 to 3 weeks during critical periods for continuous control of RPW (Llácer et al. 2009).

Dembilio et al. also found *Steinernema carpocapsae* to be highly effective against red palm weevil in the field (2009b). The efficacy of *S. carpocapsae*/ chitosan WG (SteomerBiorend R®) was equivalent to that of the systemic insecticide imidacloprid, and their efficacies did not significantly change when used together (Dembilio et al. 2009b). Imidacloprid was injected into the soil with a probe connected to a high-pressure hydraulic sprayer to a depth of 10-15 cm around the trunk. *Steinernema carpocapsae* was directly sprayed onto the top of the palm stipe with a 18 L manual backpack sprayer. The nematode formulation was slightly more laborious to apply than imidacloprid (Dembilio et al. 2009b).

Other Cultural Controls

Host Resistance

When possible, use resistant palms for new plantings. The California fan palm, *Washingtonia filifera*, which is native to southern California and western Arizona, and the European fan palm *Chamaerops humilis* were found to be resistant to red palm weevil infestation (Dembilio et al., 2009a).

Sterile Insect Technique

When the weevil population is low, the sterile insect technique can be an effective method of pest management, but with higher populations, suppression methods such as pheromone traps and chemical control measures should be used first to reduce the pest population (Krishnakumar and Maheswari 2007).

Exclusion

The movement of palm offshoots from infested areas as planting material has contributed to the spread of the red palm weevil (Alhudaib 2009b, Ferry and Gómez 2002; Giblin-Davis 2001). To prevent the introduction and spread of the weevil, strict quarantines and pest-free planting material are needed.

As an internally feeding pest, symptoms of red palm weevils are not easily seen from the outside of palms; however, larvae create audible sounds while feeding and tunneling. These sounds can be detected in a palm tree with an acoustic device in about 30 seconds with an accuracy of more than 97%, which is faster and more precise than visual inspections (Pinhas et al. 2008; Siriwardena et al. 2010; Soroker et al. 2004). Visible symptoms of RPW damage normally appear when the tree is severely infested, whereas sounding equipment can be used to lead to an earlier detection. This method would improve the detection efficiency of weevils in palm offshoots, thereby slowing the spread of RPW-infested material.

Examples of IPM Programs

Palmetto Weevil in Florida

The palmetto weevil (*Rhynchophorus cruentatus*) is a similar weevil in Florida palms (*Phoenix canariensis*). When the fronds begin to droop and larval frass can be observed in gallery windows in the petioles, the palm should be cut down and removed (Giblin-Davis 2001). When these symptoms are visible, there is an average of over 100 weevil larvae per palm, when only about 20 larvae are needed to cause a lethal infestation (Giblin-Davis 2001). Palms with these symptoms are dying from irreversible damage to their apical meristems; a delay in destroying the palms only allows more time for weevils to emerge and attack nearby palms (Giblin-Davis 2001). For further information concerning this pest refer to ***Similar Species*** on **page 3-1**.

Red Palm Weevil in Saudi Arabia

The program to control the red palm weevil in Saudi Arabia was conducted during the period 1994 to 1997. It emphasized the following components:

1. Weevils are trapped with food-baited pheromone traps.
2. Preventive insecticides are applied to more than 1 million palms using chlorpyrifos, endosulfan, and methidathion.
3. Only pest-free offshoots are transported.
4. Farmers are trained to manage the red palm weevil (Abraham et al. 2000).

Red Palm Weevil in Israel

The following protocol is currently in use in Israel (A. Haberman, personal communication).

1. Trees and offshoots are purchased from reliable sources in order to prevent the introduction of RPW.
2. Traps are routinely set to detect RPW.

If this number of weevils:	Then:	And:	And:
1 or more	Initiate a mass-trapping program in the area	Continue trapping in the area for 2 or 3 years	
3 or more	Initiate treatment in the area	Apply imidacloprid through the irrigation system once every 3 weeks for a total of 4 treatments	Spray the tops of trees with lamda-cyhalothrin or chlorpyrifos

A Geographic Information System (GIS) is used to facilitate the collection and monitoring of infestations and treatments. The methods can be modified to fit specific situations.

7

Red Palm Weevil

Environmental Compliance

Contents

Introduction

Use *Chapter 7 Environmental Compliance* as a guide to environmental regulations pertinent to the red palm weevil, *Rhynchophorus ferrugineus* (RPW).

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. For contact information refer to ***Resources*** on **page A-1**.

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.

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 insure 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. 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 (Finding of No Significant Impact) 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

PPQ requests assistance from Emergency Services 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. For contact information refer to ***Resources*** on **page A-1**.

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

Red Palm Weevil

Pathways

Contents

Introduction

Use *Chapter 8 Pathways* as a source of information on the pathways of introduction of red palm weevil, *Rhynchophorus ferrugineus* (RPW) at U.S. ports. The red palm weevil could potentially enter the continental United States through natural movement, commerce, cut flowers, or planting material.

Natural Movement

Natural spread of the red palm weevil into the continental United States is unlikely. The closest populations of this pest are in Aruba and the Netherlands Antilles, which would require a flight of over 1,100 miles. While red palm weevil flights of greater than 900 miles have been reported (EPPO 2008), the weevil would need to first establish in a closer location such as Central America, and continue multiple flights northward through Mexico and eventually into the United States.

Commerce

The early stages of a red palm weevil infestation are difficult to detect because the larvae feed within the plant; the plant does not show signs of damage during early infestation attack (EPPO 2008). *Agave americana*, *Sabal blackburnia*, *Washingtonia* spp., *Metroxylon sagu*, *Oncosperma horrida*, *O. tigillarium*, *Calamus merillii*, and *Roystonea regia* are known hosts that are permitted to enter the United States as nursery stock if they meet size restrictions, have a phytosanitary certificate, meet possible CITES requirements, and pass inspection at a Plant Inspection Station (PPQ 2010). Other potential host species that are not specifically prohibited could also convey RPW.

While these potential hosts are able to enter the United States, there have been no recorded interceptions of *Rhynchophorus ferrugineus* at U.S. ports-of-entry. There have been five interceptions of unidentified *Rhynchophorus* sp. from baggage and cargo (PestID 2009). Two were from Mexico, one from North Africa, one from Congo, and one from Ecuador. These very few interceptions indicate that the weevils in this genus may move in a limited manner as a hitchhiker.

Cut Flowers

The importation of palm frond greenery as cut flowers is another unlikely pathway for the movement and entry of red palm weevil. Eggs may be deposited in the proximal end of the frond where young larvae feed before moving into the main part of the palm (Faleiro 2006; Salama et al. 2009). Young RPW larvae in cut fronds are unlikely to be able to complete development before the frond dries to an unsuitable level, and are also unlikely to move to find a suitable host due to their limited mobility.

Planting Material

Infested date palm trees and offshoots have allowed this pest to be moved quickly to many places through movement of contaminated articles to uninfected areas (Ferry and Gómez 2002). Originating from southern Asia, the red palm weevil advanced westward to Saudi Arabia and the United Arab Emirates in 1985, then to Oman, to Iran in 1990, to Egypt in 1992, and to Spain

in 1994, to Israel, Jordan, and the Palestinian Authority Territories in 1999 (Ferry and Gómez 2002). The first weevils were introduced into Spain from adult palms imported from Egypt, and the introduction to Egypt was caused by an importation of offshoots from the United Arab Emirates (Ferry and Gómez 2002).

The red palm weevil is most likely to enter the United States through the movement of infested hosts in plants for planting. Movement of infested palm trees has been reported as the pathway for introduction of RPW in several European countries (EPPO 2008; Ferry and Gómez 2002) and Netherlands Antilles (Alhudaib 2010).

Red Palm Weevil

References

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

Publications, Web Sites, and Other

Abbas, M. S. T., S. B. Hanounik, A. S. Shahdad, and S. A. Al-Bagham. 2006. Aggregation pheromone traps, a major component of IPM strategy for the red palm weevil, *Rhynchophorus ferrugineus* in date palms (Coleoptera: Curculionidae). *Journal of Pest Science*, 79:69-73.

