

“Green” Solutions to Pests and Invasive Ant Control

Maui Flower Growers' Association

Kahului, Hawaii

May 15, 2014



Arnold Hara, Entomologist
University of Hawaii at Manoa
College of Tropical Agriculture &
Human Resources
Hilo, Hawaii
arnold@hawaii.edu



Website: <http://www.ctahr.hawaii.edu/haraa/index.asp>

<http://www.mauiflower.com/order.php>

Topics to be Covered

*Characteristics of Insects

*Control Strategies – Preventative vs Remedial

*Green Solutions

- Cultural Control = sanitation
- Physical Control = pressure wash and heat treatment
- Bio Control = natural enemies, microbes
- Natural/Softer Chemical Products = boric acid, diatomaceous earth, kaolin clay, neem, pyrethrins, oils, soaps

*Invasive Ant Control

- Argentine, whitefooted, bigheaded, little fire ant

Characteristics of Insects

- *One pair of antennae (smelling)
- *Two pairs of wings
- *Three pairs of legs
- *Hard, waxy, oily exoskeleton (outside skeleton)



Control Strategies

*Preventative

- Start with pest-free plant materials
- Disinfest propagative plant materials
- Start clean, stay clean thru sanitation

*Remedial

- Implement pest control after plants are infested
- High pest density if very difficult to control

“Green” Controls

***Cultural Control** = Sanitation

Early detection and removal of infested plant or parts

***Physical Control** – pressure wash, hot water

***Biological Control** – release of parasitic wasps, predators, pathogens (fungus, bacterium, virus, nematodes)

***Natural/Softer Products** – boric acid, diatomaceous earth, kaolin clay, neem, pyrethrins, soaps, oils

Physical Control

Pressure washing



HOT WATER TREATMENTS: NON-CHEMICAL CONTROL OF INVASIVE PESTS






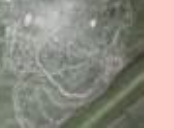










All photos by UH CTAHR unless otherwise noted.

A.HARA, C. JACOBSEN, E. OUCHI, S. MARR, and R. NIINO-DuPONTE

University of Hawai'i at Mānoa, College of Tropical Agriculture and Human Resources, Beaumont Agric. Research Center, Hilo, HI



HEAT TREATMENT TO KILL PESTS

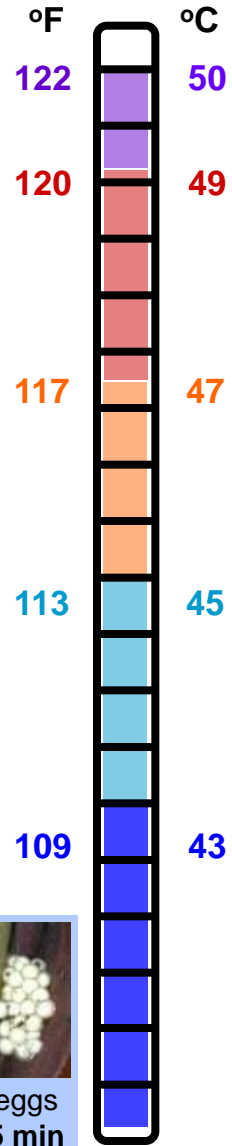
(lowest temperature, shortest duration to achieve 100% mortality)

