Tropical Hosts Commodity-based Survey Reference

2016 Version

Cover image:
A banana (*Musa acuminata*) tree, La Palma, Canary Islands. Photo taken by Michael Apel, CC-BY-SA-3.0 (http://creativecommons.org/licenses/by-sa/3.0/), via Wikimedia Commons.

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Individual Pest Datasheet Reviewers:
Many individuals have provided feedback, comments, and suggested changes to the pest datasheets. In addition, these individuals have provided information on survey and identification methods and supplied images. Their help was instrumental in the completion of the Tropical Hosts Commodity-based Survey manual. See each pest datasheet for the specific reviewers of each datasheet.

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Tropical Host Commodity Survey Reference
Table of Contents

How to Use This Manual

I: Introduction

The first section of this manual describes the purpose of the Tropical Hosts Commodity-based Survey Manual. This section provides background information about tropical commodities, including production and usage, why tropical commodities are important, and where they are grown in the United States. This section also lists the pest species targeted in this survey and their current distribution within the United States, including tropical regions.

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 located as separate links on the CAPS Resource and Collaboration site manuals page under Tropical Reference (http://caps.ceris.purdue.edu/survey/tropical-hosts/reference/2016) and on the Tropical Reference page (http://caps.ceris.purdue.edu/survey/tropical-hosts/reference/2016/introduction).

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.

II: Planning a Survey

This section describes how to plan a Tropical Hosts Commodity-based Survey and includes information on the Approved Methods for Pest Surveillance and identification/diagnostic methods for each of the eight tropical pests. General information is provided on survey sites, survey season, and the approved traps.

States should consider a pathway approach when deciding on which pests to include in their respective Tropical Hosts Commodity-based Surveys. 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 tropical pest surveys.

IV: Conducting the Survey

This section gives specific information on how to conduct a survey for tropical 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 Processing, Sorting, and Submission

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

I: Introduction

Purpose

The purpose of the Tropical Hosts Commodity-based Survey manual is to provide additional pest targets for tropical states and territories which have had difficulty finding relevant CAPS Priority Pests in the past. The hosts and climate of these areas are vastly different from those of the continental United States. The crops of importance to these areas (avocado, banana/plantain, cocoa, coffee, mango, etc.) are not grown in many states in the continental United States; therefore, pest's specific to these crops may not be of concern to the continental United States. This manual consists of pests which may impact the following tropical regions: American Samoa, Guam, Hawaii, Puerto Rico, and the U.S. Virgin Islands. States within the continental United States may also survey for these pests if the pests are of priority to their state and they have susceptible hosts.

To develop the pest list for this manual, the CPHST CAPS Support Team asked for suggestions from stakeholders in these geographic areas. To be considered for the manual, the pests had to conform to the following parameters:

1) Pests have to be high-impact pests to tropical hosts such as avocado, banana/plantain, cocoa, coffee, mango, other tropical fruits, etc.
2) Pests have to be exotic to at least two of the four tropical areas (American Samoa, Guam, Hawaii, or Puerto Rico/U.S. Virgin Islands). Puerto Rico and the U.S. Virgin Islands were grouped together due to their close proximity.
3) Pests cannot be widely distributed in the continental United States (present in three or more states).

The purpose of the Tropical Hosts Commodity-based Survey is to detect new infestations of target tropical pest species at low population levels. This document provides standardized guidelines for conducting a tropical host survey in the United States and its territories. Surveys are planned and coordinated through each Plant Protection and Quarantine, State Plant Health Director's office and state cooperators (State Departments of Agriculture). The goals of the Tropical Hosts Commodity-based Survey are to obtain information about:

- The presence, distribution, or absence of the target species;
- Patterns of distribution throughout the United States;
- Possible pathways for introduction of target species.

