

Damage caused by adult CRB boring into petiole at growing tip in Gu

Known Host Plants of CRB

Larvae feed on rotting organic matter:

- Preferred larval habitat is rotting *Cocos nucifera* (coconut) wood, followed by *Artocarpus* spp. (breadfruit), *Calophyllum inophyllum* (kamani), *Mangifera* spp. (mango), and *Pandanus* spp. (hala).

Adult beetles bore into plant tissue, causing damage:

- Cocos nucifera* (coconut), *Elaeis guineensis* (African oil palm), and other *Elaeis* spp.

Major CRB Breeding Site in Coconut Trimming Debris (Asan, Guam)



In mulch and refuse piles

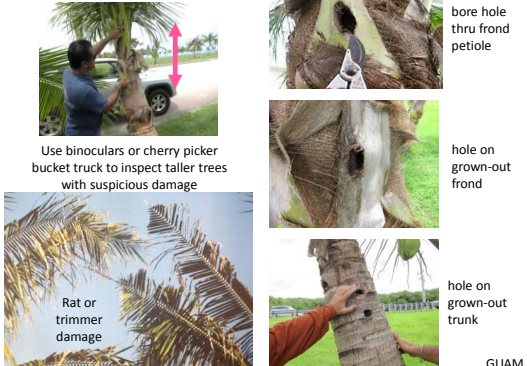
In rotting coconut trunk terminal (can breed above ground)

Circular boring damage to folded new terminal growth



GUAM

Area of attack by adult CRB



bore hole thru frond petiole

Use binoculars or cherry picker bucket truck to inspect taller trees with suspicious damage

hole on grown-out frond


Rat or trimmer damage

hole on grown-out trunk

GUAM

**Oriental flower beetle** versus **Coconut rhinoceros beetle**

- In Hawaii since 2002 (*Protaetia orientalis*)
- Adult beetles active during the day (diurnal)
- Adult feeds on pollen, nectar, plant sap.
- May damage flowers of papaya, mango, coconut.



adult grub


up to 1" length

- Adult beetle moss green to reddish-black with white or metallic flecks with smooth head capsule
- Grub crawls straight or flips on its back

REPORT SUSPICIOUS INSECTS OR DAMAGED TREES TO:  
Hawaii Department of Ag Pest Hotline 643-PEST (7378)

- Adult beetles active at night (nocturnal)
- up to 2.5" length, shiny black (largest beetle in Hawai'i)
- single, centered horn
- Rough head capsule
- Grub curls into a C-shape, crawls on its side

**Banana moth** *Opogona sacchari*



Pritchardia

wingspan ¾ to 1"

Caterpillars tunnel and feed on dead and living plant tissue, causing leaves to wilt and eventually drop.

plumeria


coconut

Frass and debris on these *Dracaena* canes infested with banana moth larvae.


Contact insecticides (pyrethroids) are not effective if caterpillars have entered the plant stem.

### Coconut leafroller *Hedylepta blackburni*


Coconut leafroller's silk threads on Pritchardia leaf




Older instars attach edges of leaves together with silk to create a protective chamber




The caterpillar molts five times (1/12 to 1-1/4" length) before pupating.



**ADULT MOTH**  
Wingspan ~1"



Larval feeding damage on coconut leaves




Ronald Hsu, HDOA

Forest & Kim Starr, Starr Environmental, Bupropion.org


### Fiorinia scale *Fiorinia phantasma*

Damage on upper leaf surface of areca


- First discovered in Hawaii in Dec 2004 on Japanese privet on Oahu; previously, only reported from Philippines.
- Found on palms, including coconut and traveler's palm, kamani, *Ficus benjamina*, *Cassia* sp., naio (*myoporum*), pandanus, heliconia, mock orange, Madagascar olive.
- Serious pest on areca palms in the landscape in Wailea/ Kihei, Maui (Sept 2011).
- Natural enemies recently observed (ladybeetle, parasitoid wasp).
- Horticultural oils should be effective against crawler stages.
- Systemic insecticides (e.g. dinotefuran) and insect growth regulators (e.g., pyriproxyfen, buprofezin) may be effective.




Scales on underside




Parasitoid emergence hole on *F. phantasma*, Plumeria leaf, Kona




Cybocephalus nigiponicus



A nitidulid beetle feeds on this scale, whiteflies, and mealybugs




Females are yellow with red stripes





Ronald Hsu, HDOA; Arnold Hara, UH CTAHR Oct 2011

### Hala Scale, *Thysanococcus pandani*

- was first observed in Hana, Maui in 1995, and East Maui's hala (pandanus) is infested
- causes loss of leaf quality (yellowing, deformation, shortening) formation of prop roots in unusual places, loss of plant vigor
- Adult scale's dark body is surrounded with a white fringe.
- Rarotonga, in the Cook Islands, apparently lost its hala trees in the 1920s to this scale.



Hala scale damage causes leaf yellowing (Ha'iku, Maui)





Wendy Oshier

http://www.reportapest.org/pestlist/thyan.htm

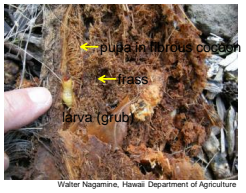
### New Guinea sugarcane weevil *Rhabdoscelus obscurus*

Adult female weevil chews through plant tissue, deposits its eggs from which larvae hatch and tunnel through host plant tissue and eventually pupates.




Walter Nagamine, Hawaii Department of Agriculture

Adult weevils are active in late afternoon, night.  
Host plants: palms, dracaena, sugarcane, anthurium




Walter Nagamine, Hawaii Department of Agriculture

Larval feeding damage to coconut palm (Albury Moore and George Wall, University of Guam)  
[http://guam.insects.net/ugos/nbwiki/index.php/Title=New\\_Guinea\\_sugarcane\\_weevil\\_damage\\_to\\_coconut](http://guam.insects.net/ugos/nbwiki/index.php/Title=New_Guinea_sugarcane_weevil_damage_to_coconut)



Larval feeding damage to loulou palm (*Pritchardia* sp.)




Walter Nagamine, Hawaii Department of Agriculture

The larvae of a parasitic fly introduced in Hawaii (*Lixophaga spenophori*) attack weevil grubs.