 <p>Infested Healthy</p> <p>Roger Lopez-Chaves</p>		122
<p>Burrowing nematode</p> <p>5 min</p>	<p>Root mealybugs</p> <p>15 min</p>	
 <p>Julie Coughlin</p> <p>Taro root aphid</p> <p>5.5 min</p>	 <p>Cockerel scale</p> <p>6 min</p>	120
 <p>Green scale</p> <p>7 min</p>	 <p>Spiraling whitefly</p> <p>10 min</p>	
 <p>Nettle caterpillar (pupa)</p> <p>7 min</p>	 <p>BioPlant</p> <p>Long-tailed mealybug</p> <p>12 min</p>	
 <p>Kearney Agric Center</p> <p>Obscure mealybug</p> <p>12 min</p>	 <p>Pink hibiscus mealybug</p> <p>12 min</p>	
<p>Foliar nematode</p> <p>10 min</p>	 <p>Nettle caterpillar (larva)</p> <p>12 min</p>	117
 <p>Chrysanthemum white rust</p> <p>5 min</p>	 <p>Little fire ant adults</p> <p>10 min</p>	113
 <p>Snails adults</p> <p>15 min</p>	 <p>Coqui Frog adults</p> <p>5 min</p>	
	 <p>Coqui Frog eggs</p> <p>5 min</p>	109

PLANT TOLERANCE TO HEAT

(highest temperature, longest duration tolerated)

	<p>Anthurium 'gobo' (propagative material)</p> <p>122</p> <p>10 min</p>
POTTED PLANTS	
<p>6 min: Rhaps palm</p> <p>10 min: Dracaena 'Massangeana', 'Compacta', Bromeliad 'Tillandsia'</p> <p>10 min w/ hot water conditioning at 102 °F (39 °C): Palms: Parlor, Bamboo, Phoenix, Fishtail; Dracaena: 'Janet Craig' and 'L'</p>	
120	
<p>PROPAGATIVE MATERIAL</p> <ul style="list-style-type: none"> Gardenia Ginger, edible Plumeria Sugarcane Dracaena: cutbacks: 'Massangeana', 'Jumbo', 'Warneckii', money tree tip cuttings: 'Janet Craig', 'L' 	<p>CUT FLOWERS & FOLIAGE</p> <ul style="list-style-type: none"> Bird-of-paradise buds, foliage Calathea foliage Red ginger Heliconia flowers (16 cv, var.) Palm foliage Papyrus foliage Ti leaves Whaleback foliage
<p>10 min</p>	10 min
<p>Orchid Oncidium</p> <p>Sharry Baby 'Sweet Fragrance'</p>	<p>117</p> <p>Chrysanthemum</p> <p>'Cupertino' 'Manhattan'</p>
<p>5 min</p>	10 min
<p>Orchid Vuylstekeara</p> <p>Michelle Rehfield 'Pacific Blue Skies'</p>	<p>Bromeliad</p> <p>Vriesea</p> <ul style="list-style-type: none"> 'Flammea' 'V. cocorvadensis' 'Purple cockatoo' (right) 
10 min	10 min
<p>Bromeliads</p> <p>Guzmania 'Fiesta', 'Marjam', 'Puna Gold'</p>	<p>5 min</p>
<p>Ornamentals</p> <p>Canna lily, Dieffenbachia, Dracaena 'Tricolor coloramma', Easter lily, Philodendron, Salvia</p>	<p>15 min</p>
<p>Landscap</p> <p>Bougainvillia, Croton, Kupukupu fern, Lantana, Laua'e fern, Liriope var., Plumbago, Podocarpus, Ti 'Kaua'i', Zoysia grass</p>	
<p>Orchids</p> <p>Dendrobium 'Din Daeng Blue', Beallara Peggy Ruth Carpenter 'Jem', Epicat Hilo Delight 'Starlight'</p>	<p>113</p>
<p>Ornamentals</p> <p>Spathiphyllum</p>	<p>15 min</p>