The following elements are pivotal to the success of the Tropical Hosts Commodity-based Survey:

- Survey activities in and around high-risk areas;

- Timely and accurate data reporting;

Background

Introduction to Tropical Commodities

Avocado
Avocado (*Persea americana*) is a stone fruit that is thought to have originated in Mexico and Central and South America. Avocado trees were first planted in Florida in 1833 and then in California in 1856 (AGMRC, 2013). Globally, the majority of avocados are grown in Central and South America, but production has increased in Asia in recent years. In 2011, Mexico was the number one avocado-growing country, producing about 40% of the global harvest. The United States was ranked fifth in the world in avocado production in 2011 (FAO, 2013).

In the United States, avocado production acreage was 64,700 acres in 2013 (57,300 acres in California, 7,000 acres in Florida, and 400 acres in Hawaii) (USDA-NASS, 2015). In 2012, Puerto Rico had 225 acres of avocado (USDA-NASS, 2012). The total value of the 2011 U.S. avocado harvest was over $490 million (AGMRC, 2013). In the United States, per person consumption of avocados has followed a generally increasing trend since 1970, increasing significantly from 1.1 pounds per capita in 1989 to a record 4.5 pounds per capita in 2011 (AGMRC, 2013).

Banana/Plantain
Bananas, possibly the first fruit on earth, likely originated in the jungles of Southeast Asia. They grow in the tropical "Banana Belt" between 30° North and South latitude. There are two main types: the table banana and the plantain (cooking banana). There are almost 1,000 varieties of bananas and plantains. Bananas are a valuable cash crop grown on large plantations for export and an essential staple food for many developing countries. In 2013, over 107 million tons of bananas were produced worldwide (FAO, 2013).

Banana is an important crop in Hawaii and Puerto Rico. In 2013, it was grown commercially on 900 acres in Hawaii, and total production was 7,300 fresh tons at a value of $13 million (USDA-NASS, 2015). In Puerto Rico, 6,447 acres of banana and 22,063 acres of plantain were grown in 2012, at a value of $12.1 and $80.5 million respectively (USDA-NASS, 2012).

Cocoa (Cacao)
The cocoa tree (*Theobroma cacao*) is a small evergreen in the family Malvaceae (mallows family), native to the deep tropical regions of Central and South America. Cocoa beans are used to make cocoa mass, cocoa powder, and chocolate. The Olmec civilization in Mexico (1500-400 BC) was likely the first group of humans to consume cocoa and even used cocoa beans as a monetary unit (WAF, n.d.). Cocoa was first introduced to Europe by Hernando Cortez in 1528, and its popularity quickly spread

throughout the continent. During the 1800s, European countries began to increasingly colonize Africa and brought the cocoa tree with them. Since the start of the 20th century, Africa has taken the lead and has become the world's primary cocoa producer (WAF, n.d.). The top five cocoa bean-producing countries in 2013 were: Cote d'Ivoire, Ghana, Indonesia, Nigeria, and Cameroon (FAO, 2013).

Commercial production of cocoa in U.S. tropical regions is currently limited to American Samoa and Hawaii. Cocoa beans were grown in 2008 on 793 farms in American Samoa with a harvest of 214,840 pounds of beans for consumption (USDA-NASS, 2015). Hawaii has recently experienced a resurgence of interest in cocoa cultivation by growers (HDOA, 2009). It is estimated that there are 50 acres of cocoa trees statewide, and the potential growth of cocoa acreage is estimated at up to 3000 acres (HDOA, 2009).

Coffee

Coffee is one of the most valuable primary products in global trade, in many years second in value only to oil as a source of foreign exchange to producing nations. Cultivation, processing, trading, transportation, and marketing of coffee provide employment for hundreds of millions of people worldwide. Coffee is a crucial part of the economies and politics of many developing countries. For many of the world's least developed countries, exports of coffee account for over 50 percent of their foreign exchange earnings. Coffee is a traded commodity on major futures and commodity exchanges, most importantly in London and New York (ICO, 2015).

Coffee is grown commercially in Hawaii and several U.S. territories, including the Mariana Islands, Puerto Rico, and the U.S. Virgin Islands. In 2014, coffee was commercially harvested on a total of 7,900 acres in these tropical regions, producing 8.1 million pounds of unroasted coffee beans valued at $54.2 million (USDA-NASS, 2015).

