# Palm Commodity-Based Survey Reference


## 2014 Version

**Cover image:** A Manila dwarf coconut palm on the grounds of the Tropical Agriculture Research Station in Mayaguez, Puerto Rico (Scott Bauer, USDA Agricultural Research Service, Bugwood.org).

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September 2013: Posted on CAPS Resource and Collaboration site for review.

June 2014: Updated distribution information for *Ca.* P. palmae subgroup D (added Louisiana) and *Oryctes rhinoceros* (added Hawaii)

# Table of Contents

# How to Use This Manual?

## I: Introduction

The first section of this manual describes the purpose of the Palm Commodity-based Survey. This section provides background information about palms including what is a palm, why palms are important, and where palms are grown in the United States. This section also lists the pest species targeted in this survey and their current distribution within the continental United States and Caribbean and Pacific states and territories.

## Pest Datasheets

Pest datasheets have been developed for each target pest species. Datasheets contain specific information on the biology, ecology, hosts, distribution, survey methods, and identification resources for each pest target. Pest datasheets are linked within this document and are also located as separate links on the CAPS Resource and Collaboration site manuals page under Palm manual (http://caps.ceris.purdue.edu/survey/palm/reference/2014).

**Host information (in all Pest Datasheets)**

In general, host information in pest datasheets is based on host species present in areas where the target is distributed. These hosts may or may not be present in the United States. Therefore, surveys should be broadened to native species within the host genera or family (*i.e.,* if the pest attacks a specific palm species and that host species is not known to occur in the United States or within the survey site(s), broaden the survey to include native species within that genus or related genera).

## II: Planning a Survey

The next section describes how to plan a Palm Commodity-based Survey and includes information on the CAPS-approved survey and identification/diagnostic methods for each of the 12 palm pests. General information is provided on survey sites, survey season, and the five approved traps.

When planning a survey, states should consider a pathway approach when deciding on which palm pests to survey for. Information regarding the hosts and climate of each pest should be considered as well.

## III: Ordering Traps and Lures

This section gives specific information on how to order traps and lures for palm pest surveys.

## IV: Conducting the Survey

This section gives specific information on how to conduct a survey for palm pests. This section lists symptoms and signs to look for when conducting a visual survey. It also provides information on trapping, including trap placement; trap setup; lure handling, changing, and storage; checking traps; and the length of effectiveness for approved lures.

## V: Sample Submission

This section gives specific information on how to submit samples for identification.

# I: Introduction

## Purpose

The purpose of the Palm Commodity-based Survey is to detect new infestations of target palm pest species at low population levels. This document provides standardized guidelines for conducting a palm commodity-based detection survey in the United States and its territories.

## Background

### What is a palm?

Palm refers to plants in the family Arecaceae (Palmae). This family includes mostly tropical or subtropical monocotyledonous trees, shrubs, or vines with usually a simple stem and a terminal crown of large pinnate or fan-shaped leaves. There are approximately 2,700 species of palms in 200 genera placed in six subfamilies in the Arecaceae (Elliott et al., 2004). These species were treated as a group in this manual because of their similar pest problems and agronomic practices.

*Identifying Commonly Cultivated Palms* is a tool to aid the non-expert user in the identification of palms. Information is provided for 82 commonly cultivated palm species from 48 genera, but given the difficulty of separating palm species and the number of hybrids among them, you might only be able to determine the genus for a particular palm. Only adult palms (not seedlings or pre-reproductive juvenile palms) are included in the key and descriptions. The key is illustrated with hundreds of images of species and their characteristics or features.

This tool provides identification support for palms that are commonly cultivated as of 2010 in the United States (continental United States and Hawaii) and Caribbean Islands (Anguilla, Antigua and Barbuda, Aruba, Bahamas, Barbados, Cayman Islands, Cuba, Dominica, Dominican Republic, Grenada, Guadeloupe, Haiti, Jamaica, Martinique, Montserrat, Netherlands Antilles, Puerto Rico, Saint Barts, Saint Kitts and Nevis, Saint Lucia, Saint Martin, Saint Vincent and the Grenadines, Trinidad and Tobago, Turks and Caicos Islands, and the Virgin Islands). Note: This tool does not specifically address palms cultivated in Guam or American Samoa but may be useful for these areas as well.

### Why Are Palms Important?

Palms are important for a variety of reasons. They are a source of food and oil, fiber, building materials, chemical and industrial products, cosmetics, fertilizer, and more. The best known and economically important food and oil species are the coconut (*Cocos nucifera*), the date palm (*Phoenix dactylifera*), and the African oil palm (*Elaeis guineensis*). The coconut and African oil palm are both commercially cultivated as sources of oil throughout the tropical realm (FAO, 1995).

Palms are also widely used and valued as landscape ornamentals. In 2007, gross sales for palms from nurseries in the United States was valued at $203.7 million (NASS, 2007b). Of the states reporting gross sales of palms from nurseries, Florida had $127 million, California had $70 million, and Texas had approximately $4 million (NASS, 2007b). In Florida, coconuts are successfully grown from the cities of Stuart on the east to Punta Gorda on the west, and south to the Florida Keys (Gilman and Watson, 1993; Broschat and Crane, 2005; Bertone et al., 2011). Floridian coconuts, however, are primarily used in landscapes, so production reports are not available (Bertone et al., 2011).

There is limited commercial production of palms within the United States. Coconut palm production in Puerto Rico, however, was 424,300 nuts (NASS, 2007c) with palm sales reaching $7.1 million in 2007 (NASS, 2007c). United States date palm production encompasses approximately 7891 acres, primarily in California and Arizona (NASS, 2007a).

**Where Are Palms Grown Within the United States?**
Palms are grown within the southern United States from Florida to California. Palms are also grown in the "Caribbean region" comprised of Puerto Rico and the U.S. Virgin Islands and the "Pacific region" comprised of Hawaii, Guam, and American Samoa.

## Selection of Target Species

The target pest species in this survey were selected by the National Committee of the Cooperative Agricultural Pest Survey (CAPS) Program, in cooperation with the USDA-APHIS-PPQ Center for Plant Health Science and Technology (CPHST). All target species included are exotic pests to some area(s) of the United States but not necessarily every state and territory. Since palms are grown in three distinct regions of the United States, the presence of a pest in Hawaii should not preclude its survey in Puerto Rico, the U.S. Virgin Islands, or the continental United States. Specific pests, however, should only be surveyed in states and territories where that particular pest is not known to occur. Tables 1 and 2 outline the targets selected for this survey, their common name, pest type, and current level of distribution within the United States (see **Table 1. Target Pathogens/Nematodes for Survey** and **Table 2. Target Arthropods for Survey**).