Beneficial Effects of Hot Water

49 C (120 F) for 10 min

PREVENTS ABSCISSION



Treated

Untreated

'Sexy Pink' heliconia

*EXTENDS VASE LIFE
BY CONTROLLING
SPIDER MITES*



Untreated

Treated

Ti leaves

PREVENTS GEOTROPISM



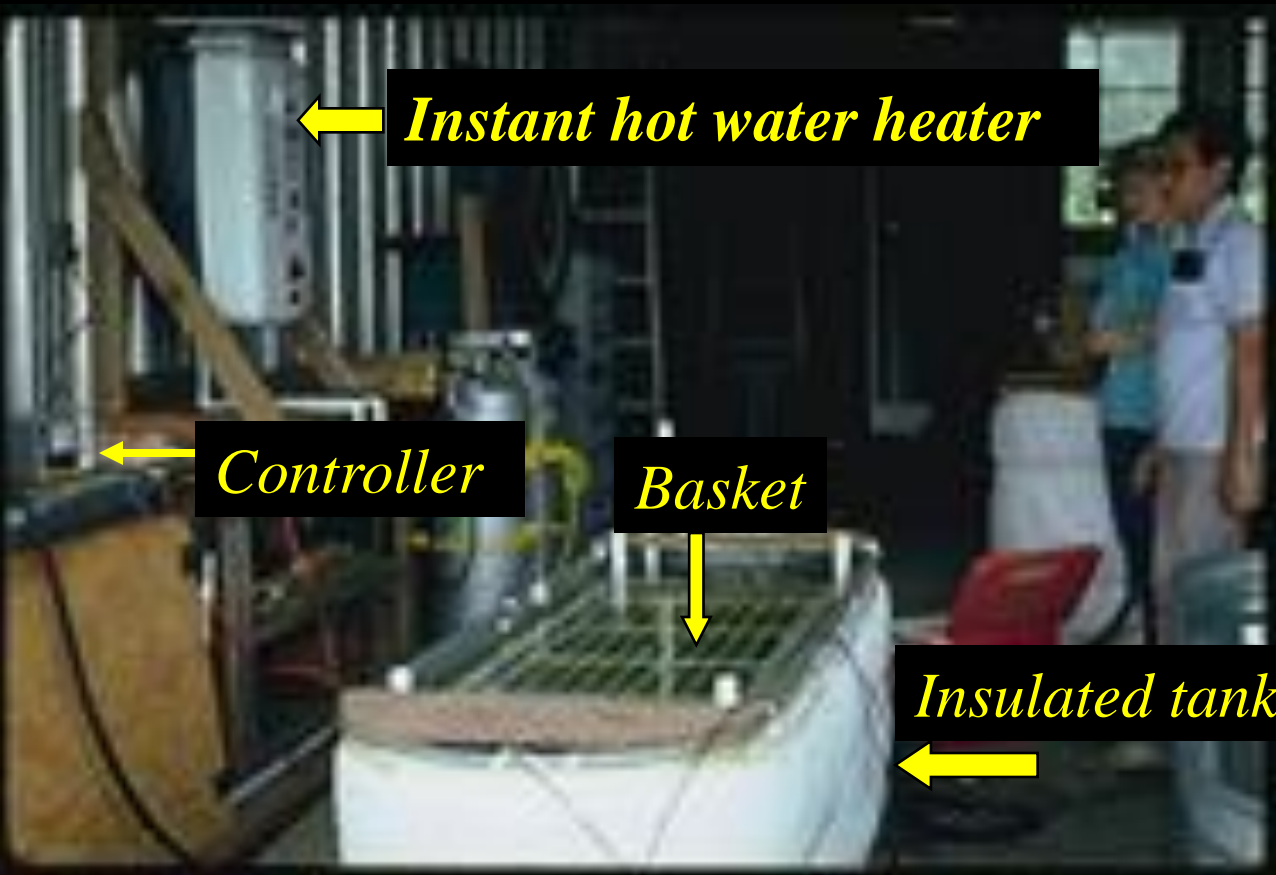
Treated

Untreated

Red ginger

Hot-Water Dip Tank (Commercial Application)

(5 installations in Hawaii)