Macadamia

The macadamia nut tree (*Macadamia* spp.) is indigenous to the Brisbane area on the eastern shore of Australia and was first introduced to Hawaii in 1881. Hawaii is now the second largest macadamia nut producer in the world behind Australia (Crop Knowledge Master, n.d.). The kernel is the main product from the macadamia nut tree. Kernels are commonly sold as snack nuts and chocolate-covered candy. In addition, oil from culled nuts is used for cooking and in the cosmetic industry. The shell and husk also have uses. Shells can be used as mulch, fuel for processing macadamia nuts, planting medium for anthurium culture, plastic manufacture, and as a substitute for sand in the sand-blasting process. Husks are used as mulch or composted for fertilizer (Crop Knowledge Master, n.d.).

In 2014, macadamia nut was grown on 16,000 acres in Hawaii, and the crop yield was 20,000 tons at a value of $35 million (USDA-NASS, 2015). Macadamia nut trees are also grown in California and Florida, with an estimated total 3,000 acres in those two states. Roughly half of the world's macadamia nuts are consumed in the Unites States (AgAlert, 2008).

Mango

Mango is one of the most important fruit crops worldwide. Originally from the Hindo-Berma region of Southeast Asia, mango has since spread to all tropical regions of the world and is widely consumed. Mango is a staple in the cuisines of the tropical and subtropical countries where it's grown, from Southeast Asia to South America (NMB, 2013). The top producers of mango worldwide are India and China (FAO, 2013). Consumer demand for fresh mango in the United States continues to grow. Mango consumption has increased 32% since 2005 to an estimated 2.47 pounds per year. Import volume for 2012 was 804 million pounds (NMB, 2013).

Commercial production of mango occurs in tropical regions of the United States. In 2012, mango was grown on 3,120 acres in Puerto Rico (USDA-NASS, 2012). Fruit-bearing and non-bearing mango acreage in the United States as of 2012 was 3,006 acres, all in California, Florida, Hawaii, and Texas. The majority of this acreage is in Florida (USDA-NASS, 2012; USDA-NASS, 2015).

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 tropical regions of the United States (regions include: Hawaii, the Caribbean, and Pacific territories) but not necessarily every tropical region. Specific pests, however, should only be surveyed for in regions 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 for Survey** and **Table 2. Target Arthropods for Survey**).

Table 1. Target Pathogens for Survey

Scientific Name	Common Name	Type of Pest	U.S. Distribution
Ceratocystis manginecans	Mango sudden decline	Fungus	Exotic to all of United States
Fusarium oxysporum f.sp. *cubense* Tropical Race 4	Panama disease (Tropical Race 4)	Fungus	Exotic to all of United States
Hemeleia vastatrix	Coffee leaf rust	Fungus	Puerto Rico, American Samoa
Neofusicoccum mangiferae	Fruit rot of mango	Fungus	Puerto Rico

Table 2. Target Arthropods for Survey

Scientific Name	Common Name	Type of Pest	U.S. Distribution
Conogethes punctiferalis	Castor capsule borer	Moth	Hawaii
Gymnandrosoma auratianum	Citrus fruit borer	Moth	Puerto Rico
Paratachardina pseudolobata	Lobate lac scale	Scale insect	Florida, Hawaii (only O‘ahu), Puerto Rico
Stenoma catenifer	Avocado seed moth	Moth	Exotic to all of United States

II. 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 target 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) climatic suitability of your state/territory for the target; 4) resources available (financial and staff) for survey and identification of the pest (see **Table 3. Target Pests by Approved Survey Method**); and; 5) the status/importance of a particular pest to your state/territory.

