MAINTAINING OUR EXPORT ORNAMENTAL MARKETS

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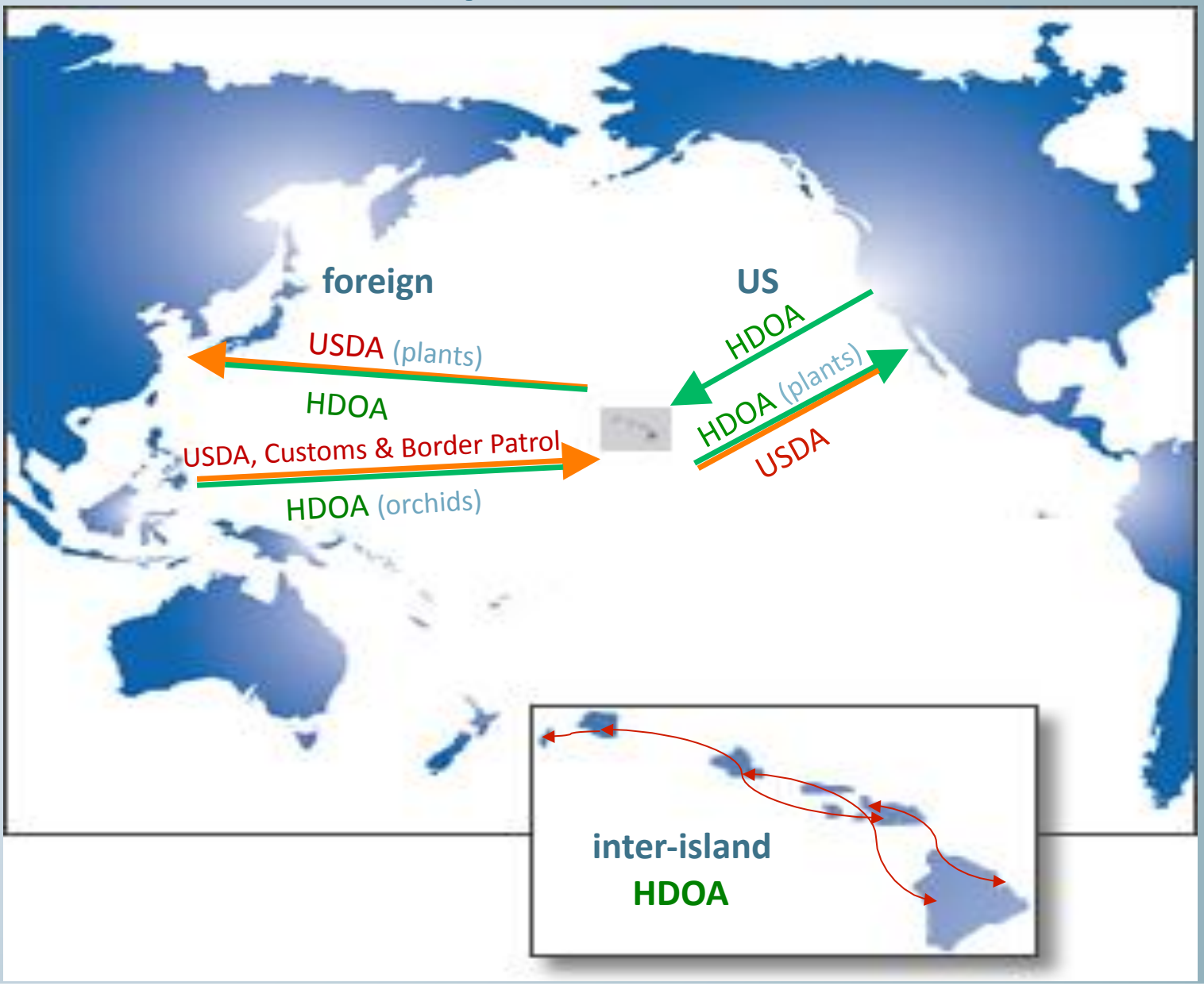
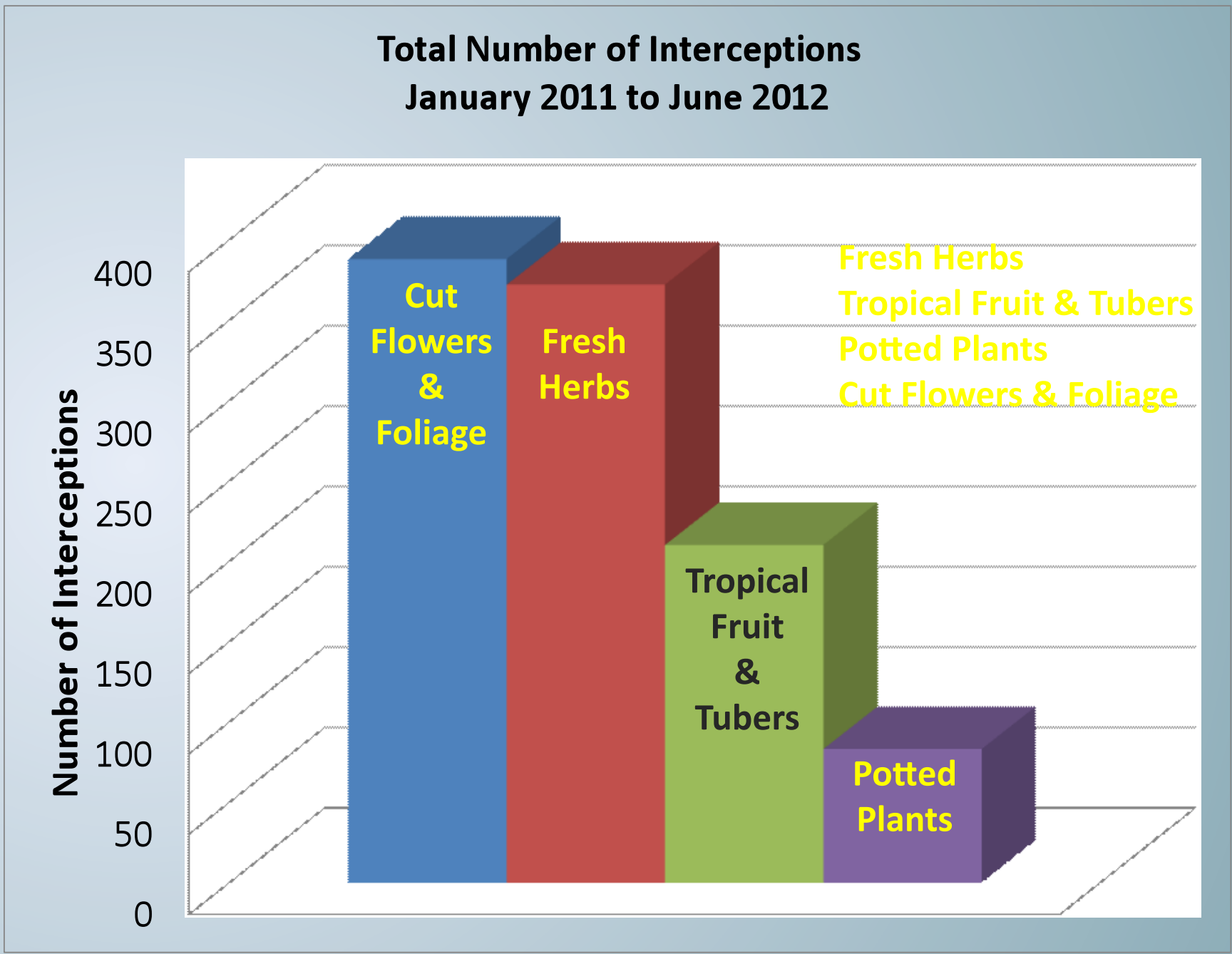
Who Regulates Agricultural Imports & Exports to/from Hawai‘i?