## Table 1. Target Pathogens/Nematodes for Survey

| Scientific Name | Common Name | Type of Pest | Where in United States (U.S.) the Pest is Known to Occur |
|---|---|---|---|
| *Bursaphelenchus cocophilus* | Red ring nematode | Nematode | Exotic to all of U.S. |
| *Candidatus* Phytoplasma palmae and related strains (subgroups A through F) | Palm lethal yellowing phytoplasma, Texas Phoenix palm decline, and others | Phytoplasma | Subgroup/strain A, D, and F occur in Florida,<br><br>Subgroup D occurs in Puerto Rico, Louisiana, Texas |
| *Coconut cadang-cadang viroid* | Coconut cadang-cadang | Viroid | Exotic to all of U.S. |

## Table 2. Target Arthropods for Survey

| Scientific Name | Common Name | Type of Pest | Where in United States (U.S.) the Pest is Known to Occur |
|---|---|---|---|
| *Darna pallivitta* | Nettle caterpillar | Moth | Hawaii |
| *Haplaxius crudus* | American palm cixiid | Planthopper | Florida, Texas, and Puerto Rico |
| *Metamasius hemipterus* | West Indian cane weevil | Weevil | Florida, Puerto Rico, U.S. Virgin Islands |
| *Oryctes rhinoceros* | Coconut rhinoceros beetle | Beetle | Guam, American Samoa, Hawaii |
| *Paysandisia archon* | No common name, a palm borer | Moth | Exotic to all of U.S. |
| *Raoiella indica* | Red palm mite | Mite | Florida, Puerto Rico, U.S. Virgin Islands |
| *Rhabdoscelus obscurus* | New Guinea sugarcane Weevil | Weevil | Hawaii, Guam, American Samoa |
| *Rhynchophorus ferrugineus* | Red palm weevil | Weevil | California |
| *Rhynchophorus palmarum* | South American palm weevil | Weevil | California, Texas |

# Planning a Survey

## Choosing Target Species

Pest targets should be added to your detection survey based on their relevance to your particular state or territory. Determining which targets species to survey for should be based on 1) the risk of introduction of the target and pathways of introduction; 2) presence of known or potential hosts in your state/territory; 3) the importance of palm to your state as a landscape ornamental or as a crop species; 4) climatic suitability of your state/territory for the target; 5) resources available (financial and staff) for survey and identification of the pest (see **Table 3. Target Pests by Approved Survey Method**); and 6) the status/importance of a particular pest to your state/territory.

## Table 3. Target Pests by Approved Survey Method

| Scientific Name | Common Name | CAPS-Approved Survey Method | CAPS-Approved Identification/Diagnostic Method |
|---|---|---|---|
| *Bursaphelenchus cocophilus* | Red ring nematode | Visual | Morphological |
| *Candidatus* Phytoplasma palmae and related strains (subgroups A through F) | Palm lethal yellowing phytoplasma, Texas Phoenix palm decline, and others | Visual | Molecular |
| *Coconut cadang-cadang viroid* | Coconut cadang-cadang | Visual | Molecular |
| *Darna pallivitta* | Nettle caterpillar | Trap and lure | Morphological |
| *Haplaxius crudus* | American palm cixiid | Trap (sticky card), Visual, or Sweep-netting | Morphological |
| *Metamasius hemipterus* | West Indian cane weevil | Trap and lure or Visual | Morphological |
| *Oryctes rhinoceros* | Coconut rhinoceros beetle | Trap and lure or Visual | Morphological |
| *Paysandisia archon* | No common name, a palm borer | Visual | Morphological |
| *Raoiella indica* | Red palm mite | Visual | Morphological |

| Scientific Name | Common Name | CAPS-Approved Survey Method | CAPS-Approved Identification/Diagnostic Method |
|---|---|---|---|
| *Rhabdoscelus obscurus* | New Guinea sugarcane weevil | Trap and lure or Visual | Morphological |
| *Rhynchophorus ferrugineus* | Red palm weevil | Trap and lure or Visual | Morphological |
| *Rhynchophorus palmarum* | South American palm weevil | Trap and lure or Visual | Morphological |

## Pathways

When planning surveys, states are encouraged to use a pathway approach when deciding on target species and locations to survey. It is understood that risk factors can be examined along a "risk continuum" beginning at offshore sites (points of origin) to points of potential establishment (commodity production areas, natural lands), and numerous risk points in between (wholesale distribution centers, nursery sites, transportation corridors, etc.).

## Hosts and Climate

The hosts of the target species as well as the climatic suitability of the targets should be considered when planning a survey.

### Pest Datasheets

Each pest datasheet within the manual gives specific guidance on the hosts, biology, pathway, and climactic suitability of the target.

### NAPPFAST Maps

The North Carolina State University APHIS Plant Pest Forecasting System (NAPPFAST) produces maps to support CAPS and other PPQ surveys. Depending on the level of biological data available, the pest datasheets will include host, risk, or Pareto NAPPFAST maps.

#### Host Map

The host risk map describes the relative density (on a scale of 1-10) of susceptible hosts. The maps are based on National Agricultural Statistics Service (NASS) and Forest Inventory and Analysis (FIA) data. The scale of one to ten describes the proportion of total host acreage per county. For example, a rank of one indicates no host acreage, while a score of ten indicates that 100% of the acres in the county contain suitable hosts for the pest.

**Final Risk Map**
A final risk map represents the combined host and climatic suitability on a scale of 0-10. The NAPPFAST risk map and the host risk map were multiplied to obtain a final risk map. A value of one represents low density of susceptible hosts and low likelihood of pest growth and survival. A value of 10 indicates high density of susceptible hosts and a high likelihood of pest growth and survival. A value of zero or the gray area indicates an unsuitable climate for the pest

**Pareto Map**
The Pareto maps integrate maps of host abundance, climate, and pathway risks into a single risk map. Where no climate map exists, the maps were created from host and pathways only. The risk is rated on a scale of 1-10 based on a series of ordinal risk rankings. The Pareto Risk Map may more accurately reflect the risk potential of a pest than the Final Risk Map because it includes importation pathways.

**NAPPFAST Zonal Statistics**
States have different levels of hosts, varying environmental conditions, and pest introduction levels represented in the risk maps at county level. Zonal statistics can be used to identify the highest risk pests for an individual state. Files for each state may be viewed on the NAPPFAST page of the CAPS Resource and Collaboration website. If you are unfamiliar with how to analyze and use this data, please contact Dan Borchert for assistance.

**For any NAPPFAST-related questions:**
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## Survey Sites
When choosing a survey site, select a site that contains known or potential hosts and is large enough to hold all of the traps that will be placed there. When possible, trap near the preferred hosts for the target species. Consult the individual pest datasheets for this information.

Some of the lures can inhibit attraction of other target species; therefore, when trapping for more than one target species, separate traps with different lure types for different pest species by at least 20 meters (66 feet) for moths and 30 meters (98 feet) for weevils/beetles. See individual datasheets for information about trapping interactions. **Rhynchophorus ferrugineus* and *R. palmarum* are the exception; lures for these two

species may be combined in the same trap. Consult the datasheets for these species for more information.

Areas of risk can include nurseries that carry palm material as well as natural and managed areas where palm plants are found. Nurseries, palm plantations, and landscape plantings of palm are suitable locations for conducting surveys. However, when the pest is known to be present in large numbers in nearby regions (*e.g., Rhynchophorus palmarum* in Mexico near the border of California), surveyors must be cautious about site selection. *R. palmarum* lures are very attractive and can bring the pest into the area

Many of the target species in this manual also have other non-palm hosts that should be considered when planning surveys. For example, sugarcane is a common host of some of the target species. As such, it may be appropriate to survey for certain targets in sugarcane fields.