Table 3. Target Pests by Approved Survey Method

Scientific Name	Common Name	Approved Survey Method	Approved Identification/Diagnostic Method
Ceratocystis manginecans	Mango sudden decline	Visual	Morphological
Conogethes punctiferalis	Castor capsule borer	Trap & Lure	Morphological
Fusarium oxysporum f.sp. *cubense* Tropical Race 4	Panama disease (Tropical Race 4)	Visual	Species level: Morphological Race: Molecular confirmation
Gymnandrosoma auratianum	Citrus fruit borer	Trap & Lure	Morphological
Hemeleia vastatrix	Coffee leaf rust	Visual	Morphological
Neofusicoccum mangiferae	Fruit rot of mango	Visual	Morphological
Paratachardina pseudolobata	Lobate lac scale	Visual	Morphological
Stenoma catenifer	Avocado seed moth	Trap & Lure	Morphological

Approved Methods for Pest Surveillance webpage

The Approved Methods for Pest Surveillance webpage, (https://caps.ceris.purdue.edu/node/223) lists the most up-to-date approved methods for survey and identification/diagnostics of CAPS target pests. This page lists approved methods for pests from the Priority Pest List, consisting of pests from 1) commodity- and taxonomic-based surveys, and 2) the Pests of Economic and Environmental

Importance list. The information on the Approved Methods pages supersedes any survey and identification/ diagnostic information found in any other CAPS document. Changes are first made on the Approved Methods pages. CAPS documents are revised to reflect these changes as soon as possible; however, the Approved Methods page should always be the authoritative source for the most up-to-date, Approved Methods for Pest Surveillance. To access the Approved Methods information, go to the Approved Methods home page and select the survey year. From there, you can select the individual CAPS pest of interest by clicking on the "info" button to the left of the pest name.

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 and the climatic suitability of the targets should be considered when planning a survey. Each pest datasheet within the manual gives specific guidance on the hosts, biology, symptoms/signs, pathway, and climatic suitability of the target.

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, survey near the preferred hosts for the target species. Consult the individual pest datasheets for this information.

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. See the specific pest datasheet for each pest to help determine the time of year to survey for each pest/pest type.

Trap Types

Traps are recommended based on the biology of the target pest. Refer to **Table 4. Tropical Pest Trap and Lure Combinations** for the trap and lure product names as they appear in the IPHIS Survey Supply Ordering System. The two trap types recommended for targets in the Tropical Hosts survey are:

- Large plastic delta traps
- Wing traps

Large plastic delta traps (Fig. 1)
Large plastic delta traps can be ordered 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 any target species in this survey. Large plastic delta traps are available with a disposable adhesive 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.

Figure 1. Large plastic delta trap (Image courtesy of John Crowe, USDA-APHIS-PPQ).

Wing traps (Fig. 2)
Wing traps are available in either a plastic or paper version. Plastic and paper traps are both equally effective and the state may decide which trap to use. Wing traps have a disposable adhesive liner. When using a wing trap, the lure (a rubber septum) should be placed inside a lure holder, which is usually included with the trap. The lure holder should be stapled to the underside of the top of the trap on a non-sticky area. This trap can be ordered through the IPHIS Survey Supply Ordering System.

Review each pest datasheet for additional guidance or trap modifications for the specific species.

Figure 2. Wing trap (Image courtesy of John Crowe).

Table 4. Tropical Pest Trap and Lure Combinations

Target Species	Lure Product Name	Trap Product Name
Conogethes punctiferalis	*Conogethes punctiferalis* Lure	Large Plastic Delta Trap Kits (Orange, Red, or White)
Gymnandrosoma auratianum	*Gymnandrosoma aurantianum* Lure	Large Plastic Delta Trap Kits (Orange, Red, or White)
Stenoma catenifer	*Stenoma catenifer* Lure	1) Wing Trap Kit, Paper or 2) Wing Trap Kit, Plastic

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

III. Ordering Traps and Lures

All traps and lures for the Tropical Hosts 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.

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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IV. 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. 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. 3). It is important to note that none of these symptoms/signs, taken singly, are a diagnostic feature for any pest.