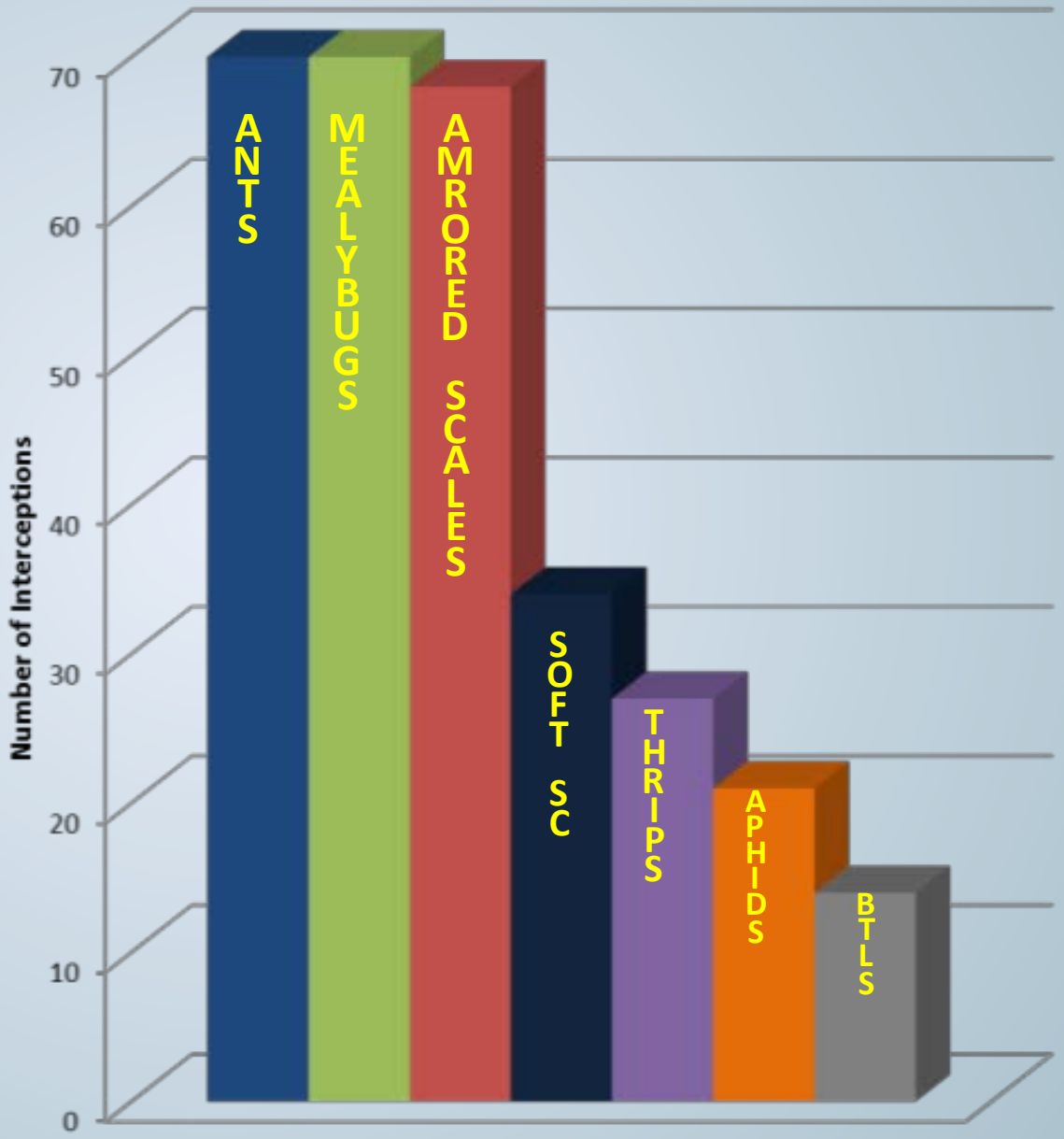
- 15-20 new species of arthropods and mollusks arrive annually
- reasons: transportation hub, island ecosystem with many diverse habitats, mild climate, lack of predators, dependent on imports

image: Michael Markieta


Total Number of Interceptions
January 2011 to June 2012
Number of Interceptions
400
350
300
250
200
150
100
50
0
Cut Flowers & Foliage
Fresh Herbs
Tropical Fruit & Tubers
Potted Plants
Fresh Herbs
Tropical Fruit & Tubers
Potted Plants
Cut Flowers & Foliage

Interceptions on Cut Flowers and Foliage

January 2011 – June 2012



Most Prevalent Species:

Ants:
- *Ochetellus glaber*
- *Pheidole megacephala*
- *Technomyrmex albipes*

Mealybugs:
- *Nipaecoccus nipae*
- *Planococcus citri*
- *Pseudococcus longispinus*

Armored Scales:
- *Abgrallaspis cyanophylli*
- *Pinnaspis buxi*
- *Pseudaulacaspis cockerelli*

Soft Scales:
- *Ceroplastes rubens*
- *Saissetia coffeae*
- *Parasaissetia nigra*

California Department of Food and Agriculture

Sacramento, CA

Division of Plant Health and Pest Prevention Services

Interior Pest Exclusion Program

High Risk Pest Exclusion Reports

- Foreign Plant Shipments
- Hawaii
- Florida
- Incoming Nursery Stock 008s
- Weekly 008 Reports **NEW**
- Monthly High Risk Interception Reports
- Monthly Nematodes Sample Results
- Parcel Facility Locations
- Suspended Out of State Shippers
- Weekly A and Q Report

Hawaii Reports

A, B, Q Weekly Reports (Hawaii Origin Nursery Stock)

Approved Nursery Stock Shippers (QC 650)

Weekly A & Q Interceptions on Cut Flowers, Fruits & Vegetables

FedEx Distribution Center Near San Francisco Airport, San Mateo County

Inspectors Mike, Erin Herbst

- Numerous inspectors on Christmas Eve

- Roses from South America: “low risk”
- Cleanly packed - no shredded newspaper
- Very clean (no pests)

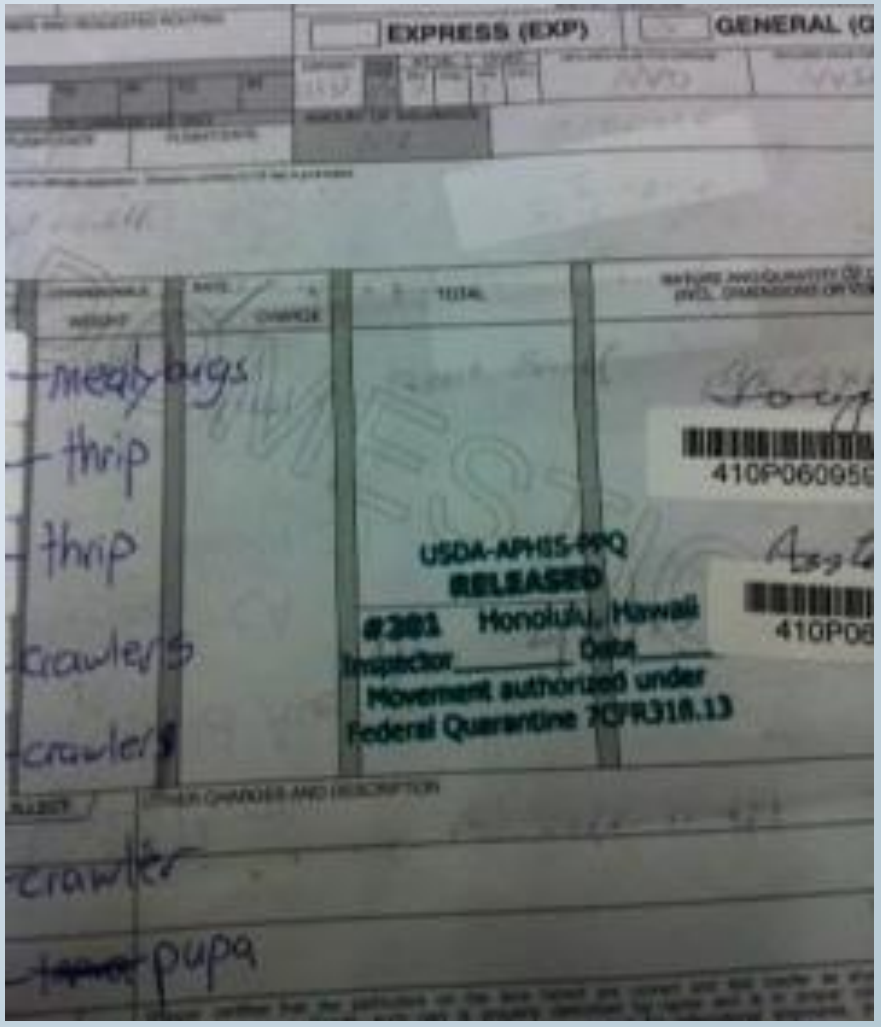
Flowers and foliage from Hawai‘i are considered “high risk”

Inspection at FEDEX Distribution Center in Oakland

With Ken Peek, Senior Agricultural Biologist, **December 21, 2010**

Hawai‘i Basil Inspected in HNL Rejected at SFO Airport

USDA-APHIS-PPQ “RELEASED” stamped shipments of cut flowers and vegetables from sources not under Compliance Agreements are inspected prior to shipment by federal inspectors to determine compliance with federal quarantines.



Basil Inspection at Air Cargo Facility at San Francisco Airport

March 2013

leafminer

beating basil on table surface

Rejection of maile from Hawai‘i that originated from the Cook Islands

cdfa CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
Karen Ross, Secretary

CDFA

ia from July 5-11,
ure's Plant Pest

R: 1626935

Fresno was scheduled for July 6, 2012. Phone conversations with Allegiant Air determined that the garland had originated in Hawaii and was being sent to Fresno Air terminal for good luck on the inaugural Hawaiian flight into Fresno. A sample submitted to the lab came back with a determination of live Q-rated *Orcharnoplatus mammaeferus* (croton whitefly) pupae. The ti leaf garland was double bagged and destroyed.