## Survey Season

Certain pests may be more prevalent during certain seasons or at different times during the year. Pests may be more common on certain plant parts when compared to other plant parts. Please see the specific pest datasheet for each pest to help determine the time of year to survey for each pest/pest type.

## Trap Types

Several different traps are recommended for the Palm Survey targets. Traps are recommended based on the biology of the pest. Refer to **Table 4. Palm Commodity-based Survey Trap and Lure Combinations** for the trap and lure product names as they appear in the IPHIS Survey Supply Ordering System. The five trap types recommended for CAPS Palm targets are:

- Jackson traps,
- Large plastic delta traps,
- Palm weevil bucket traps,
- Sticky card traps,
- Vaned bucket traps

**Figure 1.** Homemade palm weevil trap covered with burlap (Amy Roda, USDA-APHIS).

**Palm weevil bucket traps**

Palm weevil bucket traps (Fig. 1) can either be purchased through the IPHIS Survey Supply Ordering System or constructed on site. For most species, the bucket size may

range from one to five gallons. Check the individual pest datasheets to verify the appropriate bucket size for your specific target.

When making a bucket trap, surveyors may alter the design based on the materials available. The trap should include the following (from Bertone et al., 2011):

**Figure 2.** Jackson Trap (Image courtesy of John Crowe, USDA –APHIS).

- A rough texture on the outside of the bucket. This allows weevils to crawl up the outer surface. This can be achieved by attaching burlap, ground cloth, netting, or some other material to the outside of the container.
- Holes large enough (approximately 3 cm ($1\ ^{3}/_{16}$ inches)) to permit weevil entry in the side of the bucket. Holes should be cut near the rim.
- Sufficient space at the bottom for a liquid mixture used to trap and kill weevils entering the trap.
- A trap lid to prevent contamination of the trap contents (required for some targets).

Some target weevils require the trap be hung on or near host plants. For these targets, the bucket trap should have a lid with a loop so the trap may be hung in trees. This trap may be used to survey for: *Metamasius hemipterus*, *Oryctes rhinoceros*, *Rhabdoscelus obscurus*, *Rhynchophorus ferrugineus*, and *Rhynchophorus palmarum*. For specific instructions for each target, see the individual species datasheets.

Note: Surveyors should verify the bucket size that should be used for each species.

**Jackson traps (Fig. 2)**
Jackson traps can be purchased through the IPHIS Survey Supply Ordering System. They are prism-shaped and made of paper. Moths enter through openings on the triangular ends and are captured on an adhesive liner. The lures should be stapled to one of the non-sticky panels inside the trap. *Darna pallivitta* is the only species in this manual that uses this trap as an approved method.

**Figure 3.** Large plastic delta trap (Image courtesy of John Crowe).

**Large plastic delta traps (Fig. 3)**
Large plastic delta traps can be purchased through the IPHIS Survey Supply Ordering System. They are available in many different colors. Currently, the traps are available in orange, red, or white through the Ordering System. The color of the trap does not

affect the efficacy for trapping *Darna pallivitta*. States may choose any one of the three colors. Large plastic delta traps are available with an internal disposable glue liner.

The traps are prism-shaped and made of corrugated plastic. Moths enter through openings on the triangular ends and are captured on an adhesive liner. The lures should be stapled to one of the non-sticky panels inside the trap. *Darna pallivitta* is the only species in this manual that uses this trap as an approved method.

**Sticky card traps**
Sticky card traps can be purchased through the IPHIS Survey Supply Ordering System. Sticky cards are made out of paper or plastic and covered with a sticky surface to catch target insects. *Haplaxius crudus* is the only species in this manual that uses this trap as an approved method.

**Vaned bucket traps (Fig. 4)**
Vaned bucket traps can either be purchased through the IPHIS Survey Supply Ordering System or constructed on site. Vaned bucket traps consist of corrugated plastic cross-vanes fitted into a five gallon bucket. The lure is suspended from a cut-out section in the vanes.


**Figure 4.** Vaned bucket trap (Aubrey Moore, University of Guam).

When making a vaned bucket trap, the trap should have the following (from A. Moore, 2013, personal communication):

- Five gallon bucket; interior diameter at the rim should be 28.5 cm (11.25 in) (Fig. 4).
- Vane panels made out of 6 mm (~ 1/4 in.) thick corrugated plastic.
- Dimensions of panels:
  - Length of panel is 61 cm (24 in),
  - Maximum width of panel is 30.5 cm (12 in),
  - Hole cut in the panels for hanging lure: 8 cm (about 3 in) in diameter.
- The distance from the top of the bucket to the top of the vanes is 30 cm (12 in)
- Bottom part of the vanes should taper to fit in a 5 gallon bucket.

Allow a 5 cm (about 2 in) clearance between the bottom of the vanes and the bottom of the bucket.

This trap may be used to survey for *Oryctes rhinoceros*. For specific instructions for this species, see the datasheet for *Oryctes rhinoceros*.

## Table 4. Palm Commodity-based Survey Trap and Lure Combinations

| Target Pest | Lure Product Name | Trap Product Name |
|---|---|---|
| *Darna pallivitta* | *Darna pallivitta* Lure | 1) Jackson Trap Body,<br>2) Large Plastic Delta Trap Kits, Orange,<br>3) Large Plastic Delta Trap Kits, Red, **or**<br>4) Large Plastic Delta Trap Kits, White |
| *Haplaxius crudus* | N/A | Sticky Card, Blue |
| *Metamasius hemipterus* | 1) *Metamasius hemipterus* Aggregation Lure,<br>2) Palm Weevil Lure, Ethyl Acetate, **and**<br>3) Food bait (prepared on site)* | 1) Palm Weevil Bucket Trap **or**<br>2) Homemade Palm Weevil Bucket Trap |
| *Oryctes rhinoceros* | 1) *Oryctes rhinoceros* Aggregation Lure,<br>2) Palm Weevil Lure, Ethyl Acetate, **and**<br>3) Food bait (prepared on site)* | 1) Palm Weevil Bucket Trap,<br>2) Homemade Palm Weevil Bucket Trap, **or**<br>3) Vaned Bucket Trap (homemade or commercial) |
| *Rhabdoscelus obscurus* | 1) *Rhabdoscelus obscurus* Aggregation Lure,<br>2) Palm Weevil Lure, Ethyl Acetate, **and**<br>3) Food bait (prepared on site)* | 1) Palm Weevil Bucket Trap **or**<br>2) Homemade Palm Weevil Bucket Trap |
| *Rhynchophorus ferrugineus* | 1) *Rhynchophorus ferrugineus* Aggregation Lure,<br>2) Palm Weevil Lure, Ethyl Acetate, **and**<br>3) Food bait (prepared on site)* | 1) Palm Weevil Bucket Trap **or**<br>2) Homemade Palm Weevil Bucket Trap |
| *Rhynchophorus palmarum* | 1) *Rhynchophorus palmarum* Aggregation Lure,<br>2) Palm Weevil Lure, Ethyl Acetate, **and**<br>3) Food bait (prepared on site)* | 1) Palm Weevil Bucket Trap **or**<br>2) Homemade Palm Weevil Bucket Trap |

**IMPORTANT:** When more than one lure/compound is listed, all of the lures are required to report negative data for that species.