### Coconut mite *Aceria guerreronis*

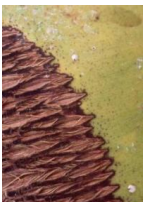


Mite pierces tissue under protective perianth at stem end of immature fruit



actual size: .01 L x .002 W inches



- mites are microscopic and translucent, and may appear only as a silvery patch when viewed with a 10x hand lens.
- mites disperse by wind, being carried on insects or birds; in dense plantings, mites are able to crawl between plants.

Fruit develop cork-like surface with deep cracks, may prematurely drop or be deformed, stunted and scarred.

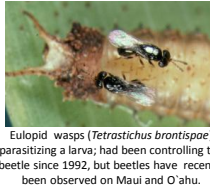
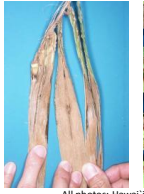
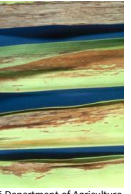




### blue coconut leaf beetle *Brontispa chalybeipennis*

Adults and larvae feed on/ between young terminal leaflets of coconut palms (browning, fraying).

Eulopid wasps (*Tetrastichus brontispae*) parasitizing a larva; had been controlling the beetle since 1992, but beetles have recently been observed on Maui and O'ahu.

All photos: Hawaii Department of Agriculture



## Cycad Pests

- cycad scale *Aulacaspis yasumatsui*



### Cycad scale *Aulacaspis yasumatsui*

female →  
male →

Adult female and eggs under armor

infests the roots, trunk, leaves and petioles of cycads, especially sago palms, and to a lesser extent, queen sago and zamia.

- Heavy infestations difficult to control with insecticides, including systemics and insect growth regulators.
- A neonicotinoid, dinotefuran, is effective on cycad scales and soft scales.
- Horticultural oils have provided the most consistent control in FL (at 4 applications at 10-14 intervals).
- Long term control with a ladybeetle

### Innoculative Biological Control of the Cycad Scale *Rhyzobius* ladybeetle

larva

pupa

adult

### Examples of Beetles Near Peak Densities (3 Months after Establishment)

### Biological Control

**Biological Control** - reduction of pest populations by natural enemies (predators, parasites or diseases).

**Classical** - introduction of natural enemies (from the pest's native home) to a new locality where they do not occur naturally.

**Fortuitous** – “do nothing”; natural enemies unintentionally arrives with pest to new locality or is already in new locality.

**Augmentative** - supplemental release of natural enemies.

- Innoculative Release:** release mass numbers of natural enemies to prey or parasitize target pest
- Inundative Releases:** release a few individuals and rely on their natural reproduction by preying or parasitizing target pest.

### Conservation of Beneficial Insects

- Learn to recognize natural enemies and when a pest is already parasitized.
- Avoid plantings in windy or ocean front areas, or extremely hot environments. Modify conditions to encourage natural enemies.
- Avoid use of broad spectrum insecticides:  
 Organophosphates: Dursban, Malathion  
 Carbamates: Sevin (carbaryl)  
 Pyrethroids: Talstar (bifenthrin)

### Insecticide Toxicity to Natural Enemies

Common name (trade name)	Class	Selectivity (affected groups)	Predator Mites	General Predators	Parasites	Duration of impact to natural enemies
carbaryl (Sevin)	carbamate	Broad (insects, mites)	Moderate/High	High	High	Long
chlorpyrifos (Dursban)	OP	Broad (insects, mites)	Moderate	High	High	Moderate
fenpropathrin (Tame) similar to (Talstar)	Pyrethroid	Broad (insects, mites)	High	High	High	Moderate Long for Talstar
imidacloprid (Merit as a drench)	Neonico-tinoid	Narrow (sucking insects)	-	Low	Low	-
imidacloprid (Merit as a foliar)	Neonico-tinoid	Narrow (sucking insects)	-	Moderate	High	Short to moderate
Insecticidal Soap (M-Pede)	soap	Broad (insects, mites)	Moderate	Moderate	Moderate	Short to none

<http://www.ipm.ucdavis.edu/PMG/r302900111.html>

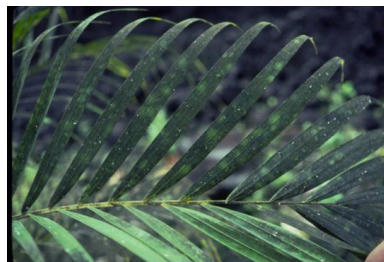
### Woody plant pests

#### - sucking/rasping mouthparts

- lobate lac scale *Paratachardina pseudolobata*
- glassy-winged sharpshooter *Homalodisca coagulata*
- Asian citrus psyllid *Diaphorina citri*
- cotton lace bug *Corythucha gossypii*
- azalea lace bug *Stephanitis pyrioides*
- spiraling white fly *Aleurodicus dispersus*
- giant white fly *Aleurodicus dugesii*
- acacia psyllid *Accizia uncatoides*
- myoporium (Naio) thrips *Klambothrips myopori*
- fringed aphids *Cerataphis* spp.

### Honeydew-producing Insects and sooty mold

Honeydew excreted by aphids, mealybugs, soft scales, and/or whiteflies adheres to plant surfaces, serving as a medium for sooty mold growth. This black, powdery fungus inhibits photosynthesis and is aesthetically unappealing.

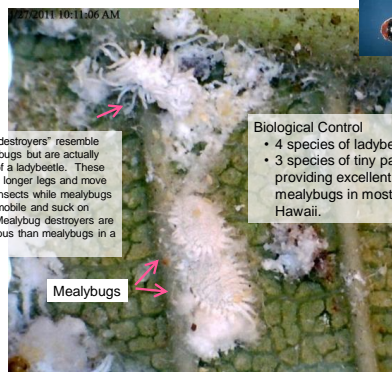


### Controlling ants to reduce infestations of honey-dew producing insects

- Ants feed on sweet honeydew excreted by aphids, mealybugs, soft scales and whiteflies.
- Ants will nurture these pests by protecting them from parasitoids/predators.
- Using "softer" chemicals and encouraging predacious insects will reduce these pests and help control ants.



### Biological control of Papaya Mealybug on Plumeria



"Mealybug destroyers" resemble adult mealybugs but are actually the larvae of a ladybeetle. These larvae have longer legs and move to prey on insects while mealybugs are not as mobile and suck on plant sap. Mealybug destroyers are less numerous than mealybugs in a colony.


#### Biological Control

- 4 species of ladybeetles.
- 3 species of tiny parasitic wasps providing excellent control of mealybugs in most situations in Hawaii.