Fresno Dog Team pictured with infested ti leaves from Hawaii

San Diego County Ag Inspectors

A. Hara gave a presentation to inspectors regarding pest management for potted foliage plants in Hawai‘i to assure pest-free shipments to California.

March 2013

TAKE-AWAY MESSAGES FROM CDFA INSPECTORS

- California considers Hawai‘i “high-risk” for quarantine pests, similar to Florida.
- USDA, Limited Permit Stamps, State Certifications on boxes do not prevent inspections.
- Boxes with Origin Inspection stickers are not inspected as frequently.
- Rubber stamp permits and certificates are often illegible, prompting inspection.
- Invite personnel from CDFA to discuss CA’s origin inspection programs for cut flowers, produce and potted plants with HI inspectors and growers/shippers.
- Public outreach program is needed on shipping clean fresh flowers and foliage to CA (esp. non-growers who ship - florists, weddings, college lu`au, graduations).

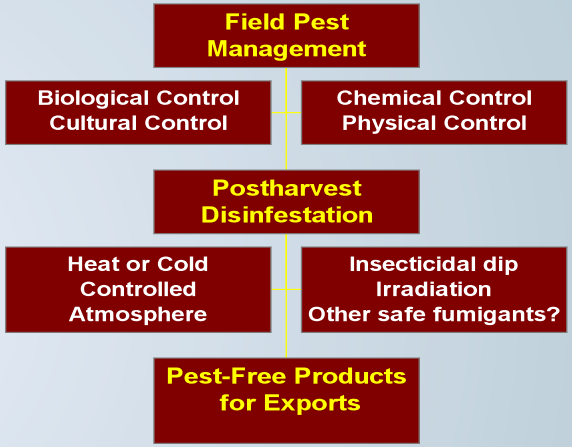
smudged State Certification stamp versus legible Origin Inspection sticker

PEST MANAGEMENT OF ORNAMENTAL CROPS

Systems Approach to Quarantine Security

Systems Approach to Nursery Certification (SANC)

Integrated Pest Management (IPM)



DRACAENA FIELD STOCK

lower leaves stripped

canes cut to various heights, potted, grown under shade

HIBISCUS SNOW SCALE

Scientific name: *Pinnaspis strachani* (Cooley)
Order: Hemiptera Family: Diaspididae (armored scale)
Common names Hibiscus snow scale, lesser snow scale

Snow scale on dracaena cane

HOST PLANTS

Hibiscus snow scale is known to infest over 150 ornamentals and fruit trees, including:

avocado
bird of paradise
carambola
cherimoya
chinaberry
citrus
coconut palm
croton
cycads
dracaena
ferns
geranium
hibiscus
indigenous hi`aloa
jacaranda
lychee
mango
Mexican creeper, native cotton (ma`o)
oleander
pandanus
pikake
plumeria
poinciana
sweet potato
ti
wisteria

DESCRIPTION

The adult female's armor is tough, flat, irregularly oyster shell- or pear-shaped, white or dirty white. The female body is flat, yellow, and an elongated oval shape without wings, legs, or eyes. Males pupate under armor that is white, long and narrow with three ridges running lengthwise. Adult males emerge with wings, eyes, and legs.

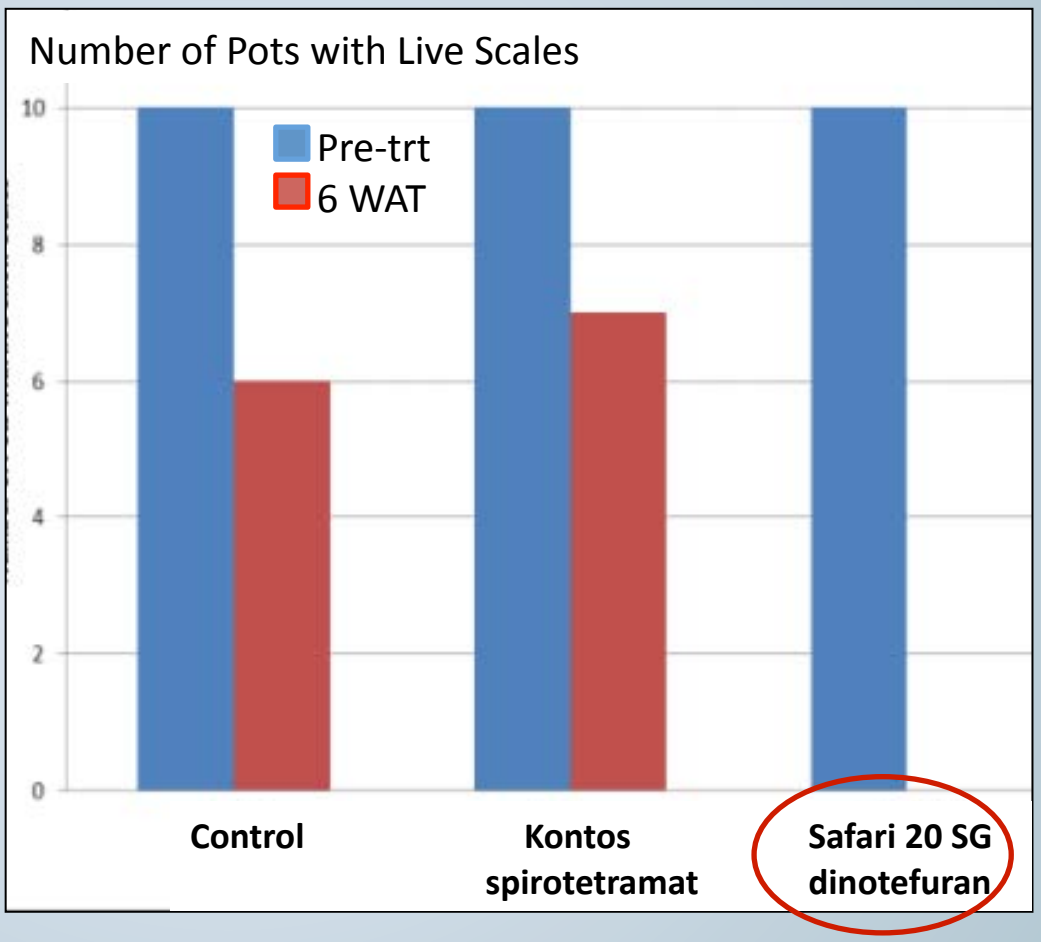
Damage on leaf surface

DAMAGE

Armored scales feed on plant juices and cause loss of vigor, deformation of infested plant parts, yellowish spots on leaf surfaces, loss of leaves, and even death of the plant. Scales can be seen on the underside of leaves beneath a yellowing area, on plant canes or branches.

Scales on underside of leaf

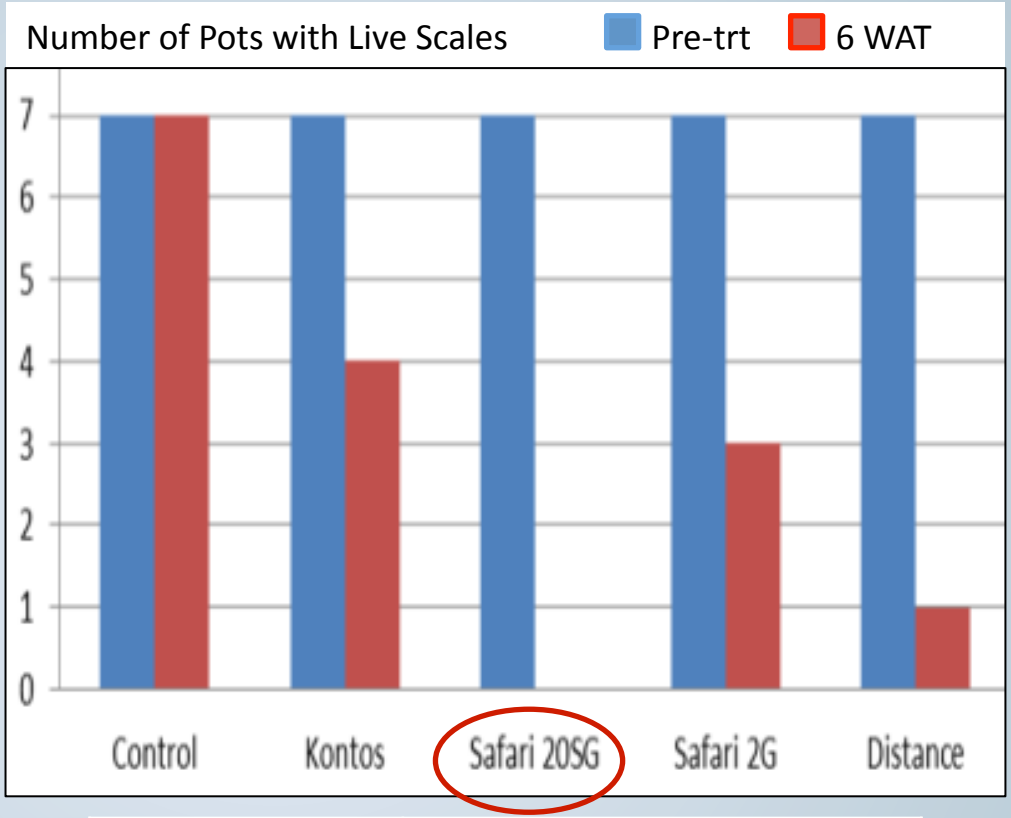
Efficacy of Insecticidal Dips to Control Hibiscus Snow Scale on Tip Cuttings of *Dracaena deremensis* 'Janet Craig Compacta'



Note: There was evidence of parasitism in each treatment group: 27% of untreated canes, 47% of Kontos-treated, and 50% of Safari-treated canes.

