Biological Control, Systemic Insecticides & Insect Growth Regulators against Landscape Pests in Hawaii

Maui Association of Landscape Professionals
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What will this presentation cover?

* Biological Control
  - Classical
  - Fortuitous
  - Augmentative
    - Inundative - flood
    - Inoculative - inoculate
* Biological Control in Hawaii
* Conservation of Natural Enemies
  - Minimize Use of Broad-Spectrum Insecticides
  - Environmental Conditions detrimental to natural enemies
* Biological or Microbial Insecticides
* Summary
* What are Neonicotinoids?
* History of Neonicotinoids
* Properties of Neonicotinoids
  • UV sensitivity
  • Water solubility
  • Residual Activity
  • Systemic Movement to leaves and flowers
* Spectrum of Insect Control
  Sucking Insects: aphids, scale insects, mealybugs, whiteflies, lacebugs
  Chewing Insects: beetles, caterpillars, grubs
* Application Methods
* Insect Growth Regulators
* Spiraling whitefly outbreak in West Hawaii
* Conclusions
Definition of Biological Control

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

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

**Fortuitous Biological Control** – “Do nothing”; natural enemies unintentionally arrive with pest to new locality or already in new locality.

**Augmentative Biological Control** - 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.
Biological Control in Hawaii

* Hawaii's government has been practicing classical biological control by purposely introducing and liberating natural enemies, for over a 100 years.

* Attempts to control pests through the introduction of animals into Hawaii were made by private citizens as early as 1865 (mongoose and mynah bird).

* 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 21 years, has attacked any native or other desirable species.

Funasaki et al. 1988
Factual Story about the Mynah Bird in Hawaii

* The mynah bird was brought to Hawaii from India in 1865 by Dr. William Hillebrand, a physician-naturalist to feed on armyworms in pastures.

* Accused as a major factor in the extinction of many native Hawaiian birds (based on speculation). Other scientists believed that the mynah had little or nothing to do with the extinction of native birds.

* Also implicated as playing a role in the dissemination of noxious weeds, (e.g., Lantana, a pasture weed), by feeding on berries and spreading undigested seeds via droppings.

Funasaki et al. 1988  PHES 28
The 1800's was a huge century for sugarcane plantations and many were started on tropical islands, including Hawaii and Jamaica.

With sugar cane came rats and lots of crop loss.

Attempt to control the rising rat populations, a manager introduced the Indian Mongoose from Calcutta to Jamaica in 1872.

The manager praised the results and local Hawaiian plantation owners, in 1883, brought 72 mongooses from Jamaica to the Hamakua Coast on the Big Island.

Issue: Mongoose are diurnal and rats are nocturnal.

Diet of mongoose includes insects, small cats, frogs, seeds, nuts, fruit, ground nesting bird eggs.

http://www.instanthawaii.com/cgi-bin/hawaii?Animals.mongoose
On O'ahu alone, nearly 2,000 trees died at city parks and golf courses.

* First described in 2004 causing severe damage in Taiwan and Singapore.
* First found on Oahu in April 2005.

Erythrina Gall Wasp, A Successful Biological Control Project in Hawaii
A Successful Example of 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.
Spiraling Whitefly (SWF) 
*Aleurodicus dispersus*

**Egg to adult**
34 to 41 days

**Eggs laid in spiral**
1st instar 6 to 7 days

**Eggs**
9 to 11 days

**1st instar**
6 to 7 days

**2nd instar**
4 to 5 days

**3rd instar**
5 to 7 days

**Pupal stage**
10 - 11 days

**Adult stage**
39 days

1.549 eggs in 37 days
Spiraling Whitefly (SWF)

* First discovered in Hawaii in 1978.
* Spiraling whitefly has been recorded on 38 genera of plants belonging to 27 plant families and more than 100 species.
* Specific plants that are attacked include annona (cherimoya, atemoya, sugar-apple), avocado, banana, bird-of-paradise, breadfruit, citrus, coconut, eggplant, guava, kamani, Indian banyan, macadamia, mango, palm, paperbark, papaya, pepper, pikake, plumeria, poinsettia, rose, sea grape, ti and tropical almond.
* Plumeria is probably the most preferred host of SWF.
* SWF usually starts building up in June and continue through September. From October, population starts decreasing and by December is very low (Kumashiro, HDOA).
* Prolonged drought may have accounted for the weakening of trees has led to the higher than usual SWF population during this past summer (Kumashiro, HDOA).
Classical Biological of the Spiraling Whitefly