### lobate lac scale

*Paratachardina pseudolobata*

- First seen in Hawaii Oct 2012 on *Ficus benjamina*, Moanalua Park.
- Produces honeydew which promotes sooty mold
- Host range of over 300 species of woody plants, including Fabaceae (Acacia), Malvaceae (Hibiscus), Moraceae (Ficus), Myrtaceae (Eugenia, guava), rose, gardenia, Phoenix palm, mango, tahitian gardenia, golden rain tree.
- Hard to spot these tiny scales against woody bark of stems; usually not found on stems larger than 1/2" diameter
- Adult female lobate lac scales are X-shaped, dark red-brown, and 1/16" in L W H
- Immature scales are bright red, flat, oval, 1/64" long




scales on red hibiscus



Adult females on red lac scale branch. Field of female scales (inset)


Hawaii Dept. of Agriculture, Plant Pest Control Branch  
Walter Nagamine, Darcy Oishi, Benmar Kumashiro, Janis Garcia



Zhiqiang Cheng, UH CTAHR

### Lobate Lac scale

(adults, black), (crawlers, red)

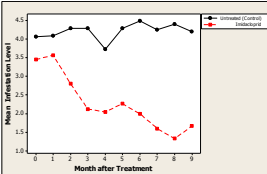


Badly infested *Ficus benjamina* tree showing dieback of large branches and defoliation.

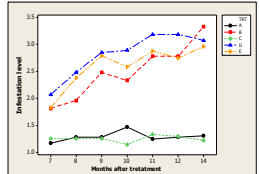
Hawaii Dept. of Agriculture, Plant Pest Control Branch  
Walter Nagamine, Darcy Oishi, Benmar Kumashiro, Janis Garcia

- Belongs to lac scale family from which shellac is made
- In Florida (Howard & Steinberg 2005), drench application of imidacloprid to large Indian Laurel Tree, *Ficus retusa*, eradicated lobate lac scale for over a year (523 days).
- Foliar applications of imidacloprid and bifenthrin were also highly effective against crawler and adult stages of lobate lac scale.
- In Hawai'i, imidacloprid was very effective for 1 year (on-going observations) on weeping banyan and Chinese banyan (Zhiqiang Cheng, UH CTAHR).

On-going research at UH Manoa on 10 weeping banyan and 45 Chinese banyan trees indicates that imidacloprid is very effective against lobate lac scale, and the treatment effect lasts for at least one year (Z. Cheng, UH CTAHR).

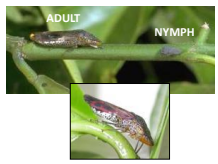


weeping banyan trial



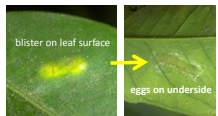
Chinese banyan trial  
(E: control; A & C: treatments containing imidacloprid)

### Glassy-winged sharpshooter *Homalodisca coagulata*




ADULT NYMPH

- Native to the SE US (Louisiana, Mississippi, Alabama, Arkansas, Texas, N & S Carolina, northern Florida) and northern Mexico
- Detected in California in 1989; threat to grape, wine, almond, and citrus as a vector of deadly plant diseases
- Found in Tahiti in 1999; "sharpshooter rain" a nuisance to residents and tourists
- Found in Waiiau and Waimalu areas on O'ahu in May 2004, spreading to adjacent areas. No plant disease-causing organisms accompanied GWSS to Hawai'i at that time.
- wide host range of >250 species of ornamental plants including, citrus, oleander, roses, avocado, and macadamia nut. In Hawai'i, also on hibiscus, Tahitian gardenia, croton, crown flower, monkeypod, oleander, African tulip, *Pittosporum tobira*, mountain apple, and plumeria.




blister on leaf surface eggs on underside




44 days from egg to egg-laying adult


Photos by Jack Kelly Clark, University of California, Davis




*Gonatocerus morrilli*




*G. ashmeadi* laying eggs in GWSS egg mass.




parasitized eggs  
Copyright: David Morgan



*Gonatocerus ashmeadi*



wasp emergence holes




*Gonatocerus triguttatus*

These GWSS egg parasitoids are found in the southeastern US, and related species may occur in Hawai'i. *G. ashmeadi* may have been on eggs when GWSS arrived in Hawai'i.


Photos by Jack Kelly Clark, University of California, Davis unless otherwise specified

### Asian citrus psyllid *Diaphorina citri*




adult feeding position (1/6-1/8" L)


- Adults and nymphs feed on plant sap.
- Huanglongbing (HLB), or citrus greening disease, is caused by a bacteria spread by this psyllid as it feeds.
- Symptoms are initial yellowing of leaves on an individual limb or part of tree's canopy, and eventually fruit are affected (abnormal shape, coloring, premature drop).
- Nymphs also excrete honeydew (through waxy tubules), which promotes sooty mold and attracts ants.



nymphs and cast skins




nymphs excrete waxy tubules



citrus greening on mock orange  
<http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn74155.html>



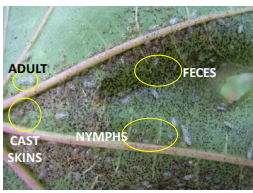
### cotton lace bug *Corythucha gossypii*



W. Nagamine, HI DOA  
Adult actual size: 1/10" length

**HOST PLANTS**

- o soursop, *Annona muricata*
- o orchid tree, *Bauhinia variegata*
- o castor bean, *Ricinus communis*
- o red hibiscus, *Hibiscus rosa-sinensis*
- o *Erythrina sandwicensis*
- o white sapote, *Casimiroa edulis*
- o akia, *Wikstroemia* sp.




ADULT  
FECEs  
CAST SKINS  
NYMPHS

Forest & Kim Starr  
Photo © 2009-2012

- First observed in the state in 2001 in Kapolei, O'ahu and has since been found on Maui, Kaua'i, and the Big Island.
- Has been observed feeding on at least 16 plant species (including weeds, vegetables) but is most common on castor bean and the orchid tree.
- Common in southern Florida


tiny, shiny black fecal spots, nymphal cast skins on undersides of leaves distinguish lace bug damage from spider mite damage

### ORCHID TREE: LEAF YELLOWING AND BLEACHING



W. Nagamine, HI DOA

### LEAF DAMAGE ON CASTOR BEAN



CONTROL METHODS FOR COTTON LACE BUG

**CULTURAL**


- For a light infestation, remove affected leaves and soak in soapy water before discarding.