**IMPORTANT:** When more than one trap option is listed, consult the specific pest datasheet to determine which option is appropriate for your state.

**IMPORTANT:** At this time, the only lure combinations for different species that can be combined in the same trap are *Rhynchophorus ferrugineus* and *R. palmarum*. Therefore, if both pests are targets, the trap should be baited with the pheromone lures for *R. ferrugineus* and *R. palmarum*, ethyl acetate, and the food bait.

When trapping for weevil/beetle species other than *Rhynchophorus ferrugineus* and *R. palmarum*, separate traps for different species by at least 30 meters (98 feet).

**IMPORTANT:** When trapping for more than one species of moth, separate traps for different moth species by at least 20 meters (66 feet).

*The type of plant material used as food bait varies by species. Consult the specific pest datasheet to determine the appropriate food bait for each target species.

# Ordering Traps and Lures

All traps and lures for the Palm Commodity-based Survey should be ordered through the IPHIS Survey Supply Ordering System during the open ordering season. By using the ordering system, PPQ can utilize quality assurance procedures that are not available when ordering directly from manufacturers.

All necessary traps and lures needed for the Palm Commodity-based Survey are specifically listed in the ordering system. See **Table 4: Palm Commodity-based Survey Trap and Lure Combinations** or the individual pest datasheets for the trap and lure product names. Note: every effort is made not to change the CAPS-approved survey methods during a survey season. However, if changes are necessary (*i.e.,* a trap or lure is not available), a notification will be sent out through the Survey Planning forum from the CAPS Resource and Collaboration Site, and a note will be placed on that target's information page on the CAPS Approved Methods page. Please visit the CAPS Approved Methods page for the most current information.

Supplies are shipped via overnight courier, ground transportation, or palletized freight. To avoid problems when receiving supplies, surveyors should specify any particular delivery requirements in the comment box of the order form. For example enter, "Call before shipping in order to arrange for storage, personnel, or equipment to unload the shipment" or "Cannot accept pallets," etc.

Inspect lures upon receiving them from PPQ. Notify the appropriate National Operations Manager of any lures that are damaged and request replacement lures (see contact information below).

## Contact information for trap and lures

For questions about the IPHIS Survey Supply Ordering System or trap and lure quality issues:

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For technical trap, lure, and survey methodology questions:

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# Conducting a Survey

## Visual Survey

Several of the pests targeted in this survey can be detected visually by looking/scouting for characteristic symptoms/damage or signs of a pest and collecting samples of plant tissues in the field (**Table 5: Palm Commodity-Based Visual Survey**). A symptom is an indication of disease or a pest by reaction of the host (e.g., canker, leaf spot, wilt, yellowing). A sign, in contrast, is an indication of a disease or pest from direct observation of a pest or its parts (physical evidence of the pest) (Fig. 5). It is important to note that none of these symptoms/signs, taken singly, are a diagnostic feature for any of the pests. Look for a combination of symptoms when inspecting plant tissue of palms reoccurring in the same tree over time.

**Figure 5.** Top: Example of plant chlorosis (a symptom), Bottom: example of eggs and neonate larvae (a sign).

In the context of the current survey, surveyors should take note of the general condition of the plant and further examine the stems, leaves/fronds, flowers, and fruit for the pests of concern. The surveyors should pay close attention to symptomatic plants first. These would be the plants that have chlorosis (yellowing), feeding holes, or a generally unhealthy appearance. If no symptomatic plants are present, the surveyor should choose plants to examine based on convenience. While the surveyor should examine several plants within the site, only one data recording will be necessary for the site. It is recommended to conduct visual surveys multiple times over the survey season. If the surveyor is trapping for insect targets, he or she will need to visit the site multiple times to service the traps and replace lures and baits. Visual surveys may be conducted during these trap servicing visits as appropriate.

Visual survey for palm plants can be applied at various levels of intensity and with various techniques (*e.g.*, ground surveys, ladders, climbing devices, bucket trucks, pole saws). In addition, an easy way to inspect palm fronds is to look at fronds that have fallen to the ground or when nursery workers or landscapers are trimming trees. The surveyor can examine the base of the frond for tunneling and the pinnae for signs of surface pests. Large piles of fronds are often available for inspection when a crew is working their way down a street. The surveyor may find it helpful to contact nursery and property owners to ask when pruning of palms may occur.

Care should be taken when climbing palms to conduct visual surveys. Palms cannot overgrow wounds made to their stems. Using tree spikes to climb palms is not advisable as the holes made by the spikes are permanent. There is also the potential risk of spreading palm diseases through such wounds (Howard, 2001).

Straight or extension ladders may be used to reach crowns that cannot be reached from the ground. However, this method may not be appropriate when trying to examine fronds of certain palm species. Examining the fronds can be difficult for some palm species as they cannot easily be reached from the tree stem.

The easiest way to examine the fronds would be to use a truck mounted hydraulic lift. The boom, which moves the platform up and down, can vary in length, but boom lengths of 10 to 15 m can usually reach the crowns of palms in most urban areas (Howard, 2001). Scaffolding used in many industries, like painting, should not be used as many areas with palms are likely to be on uneven footing. This can make balancing while surveying more difficult and dangerous. Tripod orchard ladders are a better option as they are more stable on uneven ground (Howard, 2001). Specialized binoculars have also been used successfully in California to find signs of damage.

An alternative to climbing palms is to use a pole saw or pruner to cut down fronds for closer examination. Traps can also be hung in trees in this manner using a pole with a hook on the end (Howard, 2001).

**Equipment/Supplies to take into the field**
There are hazards associated with climbing palms (falling debris, pestiferous animals, and stinging insects). As such, surveyors should wear a hard hat and safety goggles when examining host material. Wearing thick gloves is also advisable.

Note: Some palms (date palm) have sharp spines and should be handled cautiously and wearing both eye and glove protection is strongly recommended.