Abbas, M. S. T., M. M. E. Saleh, and A. M Akil. 2001. Laboratory and field evaluation of the pathogenicity of entomopathogenic nematodes to the red palm weevil, *Rhynchophorus ferrugineus* (Oliv.) (Coleoptera: Curculionidae). *Journal of Pest Science*, 74: 167-167.

Abraham, V. A., J. R. Faleiro, M. A. Al Shuaibi, and T. P. Kumar. 2000. A strategy to manage red palm weevil *Rhynchophorus ferrugineus* Oliv. on date palm *Phoenix dactylifera* L. – Its successful implementation in Al-Hassa, Kingdom of Saudi Arabia. *Pestology*, 12: 23-30.

Alhudaib, K. A. 2010. First report of RPW in Caribbean. Accessed February 10, 2010. <http://www.redpalmweevil.com/newlook/RPWReport/Caribbean.htm>.

Alhudaib, K. A. 2009. First Report RPW in Caribbean. <http://www.redpalmweevil.com/newlook/RPWReport/Caribbean.htm>.

Alhudaib, K. A. 2009a. First Report RPW in Caribbean. Chemical Control. <http://www.redpalmweevil.com/newlook/RPWReport/Caribbean.htm>.

Alhudaib, K. A. 2009b. First Report RPW in Caribbean. Methods of Control. <http://www.redpalmweevil.com/newlook/RPWReport/Caribbean.htm>.

Baldacchino, A. E. 2007. The red palm weevil- another alien species. in Times of Malta.

Baldacchino, A. E. 2007. The red palm weevil-another alien species. Accessed August 3, 2009. Alternattiva Demokratika. (In: *Times of Malta*. December 12, 2007). <http://www.alternattiva.org.mt/page.asp?p=5189&l=1>.

Beevi, S. N., P. Maheswari, P. Mohan, and A. Paul. 2004. Laboratory screening of newer insecticides against the red palm weevil, *Rhynchophorus ferrugineus* Oliv. *Entomon*., 29: 401-404.

Borchert, D. M. 2009. New Pest Advisory Group Report on *Rhynchophorus ferrugineus* (Olivier): red palm weevil. USDA-APHIS-PPQ-CPSHT-PERAL.

Bozbuga, R., and A. Hazir. 2008. Publishing Ltd. Pests of the palm (*Palmae* sp.) and date palm (*Phoenix dactylifera*) determined in Turkey and evaluation of red palm weevil (*Rhynchophorus ferrugineus* Olivier) (Coleoptera:Curculionidae). *European and Mediterannean Plant Protection Organization Bulletin (EPPO)*, 38:127-130.

Broschat, T. K., and J. H. Crane. 2005. The coconut palm in Florida. University of Florida IFAS Extension. Horticultural Sciences Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida.

Commonwealth Agricultural Bureau International (CABI). 2009. Crop Protection Compendium. Commonwealth Agricultural Bureau International (CABI), Wallingford, UK.

Conti, F., F. Sesto, E. Raciti, V. Tamburino, and S. Longo. 2008. Ecological factors affecting the spread of *Rhynchophorus ferrugineus* (red palm weevil) in Eastern Sicily. *Palms*, 52: 127-132.

Dembilio, O., J. A. Jacas, and E. Llácer. 2009a. Are the palms *Washingtonia filifera* and *Chamaerops humilis* suitable hosts for the red palm weevil, *Rhynchophorus ferrugineus* (Col. Curculionidae)? *Journal of Applied Entomology*, 133: 565–567.

Dembilio, O., E. Llácer, M. del Mar Martínez de Altube, and J. A. Jacas. 2009b. Field efficacy of imidacloprid and *Steinernema carpocapsae* in a chitosan formulation against the red palm weevil *Rhynchophorus ferrugineus* (Coleoptera: Curculionidae) in *Phoenix canariensis*. *Pest Management Science*, 66(4): 365-70. <http:www.interscience.wiley.com>.

El Ezaby, F., O. Khalifa, and A. El Assal. 1998. Integrated pest management for the control of red palm weevil *Rhychophorus ferrugineus* Oliv. in the United Arab Emirates, Eastern Region, Al Ain. First International Conference on Date Palms. Al-Ain, UAE.

El-Garhy, M. E. 1996. Field evaluation of the aggregation pheromone of *Rhynchophorus ferrugineus* in Egypt. Brighton Crop Protection Conference: Pests and Diseases (3) Proceedings of an International Conference. Brighton, U.K. pp 18-21.

European and Mediterannean Plant Protection Organization (EPPO). 2007. *Rhynchophorus ferrugineus* and *Rhynchophorus palmarum*. *EPPO Bulletin* 37:571-579.

European and Mediterannean Plant Protection Organization (EPPO). 2008. Data sheet on quarantine pests *Rhynchophorus ferrugineus*. *EPPO Bulletin* 38:55-59.

Faleiro, J. R. 2006. A review of the issues and management of the red palm weevil *Rhynchophorus ferrugineus* (Coleoptera: Rhynchophoridae) in coconut and date palm during the last one hundred years. *International Journal of Tropical Insect Science*, 26: 135-154.

Faleiro, J. R., and V. R. Satarkar. 2003.Ferrugineol based pheromone lures for trapping red palm weevil, *Rhynchophorus ferrugineus* Olivier (Coleoptera: Rhynchophoridae) in coconut plantations. *Indian Jouranl of Plant Protection*, 31: 84-87.

Ferry, M. and S. Gómez. 2002. The red palm weevil in the Mediterranean area. *Palms*, 46: 172-178.

Garrett, L. J. 2005. Coconut production in the U.S. and U.S. Territories. Personal communication to K. Colpetzer on May 25, 2005 from Lynn Garrett, APHIS–PPQ–CPHST–PERAL.

Gerling, D. 2010. Personal communication to V. DeFeo on June 22, 2010.

Giblin-Davis, R. M. 2001. Borers of palms. *In:* Howard, F. W., D. Moore, R. M. Giblin-Davis, and R. G. Abad [Eds.] Insects on Palms. CABI Publishing. United Kingdom: Wallingford. pp. 267-305.

Gilman, E.F. and D.G. Watson. 1993. *Cocos nucifera* Coconut Palm Fact Sheet ST-177. November 1993. Environmental Horticulture Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. <http://edis.ifas.ufl.edu>.

Gindin, G. S. Levski, I. Glazer, and V. Soroker. 2006. Evaluation of the entomopathogenic fungi *Metarhizium anisopliae* and *Beauveria bassiana* against the red palm weevil *Rhynchophorus ferrugineus*. *Phytoparasitica*, 34: 370-379.

Haberman, Ami. 2010. Control of red palm weevil in Israel. Personal communication to Valerie DeFeo on April 1, 2010 from A. Haberman, State of Israel, Ministry of Agriculture and Rural Development, Plant Protection and Inspection Services.

Hallett, R. H., B. J. Crespi, J. H. Borden. 2004. Synonymy of *Rhynchophorus ferrugineus* (Olivier), 1790 and *R. vulneratus* (Panzer), 1798 (Coleoptera, Curculionidae, Rhynchophorinae). *Journal of Natural History,* 38(22): 2863-2882.

Malumphy, C., and Moran, H. 2007. Red palm weevil *Rhynchophorus ferrugineus*. *Plant Pest Notice, Central Science Laboratory,* (50): 1–3.

Kaakeh, W. 2006. Toxicity of imidacloprid to developmental stages of *Rhynchoporus ferrugineus* (Curculionidae: Coleoptera): Laboratory and field tests. Crop Protection, (25)5:432-439.

Krishnakumar, R. and P. Maheswari. 2007. Assessment of the sterile insect technique to manage red palm weevil *Rhynchophorus ferrugineus* in coconut. *In:* Vreysen, M. J. B., A. S. Robinson and J. Hendrichs [Eds.]. Area-wide Control Of Insect Pests. Netherlands: Springer. pp. 475-485.

Llácer, E., M. M. Martínez de Altube, and J. A. Jacas. 2009. Evaluation of the efficacy of *Steinernema carpocapsae* in a chitosan formulation against the red palm weevil, *Rhynchophorus ferrugineus,* in *Phoenix canariensis*. *BioControl*, 54: 559-565.

Mankin, R.W., Mizrach, A., Hetzroni, A., Levsky, S., Nakache, Y., Soroker, V. 2008. Temporal and spectral features of sounds of wood-boring beetle larvae: identifiable patterns of activity enable improved discrimination from background noise. *Florida Entomologist*, 91:241-248.