**CHEMICAL**

- For heavier infestations, horticultural soap has been effective but should be sprayed directly on the insects. Follow label rates and recommendations.
- Systemic insecticides, such as imidacloprid, initially take longer to work but will provide months of protection.


**BIOLOGICAL**

- Probably only general predators, such as green lacewings.




M. Fukuda, HI DOA


### Azalea lace bug *Stephanitis pyrioides*




1/10" length




Host plants: Evergreen azalea, rhododendron, pyracantha, andromeda, and vireya varieties are preferred; other members of laurel family



Damage by nymphs and adults feeding on undersides of leaves, causing discoloration ranging from white to bronze stippling on topside of leaves, less colorful flowers (similar to thrips damage), which lowers the plants' aesthetic qualities and ability to produce food by inhibiting photosynthesis.




James L. Castner, University of Florida



Clemson University - USDA CES Slide Series


Natural enemies: stink bugs, spiders, predaceous mites, assassin bugs, lacewings.  
Physical method: Spray underside of leaves with strong stream of water  
Chemical: nymphs appear the most vulnerable stage; use contact sprays of organic soaps, insecticidal soaps, hort oils. For heavier infestations, imidacloprid, beta-cyfluthrin and cyfluthrin are most effective

### Giant Whitefly *Aleurodicus dugesii*




NYMPH

Fine, long, waxy filaments



PUPA

Patterned wings, tent-like over body





ADULT

length up to 4 mm



### Spiraling Whitefly *Aleurodicus dispersus*

EGGS laid in waxy spiral secretions

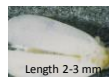



NYMPHS

Short, waxy filaments & cottony secretions


Wings with few light markings, flattened over body



ADULT

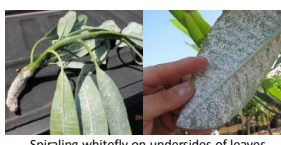
Length 2-3 mm

### Giant Whitefly



Up to 100s of giant whitefly adults and nymphs per leaf

### Spiraling Whitefly




Spiraling whitefly on undersides of leaves


- First discovered on O'ahu in 2002 on hibiscus (native to Mexico; also occurs in California, Texas, Louisiana, Florida)
- In Hawaii, favored plants include fiddlewood, hibiscus, and plumeria, with lighter infestations found on other plants such as hau, milo, avocado, citrus, and guava.
- 1/2 - 1-1/2" long filaments produced by nymphs

- First discovered on O'ahu in 1978, then on all major islands by 1981 (native to Central America and the Caribbean; also found throughout the Pacific islands, tropical Asia, West Africa, southern Florida)
- Plumeria is the most preferred, but other host plants include many vegetable, ornamental, fruit, and shade trees in Hawaii
- Population builds up during warm, dry weather (June - Sept), decreasing with heavy rains and cool temperatures (from December).

### Biological Control of the Giant Whitefly




Parasitized giant whitefly nymphs




W. Nagamine, HI DOA  
*Encarsia guadeloupe*

1 mm (1/25")



W. Nagamine, HI DOA  
*Idioporus affinis*



1/16" *Delphastus pusillus*

- Two wasps are effectively controlling the giant whitefly in Hawaii: *Encarsia guadeloupe*, brought in 1980 to control the spiraling whitefly, and *Idioporus affinis*, which arrived with the giant whitefly from California ("fortuitous" biocontrol).
- Parasitic wasps may not be effective in windy or oceanfront areas and in hotter conditions (greenhouses, interior landscapes) and partly sheltered areas (under eaves).
- Tiny black ladybeetles are found among heavy whitefly infestations. Both adult and larvae stages feed on whitefly eggs and nymphs.
- Cultural: remove and bag infested leaves for disposal; Physical: directed "syringing" with a strong stream of water directed to undersides of infested leaves as effective or better than chemical treatments; Chemical: IGRs (pyriproxyfen) and neem are not as detrimental to parasitic wasps as insecticidal soaps or horticultural oils are.

### Biological Control of the Spiraling Whitefly

Parasitic wasps are very effective against the spiraling whitefly except in windy, coastal areas.

*Aleuroctonus vittatus* *Encarsia* sp.

Normal whitefly emergence (non-parasitized)

parasitized whitefly nymphs

parasitized whitefly pupa

1.0 – 1.5 mm L  
A predacious lady beetle *Nephaspis* sp.

Parasitoid emergence hole

Physical: Apply strong stream of water to underside of infested leaves; Cultural: Healthy plants without water stress can better tolerate whitefly infestations; Chemical: Systemic neonicotinoids applied as drench or bark spray, foliar applications of IGRs are effective and least detrimental to biological control agents.

### Acacia psyllid *Psylla uncatoides*

- first found in Hawaii in 1966
- feeds and breeds in the new growth of koa
- has become a serious pest of the closely related koaia (*Acacia kooia*)
- Feeding can result in the accumulation of black sooty mold on koa leaves and phyllodes. (Leeper & Beardsley 1973)

Adult

Photos: Scot Nelson, UH CTAHR

Nymph

Damage to koa by acacia psyllid

S Nelson, UH CTAHR

### Myoporom or Naio thrips *Klambothrips myopori*

Galling damage to naio papa (false sandalwood) (Kona, HI)

Dying *Myoporom* sp. along roadway (San Diego, CA)

- *Myoporom* thrips are specific to plants in the genus *Myoporom*.
- The minute pirate bug, *Orius* sp., a thrips predator, has controlled myoporom thrips in CA and will also impact thrips in HI.
- Avoid broad-spectrum insecticides that will harm these predators.
- Suggested chemical treatments include neonicotinoid drench (dinotefuran) and spinosad foliar application (spinosad)

Leaf galls (left); larva (top) and adult naio thrips (bottom).

### fringed aphids *Cerataphis* spp.

- only aphid known to commonly occur on palms; resembles scale insects or whitefly pupae
- have been recorded on *Pritchardia* palm (loulou) and various orchids, including vanilla
- generally occur in dense aggregations, typically on the young and unopened fronds, but also occasionally on the flowers and young fruits
- secretes honeydew and are often tended to by ants, which covers the aphids with protective debris.

on orchids and palms

### Biological Control of Aphids

A parasitic wasp laying its eggs in an aphid.