Figure 3: Top. A banana plant with leaf yellowing and wilting (a symptom). Courtesy of Miguel Dita/Bioversity International, http://www.musarama.org/ **Bottom**. Example of eggs and neonate larvae (a sign). Photo courtesy of http://www.defra.gov.uk/planth/pestnote/spod.htm

In the context of the current survey, surveyors should take note of the general condition of the plant and further examine the stems, leaves (both sides), 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), necrosis (brown/dead tissue), feeding holes, or a generally unhealthy appearance. If no symptomatic plants are present, the surveyor should choose plants to examine based on convenience or at random. 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. Visual surveys may be conducted during these trap-servicing visits as appropriate. There are five pests in the Tropical Hosts Survey that have visual survey as a CAPS-approved method (see **Table 5. Tropical Pest Visual Survey**).

Table 5. Tropical Pest Visual Survey

Scientific Name	Symptoms/Damage & Signs to Look For[1]
Ceratocystis manginecans	Symptoms on affected mango trees include discoloration/ dark staining of the vascular tissue, gum exudation, galleries of the beetle vector of the pathogen, leaf wilting, and ultimately tree death. The majority of diseased trees develop large, conspicuous trunk cankers where the bark appears darker than normal. Beneath the affected bark, underlying tissue is often discolored brown to black.
Fusarium oxysporum f.sp. *cubense* Tropical Race 4	Yellow and wilted leaves are typical symptoms of affected banana. The yellowing typically progresses from the older to the younger leaves. The yellow leaves may remain erect or collapse at the petiole and hang down along the pseudostem. The first internal symptom, a reddish brown discoloration of the xylem, develops in feeder roots, the initial sites of infection. Vascular discoloration progresses to the rhizome, is most prominent where the stele joins the cortex, and ultimately proceeds up to and includes large portions of the pseudostem. On plants that are more than four months old, the oldest leaves yellow or split longitudinally at the base. Eventually younger and younger leaves wilt and collapse until the entire canopy consists of dead or dying leaves. Banana suckers that are less than about four months old do not develop visible symptoms. The fruit of the banana plant also does not show any specific disease symptoms. **Surveys for Tropical Race 4 should only occur in "Cavendish" banana cultivars.**
Hemeleia vastatrix	Infections occur on the coffee leaves. The first observable symptoms are small, pale yellow spots on the upper surfaces of the leaves. The spots continue to increase in diameter. While the lesions can develop anywhere on the leaf, they tend to be concentrated around the margins, where dew and rain droplets collect. The centers of the spots eventually dry and turn brown, while the margins of the lesions continue to expand and produce urediniospores. Early in the season, the first lesions usually appear on the lowermost leaves, and the infection slowly progresses upward in the tree. The infected leaves drop prematurely, leaving long expanses of twigs devoid of leaves. Masses of orange urediniospores appear on the undersurface of leaves with spots on the upper leaf surface and are a common sign of

	disease. The powdery lesions on the undersides of the leaves can be orange-yellow to red-orange in color, and there is considerable variation from one region to another. In old lesions, often a white cottony growth can be found, caused by the hyperparasite *Lecanicillium lecanii*. Significant reduction in photosynthetic rate can radically affect plant functions such as floral initiation and root and shoot growth. This can be followed by death of branches or even of the whole plant. Thus, yield loss is usually indirectly related to the severity of the disease. Reduced photosynthesis limits the amount of woody tissue growth that gives rise to the next season's crop; therefore, the following season's crop is reduced.
Neofusicoccum mangiferae	On mango, *Neofusicoccum mangiferae* and related *Dothiorella* spp. produce "tearstained" patterns and localized lesions that appear as discrete, dendritic, superficial spots on fruit. Necrosis remains beneath the cuticle and penetrates the entire fruit within several days at 25°C (77°F). Superficial mycelium appears around the pedicel or through ruptures in the skin or directly through the epidermis. A brown liquid can exude from the stem end or from surface ruptures. These symptoms and lesions result from airborne or windborne inocula. Stem-end rot fungi in mango are also associated with twig and branch dieback. Infected avocados develop smooth, brown, circular spots first on the surface of harvested fruits. The fungus is generally isolated from the margin of lesions and could also be found from symptomless fruit pedicles and stems.
Paratachardina pseudolobata	This scale insect is typically found on woody portions of twigs and small branches and, less frequently, main stems. *Paratachardina pseudolobata* has not been observed on foliage. Female adult scale insects are crowded and form a contiguous mass that appears to be a dark lumpy crust. Sooty mold covers the branches with insects, occurring in patches on the foliage. Particular attention should be placed on woody areas of the plants with sooty mold. Wax myrtle is highly susceptible. Check for infestations on wax myrtle in the area. In Hawaii, surveys have been focused on urban landscapes, where *Paratachardina pseudolobata* infestations have been most severe. At a survey location, all ornamental plants and shade trees should be inspected. When *Paratachardina pseudolobata* infestations are heavy, the plants may have a black color (because of the sooty mold associated with the pest). This may able to be observed from a distance. Closer inspection is then required to confirm presence of the pest. Visual inspection should be focused on twigs less 2 cm ($^{13}/_{16}$ in) in diameter.