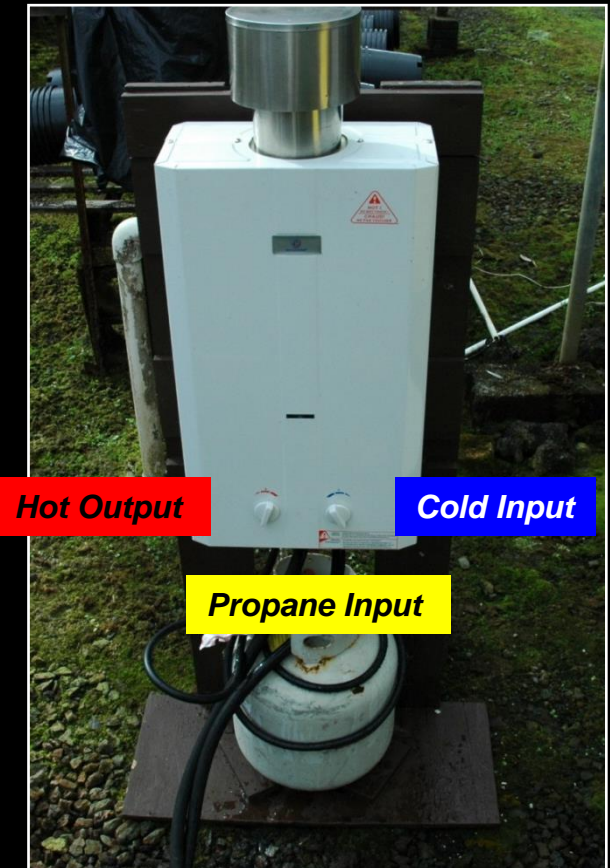
*Basket loaded
w/ red ginger*



Portable Hot Water Sprayer

Spraying hot water 115 F at nozzle against coqui frogs and other quarantine pests.

**Tankless
Water
Heater**



*Water at
115 F at
nozzle tip*



*Green
Solution!*

Hot Water Drench for Reniform Nematode 122 F for 10 min

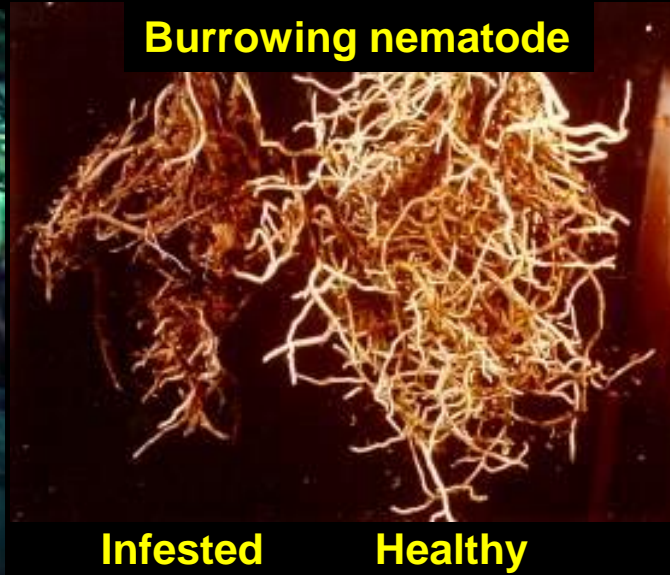


Root-Infesting Quarantine Pests Controlled by Hot Water (122 F 10 min)