Wasp eggs hatch within live aphids that swell as the wasp develops within.

The adult wasp cuts a circular hatch and emerges from the mummified aphid.

Lacewing larva with aphid prey  
David Cappaert, Michigan State University Biological

Praying mantis

Pseudoscorpion

Ladybeetles

immature

adult

*Curinus coeruleus* *Ayoa orbiger*

Lacewings

Hoverflies


Lacewing eggs

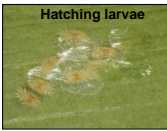
### Chewing Insects

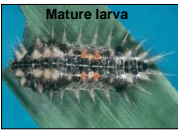
- Nettle caterpillar *Darna pallivitta*
- Chinese rose beetle *Adoretus sinicus*
- Croton caterpillar *Achaea janata*
- Citrus leafminer *Phyllocnistis citrella*
- Pacific beetle cockroach *Diploptera punctata*




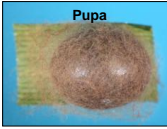
### stinging nettle caterpillar *Darna pallivitta*

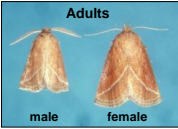
  
Newly-laid eggs

  
Hatching larvae

  
Mature larva


  
Prepupa


  
Pupa


  
Adults  
male female

Life stages S. Chun (UH CTAHR) and W. Nagamine (HDOA)

larval stage: 45-72 d (8-11 instars); pupal stage 18-20 d; adult 8-12 d  
Life cycle (egg to adult eclosion): 72 to 87 days

  
nettle caterpillars on mondo grass

  
pupae in phoenix palm

  
adult moths

### Host Status of the Nettle Caterpillar in Hawaii

(Prior to Host Range Study)

Name	Host Status*	Name	Host Status*
Coconut	C+	Honohono grass	F
Mondo grass	C+	Maunaloa vine	F
Ti plant	C+	Monkey grass	
Areca palm	C	Monstera	F
Dracaena spp.	C	Phoenix palm	F
Fishtail palm	C	Pink Quill	
Rhapis palm	C	Pony tail	F
Walking iris	F+	Rabbit's foot fern	F
Banana	F	Red ginger	F
Chickweed	F	Whaleback	F
Golden glory	F		

(HDOA & UH-CTAHR data)

\*Host Status F = Observed Feeding C = Completed life cycle + = Heavy infestations observed

#### Host range test plant species for *Darna pallivitta*

honohono grass	<i>Cammelia diffusa</i>
iris	<i>Crocsmia (Tritonia) xrocsmiiflora</i>
Manila palm	<i>Veitchia merrillii</i>
vigna (beach pea) (indigenous)	<i>Vigna marina</i>
Coffee	<i>Coffea arabica</i>
ti	<i>Cordyline terminalis</i>
starfruit	<i>Averrhoa carambola</i>
Koa (endemic)	<i>Acacia koa</i>
Mamaki (endemic)	<i>Pipturus albidus</i>
loulou plum (endemic)	<i>Pritchardia hillebrandii</i>
dracaena	<i>Dracaena massangeana ; Dracaena fragrans</i>
loulou Hiwa palm (endemic)	<i>Pritchardia martii</i>
Peace lily	<i>Spathiphyllum sp. 'Clevelandii'</i>
tree fern (hapu'u)	<i>Cibotium chamissoi</i>
pink quill	<i>Tillandsia cyanea</i>
'ie'ie (indigenous)	<i>Freycinetia arborea</i>
pandanus (hala) (indigenous)	<i>Pandanus tectorius</i>
'ohi'a lehua (endemic)	<i>Metrosideros polymorpha</i>
monstera	<i>Monstera deliciosa</i>
'uki (indigenous)	<i>Dianella sandwicensis</i>
common guava	<i>Psidium guajava</i>
Koster's curse	<i>Cleome hirta</i>
mock orange	<i>Murraya paniculata</i>

### Short Term Control Strategy

#### Insecticides Against the Nettle Caterpillar

Brand Name	Common Name	Class	Days to >95% mortality*
Decathlon	cyfluthrin	pyrethroid	3
Dursban	chlorpyrifos	organophosphate	3
Conserve	spinosad	spinosyn	14
Dipel	<i>Bacillus thuringiensis</i>	microbial	14
Sevin	carbaryl	carbamate	14


\* Moribund caterpillars stop feeding but brushing against spines will cause sting.

### Long Term Control Strategy

#### Classical Biological Control of Nettle Caterpillar

- An effective natural enemy was discovered in Taiwan, imported to Hawaii, evaluated extensively, then approved and released by Hawaii Board of Agriculture and USDA in 2007.
- Aropectrus dimerus* has been very effective on the nettle caterpillar.


Adult wasp laying eggs on caterpillar



W. Nagamine, Hawaii Department of Agriculture

→

Wasp eggs hatch, feed on caterpillar



W. Nagamine, Hawaii Department of Agriculture

### Chinese rose beetle *Adoretus sinicus*

These larval stages (grubs) reach a maximum length of 1-1/3", do not attack live plant tissue, and prefer to live in loose, rich soil, leaf litter, or compost.

**Eggs**  
Tiny eggs are laid 1-3/4 inches beneath soil surface

**1<sup>st</sup> to 3<sup>rd</sup> instars**

**Pupa**  
Pupation occurs in soil. Pupae are 3/4 W x 1/2" L.

**Egg to adult**  
6 to 7 weeks

**Adult**  
1/2 inch long, reddish brown, covered with fine white hairs

- A fungus found in soil, *Metarrhizium anisoplia*, infects and destroys many beetles (grubs and adults) particularly during the wet season.
- Adult beetles are attracted to light, so light traps can be used with light infestations.

Nocturnal feeding damage by adult beetle

### Croton caterpillar *Achaea janata*

**Adult moth** – nocturnal, black & white banding not always visible (~ 2" wing span)

- First found on O'ahu in 1944; has since spread to all of the islands.
- Outbreaks of the predominantly brownish-gray caterpillars, up to 2-1/2" long, have been documented in Green Sands, Pahala, Na'alehu, Miloli'i, and Kailua-Kona in 1955, 1992, 1996, and 2011.
- In addition to croton, other host plants include vegetables and ornamentals (kou, poinsettia, mini white poinsettia), but also consumes noxious roadside/pasture weeds (koa haole, castor bean and Christmas berry).