Murphy, S. T., and B. R. Briscoe. 1999. The red palm weevil as an alien invasive: biology and the prospects for biological control as a component of IPM. *Biocontrol News and Information*, 20(1):34n-46n.

National Agricultural Statistics Service (NASS). 2007a. Census of Agriculture United States Summary and State Data. 1 (Part 51).

NASS. 2007b. Nursery Crops 2006 Summary. U.S. Department of Agriculture. Sp Cr 6-0 (07):63.

NASS. 2007c. Puerto Rico Island and Municipio Data Census of Agriculture. U.S. Department of Agriculture.

Pelikh, K. 2009. First report of RPW in Republic of Georgia. Red Palm Weevil Website. <http://www.redpalmweevil.com/newlook/RPWReport/Georgia.html>.

PestID. 2010. Pest Identification Database (PestID). United States Department of Agriculture–Animal and Plant Health Inspection Service–Plant Protection and Quarantine–PERAL (USDA–APHIS–PPQ. Archived at PERAL. <https://mokcs14.aphis.usda.gov/aqas/login.jsp>.

Pinhas, J., V. Soroker, A. Hetzroni, A. Mizrach, M. Teicher, and J. Goldberger. 2008. Automatic acoustic detection of the red palm weevil. *Computers and Electronics in Agriculture*, 63: 131-139.

Plant Protection and Quarantine (PPQ). 2010. *Nursery Stock Restrictions*. United States Department of Agriculture–Animal and Plant Health Inspection Service–Plant Protection and Quarantine (USDA–APHIS–PPQ). 626 pp. <http://www.aphis.usda.gov/import_export/plants/manuals/ports/downloads/nursery_stock.pdf>.

Rahalkar, G. W., M. R. Harwalkar, and H. D. Rananvare. 1972. Development of red palm weevil, *Rhynchophorus ferrugineus* Oliv. on sugarcane. *Indian Journal of Entomology,* 34: 213-215.

Salama, H. S., F. N. Zaki, and A. S. Abdel-Razek. 2009. Ecological and biological studies on the red palm weevil *Rhynchophorus ferrugineus* (Oliver). *Archives of Phytopathology and Plant Protection*, 42(4): 392-399.

Siriwardena, K. A. P., L. C. P. Fernando, N. Nanayakkara, K. F. G. Perera, A. D. N. T. Kumara, and T. Nanayakkara. 2010. Portable acoustic device for detection of coconut palms infested by *Rhynchophorus ferrugineus* (Coleoptera: Curculionidae). *Crop Protection*, 29: 25-29.

Soroker, V., Y. Nakache, U. Landau, A. Mizrach, A. Hetzroni, and D. Gerling. 2004. Utilization of sounding methodology to detect infestation by *Rhynchophorus ferrugineus* on palm offshoots. *Phytoparasitica,* 32: 6-8.

Soroker, V., D. Blumberg, A. Haberman, M. Hamburger-Rishard, S. Reneh, S. Talebaev, L. Anshelevich, and A. R. Harari. 2005. Current status of red palm weevil in date palm plantations in Israel. *Phytoparasitica*, 33: 97-106.

U.S. Fish and Wildlife Service. 2009. Threatened and endangered species system (TESS). Archived at PERAL. <http://ecos.fws.gov/tess_public/> .

Red Palm Weevil

Glossary

Use the *Glossary* to find the meaning of specialized words, abbreviations, acronyms, and terms used by USDA–APHIS–PPQ–Emergency and Domestic Programs. To locate where in the guidelines a given definition, term, or abbreviation is mentioned, refer to the Index.

Definitions, Terms, and Abbreviations

°C. degree Celsius
CAPS. Cooperative Agricultural Pest Survey
delimiting survey. survey conducted after the initial first detection in an area to define the geographic range of the infection/infestation
EC. emulsifiable concentrate
EPPO. European and Mediterranean Plant Protection Organization
evaluation survey. survey conducted at a site where a disease was found and where an eradication program is being performed; also known as monitoring survey
°F. degree Fahrenheit
FONSI. Finding of No Significant Impact
general detection survey. survey conducted over a large area to discover new potential infestations/infections in areas where the pest/disease is not known to occur.
GIS. geographic information systems, a computer system capable of capturing, storing, analyzing, and displaying geographically referenced information
GPS. global positioning system, a radio navigation system
host. plant which is invaded by a parasite or pathogen and from which it obtains its nutrients
hot zone survey. choosing an area, usually residential, on which to concentrate surveys based on known pathway information with ZIP Code-based demographic information or other scientific information; also known as targeted survey or demographic survey
ICS. Incident Command System; expandable and contractible system to manage emergencies, based on the U.S. Forest Service's Forest Fire Management System
identification authority. authority to confirm the presence of a particular pest contractible issued by the APHIS–National Identification Services to diagnosticians that have demonstrated proficiency in identifying
IPM. integrated pest management
monitoring survey. survey conducted at a site where a disease was found and where an eradication program is being performed; also known as evaluation

survey
NASS. USDA–National Agricultural Statistics Service
parthenogenesis. development of an unfertilized egg into an adult female; asexual reproduction; occurs in many different types of invertebrate animals
PASS. potentially actionable suspect sample; a presumptive positive sample diagnosed or identified by provisionally approved laboratory or diagnostician with identification authority that would require confirmatory testing by an official APHIS laboratory due to the nature of the plant sampled and the necessity for Federal confirmation
pathogen. any organism that can incite a disease
SL. soluble concentrate
suspect positive. result that may require confirmatory testing if the sample is a PASS sample
symptom. external and internal reactions or alterations of a plant as the result of a disease
targeted survey. choosing an area, usually residential, on which to concentrate surveys based on known pathway information with ZIP Code-based demographic information or other scientific information; also known as hot zone survey or demographic survey
traceback. investigation of the origin of infested plants from initial detection location back through intermediate steps in commercial distribution channels to the origin
trace-forward. investigation to determine where infected plants may have been distributed from a known infestation through steps in commercial distribution channels or wholesale or retail procurement
UAE. United Arab Emirates

A

Red Palm Weevil

Resources

Use *Appendix A Resources* to find the contacts mentioned in the guidelines. To locate where in the guidelines a product was mentioned, refer to the Index. To learn how to procure survey supplies, contact the National Survey Supply Coordinator.

Table A-1 Red Palm Weevil Resources

Function	Contact Information
National Survey Supply Coordinator	USDA–APHIS–PPQ–Emergency and Domestic Programs 4700 River Road Riverdale, MD 20737 Telephone: (301) 734-4372
PPQ FIFRA Coordinator	USDA–APHIS–PPQ–Emergency and Domestic Programs 4700 River Road Riverdale, MD 20737 Telephone: (301) 734-5861
Environmental Compliance Coordinator	USDA–APHIS–PPQ–Emergency and Domestic Programs 4700 River Road Riverdale, MD 20737 Telephone: (301) 734-7175

B

Red Palm Weevil

Forms

Contents

Introduction

Use *Appendix B Forms* to locate the forms mentioned in the chapters of the guidelines. The forms purpose, and instructions for completing and distributing the forms, are located on the pages following the image of each form.

Appendix B contains images of forms that PPQ staff will use when responding to a plant health emergency. The forms are also available as electronic documents online.