- **Pest**: hibiscus snow scale (*Pinnaspis strachani*)
- **Host Plant:** Dracaena 'Janet Craig Compacta'
- **Purpose:** Efficacy of insecticidal dips as a pre-planting treatment for *Dracaena* tip cuttings
- **Treatments:** 30 canes in each treatment, 3 canes planted in 10 pots per treatment
  - Control
  - Kontos (spirotetramat)
  - Safari 20 SG (dinotefuran)
- **Observations:** Plants were checked at 1 and 2 WAT for phytotoxicity, and at 6 WAT for product efficacy.
- **Results**: At 6 WAT, no live scales were found among pots planted with canes dipped in Safari 20 SG.

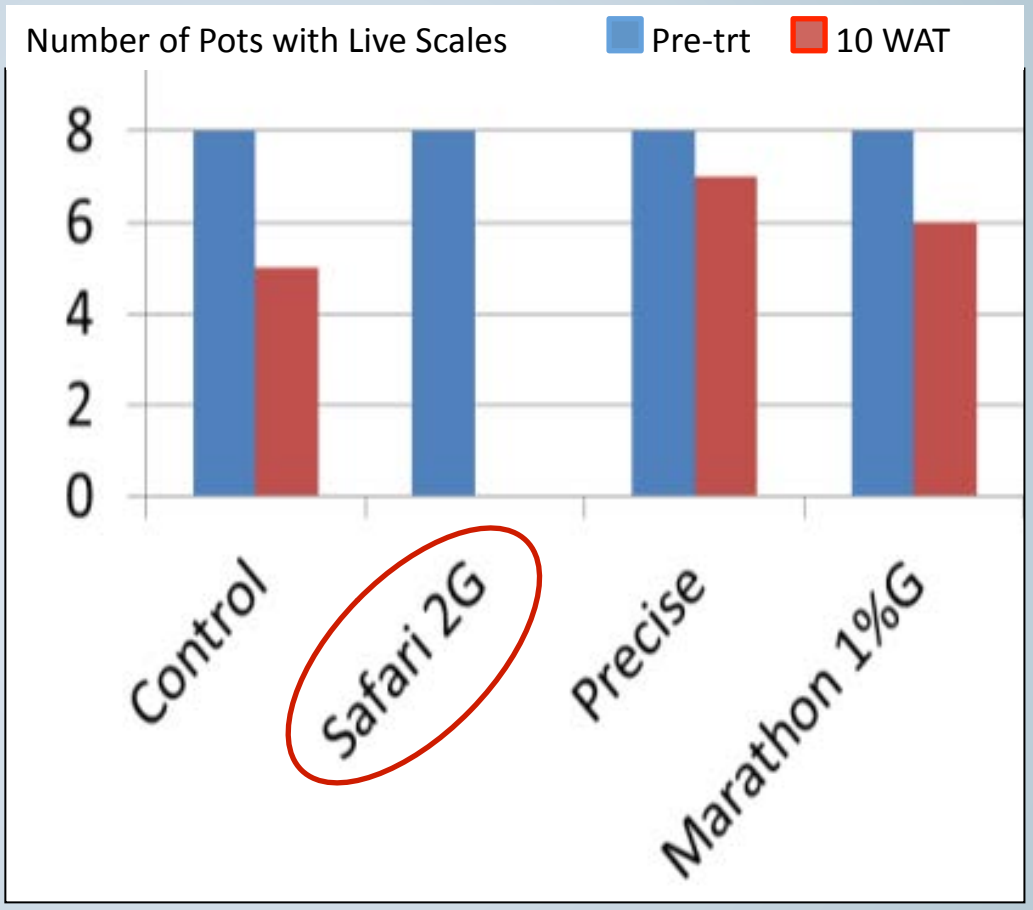
Efficacy of Foliar or Top Dressing Applications to Control Hibiscus Snow Scale on Potted *Dracaena deremensis* 'Janet Craig Compacta'



Treatment	Infestation Rate, % (pots per treatment with live scales)
Control	100
Kontos (foliar)	57
Safari 20SG (foliar)	0
Safari 2G (top dress)	43
Distance (foliar)	14

- **Pest**: hibiscus snow scale (*Pinnaspis strachani*)
- **Host Plant:** Dracaena ' Janet Craig Compacta'
- **Purpose:** Efficacy of insecticidal top dressing or foliar applications on rooted 6-wk old potted *Dracaena*.
- **Treatments:** 21 canes in each treatment: 3 canes in 7 pots per treatment
  - Control
  - Kontos (spirotetramat) foliar
  - Safari 20 SG (dinotefuran) foliar
  - Safari 2 G (dinotefuran) granular top dressing
  - Distance (pyriproxyfen) foliar
- **Observations:** Plants were checked twice a week for phytotoxicity at 1 and 2 WAT, and at 4 and 6 WAT for pesticide efficacy.
- **Results:** Only Safari 20SG (foliar) provided efficacy to meet quarantine requirements.

Efficacy of Three Granular Insecticides to Control Hibiscus Snow Scale on *Dracaena* 'Warneckii'

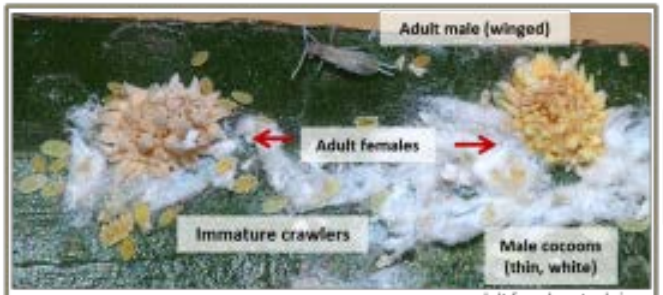


Note: Untreated plants exhibited a decrease in scale populations at 10 WAT due to a high number of predacious insects, which were not visible among other treatments.

- **Pest**: hibiscus snow scale (*Pinnaspis strachani*)
- **Host Plant**: Dracaena 'Warneckii'
- **Purpose**: Efficacy of three granular insecticides against hibiscus snow scale in potted *Dracaena*
- **Treatments:** 32 canes in each treatment: 4 canes in 8 pots per treatment
  - Control (untreated)
  - Safari 2G (dinotefuran)
  - Precise (acephate)
  - Marathon 1%G (Imidacloprid)
- **Observations:** Plants were checked at 1 and 2 WAT for phytotoxicity , and at 10 WAT for pesticide efficacy.
- **Results:** Safari 2G effectively controlled hibiscus snow scale in all treated pots.

COCONUT MEALYBUG

Scientific name: *Nipaecoccus nipae* (Maskell)
Order: Hemiptera Family: Diaspididae
Common names: coconut mealybug, spiked mealybug



adult female actual size

DESCRIPTION

Adult females range between 1.5 and 2.5 mm long, are oval, reddish-brown to orange and covered with yellowish-orange pyramid-shaped wax filaments. Males emerge from very thin, white cottony wax cocoons as adults with wings, eyes, and legs.

HOST PLANTS
Coconut mealybug is known to infest ornamentals and fruit trees, including:

avocado	ginger
bananas	grape
banyan tree	Heliconia
Chamadorea	hibiscus
citrus	kentia
coconut	orchids
coffee	potato
Cycas	rhapis
Dracaena	ti

DAMAGE


Black sooty mold on foliage


Little fire ants farming mealybugs

- Adult females and immatures feed on the sap of the host plant and secrete honeydew, which promotes black sooty mold growth and attracts ants.
- Black sooty mold can reduce photosynthesis and cause defoliation, and occasional death of a young plant.
- Ants defend the mealybugs from predators or parasitoids

LIFE CYCLE/BEHAVIOR

Egg to Reproducing Adult: approximately 1-2 months

Males and **females** cannot be readily distinguished from each other during the **first two instars**, but the **third instar female** begins to resemble the **adult**. When present, **immature males** change within a **pupal cocoon** during the third instar prior to emerging as a **winged adult**.