	If permission can be obtained from the property owner, a tree pruner may be used to collect twigs for inspection. This is especially helpful for large/tall shade trees (like banyans, which are the primary hosts for *P. pseudolobata* in Hawaii).

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

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. Often times, trap efficiency is 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 Tropical Hosts Survey, there are three insect targets that have an approved trap and lure combination. See **Table 4: Tropical Pest Trap and Lure Combinations** for information on which traps to use with each target species.

Trap Sites

When choosing a site for traps, select a site that is large enough to hold all the traps that will be placed there.

Trap Placement

Many of the target species listed in this manual are polyphagous and could potentially be found in multiple types of environments. Surveys could occur in commercial tropical crops (either in the field or in greenhouses when relevant) or in residential/urban areas where tropical hosts are grown or sold (community gardens/garden centers).

- Survey sites should have host species of the target species.
- 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.

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

Lure Handling

Care should be taken to avoid contaminating external surfaces of traps with the attractant (lure) or cross-contaminating traps with attractants (lures) of different species (Lance, 2006). For example:

- Use latex or latex-substitute gloves when handling lures;
- Minimize direct contact with lures;
- Do not touch external portions of traps with gloves that have contacted lures; and

- At a minimum re-glove after handling lures for one species before handling traps or lures for another.

Lure Storage

Inspect lures upon receiving them from the manufacturer. Notify the appropriate National Operations Manager of any lures that are damaged and request replacement lures. Store lures as directed by the manufacturer until used. It is generally acceptable to store lures for different species in the same freezer if they are doubly contained in factory-sealed packages that are, in turn, held separately by species in a secondary closed container such as a glass jar or re-sealable plastic bag (Lance, 2006).

Lure Changing

The length of effectiveness of lures is usually reported by lure manufacturers assuming temperatures of 30°C (86°F) during the day and 20°C (68°F) at night for a daily average of 25°C (77°F) under laboratory conditions. However, release rates of many lures are dependent on several factors including temperature, humidity, and other environmental conditions. Therefore, the length of effectiveness of lures may be reduced in hot and dry climates. In this manual, CAPS has listed a conservative length of effectiveness that should be effective for even the warmest climates in the United States (see **Table 6. Length of Effectiveness for Tropical Pest Survey Lures**). However, if you notice reduced non-target captures in your traps while the lure should still be effective, go ahead and change the lure and decrease the number of weeks between lure changes. In addition, notify Lisa Jackson (lisa.d.jackson@aphis.usda.gov) of this problem.

Table 6. Length of Effectiveness for Tropical Pest Survey Lures

Target Species	Lure Product Name	Length of Effectiveness
Conogethes punctiferalis	*Conogethes punctiferalis* Lure	28 days
Gymnandrosoma auratianum	*Gymnandrosoma aurantianum* Lure	28 days
Stenoma catenifer	*Stenoma catenifer* Lure	28 days

Checking Traps

- Check traps every two weeks or after bad weather events (rain, strong winds, or snow) which can disturb the sample.
- Examine traps for damage.
- Remove any debris blocking entrances, including leaves, twigs, spider webs, etc.
- Ensure that all lures are still in place.