If you need electronic versions of forms from this source:	Then go to this Web site:
APHIS or PPQ	http://www.aphis.usda.gov/library/forms/

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-2 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-3 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-5**. 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-4 Example of PPQ 523, Emergency Action Notification

Purpose

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

The EAN may also be issued to hold plant material in fields pending positive identification of suspect samples. When a decision to destroy plants is made, or in the case of submitted samples, once positive confirmation is received, the same EAN which placed plants on hold also is used to document any actions taken, such as destruction and disinfection. 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-9** 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

Red Palm Weevil

Images

Figure C-1 Palmetto Weevil Adult [Reproduced by permission of Joshua S. Rose. April 24, 2008. Hidalgo County, Texas. Texas Parks and Wildlife. <http: www.texasento.net/Rhynchophorus.htm>]

Figure C-2 Red Palm Weevil Larva [Reproduced by permission of Jimmy Smith, http:www.flickr.co]

Figure C-3 Red Palm Weevil Pupae [Courtesy of Amy Roda]

Figure C-4 Red Palm Weevil Adult [Courtesy of Amy Roda]

Figure C-5 Palm Frond Infested with Red Palm Weevil [Courtesy of Amy Roda]

Figure C-6 Red Palm Weevil Damage to Date Palm [Courtesy of Amy Roda]

Figure C-7 Yellow Bucket Trap (10 to 12 L) With Entry Holes in the Side and on Top [Reproduced by permission of ChemTica International http://www.chemtica.com/)

Figure C-8 Adult Red Palm Weevil Near Entrance to White Bucket Trap with Rough Outer Surface and Partially Buried in Soil [Reproduced by permission of ChemTica International http://www.chemtica.com/]

Figure C-9 Placement of Red Palm Weevil Traps on Soil Surface (left) and Buried (right) [Reproduced by permission of ChemTica International http://www.chemtica.com/]

Figure C-10 Homemade Red Palm Weevil Trap Covered with Burlap [Courtesy of Amy Roda]

Figure C-11 Homemade Bucket Trap for Red Palm Weevil [Courtesy of Amy Roda]

Figure C-12 Lid of Homemade Bucket Trap for Red Palm Weevil with Hanging Lure [Courtesy of Amy Roda]

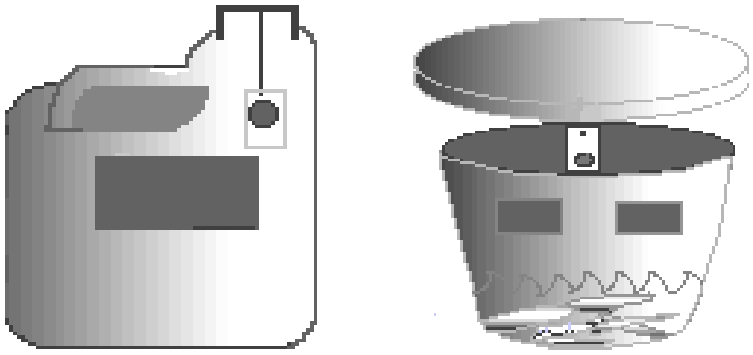

Figure C-13 Schematic Drawings of Traps for Red Palm Weevil Adults, with Lures attached Inside the Lids [Reproduced by permission of ChemTica International http://www.chemtica.com/)

D

Red Palm Weevil

Rhynchophorus ferrugineus and *Rhynchophorus palmarum* Diagnostics

European and Mediterranean Plant Protection Organization
Organisation Européenne et Méditerranéenne pour la Protection des Plantes

PM 7/83 (1)

Diagnostics
Diagnostic

Rhynchophorus ferrugineus and *Rhynchophorus palmarum*

Specific scope

This standard describes a diagnostic protocol for *Rhynchophorus ferrugineus* and *Rhynchophorus palmarum*.

Specific approval and amendment

Approved in 2007/09.

Introduction

The genus *Rhynchophorus* currently contains nine species, of which six are known to attack palms. Two species, *R. ferrugineus* and *R. palmarum* are EPPO listed pests, with *R. palmarum* on the A1 list and *R. ferrugineus* on the A2 list.

Rhynchophorus ferrugineus is essentially a pest of palms. The known hosts include *Areca catechu*, *Arenga pinnata*, *Borassus flabellifer*, *Caryota maxima*, *C. cumingii*, *Cocos nucifera*, *Corypha gebanga*, *C. elata*, *Elaeis guineensis*, *Livistona decipiens*, *L. chinensis*, *L. subglobosa*, *Metroxylon sagu*, *Oneosperma horrida*, *O. tigillaria*, *Oreodoxa regia*, *Phoenix canariensis*, *P. dactylifera*, *P. sylvestris*, *Sabal umbraculifera*, *Trachycarpus fortunei* and *Washingtonia* sp. *R. ferrugineus* has also been found on rattan (specifically, *Calamus merillii*) in the Philippines (Braza, 1988) and is reported to attack *Agave americana* and *Saccharum officinarum* (Esteban-Duran *et al.*, 1998).

Rhynchophorus palmarum is common in Neotropical virgin forests and in agroecosystems exploiting oil palms, and has been reported on 35 plant species in 12 different families. It is, however, found predominantly on Arecaceae, the main hosts being, *Cocos nucifera*, *Elaeis guineensis*, *Euterpe edulis*, *Metroxylon sagu*, *Phoenix canariensis*, *Phoenix dactylifera*, and sugarcane *Saccharum officinarum*. Although only reported as a pest on palms and sugarcane (Arango & Rizo, 1977; Restrepo *et al.*, 1982), the adults also feed on ripe fruits of plants such as *Ananas comosus*, *Annona reticulata*, *Artocarpus altilis*, *Carica papaya*, *Citrus* spp., *Mangifera indica*, *Musa* spp., *Persea Americana*, *Psidium guajava* and *Theobroma cacao*, but without causing economic damage (OEPP/EPPO, 2005).

In the EPPO region, *R. ferrugineus* is present in Cyprus, Greece, Egypt, France, Israel, Italy, Jordan, Spain and Turkey. It is possible that it could establish across the Mediterranean part of the EPPO region.

Further information on the biology and ecology of the species can be found in Martin Monina & Cabello Garcia (2005) and the EPPO data sheets on *R. palmarum* (OEPP/EPPO, 2005) and *R. ferrugineus* (EPPO Website).

Identity

Name: *Rhynchophorus ferrugineus* (Olivier, 1790)
Synonyms: *R. signaticollis*, *R. vulneratus*, *Calandra ferrugineus*, *Curculio ferrugineus*
Taxonomic position: Insecta, Coleoptera, Dryophthoridae, Rhynchophorinae
EPPO computer code: RHYCFE
Phytosanitary categorization: EPPO A2 (339).

Identity

Name: *Rhynchophorus palmarum* (Linnaeus, 1758)
Synonyms: *R. cycadis*, *R. depressus*, *R. longuinossis*, *Calandra palmarum*, *Cordyle barbirostris*, *C. palmarum*, *Curculio palmarum*
Taxonomic position: Insecta, Coleoptera, Dryophthoridae, Rhynchophorinae
EPPO code: RHYCPA
Phytosanitary categorization: EPPO A1 (332).

Detection

Early signs of attack are distinctive but not easily visible: notches at the base of palm leaves with frass, cocoons inserted into the base of the palm leaves, eccentric crown growth, holes at the base of the cut palms and symptoms resembling those of drought stress (wilting, yellowing). Larvae and adults may destroy the interior of the palm tree, without the palm tree showing distinctive signs of deterioration. When attacked, the

Table 1 For identification of the genus *Rhynchophorus* see Arnett *et al.* (2002). Key to the species of Adult ***Rhynchophorus*** (after Wattanapongsiri, 1966) *Rhynchophorus vulneratus* is considered as a colour morph of *R. ferrugineus* (Hallett *et al.*, 2004).