Root mealybug

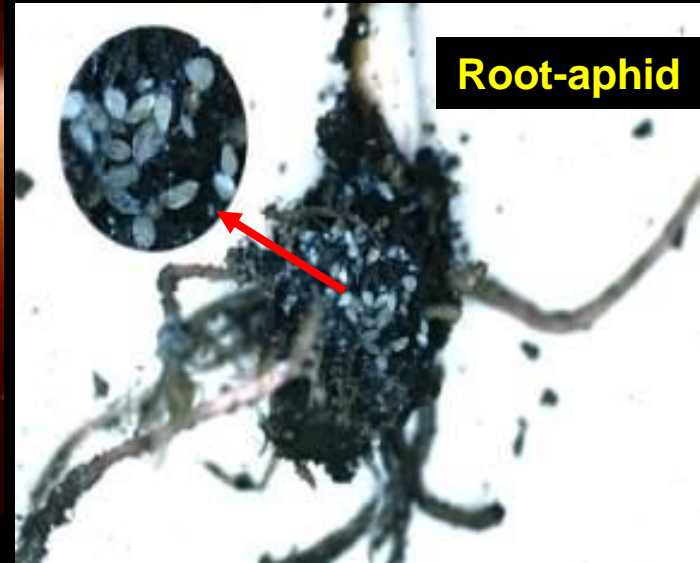


Burrowing nematode



Infested

Healthy



Root-aphid

Ensign scale insect

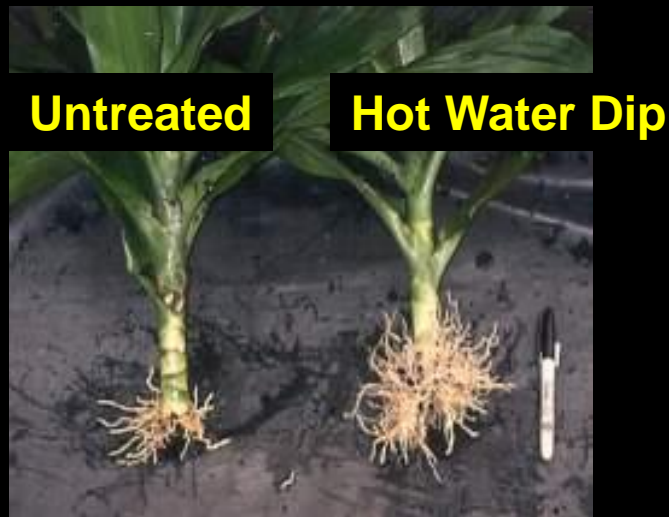


Root Knot Nematode



Snail

Hot Water and IBA Treatments on Dracaena Bush Tip Cuttings



Treating Propagative Materials with Hot Water & Rooting Hormone

(49° C for 10 min + 0.8% indole butyric acid (IBA) rooting powder)

	<u>Number of roots</u>	
	<u>Hot water + IBA</u>	<u>IBA only</u>
'Massangeana'	8.3	3.3
Gardenia	118.3	15.6
Plumeria	12.4	3.2
'Janet Craig'	2.2	1.1

Hot water @ 49° C + IBA



Gardenia

IBA only





Biological Control in Hawaii



- *Hawaii's government has been practicing classical biological control by purposely introducing and releasing natural enemies for over 100 yrs.
- *Early attempts to control pests (rats & armyworms) through the introduction of animals (mongoose, mynah bird) into Hawaii were made by private citizens in 1865.
- *In 1890, 25 years later, procedures of biological control were regulated and supported by the Hawaiian government.
- *Of the 243 natural enemies purposely introduced (1890-1985), 86.4% have been recorded to prey on or attack about 200 pest species.
- *No purposely introduced species, approved for release in the past 35 years, has attacked any native or other desirable species.

Plumeria at Keahole Ag
Park (09/2010)



Immature Lady Beetle



Adult Lady Beetle



*No natural
enemies
present*

2010/09/29

Biological Control of Mealybugs

Mealybug destroyer



Immature ladybeetles



Live Biological Control Agents for Sale in Mainland U.S.



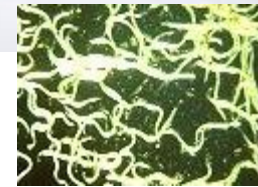
Parasite for
Aphids



Parasite for
whiteflies



Ladybeetle
for mealybugs



Nematodes for
Root weevils



Predatory
Mite

*Importation and sale in Hawaii requires Hawaii Dept. of Ag permit and approval because of possible contamination by the host pest or hyperparasites.

*Most of these parasitic wasps & predators already occur naturally in HI.