References: Williams, D.J. & Granara de Willink, M.C. 1992. *Nipaecoccus nipae*. In: Mealybugs of Central and South America. CAB International, London, England. 635 pp.
Zimmerman, E. C. 1948. Insects of Hawaii, Homoptera: Sternorrhyncha. Univ. of Hawaii, Honolulu 5:1-464.

PALM MEALYBUG

Scientific name: *Palmicultor palmarum* (Maskell),
Order: Hemiptera Family: Pseudococcidae
Common Name: Palm mealybug


Palm mealybugs on rhapis palm

HOST PLANTS
Palm Mealybugs are known to infest ornamentals and fruit trees, including:

avocado	kentia palm
banana	lady palm
Chamaedorea	orchids
citrus	parlor palm
Dracaena	potato
gardenia	pygmy palm
ginger	queen palm
grape	Rhapis palm
Heliconia	sago palm
hibiscus	


actual size

DESCRIPTION

Palm mealybugs are soft-bodied, oval, and pink, measuring 0.5mm as immature nymphs and growing to 8.0 mm when mature. Their bodies are covered by white, waxy material, with short filaments radiating from the margins of the body. Adult male mealybugs are tiny two-winged fly-like insects.


Waxy filaments of mealybugs are visible on unopened fronds of a rhapis palm

DAMAGE

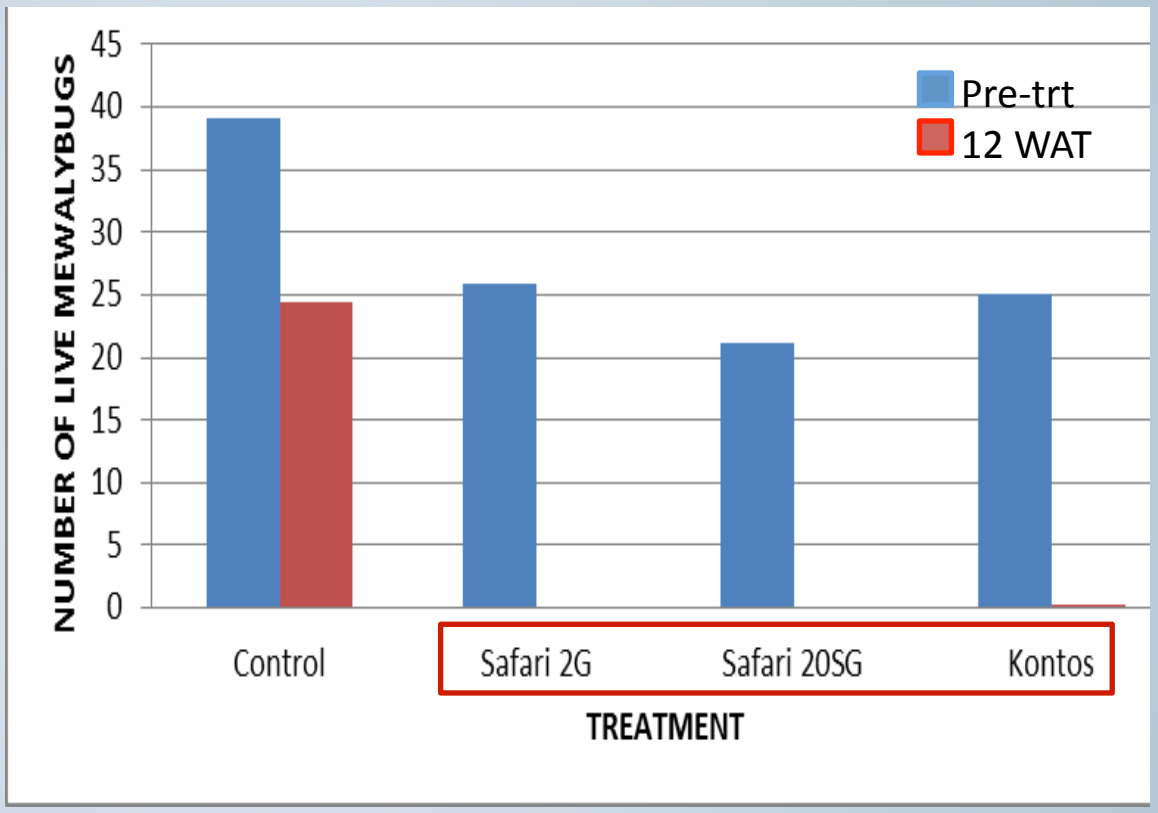
- Mealybugs weaken plants by feeding on plant juices then excreting honeydew upon which sooty mold grows.
- Black sooty mold growth reduces photosynthesis, causes defoliation, and occasionally death of a young plant.
- Honeydew also attracts ants that can farm and protect mealybugs from predators and parasitoids.

LIFE CYCLE/BEHAVIOR

Egg to Reproducing Adult: approximately 1-2 months

- **Adult female** mealybugs lay from **300 - 600 eggs** in a compact, cottony, waxy sac protected beneath their posterior ends for 1-2 weeks and die shortly thereafter.
- Within 7 -10 days **eggs** hatch into **nymphs (crawlers)** that move about searching out places to settle and feed on the plant.
- **Male crawlers** will pupate and emerge **as winged adults.** (http://entoweb.okstate.edu/ddd/insects/mealybugs.htm)

Efficacy Of Granular and Drench Insecticides on Palm Mealybugs in Potted Rhapis Palms



- **Pest**: Palm mealybug *Palmicultor palmarum*
- **Host Plant**: Rhapis palm *Rhapis excelsa*
- **Purpose**: Efficacy of drench or granular insecticides on palm mealybug in rhapis palms
- **Treatments:**
  - Control
  - Safari 2G (dinotefuran)
  - Safari 20 SG (dinotefuran)
  - Kontos (spirotetramat) (drench)
- **Observation:** Plants checked at 1 and 2 WAT for phytotoxicity and 6,8,10 and 12 WAT for efficacy.
- **Results:** Among Kontos –treated pots, 2 had a live mealybug at 8 and 12 WAT. None of the pots treated with either Safari treatment had live mealybugs from 6-12 WAT.

BANANA MOTH

Scientific name: *Opogona sacchari* (Bojer)
Order: Lepidoptera Family: Tineidae
Common name: banana moth, sugar cane borer

DAMAGE

Banana moth caterpillars feed voraciously on living and decaying plant tissues, which can cause extensive damage and even plant collapse in the advanced stages of infestation.

As they feed, caterpillars excrete "frass", fine powdery indigestible woody tissue held together with silk produced by the caterpillar

Pupal casings have 2 bent hooks at the abdominal end and can be seen protruding from feeding tunnels (circled).

HOST PLANTS

Banana moth is known to infest ornamentals and fruit trees, including:

bamboo	kentia palms
banana	maize
cacti	Maranta
capsicum	Philodendron
Chamaedorea	pineapple
coconut palms	Pritchardia
coffee	rhapis palms
Dracaena	sugarcane
ficus	ti
Heliconia	yucca

actual size

Larvae (caterpillars) are dirty-white and somewhat transparent, allowing some of its internal organs to be visible, with a reddish-brown head. seen. The larvae typically grow to 21-26 mm in length with a diameter of 3 mm.

actual size

Pupae are brown, <10 mm long and are found in plant tissue at the end or the feeding tunnels. Pupae casings can be found protruding from feeding tunnels (see photo, left).

Adult moths are 10–15 mm long and have grayish-brown wings, each with two small but prominent black spots.

LIFE CYCLE/BEHAVIOR **Eggs to Reproducing Adult: approximately 40-45 days.**

- Upon hatching, the young **larvae(caterpillars)** bore into weakened or dead tissue of the plant, eventually producing characteristic piles of excrement or frass (fine, powdery indigestible plant material held together with silk).
- **Maturing pupae** work themselves partially out of the infested plant tissue to allow emergence of the adult.
- **Adult moths** are nocturnal, and are attracted to damaged, stressed plants where they lay their eggs that hatch in about a week. Males are also attracted to lures containing female sex pheromone ((*E, Z*)-2,13-octadecadienal).