### Citrus leaf miner *Phyllocnistis citrella*

Pupation occurs in leaf mines; the 4<sup>th</sup> instar spins a silk cocoon, and draws the leaf edge over the pupa as protection.

**Egg to adult**  
3 weeks

**Larva and leaf mine damage**

**pupae**

**adult**

Silvery, serpentine leaf mines caused by tunneling larvae (3 of 4 instars) are typically found on undersides of young terminal leaves, rarely on upper leaf surfaces, stems or fruit.

Adult moths are about the size of a mosquito (2/10"), with hindwings that appear feathery with a black spot at the tip

A tiny parasitic wasp *Ageniaspis citricola* (adult, far left and pupae, near left) is established on all islands and has kept citrus leafminer under control.

### Pacific beetle cockroach *Diploptera punctata*

**burrowing cockroach *Pycnoscelus indicus***

**girdling**

### Boring Insects

- Black twig borer *Xylosandrus compactus*
- Plumeria stem borer (long-horned beetle) *Lagocheirus undatus*
- Eucalyptus long-horned borer *Phoracantha semipunctata*
- Monkeypod round-headed borer *Xystrocera globosa*

### black (coffee) twig borer *Xylosandrus compactus*

Tiny eggs are laid on ambrosia fungus inside twig galleries.

**Eggs** (15 X, 25 X)

**Egg to adult**  
30 days

**Grubs**  
Two larval stages that feed on ambrosia fungus precede pupation.

**Pupae**  
The pupae are initially white, changing to light brown with black wings (female) near maturity. Upon emergence, adults are light brown.

**Adults**

**Dieback symptoms**



Female beetles become shiny black in 3-4 days, and are about 1/16" L, while males are about half as long, incapable of flight, and turn reddish-brown.

**Plumeria borer, plumeria stem borer or plumeria longhorned beetle** *Lagocheirus undatus*

**DAMAGE**

- The larval stage of the plumeria longhorned beetle first feeds on dying or decaying plant tissue, moving on to feed on live stem tissue from within
- Affected stalks have a small entry hole oozing with black liquid. Leaves fall and the tree eventually dies.
- Hosts include but are not limited to plumeria, hibiscus, allamanda vine, kukui nut, breadfruit, and poinsettia.
- Cut off infested branches; remove and destroy to prevent adult beetles from spreading.


Source: (PDDIRS – submitted by J Yalamar)


Juliana Yalamar HI Dept of Agriculture  
Adult beetle: ¾ inch long

Steve Freedland

**Eucalyptus longhorned borer** *Phoracantha semipunctata*




Adult beetle (1/2 - 1-1/4" length)



Walter Nagamine, Hawaii Department of Agriculture

larvae causing feeding and boring damage to a eucalyptus log

**Monkeypod round-headed borer** *Xylocopa globosa*



Host plants: mostly leguminous trees, including albizia, acacia

adult beetle  
0.6-1.25" length  
<http://www.cerambycoidea.com/foto.asp?id=96>

- Moisture-stressed, injured or pruned trees most susceptible but borers will also attack healthy trees.
- Breeding sites: freshly chopped logs, drying branches for firewood (burn, bury, chip, or solar-treat bagged wood for several months)

**Gall-forming**

- Erythrina Gall Wasp *Quadrastichus erythrinae*
- Chinese banyan stem gall wasp *Josephiella* sp.
- Chinese banyan leaf gall wasp *J. microcarpae*

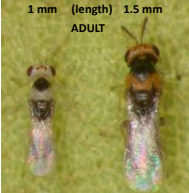
**Erythrina Gall Wasp** *Quadrastichus erythrinae*



14 day old LARVAE



PUPAE (20 d after egg-laying)



1 mm (length) 1.5 mm ADULT  
Male Female

Causes galls by egg deposition and larval feeding on leaves and petioles – native wiliwili

**THE GOOD BUG** *Eurytoma erythrinae*




Size: Female: 4.0 mm  
Male: 2.5 mm  
(about the size of a black sesame seed)




Photos: W. Nagamine, Hawaii Department of Agriculture

**A Successful Classical Biological Control**



**BEFORE INTRODUCTION:** This photo taken on Dec. 3, 2008, shows a wiliwili tree infested by gall wasps. Most of the tree's leaves are gone.



**1 YEAR AFTER INTRODUCTION:** A year later, after introducing *eurytoma erythrinae*, a natural gall wasp predator, the leaves are back.

Hawaii Dept. of Agriculture photos

**Banyan leaf gall wasp** *Josephiella microcarpae*






Figure 3. Stem-galling wasp (1.5xh inch)


**Banyan stem gall wasp** *Josephiella* sp.




Zhiqiang Cheng, UH CTAHR



2. Galls in green stem tissue (left side in each picture) and old galls in woody tissue with wasp exit holes (right side).



4. Wasp larva in gall (1.5xh inch)



5. Adult wasps in dissected stem gall.

Hawaii Dept of Agriculture



### Treating a tree for banyan stemgall wasp

Injected with Ace-Jet using Tree I.V. (09/12/12)

Kennedy Theatre

- 40" diameter trunk at chest height
- Fast drilling with 3/8" drill bit
- Injected with AceJet (acephate 97.4%) ( 90 g /400 ml water)
- Pressure applied with bicycle pump (50 PSI)
- Better uptake during mornings with cooler temperatures
- Acephate had quicker knockdown of stem-galling wasp compared with imidacloprid; emamectin benzoate and imidacloprid were effective against the leaf gall wasp up to 18 months after trunk injection (Zhiqiang Cheng, UH CTAHR)

On-going research at UH Manoa on 45 Chinese banyan trees indicates that emamectin benzoate is effective to some extent against stem gall wasp up to 14 months after trunk injection.