## Table 5. Palm Commodity-based Visual Survey

| Scientific Name | Symptoms/Damage & Signs to Look For[1] |
|---|---|
| *Bursaphelenchus cocophilus* | Target plants that are 2.5 to 10 years old. The greatest incidence typically occurs in trees between four and seven years old. Older leaves will show leaf symptoms before younger leaves.<br><br>**Red ring:**<br>Reddish lesions form in the stem and looks like a “red ring” when the stem is cut in cross-section. The soft, white cortex of the roots becomes orange to faint red in color and dry and flaky in texture. Established leaves become short, deformed, and turn yellowish-bronze before turning deep reddish-brown in color. In coconut palm, fruit typically drop prematurely (before mature). The palm crown will often topple over (four-to-six weeks after symptoms develop); this is associated with severe internal damage caused by the larvae of the weevil vector.<br><br>*B. cocophilus* is primarily found in areas where the red ring develops and is relatively confined to this area.<br><br>**Little leaf:**<br>Some African oil palms and older coconut palms will produce small, deformed leaves, which remain green with no initial necrosis. The trees |

| Scientific Name | Symptoms/Damage & Signs to Look For[1] |
|---|---|
| | usually stop producing fruit.<br><br>Nematodes can be found in high numbers in young leaves, when the leaves are elongating. These leaflets eventually become partially necrotic (brown/dead tissue) and remain partially folded along the rachis (main axis/stem of leaf). |
| *Candidatus* Phytoplasma palmae and related strains (subgroups A through F) | For mature palm species, the earliest visible symptom is a premature shedding of most or all fruit regardless of developmental stage. Fruit that are shed from coconut often develop a blackened or water soaked appearance at the calyx end. Necrosis of newly emergent inflorescences accompanies or follows fruit drop. Flower spikelets, which are normally light yellow to creamy white in color, appear partially or totally blackened.<br><br>Fruit and flower symptoms are followed shortly thereafter by foliar discoloration. On the Atlantic tall coconut ecotype, leaves turn a golden yellow color. Discoloration begins on the lowermost (oldest) leaves and progresses to successively younger leaves in the upper part of the crown. Discolored leaves typically remain turgid for some time before turning brown, drying and hanging downward around the stem for a few days before falling to the ground. The newest unopened leaf (spear) collapses, once foliar discoloration is advanced. Death of the apical meristem occurs at this stage after which the remaining crown withers and topples away leaving just a bare trunk standing.<br><br>While premature fruit drop and inflorescence necrosis are common to all palms with lethal yellowing, leaves turn reddish brown rather than yellow on many coconut ecotypes and most other palm species. On date palms, death of the spear leaf and underlying apical meristem occurs shortly after leaves first begin to discolor. Most affected palms die within three to five months after the onset of symptoms. |
| *Coconut cadang-cadang viroid* | Younger palms are more susceptible to the viroid than older palms.<br><br>Most of the time, the lower two-thirds of the leaf crown is yellow; while the upper one-third is still dark green with CCCVd infection.<br><br>Some of the general symptoms of CCCVd include: reduced nut size and production, reduced husk production in nuts, reduced tree length/stunting, “genetic” orange spotting on fronds (especially in oil palms), and yellow spotting on leaves. All of these symptoms can eventually lead to plant death. If a palm patch is infected with CCCVd, death of the palms within the patch will continue until the patch is “bare”.<br><br>The CCCVd-infected leaves in the palm crown are typically smaller than those observed in healthy palms. Leaf scarring is often found on the trunk of the infected palm. Palms that are infected with CCCVd before flowering have leaf scars that are spread farther apart than healthy plants. In contrast, plants infected with CCCVd after flowering have leaf scars that are closer together than healthy plants. Water-soaked leaf spots may appear, but this symptom is not unique to CCCVd . Another possible symptom (although rarely found in the field and in only about 3% of experimental inoculations) is lamina reduction. This symptom can lead to a “brooming symptom” where parts of the frond contain only the midrib. |

| Scientific Name | Symptoms/Damage & Signs to Look For[1] |
|---|---|
| | |
| *Haplaxius crudus* | Adults are usually found on the underside of palm fronds and are active diurnally and nocturnally. Relatively high numbers of adults are consistently observed on certain palm species including coconut palm (*Cocos nucifera*), Manila palm (*Andonidia merrillii*), and Mexican fan palm (*Washingtonia robusta*). Adults are rarely observed on certain other palm species, including Cuban royal palm (*Roystonea regia*) and yellow-cane palm (*Dypsis lutescens*). Although this species does not cause notable damage, it does vector the Lethal Yellows (LY) pathogen. Adults may be found on host plants exhibiting symptoms of LY. |
| *Paysandisia archon* | Plugs of debris (sawdust) can be found at the outermost extremity of the gallery. Sawdust can be found in the palm crown and/or the palm trunk.<br><br>Larval damage may lead to slowed growth and/or crown deformation. This can be observed as abnormal development of the axillary leaf buds and deformation and abnormal twisting of the palm trunks. Abnormal drying of the palms may also be observed, especially on the core leaves.<br><br>Axial and transversal galleries may also be observed, but this is only possible through destructive sampling (Sarto i Monteys and Aguilar, 2005). |
| *Raoiella indica* | Feeding by this mite can cause spotting on leaves; leaves may also be completely discolored. Localized yellowing is followed by leaf necrosis. Heavy infestations typically occur on the lower surface of the leaf, while yellowing occurs on both sides of the leaf. This species can severely affect very young coconuts to very old palms (>50 ft tall).<br><br>In coconut, feeding causes an initial bronzing of the leaves which will eventually turn into necrotic tissue. Leaf yellowing is then followed by the abortion of flowers or small nuts. Damage can be more noticeable on the lower third part of the plant. On banana and plantain, lower leaves turn yellow with small patches of greenish-yellow areas.<br><br>Mite clusters can be observed as reddish-brown areas on host material with the naked eye and are usually found on the undersides of the leaves. Colonies can range from a few to hundreds. Mites are often found in huge numbers (100 to 300 individuals). All life stages are predominantly red; adult females often have dark spots on their body. The white cast skins can be found alongside the mites and can be more numerous than living mites if populations are very productive.<br><br>Recent data has shown that fronds from the middle stratum of coconuts had significantly more mites than fronds from the upper and lower stratum (Roda et al., 2012). |
| *Metamasius hemipterus*[2] | Damaged palms often produce an amber-colored, gummy exudate and have chewed plant tissue extruding from the gallery window at the frond bases, which break prematurely (Giblin-Davis, 2001). When peeling the outer leaf, the younger leaf bases may be scarred with galleries dug by feeding larvae. |
| *Oryctes rhinoceros*[2] | Damage is caused by the adult stage, specifically young adults that bore into the crowns of healthy palms. Adults can penetrate 10 to 50 cm (~4 to ~20 inches) down close to the center of the spear cluster. Adults bite through the |