BEST MANAGEMENT PRACTICES FOR BANANA MOTH

	OPTIONS AVAILABLE
MONITORING TECHNIQUES	• Visually inspect plants for frass. • Set out pheromone traps 2-4 ft. off the ground 100' apart to monitor banana moth populations in and around the nursery. Pheromone lures are available from *www.**pherobank**.com*.
SELECT BEST CONTROL METHOD	• Minimize attracting egg-laying banana moths by avoiding conditions that stress plants (over-pruning, poor nutrition, overcrowding, over- or under-watering, stem and trunk wounds). • Clear exterior perimeter of shade house of banana moth host plants. • Remove and properly discard or destroy infested plants or plant parts. • Mass-trapping male moths with pheromone lures could possibly disrupt reproduction and reduce population. • Spray treatments of chlorpyrifos (a restricted use pesticide, RUP) or pyrethroids at 2-week intervals for 2-3 applications. • *Bacillus thuringiensis* (B.t.) may be used as a preventative treatment prior to infestations becoming extensive; however, effective applications of B.t. to the site of boring/feeding is very difficult. • Applications of entomogenous nematode such as *Steinernema carpocapsae* may also reduce populations of banana moth.
TREATMENT BEFORE MARKET	• Hot water treatments at 120° F for 10 minutes (all stages) • Hot air treatments at 111° F for 30 minutes (eggs, larvae)
FINAL INSPECTION	• Visually inspect for pupal casings, caterpillar feeding damage and frass. • Remove infested plant material.

AMBROSIA BEETLES

Scientific names: *Xyleborus perforans, X. affinis, X. ferrugineus*
Order: Coleoptera Family: Curculionidae
Common names: island pinhole borer, ambrosia beetle, sugarcane shothole borer

HOST PLANTS
Ambrosia beetles are known to infest ornamentals and fruit trees, including:

anthurium
avocado
brush box
Dracaena
cacao
Christmas berry
citrus
coconut palms
coffee
ti
eucalyptus
guava
hibiscus
koa haole
kukui
litchi
macadamia
mahogany
mango
paper-bark
red ginger
Surinam cherry
turpentine tree

Adult females are slightly larger (2 to 3 mm) than males (1.5 mm). They are stout bodied, dark reddish brown, and have a hunched-back appearance, with their heads completely hidden when viewed from above.

DAMAGE

Sawdust tubes are extruded from tunnels bored by adult beetles.

Pinholes with **staining** and **sawdust tubes** are signs of ambrosia beetle damage.

Ambrosia beetles are considered secondary pests, attacking stressed or unhealthy plants.

LIFE CYCLE/BEHAVIOR
Egg to Reproducing Adult - approximately 50-55 days

- **Adult females** bore into host plant trunks and branches, excavating tunnels or galleries.
- **Galleries** are inoculated with a symbiotic **fungus ("ambrosia")** on which **adults** and **larvae feed.**
- **Mating, egg laying** and **larval development** are completed within these galleries.
- **Mature females** leave infested plants and fly to new hosts; **flightless adult males** remain within the infested plant.

References: Mayfield, A.E. and M.C. Thomas MC. 2009. The redbay ambrosia beetle, *Xyleborus glabratus* Eichhoff (Scolytinae: Curculionidae). DACS-P-01651 .Florida Dept of Agric. & Consumer Services, Gainesville, FL.
Rabaglia, R. 2008.. *Xyleborus glabratus*. Exotic Forest Pest Information System for North America. Forest Health Protection, USDA Forest Service, Arlington, VA..

BEST MANAGEMENT PRACTICES FOR AMBROSIA BEETLE

	OPTIONS AVAILABLE
MONITORING TECHNIQUES	▪ Visually inspect plants for sawdust strings from gallery excavation and stains from ambrosia fungus near beetle tunneling. ▪ Check plantings near water sources, which may be more susceptible to ambrosia fungi infection. ▪ Set out ethanol traps 1-5 feet off the ground, 30-50 feet apart to monitor ambrosia beetle populations in the nursery.
SELECT BEST CONTROL METHOD	▪ There are no effective treatments once beetles bore into plant trunks or stems; preventative measures include: ○ Keep plant stock healthy to minimize attracting ambrosia beetles. ○ Remove and properly discard or destroy infested plants or plant parts. ○ Use pyrethroids or chlorpyrifos (a restricted use pesticide, RUP) as **preventative** dips or trunk treatments every two weeks in 3 to 4 applications to reduce infestations (systemic insecticides are not as effective because beetles do not feed on plant material).
TREATMENT BEFORE MARKET	▪ Remove infested plant material.
FINAL INSPECTION	▪ Visually inspect for evidence of ambrosia beetle infestation (sawdust).

PRECAUTIONARY STATEMENT / DISCLAIMER: These recommendations are provided only as a guide. Please read and follow all label directions

LURES FOR MONITORING AND POPULATION REDUCTION

Banana moth pheromone lures attract adult males

Lindgren funnels with ethanol lures attract and trap ambrosia beetles

New Microbial Insecticide (MBI 203)

- Discovered by Dr. Phyllis Martin (USDA-ARS); developed by Marrone Bio Innovations
- New species of *Chromobacterium subtsugae* isolated from forest soil in U.S. Activity from compounds produced by the bacterium; is not a live product.
- Active by ingestion and contact (potent anti-feeding agent).
- Death in 2-5 days for chewing insects and 4-7 days for sucking insects.
- Toxic to multiple orders of insects (sucking and chewing insects (Lepidoptera, Coleoptera) and flies).
- LOW RISK to non-target mammals, fish, birds, parasitic wasps, honeybees, lacewings, ladybeetles
- GRANDEVO (registration pending for HI)

LITTLE FIRE ANT

Scientific name: *Wasmannia auropunctata* (Roger)
Order: Hymenoptera Family: Formicidae
Common name: little fire ant

DESCRIPTION

- Little fire ant (LFA) workers are approximately 1.5 mm in length, reddish to golden brown , and move very slowly. They can be identified by looking for distinctive characteristics under magnification.

- 2 **grooves** on the front of the head where the antennae can lay at rest (antennal scobes).
- antennae end in two-segmented **clubs**
- long, pointy **spines** on the upper abdomen (propodeum)
- 2 **nodes** (petiole and post-petiole)

Photo credits: (left) http://antkey.org/taxa/wasmannia-auropunctata; (right) Michael Branstetter / © AntWeb.org / CC-BY-SA-3.0

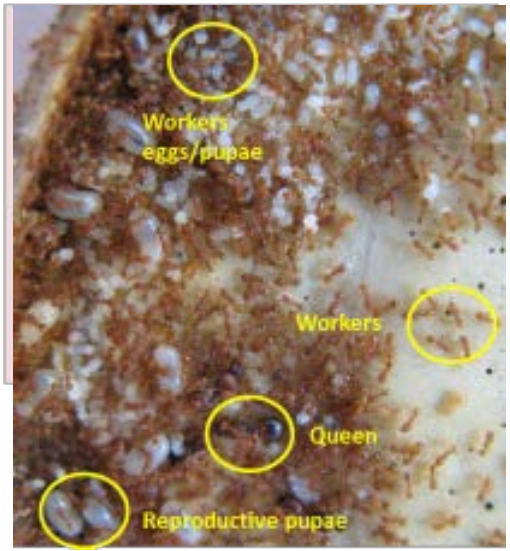
Queens are **winged**, **dark brown** and **approximately 3 times the size of workers**, 4.5-5.0 mm in length. Nests may have **multiple queens** who lay eggs that develop into **sterile workers** or **reproductive adults**.

Adult males are **winged**, dark brown with yellowish antennae and legs, and approximately 4.5 mm in length with a slender body. At their posterior ends are very **conspicuously curved** genitalia.

- actual size of LFA worker
— actual size of LFA queen and adult male

DAMAGE

LFA have been responsible for painful stings to visitors, residents, and landscape and nursery workers. Its sting can also harm animals (pets and livestock), and multiple stings to the eye can cause blindness.