1.	Mandible distally rounded or oval.	**2**
	Mandible distally toothed.	**4**
2.	Nasal plate absent; setae beneath the third tarsal segment covering one-sixth the entire area, pronotum oval posteriorly; gular suture narrowed; tip of rostrum not convex ventrally, slightly compressed or cylindrical, and not convex or oval baso-dorsally; submentum truncate distally.	**3**
	Nasal plate present, distinct rounded; setae beneath the third tarsal segment covering two-thirds the entire area; pronotum almost square and broadly rounded posteriorly; gular suture wide; tip of rostrum strongly convex ventrally, strongly compressed, convex and oval baso-dorsally; submentum oval distally (African).	***quadrangulus***
3.	Front tibia broad, flat, with two broad distal lobes; middle and hind tibia truncate distally; pronotum with sides curved and broadened before constricting anteriorly; rostrum quadrate and slightly compressed, dorsally concave or grooved at apex; submentum truncately concave distally; male rostral setae thick, erect (South American).	***ritcheri***
	Front tibia not flat; middle and hind tibiae not truncate; pronotum with sides straight before contracting anteriorly; rostrum cylindrical, oval or feebly convex at apex; submentum sharply concave distally, mandible broadly oval distally; male rostral setae absent, represented by tubercles dorsally (American).	***cruentatus***
4.	Pronotum produced at base (Fig. 8); pre-gular suture narrowed; ventral space between antennal scrobes narrowed; tip of rostrum dorsally grooved or nearly truncate; interocular space always one-third or less than one-third the width of rostrum at base.	**5**
	Pronotum oval or broadly rounded at base (Fig. 1); pre-gular suture widened; ventral space between antennal scrobes broadened; tip of rostrum not grooved but oval distally; interocular space not less than one-third the width of rostrum at base.	**6**
5.	Mandible deeply tridentate and sharply pointed distally; ventral space between antennal scrobes smooth, without setae; middle and hind tibia with distinct spines at base of uncus; pygidium flat dorsally; setae beneath third tarsal segment almost covering the entire area; submentum tridentate, sharply pointed and curved inwards; antenna small, slender; scutellum sharply pointed posteriorly; body ferrugineus with black patches (Asian).	***distinctus***
	Mandible with two broad lobes (Fig. 13); ventral space between antennal scrobes rugous with several long, slender setae (Fig. 14); middle and hind tibia without distal spines; pygidium convex dorsally; setae beneath third tarsal segment covering one-half the entire area (Fig. 15); submentum oval; antenna thick; scutellum produced posteriorly; body completely black (American).	***palmarum***
6.	Pygidium smooth; beneath third tarsal segment without two rows of lateral setae; interocular space nearly one-third the width of rostrum at base; base of pronotum broadly rounded, usually with two long red stripes extending the entire length; scutellum very narrowly produced posteriorly (African).	***phoenicis***
	Pygidium punctured (Fig. 16); beneath third tarsal segment with two rows of lateral setae (Fig. 17); base of pronotum oval or broadly oval, usually with one broad red or two small, short red stripes, or several spots on pronotum; scutellum somewhat pointed posteriorly.	**7**
7.	Pre-gular suture uniformly broadened to the base, mandible four-dentate; submentum truncate with small triangular median depression confined to the apex; body black, usually with small narrowed, short, red stripes on pronotum (Australasian).	***bilineatus***
	Pre-gular suture with elongate-oval shape before narrowing to the base (Fig. 18); mandible tridentate (Fig. 19); submentum truncately concave with narrowly elongate median depression, extending throughout its length; body black or ferrugineus, usually with a broad red stripe or spots on pronotum (Asian, Australian).	***ferrugineus***

trunk is structurally weakened, making the plant liable to collapse, thus the plant becomes a danger to the public. An attack on *Phoenix* leads, in the majority of the cases, to death of the palm trees whatever the size. Visual examination allows the detection of signs of attack such as notches on the base of palm leaves, frass, cocoons and holes but will not detect larvae and adults inside the trunk stipe. Adult populations can be monitored by pheromone traps, acoustic detection (Soroker *et al.*, 2004) or infra-red systems.

Identification

Morphological identification is the recommended method (see Tables 1 and 2 and Appendix 1), for which. A binocular microscope with × 50 magnification is needed.

Rhynchophorus ferrugineus

Adult male (habitus Figs 1 and 2)

Length: 19 to 42 mm, width 8 to 16 mm. Body elongate-oval, general colour ferruginous to black, legs lighter coloured than body; elytra dark red to black, shiny or dull, slightly pubescent; black spots on pronotum extremely variable.

Head: dull to shiny; smooth to finely punctured; interocular space slightly more than one-half width of rostrum at base.

Antennae: arising laterally from scrobe at base of rostrum; scrobe deep, broad and widely opened ventrally; scape elongate, longer than funicle and club combined or equal to one-half length of rostrum; funicle with 6 segments; antennal club large usually ferruginous or reddish-brown; broadly triangular with several setae dorsally and ventrally; inner side of spongy area with 8 to 15 setae.

Mouthparts: brown, mandible about one-half width of rostrum at base; tridentate distally and all teeth sharply pointed; apical and subapical teeth widely separated; maxillary palpus segments flat-rectangular, palpifer triangular; stipe one-half as long as palpifer; cardo pointed at both ends, sinuated at both sides, more then three times as long as stipes; mala with narrow invagination at inner margin, gradually curved at outer margin.

Rostrum: varying from ferruginous to black; usually ferrugineus; nearly four-fifths length of pronotum in males, in female longer, slender, more cylindrical; in profile straight,

Rhynchophorus ferrugineus ***Rhynchophorus palmarum***

Table 2 Key to known species of ***Rhynchophorus*** and ***Dynamis*** larvae (after Wattanapongsiri, 1966)

1.	Labrum with 10 lateral; setae; epipharyngeal setae 2 thick, distance between setae 2 twice as wide as between setae 1; epipharynx V-shaped; second segment of maxillary palpus with circular sensory spot distally; prothoracic sternum with crescent-shaped opening.	***Dynamis borassi***
	Labrum with 16–30 lateral setae; epipharynx setae 2 simple, slender, distance between setae 2 as wide as or slightly wider than between setae 1; epipharynx not V-shaped; second segment of maxillary palpus with oval sensory spot distally; prothoracic sternum with median depression.	***Rhynchophorus*** **2**
2.	Epipharyngial sensory pores placed closer to epipharyngial setae 2 than 1; labrum with 16–22 lateral setae.	**3**
	Epipharyngial sensory pores placed at or near the mid point between epipharyngial setae 1 and 2; labrum with 24–30 lateral setae.	**4**
3.	Labrum with 16 short lateral setae; distance from sensory pores to epipharyngial setae nearly three times as long as setae 2; eight abdominal tergite without prodorsal setae; epipharynx without enlarged portion lateroanteriorly; mala with bifurcate dorsal setae.	***cruentatus***
	Labrum with 22 long lateral setae; distance from sensory pores to epipharyngial setae 1 less than twice as long as setae 2; eight abdominal tergite with four prodorsal setae; epipharynx with enlarged portion latero-anteriorly; mala with both bifurcate and trifurcate dorsal setae.	***ferrugineus***
4.	Mandible toothed or bilobed; epipharynx broadened anteriorly; mala with 26–27 dorsal setae.	***palmarum***
	Mandible not toothed or lobed; epipharynx narrowed or tapering anteriorly; mala with 18–20 dorsal setae.	**5**
5.	Labrum with 30 lateral setae; mala with 20 dorsal setae; mandible large, very thick and stout; abdominal tergite eight with two prodorsal and two postdorsal setae.	***phoenicis***
	Labrum with 24 dorsal setae; mala with 18 dorsal setae; mandible small, not stout; abdominal tergite eight without prodorsal or postdorsal setae.	***bilineatus***

Fig. 1 *Rhynchophorus ferrugineus* male.

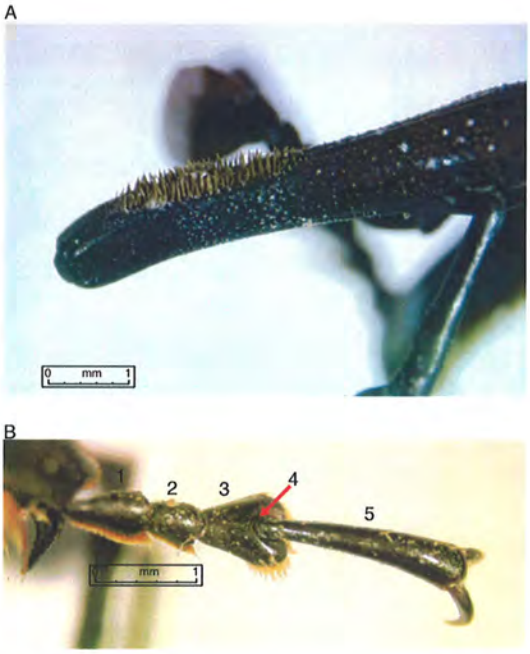

Fig. 2 *Rhynchophorus ferrugineus* male rostrum (A) and pseudotetramerous tarsus (B).

broad at base, smooth to minutely punctured; viewed dorsally with apical or subapical thick, erect, setae; extending more than one-half length of rostrum; rows of tubercles present or not.