*Capture these biocontrol agents that naturally occurs in HI and release in areas with no natural enemies of pests.

Biological or Microbial Insecticides

Bacteria *Bacillus thuringiensis* – caterpillars
B.t. israelensis – mosquitoes, fungus gnats

Fungi *Paecilomyces fumosoroseus* – whiteflies,
Preferal aphids, thrips, mealybugs
Humidity is 80% or higher for 8 - 10 hours
Temperature is between 68° and 82° F

Beauveria bassiana – whiteflies, thrips, aphids
BotaniGard coffee berry borer
High humidity and free water enhance activity.
Sunlight kills fungal spores.

Nematodes *Steinernema carpocapsae* – banana moth, borers
Nematac (weevil), soil-dwelling
High humidity required. insects.

Oils

- * Horticultural oils (petroleum, vegetable & essential) are effective in controlling insects by suffocation.
- * Safe to the environment and nontarget organisms.
- * No development of resistance.
- * Major disadvantage, as with soap, is plant injury.
- * Essential plant oils include cedar, lavender, citrus (citronella, lemon, orange) peppermint, eucalyptus, etc.
- * Neem oil works as an oil only as the oil fraction from the neem seed is free of the insect growth regulator and repellent, azadirachtin (Azatin).
- * Limonene, refined from citrus oil, is thought to be a nerve poison causing excessive motor nerve activity.

Horticultural Oils against Spider Mites

“For spider mites, a low rate of horticultural oil, 0.5%, can be exceptionally effective and is compatible with predaceous mites. Nurseries that adopted the use of low dosage oil for managing mites, while at the same time avoiding use of acephate or pyrethroids, essentially saw their spider mite problems disappear.”

Richard Cowles, Entomologist

The Connecticut Agricultural Experiment Station

July 20, 2013

Insecticidal Soaps and Detergents

- *Soaps and detergents destroy the oily & waxy exoskeleton insects.
- *Broad-spectrum against most insects causing them to drown in water.
- *Major disadvantage to injury to plant tissue, especially at higher rates >1-2%.
- *Do not apply under hot conditions (>90 F).
- *Soaps and detergents act strictly as contact insecticides, with no residual effect. To be effective, sprays must be applied directly to and thoroughly cover the insect.
- *Certain brands of hand soaps and liquid dishwashing detergents can be effective for this purpose.
- *Dry dish soaps and all clothes-washing detergents are too harsh to be used on plants.



(Cranshaw, Colorado State)

Soaps and Detergents

- *Breaks surface tension and insects drown because of their oily cuticle.
- *Used for mosquito larvae control in vase water at cemeteries.

BEFORE Dishwashing Detergent



“Rafting, live LFA”

AFTER Dishwashing Detergent



“LFA drown in soapy water”

Boric Acid is a weak acid of boron used for control of cockroaches, ants and other insects by acting as a stomach poison, and the dry power is abrasive to the insect's exoskeleton?

Diatomaceous Earth is a soft, silica rock crumbled into a powder and used as an insecticide, due to its abrasive and absorptive properties. The fine powder absorbs oils from insects' exoskeleton, causing them to dehydrate.

Kaolin Clay is a clay mineral used in organic farming as a spray applied to crops to deter insect damage, and in the case of apples, to prevent sun scald.
Commercial product: Surround WP

Kaolin Clay Crop Protectant

White residue may be washed or brushed off prior to sale or installation in interior landscapes (Preventative)



Natural Pyrethrin Insecticide



- *Pyrethrins are produced by seeds of chrysanthemum.
- *Pyrethrins are a repellent and a nerve poison to insects & coqui frog.
- *Non-persistent in the environment and biodegradable.
- *One of the safest insecticides as pyrethrins are degraded by stomach acids in mammals.
- *Non-phytotoxic, unlike citric acid.