Both emamectin benzoate and imidacloprid were effective against leaf gall wasp up to 18 months after trunk injection. (Z. Cheng, UH CTAHR)

Stem gall infestation level (1-5)

Leaf gall infestation level (1-5)

## Ants

- Little Fire Ant *Wasmannia auropunctata*

## COMMON ANTS IN HAWAII

Larger than 2.0 mm			Smaller than 2.0 mm		
Red	Brown	Black	Red	Pale	Two-tone
<i>Phorbus megapheles</i> "big-headed ant" Length: 3.0 mm Soldier w/ enlarged head Slow moving	<i>Tachonomyx spp.</i> "white-footed ant" Length: 3.0 mm Abdomen head-to-hip shaped Slow/moderate moving	<i>Monomorium pharaonis</i> "pharaoh ant" Length: 1.5-2.4 mm Slow/moderate moving	<i>Phragmites affinis</i> "yellow ant" Length: 1.4 mm Semi-transparent body Moderate moving	<i>Tapinoma melanoccephalum</i> "ghost ant" Length: 1.6 mm Fast moving	<i>Monomorium farinosum</i> "flour ant" Length: 1.8 mm Narrow body Slow moving
<i>Monomorium destructor</i> "Singapore ant" Length: 1.8-3.5 mm polymorphic workers Slow moving	<i>Anoplolepis gracilipes</i> (longlegs) "long legged ant" Length: 4.0 mm Long antenna Fast moving	<i>Ochilobius glaber</i> "back house ant" Length: 2.5-3.0 mm Abdomen short, rounded Moderate moving Prefers sweets (sucroses)	<i>Solenopsis japonica</i> "red ant" Length: 1.8 mm Dark brown abdomen Slow moving Prefers fats, protein	<i>Monomorium farinosum</i> "flour ant" Length: 1.8 mm Narrow body Slow moving	<i>Wasmannia auropunctata</i> "little fire ant" Length: 1.2-2.0 mm Stings Slow moving Prefers fats, protein
<i>Solenopsis geminata</i> "red ant" Length: 3.5 mm Moderate moving	<i>Pheidole sp.</i> "tricky ant" Length: 2.0-3.0 mm Long antenna and legs Fast, erratic moving	<i>Wasmannia auropunctata</i> "little fire ant" Length: 1.2-2.0 mm Stings Slow moving Prefers fats, protein	<i>Lasius niger</i> "black garden ant" Length: 2.0-3.0 mm Stings Slow moving Prefers sweets (sucroses)	<i>Lasius niger</i> "black garden ant" Length: 2.0-3.0 mm Stings Slow moving Prefers sweets (sucroses)	<i>Lasius niger</i> "black garden ant" Length: 2.0-3.0 mm Stings Slow moving Prefers sweets (sucroses)

\* Actual size bar in upper right corner of photo

### little fire ant (LFA) *Wasmannia auropunctata*

Tropical fire ant or "red ant" *Solenopsis geminata*

Little fire ant (LFA) *Wasmannia auropunctata*

- LFA workers are ~ 1.5 mm (1/16") L, reddish to golden brown, and move very slowly
- Distinctive characteristics under magnification.

- 2 GROOVES on the front of the head where the antennae can lay at rest (antennal scrobes)
- antennae end in two-segmented CLUBS
- long, pointy SPINES on the upper abdomen (propodeum)
- 2 NODES (petiole and post-petiole)

Worker Male

Worker Queen

Large, dark colored, often winged ants in LFA colony are **reproductive males and queens** (although queens can reproduce without mating (cloning)).

(queen's wings clipped)

**FIRST STEP: MONITOR / SURVEY FOR LFA USING FOOD LURES**

- LFA prefer protein sources, like peanut butter, hot dog, luncheon meat (use SMALL amounts).
- Spray paint the chopsticks or vials a bright color to make them easier to locate and recover.

- morning, late afternoon, or when overcast
- hot and sunny conditions or heavy rain



vial with luncheon meat

- smear
- dollop



stick with peanut butter

**SECOND STEP: APPLY INSECTICIDAL ANT BAITS (REPEAT AS NEEDED)**

**Amdro Pro, Probait, Maxforce Complete** (hydamethylnon)



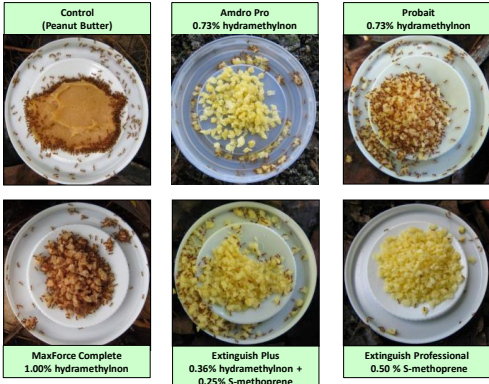
Corn grit with soybean oil

sugars, proteins (including silk worm pupae), fats and oils, which accommodate insects' changing nutritional needs



**Extinguish Plus**  
(hydamethylnon + methoprene)

**LFA attraction to different baits (2 hours after placement)**



**TIPS for SUCCESSFUL ANT BAITING**

- Be consistent (re-apply every 4-6 weeks according to label)
- Make your applications count!



Scott™ "Handy Green" fertilizer spreader

**WHEN: afternoon with no forecast of rain** since it degrades in sunlight (12 hours) and more rapidly in rain (45 minutes)

**minimal wind movement** to control where granules are placed

**WHERE: LFA do not forage very far, so monitor populations** to place bait near each colony

Apply baits according to label specifications for site and type of plants (edible or ornamental)

LFA Fact Sheet 4 "An improved spreader for ant baits: How to modify a cheap fertilizer spreader so it works more effectively" – Hawai'i Ant Lab

**PASTE ANT BAIT FOR COLONIES IN TREES**



- 3 cups warm water
- 2 cups corn oil or other vegetable oil
- 4 Tbsp Tango (methoprene)
- 1 Tbsp xanthan gum



LFA attracted to a splatter of bait on a plant leaf

Formulation will have the consistency of mayonnaise. Apply with hand-held sprayer up into trees.

Cas Vanderwoude www.littlefireants.com

**ACCEPTED**  
December 5, 2014  
0.0 per acre (0.000000 lbs/acre) to 0.24 per acre (0.240000 lbs/acre)

**syngenta**  
**FITRA**  
Section 24(c) Special Local Need Label

For Control of LFA Fire Ant (LFA) (Invasive Species) in Hawaii (Invasive Species), Microorganisms, Insects, and Other Pests, and Other Invasive Species (Invasive Species) in Hawaii (Invasive Species) in Hawaii (Invasive Species)

Do not use in areas that may affect threatened or endangered species or critical habitat.

**DIRECTIONS FOR USE:**

- 1. Use a quantity of Pro bait that will provide for complete coverage with no overlap.
- 2. The user must be in the possession of the user at all times of application.
- 3. Pro bait is not to be used in areas where it is not intended for use.
- 4. Pro bait is not to be used in areas where it is not intended for use.
- 5. All use and application must be in accordance with the label.
- 6. All use and application must be in accordance with the label.
- 7. All use and application must be in accordance with the label.