Pronotum: with sides gradually curved to apex and abruptly constricted anteriolaterally; slightly pubescent to shiny; posterior margin nearly rounded; colour mostly ferruginous

Rhynchophorus ferrugineus ***Rhynchophorus palmarum***

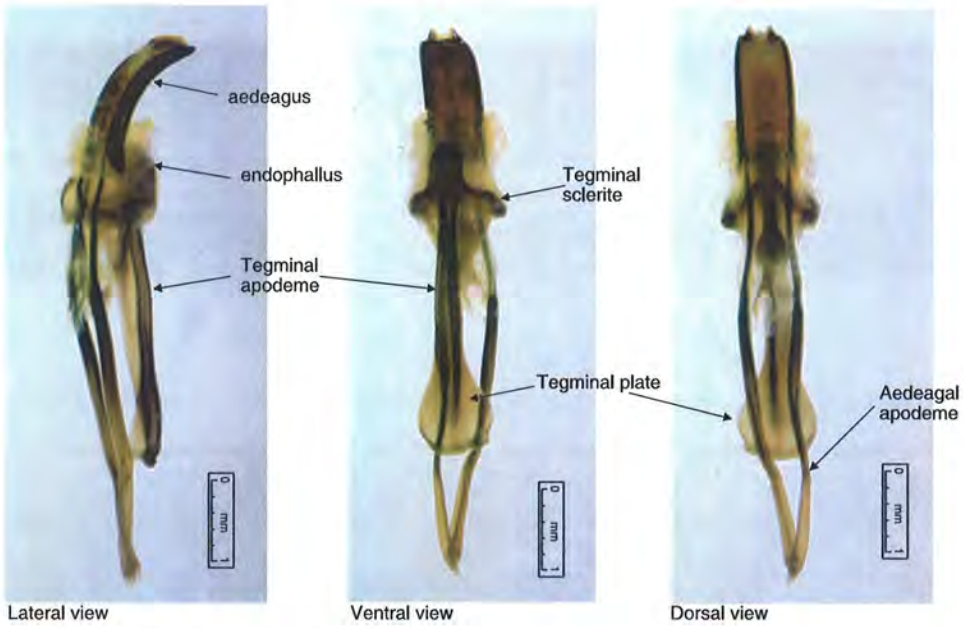

Fig. 3 *Rhynchophorus ferrugineus* male: aedeagus, endophallus and tegmen.

and varying to dark brown and black; underside of pronotum mostly ferrugineus or dark brown, may vary to almost black, very minutely punctured. Scutellum varying from reddish-brown to black; somewhat pointed posteriorly, one-quarter to one fith elytral.

Legs: usually punctured on outer edges of both femur and tibia; front coxa strongly globose, widely separated; middle coxa covered with soft reddish-brown hairs; front femur as long as middle but shorter than hind femur; fore tibia as long as hind and longer than the middle; tarsi pseudotetramerous (see Fig. 2), first tarsal segment twice as long as second and or slightly shorter than third; reddish brown setae beneath third segment; fifth segment as long as first 4 segments combined, with 9 to 12 setae ventrally.

Elytra: smooth or slightly velvety pubescent, nearly rectangular, with punctuation along the outer edges with 5 deep striae and traces of 4 laterally; length of each elytron two and one-third times its own width.

Abdomen: usually ferruginous, but may vary from ferruginous to almost black; first abdominal sternite as long as third and fourth combined but much shorter than second.

Pygidium: varying from ferruginous to nearly black, mostly ferruginous or dark brown, sparsely and minutely punctured posteriorly and dorsolaterally.

Genitalia: illustrated in Fig. 5. For a complete description, see Wattanapongsiri (1966). For preparation see Appendix 1.

Adult female (habitus Figs 3 and 4)

Length 26–40 mm, width 10–16 mm. Very similar to male in body size, colour, markings on pronotum, except rostral setae absent; snout longer, slender and more cylindrical, setae on front femur absent and on front tibia much shorter.

Eggs

Whitish-yellow, smooth, very shiny, cylindrical with rounded ends, slightly narrower at the anterior end, averaging 0.98 by 2.96 mm.

Larvae (Fig. 6)

Piriforme, apodous, colour, creamy white to ivory, cephalic capsule brown russet-red to brilliant brown-black. Body slightly curved. Last instar is 36 to 47 mm in length by 15 to 19 mm in width.

Pupae (Fig. 7): protected in a cocoon made up of vegetable fibres, 4 cm long by 1.6 cm broad.

For a complete description of larvae and pupae, see Wattanapongsiri (1966).

Rhynchophorus palmarum

Adult male (habitus Figs 8 and 9)

Length: 29–44 mm, width 11.5–18 mm. Body elongate-oval, flat dorsally, convex ventrally, deep black; dorsum dull or shiny, except pronotum of some populations with velvety pubescence, venter shiny.

Head: dull to shiny, bulbous, almost rounded, posterior end trilobed, with interocular sulcus; interocular space narrowed about one-fifth the width of rostrum at base; frons finely punctured.

Antennae: arising laterally from scrobe at base of rostrum; scrobe deep, broad and widely opened ventrally; scape elongate,

Rhynchophorus ferrugineus ***Rhynchophorus palmarum***

Fig. 4 *Rhynchophorus ferrugineus* female.

Fig. 5 *Rhynchophorus ferrugineus* female rostrum.

longer than funicle and club combined or equal to one-half length of rostrum; funicle with 6 segments; antennal club large; broadly triangular with several setae dorsally and ventrally; inner side of spongy area with 8 to 10 setae.

Mouthparts: brownish-black and located at apex of rostrum; mandible two-thirds the width of rostrum at base, anteriorly bilobed, teeth deeply divided, basal tooth sometimes slightly depressed; maxilla brown, small, with 3 segmented maxillary palpi; first segment broad, nearly quadrate; second similar and half-size of the first; third truncate basally and oval distally, one-third size of the first; palpifer almost triangular, obtuse distally, truncate basally, with inner margin slightly concave; stipe quadrate, nearly one-half as long as palpifer; cardo elongate somewhat pointed distally, slightly sinuate basally; mala elongate, constricted distally.

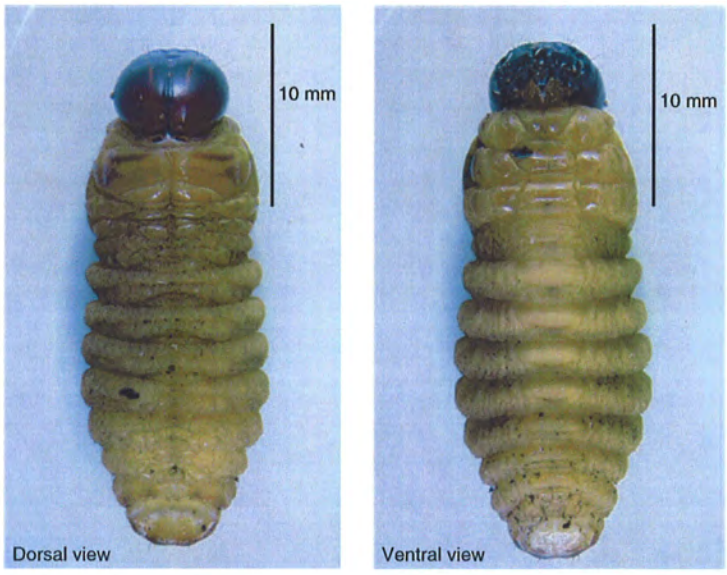

Fig. 6 *Rhynchophorus ferrugineus* larvae.

Rhynchophorus ferrugineus ***Rhynchophorus palmarum***

Fig. 7 *Rhynchophorus ferrugineus* nymph.

Fig. 8 *Rhynchophorus palmarum* male.

Rostrum: stout, shorter than pronotum; in profile, slightly arcuate at apex, broad at base and tapering to apex; apical half on upper surface with thick, erect, fulvous setae, or similar setae extending from anterior of antennal scrobes to apex.

Pronotum: black, longer than wide, flat, opaque, velvety to shiny, narrowed to apex and constricted anteriolaterally, base produced posteriorly, covered with brown setae, beneath the posterior border, bisinuate on either side, with fine raised margin; very finely and diffusely punctured, more strongly at sides and apex, with traces of a median longitudinal carina. In profile, margin convex ventrally; under side completely black, finely punctured punctures being close and rough on mesosternum and anterior parts of matasternum. Prosternum elevated. Scutellum always black, smooth, large, triangular-elongate, produced at apex, about one-fourth the length of elytron, concave anteriorly.