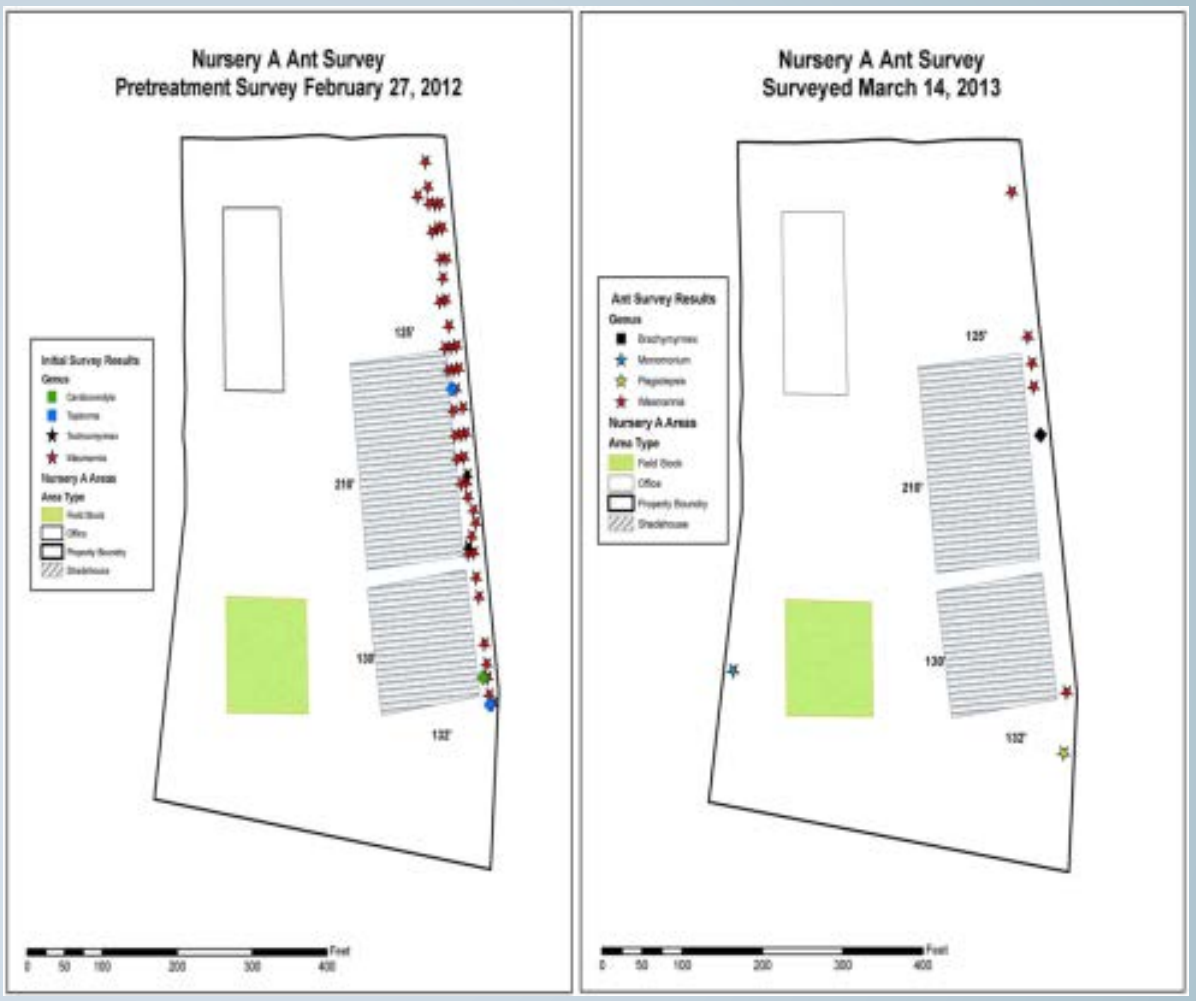


BEST MANAGEMENT PRACTICES FOR LITTLE FIRE ANTS

	OPTIONS AVAILABLE
MONITORING TECHNIQUES	▪ Inspect all incoming propagative materials and plants before moving them into the nursery. ▪ Survey nursery/field stock for LFA using peanut butter smeared thinly on wooden chopsticks placed every 10 ft along perimeters and within shadehouses or fields. After 30-45 min, retrieve and inspect the sticks for foraging ants. (Refer to UH CTAHR publication IP-24 for more details.)
SELECT BEST CONTROL METHOD	▪ Inspect all field/nursery stock movement. ▪ Treat with an approved bait insecticide and survey 2-3 weeks after treatment. Repeat these steps until ants are no longer found when surveying. ○ Granular baits: ▪ **Amdro** (0.73% hydramethylnon) ▪ **Extinguish Plus** (0.365% hydramethylnon, 0.250% S-methoprene) ▪ **MaxForce Complete** (1.0% hydramethylnon) ▪ **Probait** (0.73% hydramethylnon) ▪ **Tal-Star** (7.96% bifenthrin) ○ Tango - IGR (insect growth regulator) (S-methoprene) ○ Contact / residual sprays to kill foraging workers
TREATMENT BEFORE MARKET	▪ Hot water shower at 113°F for 10 minutes will kill adult LFA. ▪ Apply approved ant bait to kill ant colony.
FINAL INSPECTION	▪ Visually inspect plants for LFA on plants or pots. ▪ Place a wooden chopstick with peanut butter in pots for 30-45 minutes to ensure that no LFA are present.

Precautionary statement / Disclaimer: These recommendations are provided only as a guide. Please read and follow all label directions.

BAITING ALONG BORDERS FOR LITTLE FIRE ANTS (LFA)



ANT BAIT APPLICATIONS

3/13/12	Amdro
4/2/12	Extinguish Plus
4/28/12	Amdro
5/4/12	Amdro
5/20/12	Amdro
6/23/12	Extinguish Plus
7/28/12	Amdro
8/19/12	Extinguish Plus
11/12/12	Extinguish Plus
1/13/13	Amdro
3/9/13	Extinguish Plus (ground), Tango (trees)

Recommendations:

- Apply baits every **3-4 weeks.**
- **Survey with peanut butter every 2-3 weeks and reapply baits as needed.**
- Extinguish Plus and Tango (**IGR**, S-methoprene - interferes with egg dev and queen reprod)
- **Rotate** ant baits with different AI (**may become repellent**)

WHITEFOOTED ANT

Scientific names: *Technomyrmex albipes, T. difficilis, T. vitiensis*
Order: Hymenoptera Family: Formicidae
Common name: whitefooted ant

Actual size

DESCRIPTION

Adults have different body types according to their role in the colony

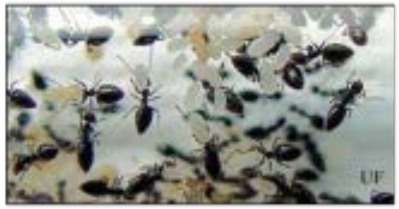
- Adult workers are females, wingless, 2 to 4 mm (< ¼ ") long, and dull black with yellowish-white lower legs.
- Queens are larger, winged early in life, and lay fertile and infertile eggs throughout their lives.
- Males are wingless, short-lived, and function only in reproduction.

DAMAGE

- Damage by whitefooted ants (WFA) is usually indirect since they tend honeydew-producing insects (mealybugs, aphids, soft scales, whiteflies), protecting them from control by natural enemies.
- Although WFA are strongly attracted to sweet foods, such as plant nectar and honeydew, they also feed on decaying plant and animal tissue.
- WFA are a nuisance to homeowners as they forage indoors and outdoors, attracted by food and electrical contacts.

LIFE CYCLE / BEHAVIOR The lifespan of worker ants is not known, but **queens** can live more than a year.

- **Eggs** are tiny (.5 mm), white or yellowish , oval, and are found, along with other developmental stages, in the nest constructed of dirt and plant debris (such as red ginger flowers).
- Young **larvae** are legless, pale, and shaped like a crook-necked gourds (heads at smaller, narrow end).
- Larvae develop into pupae without cocoons; both pupae and larvae are often mistaken for eggs.
- Whitefooted ants are very difficult to control because they do not exchange baits orally. If the majority of workers feed on the bait and die, the rest of the colony will eventually die of starvation.



HABITAT

- White-footed ants are often found in forested areas, between 1,000 to 5,000 feet elevation, where annual rainfall exceeds 60 inches; however, these ants occur down to sea level in Hawai'i (HDOA).
- WFA nest in vegetation, as well as in houses and other structures, preferring to be near moisture and food sources, and where they are protected from predators.

WFA can be found nesting in trees, under bark, in branch crotches, undersides of leaves, and rotting logs.

References: Warner, J., R. H. Scheffrahn & B. Cabrera. 2002 (rev. 2010). Featured Creatures. EENY 273 (IN551). Entomology and Nematology Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL. http://edis.ifas.ufl.edu/in551

Warner, J., R. H. Scheffrahn & B. J. Cabrera. 1998 (rev. 2010). White-footed Ants. ENY-635 (IN098). Entomology and Nematology Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL. http://edis.ifas.ufl.edu/in098

BEST MANAGEMENT PRACTICES: WHITE-FOOTED ANT

	OPTIONS AVAILABLE
MONITORING TECHNIQUES	▪ Inspect all incoming propagative materials for ants before introducing into them into the nursery. ▪ Limit plant overcrowding to slow the spread of ants in the field. ▪ Survey nursery/field stock with sugar water or liquid sugary baits plus borax (sodium tetraborate decahydrate) for presence of white-footed ants.
SELECT BEST CONTROL METHOD	▪ Inspect all field/nursery stock for ants before movement. ▪ Use contact pyrethroid insecticides, such as bifenthrin, which are effective on workers. ▪ Incorporate bifenthrin in pot media when planting. ▪ Keep area free of any plant debris where ants can hide. ▪ Use baits containing borates, which can kill workers by starvation (the toxicant cannot be orally transferred between workers but may eventually end up in eggs).
TREATMENT BEFORE MARKET	▪ Place liquid sugary baits around holding area to monitor for ants.
FINAL INSPECTION	▪ Visually inspect all plants for ants before shipment. ▪ Treat with a pyrethroid insecticide before shipping to assure there are no live ants.