**Preparation Instructions:**

- 1. Mix 1.00% of Pro bait with 1.00% of water to make a 1.00% solution.
- 2. Apply the solution to the target area.
- 3. Do not apply more than 1.00% of Pro bait per acre per year in a single application.
- 4. Do not apply more than 1.00% of Pro bait per acre per year in a single application.
- 5. Do not apply more than 1.00% of Pro bait per acre per year in a single application.
- 6. Do not apply more than 1.00% of Pro bait per acre per year in a single application.
- 7. Do not apply more than 1.00% of Pro bait per acre per year in a single application.

**Information on LFA may be obtained from local Hawaii Cooperative Extension Service offices or the Hawaii Ant Lab.**

**Cleaning and Disposal:**

After use, thoroughly clean the spray bottle using a heavy duty detergent. Failure to do this will cause the residue to get on your hands and other surfaces. Spray the detergent through the nozzle. We stand for our products, our users and our environment.

Issue Date: 12/05/14  
Revision Date: 12/05/14

Company: Syngenta Crop Protection, LLC  
2000 N. 10th Street  
Greensboro, NC 27410-8300  
Label Code: H0197121214

Page 2 of 2  
EPA 607 (Rev. 11-1983)

**THIRD STEP: CONTINUE TO MONITOR/SURVEY WITH FOOD LURES AND PREVENT REINFESTATION**

- **Look for and correct potential nesting sites** around buildings and grounds to deter LFA colonies.
- To prevent dispersal by movement of infested plants, **carefully inspect plants** before transporting them.
- **Drench** potted plants with hot water (113 °F for 10 min) or Sevin before movement from an infested area.
- Create chemical barriers, if necessary, to deter LFA migration from adjacent properties (Talstar or Upstar (bifenthrin), or Termidor (fipronil) (PCO only, around buildings).

**Pest Alerts**

- Red palm mite *Raoiella indica*
- Red palm weevil *Rhynchophorus ferrugineus*
- Giant palm weevil (South American palm weevil) *Rhynchophorus palmarum*
- Bamboo Long-Horned Beetle *Chlorophorus annularis*
- Wingless Weevil *Otiorynchus dieckmanni*
- Soft Wax Scale *Ceroplastes destructor*
- Japanese Wax Scale *Ceroplastes japonicus*

*Raoiella indica*  
Multigenerational colonies

egg, larva, protonymph, deutonymph, adult

Immature development ~ 24.5 days

**red palm mite *Raoiella indica***

Photos by: Daniel Carrillo

**Red palm weevil (RPW) *Rhynchophorus ferrugineus***

Photos by: John Kabashima, UCCE; Christina Hoddle - UCR, CBR

- Two color forms: red stripe (found in Laguna Beach, CA from Malaysia/Asia) and orange/red color (Saudi Arabia, Egypt, Mediterranean)
- Feeds on over 19 palm species but prefers Phoenix spp., Canary Island date palm. Adults attracted to dying, damaged, or healthy palms.
- Larvae bore into soft tissue (tree crown, upper portion of trunk, base of petioles in mature palms, decaying tissue of dying palms, trees < 5 yrs old)

Oozing brown sap, exit holes    Damage at growing tip    Damage at base    Chewed fiber, sawdust

[http://www1.montpellier.inra.fr/rhynchophorus/sources/index.php?page=rhynchophorus\\_cycle\\_de\\_ve](http://www1.montpellier.inra.fr/rhynchophorus/sources/index.php?page=rhynchophorus_cycle_de_ve)

**giant palm weevil *Rhynchophorus palmarum* or South American palm weevil**

John Kabashima    Peter Kovarik

Description	Distribution	Host Plants
Larvae feed on growing tissue at crown of palm; vector of nematode that causes red-ring disease of coconut; deep black (1.8" L)	Tropical regions of Mexico, Caribbean and Central America, South America	palms: oil, coconut, Phoenix; papaya, citrus, banana, guava, mango


**Bamboo Long-Horned Beetle *Chlorophorus annularis***

Oregon DOA, Steve Valley    Ken Walker

Description	Distribution	Host Plants
Found in bamboo products (garden stakes, baskets, building supplies); black and yellow pattern on adult (0.5" L)	South/Southeast Asia, Australia	dried bamboo products (garden stakes, baskets, building material), sugarcane, citrus




**Wingless Weevil**  
*Otiorynchus dieckmanni*



Christoph Benisch

Description	Distribution	Host Plants
Found in soil under plants; female can reproduce parthenogenically (without fertilization by male); nocturnal (0.3" L)	Western Europe	grasses, clovers, mock orange, lettuce, privet, strawberry, rose, conifers


**Soft Wax Scale**  
*Ceroplastes destructor*



Rosa Henderson, Landcare Research, NZ Bugwood.org      Botanic Gardens Trust Sydney

Description	Distribution	Host Plants
Body completely embedded in white wet wax with irregular ridges and furrows. Under wax, adult is reddish-brown. (0.25" L)	Africa, Asia, Australia, South Pacific Islands	citrus, coffee, avocado, cocoa, guava, plumeria, oleander

**Japanese Wax Scale**  
*Ceroplastes japonicus*



Giuseppina Pellizzari Bugwood      Giuseppina Pellizzari Bugwood

Description	Distribution	Host Plants
Oval or rectangular, reddish brown under thick oily wax covering that is pinkish-gray to pinkish white. (0.2" L)	East Asia, Europe, Russia	ornamentals, fruit trees (apples, pears, peaches, citrus)

**Links to Presentation and Handouts**

**Dr Arnold Hara's website** (select "Presentations" on menu at left)  
<http://www.ctahr.hawaii.edu/haraa/index.asp>

**University of Hawai'i CTAHR Publications** (search by topic)  
<http://www.ctahr.hawaii.edu/site/info.aspx>

**Hawai'i Department of Agriculture New Pest Advisories**  
<http://hdoa.hawaii.gov/pi/ppc/new-pest-advisories/>

**Hawai'i Ant Lab / Dr Cas Vanderwoude** (download "how-to" guides)  
<http://www.littlefireants.com/>

**Insect Resistance Action Committee** (updated MoA booklet)  
<http://www.irac-online.org/updated-irac-moa-classification-booklet-and-poster-now-available/>