| Scientific Name | Symptoms/Damage & Signs to Look For[1] |
|---|---|
| | tightly packed unopened leaves in the central bud. The leaf midribs are most often injured.<br><br>After entering the palm and feeding, the adult bores outwards, emerging from the base of a central frond. Adult feeding damages the inflorescences and fronds which may decrease or delay fruit production. Mature fronds will often have patches of missing foliage if attacked while in the developing stage. Damage can appear as V-shaped cuts in the fronds or holes in the midrib.<br><br>In palms from one to three years old, damage by *O. rhinoceros* can result in severe malformation or death. Death of the palm occurs when the beetle bores down to the meristematic tissue and destroys the growing point. This is more likely to occur in young palms with small crowns. Attacks are typically concentrated on the margins of palm groves and on taller palms.<br><br>Adults chew the plant tissue and leave a fibrous frass which is pushed out of the burrow entrance. This extruded material is a sign that adults are still present in the host. They will infrequently bore into partly grown nuts (causing nut drop) and into date palm inflorescences. *Oryctes rhinoceros* prefers tall, mature palms, but when lacking will attack young palms. |
| *Rhabdoscelus obscurus*[2] | Adult females bore into the outer layer of stems and leaf bases of maturing palm trees to lay their eggs. Larval development inside the trunks results in exudation of pinkish sap. Larval damage has been observed from just above and adjacent to the root mass to 2 m (6.6 ft) or more above the ground. The grubs then pupate in a cocoon of fibers inside the trunk. In young palms, the larvae mine the central portion of the stem, destroying the plants. Damage extends up and down the stem for a number of centimeters from the initial point of entry.<br><br>In older palms, *R. obscurus* mines the thicker leaf bases, as well as a short distance into the trunk. Older palms are disfigured by the emergence holes made by the weevils and also by trunk splitting, rendering them unfit for sale. Heavy infestations may weaken the trunk sufficiently for the tree to collapse, with damage occurring mostly up to 1 m (3.3 ft) above the ground. Jelly-like exudates from holes in leaf bases and/or stems may be observed.<br><br>One of the signs of infestation includes pin holes all over the trunk 0.6 to 0.9 m (~2 to ~3 ft) above the ground. During heavy infestations, a large number of grubs feed inside the palm, tunneling through and destroying the tissues. Trunk staining can occur, especially with high larval populations. If a large area of the base is destroyed in some hosts, the palm can become susceptible to lodging (toppling of a plant during wind or rain). Trees can collapse and die with heavy infestations. |
| *Rhynchophorus ferrugineus*[2] | Under careful observation, surveyors may be able to detect infested plants with holes in the crown or trunk, with or without oozing brown liquid and chewed up fibers. Additionally, distorted or “clipped” fronds may be seen. At high infestation levels, symptoms resembling drought stress, like wilting or yellowing, may be observed. Green leaves may droop because of loss of support by bored axils and a collapsed canopy.<br><br>A typical sign of infestation is the distorted growing point at the top of the palm. The growth at the top of the canopy can become deformed and offset. |

| Scientific Name | Symptoms/Damage & Signs to Look For[1] |
|---|---|
| | This distortion is a very common symptom and is more easily seen than other symptoms of infestation. Frass and cocoons may also be visible, particularly at the base of damaged fronds after they are removed from the tree. The interior of the palm may be destroyed without there being distinctive signs of deterioration externally. The trunk of the host becomes weakened when attacked and can become a hazard due to the possibility of collapsing onto the surrounding area.<br><br>Larvae may be found in the bole, frond, or crown of palms five years or younger. As palms age, larvae are generally found in the crown and at the base of fronds.<br><br>Damage caused by larval feeding can resemble symptoms caused by *Fusarium* fungi, lethal yellowing, red palm mite, and other pests (*e.g.*, wilting, drooping fronds) or rodents (*e.g.*, holes at the base of fronds). It can be difficult to make the distinction as to the cause of the damage until life stages of *R. ferrugineus* can be found. Tunneling is a good indicator for this species and *Rhynchophorus palmarum.* |
| *Rhynchophorus palmarum*[2] | Infested palms show a progressive yellowing of the foliage. The emerging leaves are destroyed, and flowers are necrotic. The leaves dry out in ascending order in the crown, and the apical leaf bends and eventually drops. Galleries and damage to leaf-stems made by the larvae are easily detected in heavily infested plants.<br><br>In coconut, larval tunnel openings and frass can be found at the bases of the leaf axils. Tissue of affected plants produces a strong, characteristic foul odor. Pupae and old larvae are frequently found in the crown area in the petiole bases where they are often well concealed and hard to locate.<br><br>The internodal stem region is soft and can have both feeding and oviposition punctures. Punctures may also be present on the edges of the petiolar bases as well as on the undamaged surfaces of immature nuts.<br><br>The most extensive damage is caused by the older instars which are capable of excavating tunnels 30 to 40 cm (11 $^{13}/_{16}$ to 15 $^{3}/_{4}$ inches) in length and 2 to 3 cm ($^{13}/_{16}$ to 1 $^{13}/_{16}$ inches) in diameter within 24 to 36 hours. Multiple larvae can completely destroy the internal tissues of a three to five year old palm in about five to six weeks. |

[1] See pest datasheets for more specific pest information.

[2] Visual surveys can be used to detect larval populations before adults emerge. Visual survey should only be used when palms with highly suspect damage and signs of infestation are observed. Some of the methods involved include destructive sampling. Because of this, permission must be obtained by the property owner beforehand. Inspecting fronds on the ground is a good, non-destructive way to visually survey for pests.

## Sweep Netting

Sweep nets, also called beat nets, are used to sweep vegetation to collect insects. They are made of a heavy, inflexible hoop that attaches the net to a short, thick handle. The net is made of small mesh or light canvas cloth; a standard sweep net has a

diameter of 38 to 43 cm (15 to 17 inches). The surveyor sweeps the net back and forth, collecting insect specimens that are jarred loose by the movement of the net (Ferro, 2011). Sweep-netting provides a good representation of the arthropod community present in the surveyed vegetation (Aguilar, 2010).

Surveyors should complete a constant number of sweeps at each sampling site. In most cases, twenty sweeps is a good number of sweeps per sampling site. All insects collected during this set of sweeps constitute one sample. In addition, each sweep should cover approximately the same amount of vegetation at the same height. This will allow for comparison between surveys (Gempler's, 2013).

Once 20 sweeps have been completed at the sampling site, the bag of the net should be flipped over or quickly closed. The net bag should be inverted into a gallon-sized re-sealable bag or other container for transportation back to the lab. All arthropods in the net should be emptied into the plastic bag or other container. The bag should be placed in a cooler for transportation. At the lab, the entire re-sealable bag or container should be placed in the freezer for a minimum of 24 hours. After this time, the bag contents should be dumped into a sorting pan. Sort the samples: remove debris and non-target species. The taxonomic level of sorting will depend on the expertise available on hand and can be confirmed with the identifier. If possible, screen for the target pest. Some states may have taxonomic support, access to local training aids, or identification guides.

There are some steps surveyors can take to make their sweeps more uniform (Gempler's, 2013):

1) The sweep net hoop should be facing down towards the ground with the plane of the hoop perpendicular to the surveyor.
2) The surveyor should swing the net a full 180° with one sweep per step. When swinging, the lower edge of the hoop should be tilted so it is slightly ahead of the upper edge of the hoop.
3) Sweeping height is dependent on the height of the vegetation. In general, the surveyor should swing the net as deeply as possible in the vegetation. The upper edge of the sweep net should be even with the top of the plants in taller vegetation.

Surveyors should keep in mind that sweeping efficiency can be affected by many factors including weather, type of habitat, time of day, and differences in sweeping techniques (Gempler's, 2013).

*Haplaxius crudus* is the only species in this manual that uses this type of survey as an approved method.

## Trapping

In general, trapping is a type of survey that involves the use of a trap to catch arthropods of concern in a specific location. Trap efficiency is often increased through the use of some type of chemical or physical attractant. These attractants might be a light source, a food source, a pheromone, or host volatile that is attractive to the target species. In the context of the current survey, there are seven arthropods which can be surveyed via this method (**Table 3. Target Pests by Approved Survey Method**).