- 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 Tropical Pest Survey Lures**).

Trapping Season

The trapping period will be the period of expected flight activity of adult arthropods. Traps should be placed in the field as soon as adult flight activity is expected to begin and remain throughout the active period. Actual trapping seasons may vary by location and target species. Refer to individual pest datasheets to determine the trapping season for each target. Flight period descriptions in the datasheets are usually based on the flight season in the pest's native range. The country/region is listed in the datasheet. States should compare the hardiness zones of these regions to the hardiness zones of their state to determine the predicted flight period in their state. Degree Days may also be used, where listed.

V. Sample Processing, Sorting, and Submission

Consult the most recent version of the "Sample Submission Guidelines" for information on how to process and submit survey samples. This document is available in each year's version of the CAPS Guidelines found here.

Screening Specimens

Screeners should have had some training in recognition of common native tropical pests. Familiarity with the CAPS target species is also helpful. Work with your state or university taxonomists for individual training and consult the screening aids that are available for some groups at: https://caps.ceris.purdue.edu/node/34.

For states without screening ability, there are PPQ domestic identifiers and several other options. If your state would like to take advantage of the arrangements listed below to receive unscreened samples, please contact your PPQ Program Manager (Brian Kopper) for more information prior to the trapping/survey season.

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

Domestic Identifiers for arthropods:
Western United States
Kira Metz
412 Minnie Belle Heep
2475 TAMU
College Station, TX 77843
979-450-5492
Kira.Metz@aphis.usda.gov

Eastern United States:
Julieta Brambila
CAPS Office
USDA, APHIS, PPQ
1911 SW 34th Street
Gainesville, FL 32608
352-372-3505 ext. 438
Julieta.Brambila@aphis.usda.gov

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 a new or target species, consider sending the specimens first to one of the contacts listed above, as an intermediate step before forwarding to SEL.

When sending to SEL, be sure to include the PPQ form 391 (see Appendix B or use the fillable form available at: http://www.aphis.usda.gov/library/forms/pdf/PPQ_Form_391.pdf) 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 the National Field Operations Manager for Pest Detection or the Domestic Diagnostic Coordinator (addresses below);

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

Vacant (information will be updated when available)
Domestic Diagnostics Coordinator
USDA, APHIS, PPQ National Identification Services
Riverdale, MD 20737

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 that are forwarded to SEL for final identification must be entered into 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:
Prescreened suspect samples of CAPS pathogen target species must be sent to the state or university 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 samples to the CPHST Beltsville Laboratory for final confirmation.

When sending to CPHST Beltsville, be sure to include the PPQ form 391 (see Appendix B or use the fillable form available at http://www.aphis.usda.gov/library/forms/pdf/PPQ_Form_391.pdf) 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 the National Field Operations Manager for Pest Detection or the Domestic Diagnostic Coordinator (addresses below);

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

Vacant
Domestic Diagnostics Coordinator
USDA, APHIS, PPQ National Identification Services
Riverdale, MD 20737

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 that are forwarded to CPHST Beltsville for final ID must be entered in AQAS prior to sending.

Send the specimen(s)/samples to the following address:

Sample Diagnostics:
USDA-APHIS-PPQ-CPHST
BARC-East, Bldg. 580
Powder Mill Road
Beltsville, MD 20705-2350
301-504-7100
Group E-mail Address: APHIS-PPQCPHSTBeltsvilleSampleDiagnostics@aphis.usda.gov
Communications of identification results will be through the PPQ NIS domestic diagnostics coordinator in Riverdale, Maryland.

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/pathogen is confirmed as a CAPS target species or new pest to the United States, the Domestic Diagnostics Coordinator will alert the National Survey Coordinator of the identification. The notification will then go to PPQ Policy Management and Field Operations program managers, and the SPHD and SPRO of the state of origin. One of these individuals 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.

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Appendix: PPQ Form 391

According to the Paperwork Reduction Act of 1995, an agency may not conduct or sponsor, and a person is not 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 0579-0377. 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.