Legs: black with fine punctuation, front coxae separated by a distance equal to one-fourth width of a coxa, bulbous, almost rounded, with scattered fine fulvous hairs and punctuation; middle coxa similar to front coxa but covered with patch of long slender fulvous setae; hind coxa eye-shaped, widely separated. All trochanters triangular, pointed distally; femora flat, broad distally; front femur shorter than hind femur and about as long as middle femur; tibia slightly curved outward and tapering

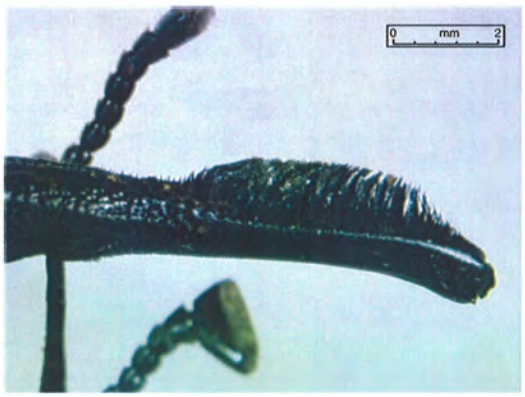

Fig. 9 *Rhynchophorus palmarum* male rostrum.

distally, each with long recurved uncus and a small subuncus about one-fifth the length of uncus; front tibia as long as hind tibia but longer than middle; all tibiae similar in shape; tarsi pseudotetramerous, five-segmented; first segment elongate,

Rhynchophorus ferrugineus ***Rhynchophorus palmarum***

Fig. 10 *Rhynchophorus palmarum* female.

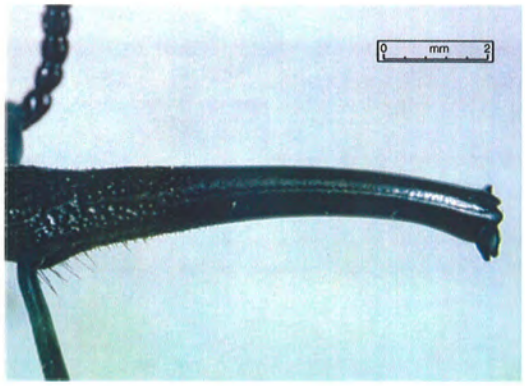

Fig. 11 *Rhynchophorus palmarum* female rostrum.

twice as long as second; third segment dilated, one-half of the entire area beneath covered with matted fulvous setae; fifth segment elongate, as long as the first 4 tarsal segments combined, with more than 10 slender fulvous setae scattered beneath; 2 simple, slender, movable claws. Setae on ventral side of femora, tibiae, and first 3 tarsal segments dark brown. These setae are conspicuous on the legs of the male. Femora with 2 to 3 long dark brown setae proximally; setae on first tibia twice as long as the setae on femora and longer than setae on middle or hind tibia.

Elytra: wider than pronotum, length of each elytron two and one-half times its own width, narrowed posteriorly with side

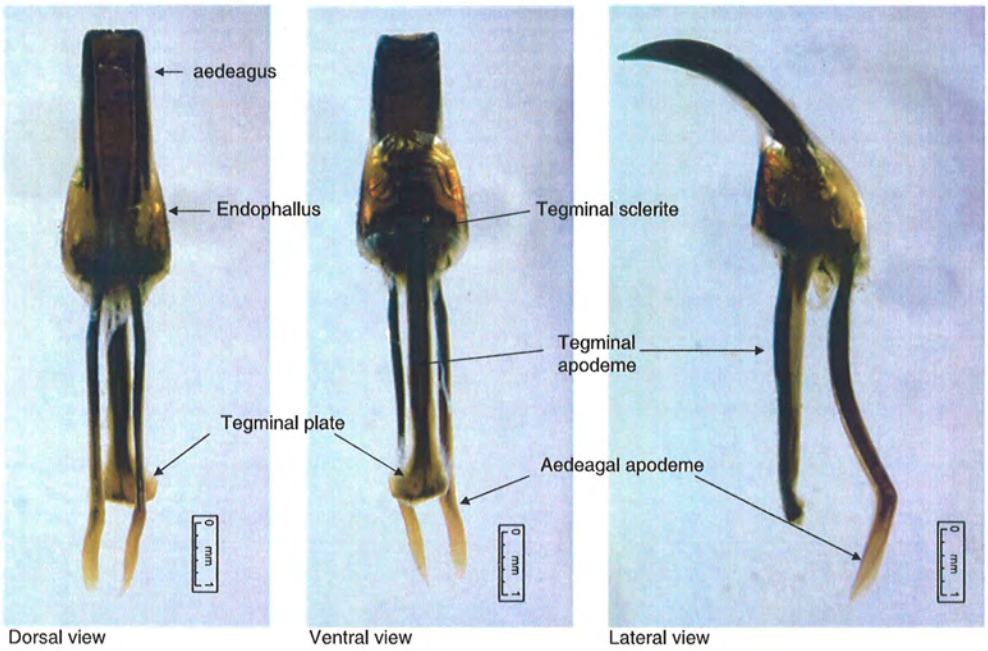

Fig. 12 *Rhynchophous palmarum* male, aedeagus, endophallus and tegmen.

Rhynchophorus ferrugineus ***Rhynchophorus palmarum***

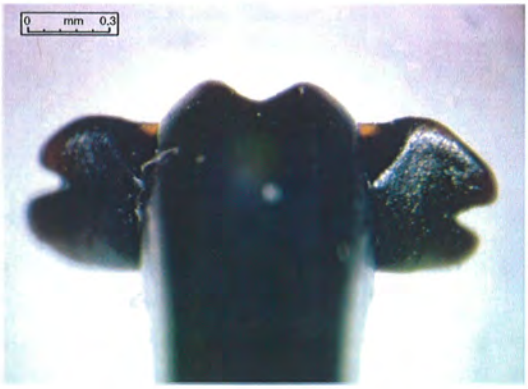

Fig. 13 *Rhynchophorus palmarum* mandible with two broad lobes.

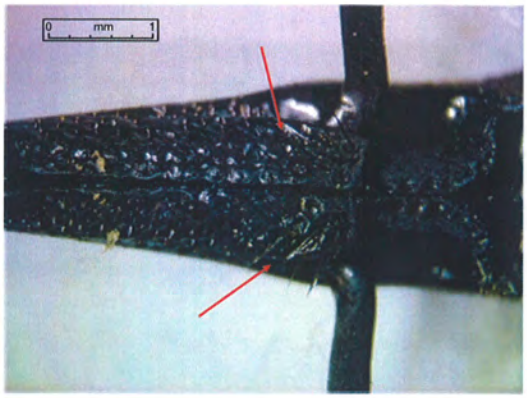

Fig. 14 *Rhynchophorus palmarum* ventral space between antennal scrobes.

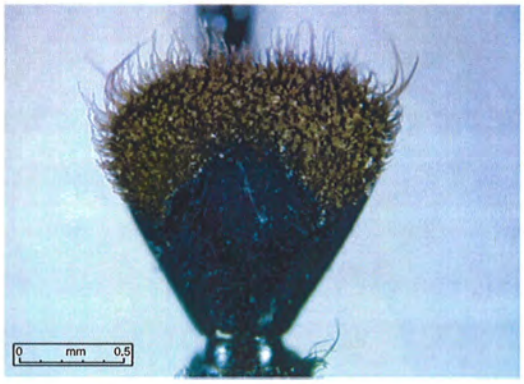

Fig. 15 *Rhynchophorus palmarum* setae beneath third tarsal segment.

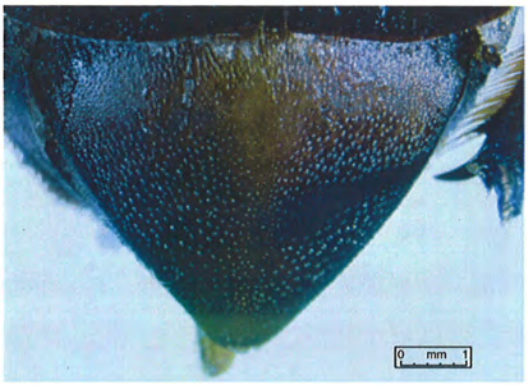

Fig. 16 *Rhynchophorus ferrugineus* pygidium punctuation.