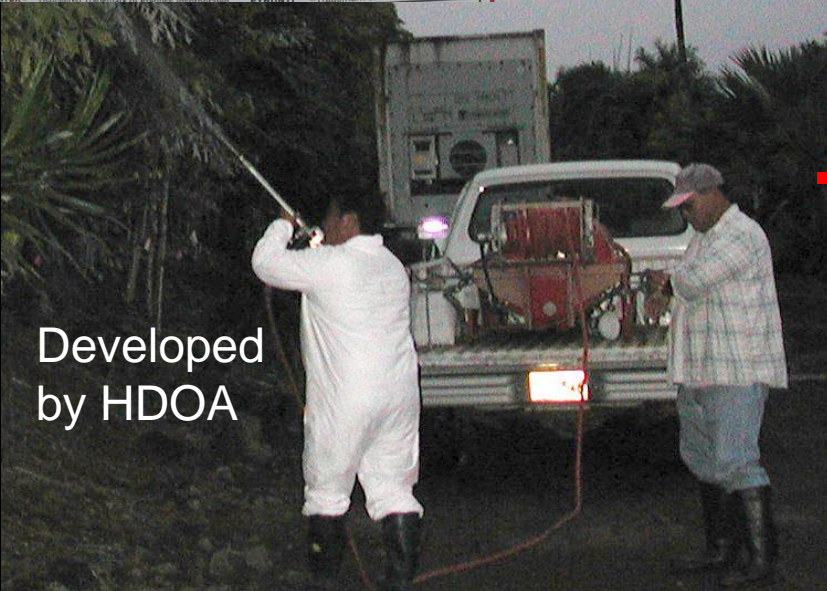
Pyrethrins + Hydrated Lime Strategy

PYRONYL™ CROP SPRAY
Authorized by U.S. D. A. for use in Federally Inspected meat and poultry plants
• Contains 0.5 pounds of pyrethrins per gallon • Contains 5.0 pounds of piperonyl butoxide per gallon • Designed for use on minor crops • Can be used up to and including the day of harvest • Can be used as a tank-mixed exciter

ACTIVE INGREDIENTS:	6.00%
Pyrethrins	6.00%
Piperonyl Butoxide, Technical	60.00%
** OTHER INGREDIENTS:	34.00%
Equivalent to 48.0% (butylcarbityl)(6-propylpiperonyl) ether and 12.0% related compounds.	TOTAL 100.00%

* Contains Petroleum Distillates
PRENTOX® - Registered Trademark of Prentiss Incorporated PYRONYL™ - Trademark of Prentiss Incorporated.

= pyrethrins



Developed by HDOA



Paralyzed but not dead, may recover.



Hydrated Horticultural
Lime
A hydrated lime that helps reduce soil acidity.
Satisfaction Guaranteed



Fatal

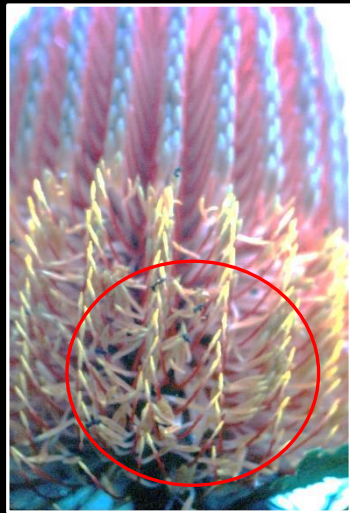
Invasive Ants

Attracted to
sugar liquid baits

Argentine Ant



Whitefooted ant



Banksia protea
for nectar



Red ginger
Tending mealybugs
for honeydew

Attracted to
oil / fat baits

Little Fire Ant



Bigheaded Ant



Anthurium spadix
for nectar, also
nests in trees without
connection to ground



In corrugated
cardboard, also
in *Banksia* for
nectar

Control of Argentine Ants in *Banksia Protea*

- *Primarily higher elevation >3,000 elev. (Kula Res. Stn)
- *Lower elevation infested with bigheaded ant controlled with ant baits such as Amdro, which is not attractive to Argentine ants.