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.

OMB APPROVED
0579-0010
EXP. DATE
02/2017

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE

SPECIMENS FOR DETERMINATION

Instructions: Type information requested. Block 1 – assign a number for each collection using your own numbering convention or use the following example by beginning with the year, followed by the collector's initials and the collector's number. Example: 14-JJD-001.

Pest Data Section – Complete Blocks 14, 15 and 16. Complete Items 17 and 18 if a trap was used.

LOT NUMBER

PRIORITY
☐ URGENT
☐ PROMPT
☐ ROUTINE

1. COLLECTION NUMBER

2A. DATE - SUBMISSION: MONTH | DAY | YEAR

2.B. DATE - COLLECTION: MONTH | DAY | YEAR

3. SUBMITTING AGENCY
☐ State Cooperator ☐ University ☐ APHIS PPQ
☐ Other:

SUBMITTER AND ORIGIN

4A. NAME OF SUBMITTER

4B. NAME OF COLLECTOR

5. ADDRESS OF SUBMITTER

ZIP

EMAIL ADDRESS OF SUBMITTER

INTERCEPTION SITE

6. TYPE OF PROPERTY (FARM, RESIDENCE, NURSERY, ETC.)

7. NAME AND ADDRESS OF PROPERTY OWNER

CITY | COUNTY | STATE

LATITUDE | LONGITUDE

PURPOSE

8. REASON FOR IDENTIFICATION ("X" all applicable items)

A.	Biological Control (Target Pest Name _____)	E.	Export Certification
B.	Damaging Crops/Plants	F.	Targeted Survey (Pest Name _____)
C.	Suspected Pest of Regulatory Concern *(Explain in REMARKS)*	G.	Smuggling Interdiction/Trade Compliance (SITC)
D.	Stored Product Pest	H.	Other *(Explain in REMARKS)*

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

HOST DATA

10. HOST INFORMATION
NAME OF HOST *(Scientific name and name of cultivar if appropriate)*

11. QUANTITY OF HOST
NUMBER OF ACRES/PLANTS
Plant 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. REMARKS

METHOD
☐ MORPHOLOGY
☐ SYMPTOM
☐ CULTURE
☐ SEROLOGICAL
☐ PCR
☐ SEQUENCING

20. TENTATIVE DETERMINATION | DETERMINED BY | POSITION AND AFFILIATION

21.FINAL DETERMINATION AND NOTES *(Not for Field Use)*

METHOD
☐ MORPHOLOGY
☐ SYMPTOM
☐ CULTURE
☐ SEROLOGICAL
☐ PCR
☐ SEQUENCING

PRINT NAME *(Person Making Final Determination)*

DISPOSITION OF SPECIMEN/SAMPLE
☐ Returned ☐ Retained for Collection/Stored ☐ Destroyed ☐ Transferred to:

SIGNATURE | DATE | LAB CONFORMATION NUMBER | DATE RECEIVED

PPQ Form 391
AUG 2014

Previous editions are obsolete.

INSTRUCTIONS

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

BLOCK	INSTRUCTIONS
1	1. Assign a number for each collection using your own numbering convention or use the following example by beginning with the year, followed by the collector's initials and the collector's number. **EXAMPLE** In 2014, Brian K. Long collected his first specimen of the year for determination. His first collection number is 14-BLK-001 2. Enter the collection number
2A-2B	Enter dates
3	Check block to indicate Agency submitting specimens for identification
4A	Enter name of submitter
4B	Enter name of collector
5	Enter address of submitter
6	Enter type of property specimen obtained from (farm, nursery, residence, etc.)
7	Enter name and address of property owner
8A-8H	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	Provide a brief explanation if Prompt or URGENT identification is requested
20	Enter a tentative determination and who made it
21	Leave blank

Distribution of PPQ Form 391

Distribute PPQ Form 391 as follows:

1. Send Original along with the sample to your Area Identifier or for national confirmation.
2. Retain and file a copy for your records.