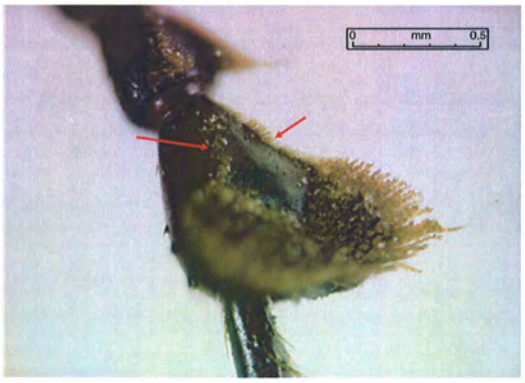

Fig. 17 *Rhynchophorus ferrugineus* third tarsal segment.

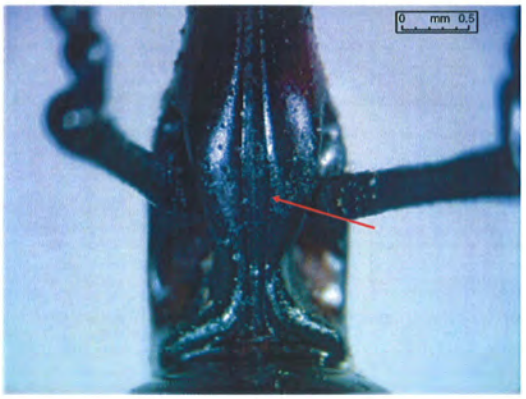

Fig. 18 *Rhynchophorus ferrugineus* pregular suture elongate oval shape.

almost straight, thence more abruptly narrowed, posterior border slightly emarginated. Wing brown, almost hyaline from lower part of median area to anal area; all veins dark brown, heavily sclerotized and thick.

Abdomen: completely black, ventrally convex, with 5 segments, first abdominal sternite shorter and medially fused with second, the latter one and one-third times wider then third and fourth combined; fifth segment broad, almost triangular, fringed with a row of thick, long dark brown setae laterally, and without apical emargination; punctured dorsolaterally.

Rhynchophorus ferrugineus ***Rhynchophorus palmarum***

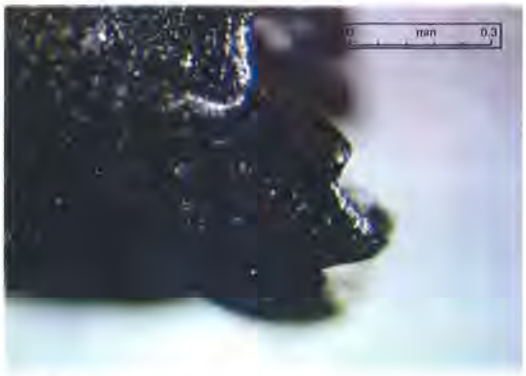

Fig. 19 *Rhynchophorus ferrugineus* mandible tridentate.

Pygidium: black, triangular with central elevation, strongly punctured at base, sides and apex; more diffusely at the middle; edged with lateral fucous setae; pygidium slightly wider than the female.

Genitalia: illustrated in Fig. 12. For a complete description see Wattanapongsiri (1966). For preparation see Appendix 1.

Adult female (habitus Figs 10 and 11)

Length 26 to 42 mm, width 11 to 17 mm. Similar to male except rostrum without setae; more slender and cylindrical, uniformly curved from posterior third to apex, punctuation weaker and less confluent; setae on first femur lacking. Pygidium narrowed and more pointed at apex.

Male genitalia

Prepared male genitalia is represented in Fig. 12. For a complete description, see Wattanapongsiri (1966). For preparation see Appendix 1.

Egg

Yellowish-brown, smooth, shiny, slender, cylindrical with rounded ends; averaging 0.9 by 2.5 mm (small, considering the size of the adult female); chorion very thin and hyaline; vitelline membrane yellowish-brown.

Larvae and pupae

For a complete description of larvae and pupae, see Wattanapongsiri (1966).

Larvae: similar to that of *R. ferrugineus*, body length 44–57 mm, width 22–25 mm. Pupae: light brown similar to that of *R. ferrugineus*, body length 40–51 mm, width 16–20 mm.

Reference material

Not appropriate.

Reporting and documentation

Guidance on reporting and documentation is given in EPPO Standard PM 7/77 (1) *Documentation and reporting on a diagnosis.*

Further information

Further information on these organisms can be obtained from:

J.-F. Germain, LNPV Unité d'entomologie, 2 place Viala, 34060 Montpellier cedex 01 (FR). E-mail: germain@supagro.inra.fr

Acknowledgements

This protocol was originally drafted by J.-F. Germain, LNPV, Montpellier (FR).

References

Arango G & Rizo D (1977) [Some considerations on the behaviour of *Rhynchophorus palmarum* and *Metamasius hemipterus* on sugarcane.] *Revista Colombiana Entomologica* **3**, 23–28 (in Spanish).

Arnett RH, Thomas MC, Skelley PE & Frank JH (2002) *American beetle. Polyphaga: Scarabaeoidea through Curculionoinoidea*, Volume 2. CRC press, Boca Raton, Florida (US).

Braza RD (1988) Asiatic palm weevil destroys rattan too. *Canopy International* **13**, 6.

Esteban-Duran J, Yela JL, Beitia-Crespo F & Jimenez-Aluarez A (1998) Biology of the red palm weevil *Rhynchophorus ferrugineus* (Olivier) in the laboratory and field: life cycle, biological characteristics in its zone of introduction in Spain, biological methods of detection and possible control. *Boletin de Sonidad Vegetal* **24**(4), 737–748.

Hallett RH, Crespi BJ & Borden JH (2004) Synonymy of *Rhynchophorus ferrugineus* (Olivier) 1790 and *R. vulneratus* (Panzer), 1798 (Coleoptera, Curculionidae, Rhynchophorinae). *Journal of Natural History* **38**, 2863–2882.

Martin Monina MM & Cabello Garcia T (2005) *Biology and ecology of the Red Palm Weevil Rhynchophorus ferrugineus (Olivier, 1790) (Coleoptera, Dryophthoridae)*. University of Almeria, Department of Applied Biology (ES) (in Spanish).

OEPP/EPPO (2005) Datasheets on Quarantine pests *Rhynchophorus palmarum*. *Bulletin OEPP/EPPO. Bulletin* **35**, 468–471.

Restrepo L, Rivera F & Dios Raigosa J (1982) [Life cycle, habitats and morphology of *Metamasius hemipterus* Olivier. And *Rhynchophorus palmarum* L. (Coleoptera: Curculionidae) on sugarcane (*Saccharum officinarum* L.). *Acta Agronomica, Palmira* **32**(1/4), 33–44.

Soroker V, Nakache Y, Landau U, Mizrach A, Hetzroni A & Gerling D (2004) Utilization of sounding methodology to detect infestation by *Rhynchophorus ferrugineus* on palm offshoots. *Phytoparasitica* **32**, 6–8.

Wattanapongsiri A (1966) A revision of the genera *Rhynchophorus* and *Dynamis* (Coleoptera: Curculionidae). *Department of Agriculture Science Bulletin*, Vol. 1. Bangkok (TH).

Appendix 1

Preparation of male genitalia for observation under a binocular microscope with × 50 magnification

Remove the terminal third of the abdomen and macerate by warming to dissolve the body contents in a 10% potassium solution for 10–20 min.

When the abdominal sclerites are sufficiently smooth, remove them leaving only the genitalia. Rinse the genitalia in cold distilled water and mount in 70% alcohol or glycerine in a cavity slide and observe.

The genitalia can be retained for future reference by enclosing them in a drop of glycerine in a glass or plastic microvial which is kept with the pinned specimen.

Rhynchophorus ferrugineus ***Rhynchophorus palmarum***

E

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.

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.

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.

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.

F 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 Telephone: (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 F-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	Telephone: (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	Telephone: (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	Telephone: (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	Telephone: (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 Telephone: (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.

Red Palm Weevil

Index

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z