Non-Chemical Control Barrier Treatment

Sticky Tanglefoot – Effective but girdles tree. Must protect bark from Tanglefoot penetrating into bark (pruning seal).



Insecticide Barrier Treatment for Argentine Ants Foraging into *Banksia* flowers



Spray surrounding ground and trunk 2-3 ft with a synthetic pyrethroid such as Discus, Decathlon or Talstar.



Active Ingredients:

1.00% Hydramethylnon, similar AI to Amdro & Pro bait

Mode of Action: Disrupts energy metabolism.

Maxforce Complete granules contain a bait matrix combining sugars, proteins (including silk worm pupae), fats and oils, which accommodate insects' changing nutritional needs.

Ants (Acrobat, **Argentine**, **Big Headed**, **Carpenter**, Cornfield, Field, imported and native Fire, **Ghost**, Harvester, **Odorous House**, Pavement, **Pharaoh**, Thief)

Maxforce® Complete Brand Granular Insect Bait is a ready-to-use product for use indoors and outdoors and around buildings, on lawn, and other non-crop areas: (including school yards, playgrounds, golf courses, and ornamental nurseries).

Treatments Commonly Used to Control LFA in Urban, Landscape and Nursery Settings

- ❖ Drenches – Bifenthrin and hot water (113° F for 5 min).
- ❖ Granules – Bifenthrin incorporated into media.
- ❖ Granular Baits – Most of the Red Imported Fire Ant (RIFA) baits are effective:
 - Hydramethylnon, methoprene, pyriproxyfen, metaflumizone.
 - Limiting effectiveness in tropical environment is moisture, leading to moldy baits.
- ❖ IGR Gel Bait – Methoprene (Tango) with vegetable or corn oil, peanut butter and xanthan gum.
(Vanderwoude 2012, <http://littlefireants.com/>)

*These treatments are also effective against bigheaded ant

Homeowner & Commercial Baits Attracted Little Fire Ant and Should Effectively Control LFA

<u>Tradename</u>	<u>Common Name % AI</u>
Advance 375A	(abamectin 0.011%)
Raid Double Control Ant Baits II	(abamectin 0.050%)
Raid Ant Baits III	(abamectin 0.010%)
Amdro	(hydramethylnon 0.73%)
Amdro Ant Block Home Perimeter Ant Bait	(hydramethylnon 0.88%)
Maxforce Complete	(hydramethylnon 1.00%)
Pro bait	(hydramethylnon 0.73%)
Hot Shot MaxAttrax Ant Bait 2	(indoxacarb 0.05%)
Siesta/Altrevin	(metaflumizone 0.063%)
Extinguish Professional	(methoprene 0.500 %)
Amdro Firestrike Yard Treatment	(methoprene 0.0172% hydramethylnon 0.0360%)
Extinguish Plus	(methoprene 0.2500% hydramethylnon 0.3650%)

*Products also effective against other oil/fat attracted ants, such as bigheaded and other *Solenopsis* fire ants.

Conclusions

- *Green solutions are effective options that include natural enemies, hot water, oils, soaps, pyrethrins.
- *New green products are being produced by major agrochemical companies, including natural enemies, and microbial control products.
- *All new insecticides developed by agrochemical co. will be considered reduced-risk with a movement to organically acceptable or green pest control products.
- *Invasive ants can be effectively controlled with the use of certain effective bait insecticides.

A BIG THANK YOU!

For assistance:

Kris Aoki

Peter Ballerini

Brian Bushe

Susan Cabral

Pat Conant

Stacey Chun

Christopher Jacobsen

Ruth Niino-DuPonte

Johnny Gordines

Reggie Hasegawa

Clyde Hirayama

Andrew Kawabata

Charlie Nelson

Ken Ogawa

Kyle Onuma

Erik Ouchi

Marcel Tsang

Jorden Zarders

08 Feb 14