Trapping requires a minimum of two trips per site (one to set up the trap and one to take down the trap). If using a lure with the trap, additional trips may be required to change lures, remove specimens, or inspect traps for damage (**Table 6. Length of Effectivess for Commodity-based Survey Lures**). Field personnel are encouraged to visually inspect for foliar pests during each trip.

## Trap Placement

- Survey sites should have host species of the target species.
- When possible, place traps out of direct sunlight or in partial shade.
- Make sure traps are not obscured by vegetation. Clip or remove any such vegetation.
- Separate traps with different lure types by at least 20 meters (66 feet) for moths and 30 meters (98 feet) for weevils/beetles.

For specific information on where to place traps see the specific pest datasheet as it may vary between species.

## Lure Handling, Changing, and Storage

- Inspect lures upon receiving them from the manufacturers. Notify the appropriate National Operations Manager (see contact information below) of any lures that are damaged or leaking and request replacement lures.
- Store lures as directed by the manufacturer until used.
- Replace lures as directed by this survey manual, keeping the following information in mind:
    - Many lure dispensers do not release the compounds at a constant rate; initial rates are high and then drop off significantly over the life of the dispenser. This is normal. The lure is still attractive at the lower emission rate for the length of time as described by CAPS. Surveyors should be aware of this and

not be alarmed by a sharp decline in the amount of lure visible in the dispenser. However, if lures are completely depleted before the length of effectiveness (as defined by CAPS), replace the lure with a fresh lure and record the following information regarding the prematurely expelled lure:

- Lot number,
- Number of days the lures have been in the field, and
- Environmental conditions such as average temperature, sun exposure, etc.

Then contact your program manager through the proper channels.

- Transport and store lures separately in a large, sealable plastic container to prevent breakage and contain leaks.

For any questions or concerns regarding quality or effectiveness of traps and lures, contact Brian Kopper or Kristian Rondeau.

**Brian Kopper**
Field Operations Manager – Pest Detection
USDA-APHIS-PPQ
920 Main Campus Dr.
Raleigh, NC 27606
919-855-7318
Brian.J.Kopper@aphis.usda.gov

**Kristian Rondeau**
National Operations Manager, Farm Bill
USDA-APHIS-PPQ
2150 Centre Ave., Building B.
Ft. Collins, CO 80526
970-490-7563
Kristian.c.rondeau@aphis.usda.gov

## Checking Traps

- Check traps after bad weather events (rain, strong winds, etc.), which can disturb the sample or as local conditions warrant for a given pest.
- Examine trap for damage.
- Remove any debris blocking trap entries, including leaves, twigs, spider webs, etc.

- Ensure that all lures are still in place.

- For traps that require liquid, ensure that adequate liquid levels are maintained, especially during hot, dry periods.

- Remove any suspect specimens from the trap and submit the samples per the sample submission instructions.

- Change lures per the length of effectiveness for each species (see **Table 6. Length of Effectiveness for Palm Commodity-based Survey Lures**).

## Table 6. Length of Effectiveness for Palm Commodity-based Survey Lures

| Target Pest | Lure Product Name | Length of Effectiveness |
|---|---|---|
| *Darna pallivitta* | *Darna pallivitta* Lure | The length of effectiveness for the lure is under review (it is dependent on the lure manufacturer) |
| *Metamasius hemipterus* | 1) *Metamasius hemipterus* Aggregation Lure, | Six weeks (42 days) |
| | 2) Palm Weevil Lure, Ethyl Acetate, **and** | Six weeks (42 days) |
| | 3) Food bait (prepared on site) | 7 to 9 days |
| *Oryctes rhinoceros* | 1) *Oryctes rhinoceros* Aggregation Lure, | Six weeks (42 days) |
| | 2) Palm Weevil Lure, Ethyl Acetate, **and** | Six weeks (42 days) |
| | 3) Food bait (prepared on site) | 7 to 9 days |
| *Rhabdoscelus obscurus* | 1) *Rhabdoscelus obscurus* Aggregation Lure, | Six weeks (42 days) |
| | 2) Palm Weevil Lure, Ethyl Acetate, **and** | Six weeks (42 days) |
| | 3) Food bait (prepared on site) | 7 to 9 days |
| *Rhynchophorus ferrugineus* | 1) *Rhynchophorus ferrugineus* Aggregation Lure, | Six weeks (42 days) |
| | 2) Palm Weevil Lure, Ethyl Acetate, **and** | Six weeks (42 days) |
| | 3) Food bait (prepared on site) | 7 to 9 days |
| *Rhynchophorus palmarum* | 1) *Rhynchophorus palmarum* Aggregation Lure, | Six weeks (42 days) |
| | 2) Palm Weevil Lure, Ethyl Acetate, **and** | Six weeks (42 days) |

| Target Pest | Lure Product Name | Length of Effectiveness |
|---|---|---|
| | 3) Food bait (prepared on site) | 7 to 9 days |

**IMPORTANT:** When more than one lure/compound is listed, all of the lures are required to report negative data for that species.

# Sample Processing and Submission

Consult the most recent version of Procedures for Submitting Survey Samples to Domestic and Other Identifiers for information on how to process and submit survey samples.

## Processing, Sorting, and Screening Specimens

**Arthropods:**

Specific guidance is listed below for processing and submitting samples from several unique survey methods/ target species. For all other arthropods in this survey, use the general guidance in the Procedures for Submitting Survey Samples to Domestic and Other Identifiers

*Haplaxius crudus*:

Sticky card traps

When submitting specimens from sticky cards, surveyors should remove suspects from the sticky cards before submitting for identification. Suspects can be lifted off the sticky cards carefully with forceps and cleaned of the tanglefoot using an oil solvent (see Miller et al. 1993 for more information; found here: http://caps.ceris.purdue.edu/webfm_send/727).

Sweep net samples

At the lab, the entire re-sealable bag or container should be placed in the freezer for a minimum of 24 hours. The bag contents should be dumped into a sorting pan. Sort the samples: remove debris and non-target species. The taxonomic level of sorting will depend on the expertise available on hand and can be confirmed with the identifier.

If possible, screen for the target pest. Screening is a process of eliminating non-target families, genera, or "look-a-like" species being surveyed for. When in doubt, forward the specimens to the identifier.

Once sorting and screening (if possible) have been completed, place specimens into vials of 75-90% ethanol and submit for identification. Follow the instructions in Procedures for Submitting Survey Samples to Domestic and Other Identifiers for additional guidance on sample submission.

*Metamasius hemipterus*, *Rhynchophorus palmarum*, and *R. ferrugineus*: vectors/ potential vectors of *Bursaphelenchus cocophilus,* the nematode that causes red ring disease of palms.

*Rhynchophorus palmarum* vectors the nematode *Bursaphelenchus cocophilus* that causes red ring disease of palms. Other Rhynchoprinae beetles, including *Dynamis borassi* (exotic to the United States) and *Metamasius hemipterus,* are also reported to vector the red ring nematode. To date the geographic areas of the nematode-carrying weevils have not overlapped with the U.S. native palmetto weevil *R.*

*cruentatus* or with the invasive red palm weevil, *R. ferrugineus*. These beetles are not known to vector the nematode but the possibility exists as other species of Rhynchorpinae serve as hosts.