Precautionary statement / Disclaimer: These recommendations are provided only as a guide. Please read and follow all label directions.

Peanut Butter

Maxforce Quantum
(imidacloprid)

Maxforce Complete
(hydramethylnon)

WHITE-FOOTED ANT: FIELD BAIT ATTRACTION @ 45 MIN OF EXPOSURE

Terro
(borax)

Number of Ants @ 45 min:

Peanut Butter:	0.2
Maxforce Quantum:	17.0
Maxforce Complete:	0.6
Terro:	12.8
Optiguard Gel:	3.2

Optigard Gel
(thiamethoxam)

CUBAN SLUG

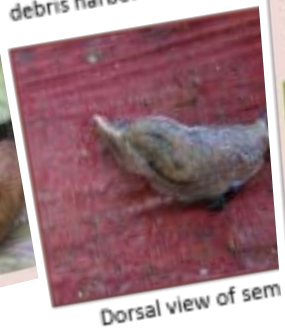
Scientific name: *Veroni*
Clade: Heterobranchia
Common names: Cuba

Two Cuban slugs

SEMI-SLUG

Scientific name: *Parmarion*
Subclass: Pulmonata Fa
Common names: Semi-slug

Weeds, culled plants and debris harbor slugs.



Dorsal view of sem

GARDEN SLUG

Scientific name: *Deroceros reticulatum* (formerly *Agriolimax meticulatus)*
Subclass: Pulmonata Family: Agriolimacidae
Common name: Gray garden slug

Description

The gray garden slug is variable in color: creamy to light coffee colored, rarely blackish with spots. Eggs are white, slightly transparent, similar to other slug eggs (~1mm diameter).

HOST PLANTS

Garden slugs prefer succulent foliage or flowers, pests primarily of seedlings and herbaceous plants, ripening fruits, and foliage plants.

Scientific name: *Meghimatium striatum* Van Hasselt
Subclass: Pulmonata Family: Philomycidae

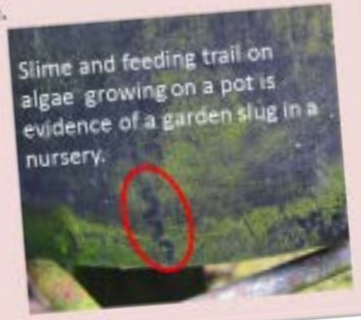
Description

***M. striatum* is a slender slug (up to 45 mm long)usually having 5 regular and straight black longitudinal dorsal bands with the outer 2 dissolving into dots or absent. Upper tentacles are dark.**

Damage

Feeding habits are similar to other slugs. Small irregular holes with smooth edges are commonly found on plants. Slime trails will be visible.

Deroceros sp. feeding on JC Compacta



Slime and feeding trail on algae growing on a pot is evidence of a garden slug in a nursery.

M. striatum and slime trail on Dracaena.

BEST MANAGEMENT PRACTICES FOR SLUGS

	OPTIONS AVAILABLE
MONITORING TECHNIQUES	Sanitation is the safest and cheapest method to control slugs. ▪ Remove debris and stored material where slugs can hide and breed. ▪ Remove culled and rotting plant material that slugs can feed on, hide in and breed. ▪ Control weeds and algae or moss on walkways and benches where slugs might hide. ▪ Check benches in early morning to hand collect slugs. ▪ Natural predators include toads, some predacious beetles and their larvae, planaria (flatworms) and the rosy predator snail (*Euglandina rosea* (Ferussac)).

SELECT BEST CONTROL METHOD	▪ Create barriers to keep slugs off benches such as:
	  ▪ Copper screens
	  ▪ Copper hydroxide
	▪ Use repellents to reduce slug populations:
	  ▪ Copper hydroxide, also used as a fungicide (Kocide, Champ)
	  ▪ Bordeaux mixture, a fungicide, containing lime and copper sulfate
	  ▪ Spinout (copper hydroxide, Sepro), used as a root growth regulator, as a pot or groundcover treatment.
	▪ Limit watering to reduce moisture, such as using drip irrigation instead of overhead sprinklers.
	▪ Molluscicides with metaldehyde effectively control slugs.
	  ▪ In a lab trial, Deadline remained effective longer (for 14-21 days) than other products (4% metaldehyde) under wet conditions .

TREATMENT BEFORE MARKET	▪ Hot water shower treatments before shipping controls slugs:
	  • Cuban slug 113°F for 13 minutes
	  • Semi-slug 113°F for 3 minutes
	  • Garden slug 113°F for 3 minutes

FINAL INSPECTION	▪ Visually inspect all plants for eggs and slugs before shipment.

GARDEN SLUGS ON AGED COPPER SCREEN

7 hours after release: No slugs crossed the copper screen barrier

GARDEN SLUGS ON NYLON MESH SCREEN

4 hours after release: All slugs crossed the nylon screen barrier

CONTROL: GARDEN SLUGS WITHOUT SCREEN

2 hours after release: All slugs migrated to lettuce

COQUI FROG

Scientific name: *Eleutherodactylus coqui*
Order: Anura Family: Leptodactylidae
Common names: Puerto Rican tree frog, coqui frog

LIFE CYCLE

EGGS

- Egg diameter averages 4 mm
- hatches in 14 -17 days
- clusters of eggs (average 28 eggs) are laid every 2 to 4 weeks year-round
- no free-swimming tadpole stage.

FROGLETS

- can live up to a week after hatching on yolk reserve
- able to reproduce at 8 - 12 months old
- males begin calling from 6 months of age

ADULTS

- females (*upper left*) grow up to 2" in length, while males (*lower right*) grow up to 1.5" long
- entirely terrestrial
- adults may live 4 - 6 years
- males guard eggs to prevent drying and predation

BEHAVIOR

- As amphibians, coqui frogs need to keep their skin **moist** and can tolerate cold better than hot temperatures and direct sunlight.
- They are **nocturnal** and retreat during the day to sites that provide shade and moisture, such as crevices and rock walls *(pictured, top,* irrigated nursery facilities, thick vegetation *(circle)*, ground cover ,and leaf litter *(left)*.
- Coqui frogs **"hitchhike"** from infested areas on plants, construction, landscaping and gardening materials, trash, and vehicles (tire wells, truck beds) and are **spread along roadways** to refuse stations, construction sites, nurseries, garden shops, and residences.
- While adult males can be detected by their call, the presence of eggs, juveniles (< 6 months), and adult females often go **undetected for months** until males mature and begin calling.

Reference: Townsend, D.S. and M.M. Stewart. 1994. Reproductive ecology of the Puerto Rican Frog *Eleutherodactylus coqui*. Journal of Herpetology 28:34-40.

BEST MANAGEMENT PRACTICES FOR COQUI FROGS

	OPTIONS AVAILABLE
MONITORING TECHNIQUES	• Use **sound-activated recorders** to detect calling males on-site at night on a monthly basis. • Set out **PVC lures** *(pictured)* o Use 3/4" diameter pipe (8-9" length) with a tee-joint. Do not glue. "Weather" the pieces first to reduce PVC odor. Mount no higher than 2-3 ft off the ground at 2-ft intervals. o Check the PVC lures at least every 2 weeks; remove nesting adults and eggs. • **Conduct visual inspection routinely.** o Scan plants, media, and leaf litter beneath plants for adults and [illegible] o Inspect building materials and nursery supplies before bringing them onto your property. o Inspect your vehicle (tire wells, truck beds) for hitchhiking frogs after leaving infested areas.
SELECT BEST CONTROL METHOD	• **Minimize retreat and nesting sites** o Avoid stockpiling discarded plant material. o Re-landscape with less broad-leafed plants. • Install **screen barriers** *(pictured)* to keep frogs out of designated areas (fine mesh screen at a 90° angle that frogs cannot cross). • **Hot water "sprench"** (spray + drench) o Set hot water heater to 120 °F and "sprench" plants for adults and eggs. • **Chemical "sprench"** with weekly monitoring for frogs o Natural pyrethrins with piperonyl butoxide (PBO), or 8% citric acid as contact spray o 16% citric acid as contact spray (may burn sensitive plants, including orchids; can be rinsed off 1 hour after application to minimize phytotoxicity but will reduce effectiveness on treated eggs by 15%. • Continue to inspect and listen for frogs **weekly after spraying.**
TREATMENT BEFORE MARKET	• **Hot water shower** o 109 -113 °F for 5 min for eggs, juveniles, adults o Place treated plants in a coqui-free holding area to prevent re-infestation prior to transport.
FINAL INSPECTION	• Use **sound-activated recorders** *(pictured)* to detect calling males in shipments at night for at least two nights prior to movement/sale. • Use **visual inspection** for frogs and eggs in cryptic areas and plant parts.

Mahalo

WORK SUPPORTED BY:

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