In order to detect the red ring nematode, follow these procedures **if** suspect palm weevils are found in traps (any of the species listed above). The following information has been excerpted from the **Protocol for Preparing and Forwarding Suspect South American Palm Weevil from Survey Traps for Confirmation and to Maximize Red Ring Nematode Detection**:

1. When suspect palm weevils are recovered from palm weevil bucket traps, carefully remove the weevil and place it in a screw-top vial containing water. Do not rinse the surface of the weevil or put the weevil in alcohol. If the weevil is still alive, freeze it for several hours to kill it before immersing in water.

2. If possible, wrap Parafilm® around the vial screw cap to prevent leakage. Label the vial with a local collection number using a Sharpie® permanent pen.

3. From the liquid in the trap with a weevil, extract approximately 50 cc's from the:
   a. top surface of the liquid in the trap if it is mostly propylene glycol;
   b. bottom of the trap if it's mostly water.

Place the liquid sample in a separate container that will not leak. A pipette or glass (not plastic) turkey baster can be used for this. Be sure to rinse it thoroughly between samples if reused to prevent cross-contamination. Write the same collection number on this container.

4. Until the specimen and other container of water can be shipped for identification, place the vial in cool conditions such as an ice-chest with cool packs, but do not freeze the specimen.

Follow the rest of the sample submission instructions in the **Protocol for Preparing and Forwarding Suspect South American Palm Weevil from Survey Traps for Confirmation and to Maximize Red Ring Nematode Detection**.

**Pathogens:**
For lethal yellowing of palm, follow the instructions in **Phytoplasma sample submission for Cooperative Agricultural Pest Survey (CAPS) Program and Farm Bill Goal 1 Surveys FY 2014.**

For red ring nematode and *Coconut cadang-cadang viroid* follow the instructions in the CPHST pest datasheet.

## Screening Specimens

Screeners should have had some training in recognition of common native palm species. Familiarity with the CAPS target species is also helpful. Work with your state or university taxonomists for individual training.

*A Resource to Pests and Diseases of Cultivated Palms* may be a useful tool when screening specimens.

The domestic identifier who can identify mites is:

Eric McDonald
PPQ Domestic Acarology Identifier
USDA, APHIS, PPQ, Houston, TX

The domestic identifiers who can identify insects are:

Kira Metz
PPQ Domestic Entomology Identifier
Texas A&M University, College Station, Texas
Area of Coverage: West of Mississippi

Julieta Brambila
PPQ Domestic Entomology Identifier
USDA, APHIS, PPQ, Gainesville, FL
Area of Coverage: East of the Mississippi

The identifier for *Bursaphelenchus cocophilus* (red ring nematode) is:

Lynn Carta
Research Plant Pathologist/Nematologist
USDA, ARS, Beltsville, Maryland

The identifier for *Candidatus* Phytoplasma palmae and related strains (subgroups A through F) (lethal yellowing) are:

**Screening**:
Curt Colburn
Clemson University
Molecular Plant Pathogen Detection (MPPD) laboratory
511 Westinghouse Rd.
Pendleton, SC 29670
Voice: 864-646-2133
Email: gcolbur@clemson.edu

Kevin Ong

Texas Plant Disease Diagnostic Lab
1500 Research Parkway, Suite A130
College Station, TX 77845
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Plant Pathologist - Domestic Identifier
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Department of Plant Pathology
Kansas State University
4024 Throckmorton Plant Sciences
Manhattan, Kansas 66506-5502
Office: (785) 532-134, Cell: (785) 633-9117, Fax: (785) 532-5692

Follow the instructions in Phytoplasma sample submission for Cooperative Agricultural Pest Survey (CAPS) Program and Farm Bill Goal 1 surveys FY 2014.

The identifier for *Coconut cadang-cadang viroid* (CCCVd) is:

Rosemarie Hammond
Molecular Plant Pathology Laboratory
USDA, ARS, Beltsville, Maryland

## Handling and Submission of Suspect Specimens for Identification

**Arthropods:**

Prescreened suspect samples of CAPS arthropod target species must be sent to the state or university insect taxonomist in your state for identification. If there is no such position, and/or if arrangements are not made with the entities listed in the previous section, as a fall-back procedure, the specimens can be sent to the PPQ Area Identifier that covers the geographic area. Consult The Lists of PPQ Identifiers and PPQ National Specialists for contact information. Check their areas of coverage and notify the identifier prior to sending any specimens.

If a state or university taxonomist, or PPQ area identifier, believes the submitted specimen is a species new to the United States or state, and/or a CAPS target species, it is necessary to send the preserved specimens to the USDA-ARS Systematic Entomology Laboratory (SEL) for final confirmation. If an Area Identifier or other taxonomist is uncertain as to the possibility that the specimen is new or a target species, consider sending the specimens first to one of the contacts listed above first, as an intermediate step before forwarding to SEL.

When sending to SEL, be sure to include the PPQ form 391 marked “Prompt” with the sample going forward. Notify and send an electronic copy of the 391 to the PPQ National Identification Services (NIS) Urgent Team at ppq.nis.urgents@aphis.usda.gov,

an e-mail group, with the sample number and date forwarded. If you have any questions, contact your regional survey coordinator or the Domestic Diagnostic Coordinator, Joel Floyd, with PPQ National Identification Service in Riverdale, Maryland.

PPQ identifiers processing domestic samples can notify submitters of non-target and native species identifications without entering the samples in the AQAS database; however, any suspects being forwarded to SEL for final ID must be entered in AQAS prior to sending.

Send the specimen(s) to the following address:

Location Leader
Systematic Entomology Laboratory
Attn: Communication and Taxonomic
Services Unit
Building 005, Room 137, BARC-West
10300 Baltimore Avenue
Beltsville, MD 20705
Phone number for overnight carrier airway bill (301) 504-7041

The specimens will be routed by the SEL location leader to the appropriate specialist for final confirmation. Communications of identification results will be through the PPQ NIS domestic diagnostics coordinator in Riverdale, Maryland.

**Pathogens:**
For lethal yellowing of palm follow: Phytoplasma sample submission for Cooperative Agricultural Pest Survey (CAPS) Program and Farm Bill Goal 1 surveys FY 2014.

For red ring nematode and coconut cadang-cadang viroid the screening laboratory is the confirmation laboratory. NIS and CPHST Beltsville will be notified of any suspect positives and/or confirmed positive samples.

## Communication of Results

Native or non-target species identifications will be communicated directly back to the state taxonomist, identifier, or originator of the sample. If the insect or pathogen is confirmed by SEL or the approved pathogen confirmation laboratories as a CAPS target species or new pest to the United States, the Domestic Diagnostics Coordinator will contact the National Survey Coordinator of the identification. The notification will then go to PPQ Policy Management and Field Operations managers and the SPHD and SPRO. One of them will then forward the confirmation to the originator of the sample and other state CAPS personnel. Confirmations of CAPS targets or new species to the United States can then be entered in the NAPIS system.

# References

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