* First discovered in Hawaii in 1978.
* Heavy infestations in Hawaii on over 100 plant species, of which guava, banana, plumeria, mango, and sea grape were most preferred.
* Importation of ladybeetles and whitefly parasites from Trinidad brought it under control.
* Heavy infestations are now only observed where these natural enemies are not present due to insecticide or windy, ocean salt condition.
Stems infested with White Peach Scale
Spiraling Whitefly in West Hawaii

Parasitic wasp very effective against spiraling whitefly in windy, coastal areas in Hawaii (Kumashiro HDOA)

Eulophid parasitic wasp, *Aleuroctonus vittatus*
Spiraling Whitefly heavily parasitized by parasitic wasps
(Note 4\textsuperscript{th} Instar pupae with round exit holes)
Immature Lady Beetle

Adult Lady Beetle

No natural enemies present
Biological Control of Mealybugs

Mealybug destroyer

Immature ladybeetles

http://www.youtube.com/watch?v=l69sltGaZW0
Mealybug Destroyer, Ladybeetles, Parasitic wasps working on Papaya Mealybug on Plumeria

Biological Control

• 4 species of ladybeetles.
• 3 species of tiny parasitic wasps providing excellent control in most situations in Hawaii.
Conservation of Natural Enemies

* Recognize the natural enemies and know when the pest is parasitized. **Most Important!!!**

* 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

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

[http://www.ipm.ucdavis.edu/PMG/r302900111.html](http://www.ipm.ucdavis.edu/PMG/r302900111.html)
Inundative Biological Control

Inundative releases work best in totally enclosed greenhouses.

* Inundative releases work best in totally enclosed greenhouses.
* Most of these parasites, predators already occur naturally in HI
* Importation and sale in HI requires HI Dept of Ag permit, approval.
* Expensive, e.g. 3,000 whitefly parasites for $97.95 (ARBICO Organics)
Biological or Microbial Insecticide

- an *insecticide* in which the *active Ingredient* is a microorganism.

Biological insecticides include products based on:

- **Bacteria** *(Bacillus thuringiensis) (Bt)*
- **Fungi** *(Paecilomyces fumosoroseus)*
- **Nematodes** *(Steinernema carpocapsae)*
- **Viruses** *(No products registered in Hawaii)*
Summary

* Don’t blame mongoose and mynah bird on Hawaii Dept. of Ag.
* Biological Control in Hawaii has controlled over 200 invasive pests.
* Biological Control has provided sustainable control of many invasive pests with no negative environmental impact.
* Avoiding the use of broad-spectrum insecticide, such as OP’s carbamates and pyrethroids, will conserve natural enemies.
* Use more selective insecticides and application methods, such as drench application of neonicotinoids (Merit, Safari), insect growth regulators (Distance, Talus), biological insecticides (Bt) to avoid negative effects on natural enemies.
* Use of commercial biological control agents in mass numbers is only effective in enclosed greenhouses and requires permit.
* Biological or microbial insecticides (fungi, nematodes) require very specific environmental conditions (very humid, moist conditions) for effectiveness.
Evolution of Insecticides

1940-50's
Chlorinated hydrocarbons
DDT, Chlordane, Dieldrin, Mirex

1960-70's
Organophosphates & Carbamates
Dimethoate, Diazinon, Dursban, Orthene

1980-90's
Pyrethroids (synthetic)
Mavrik, Tame, Tempo, Decathlon, Talstar

1990-2000's
Reduced-Risk Insecticides

Naturalytes
Conserve, Avid, Ultiflora, Neem

Insect Growth Regulators
Distance, Enstar, Talus

Neonicotinoids
Merit, Marathon, Flagship, Safari, TriStar
NEONICOTINOID INSECTICIDES

Acetamiprid

Arena® INSECTICIDE

clothianidin

thiomethoxan

Dinotefuran

Optigard Flex Gel Flagship

Marathon

Premise

ADMIRE® PRO Systemic Protectant

imidacloprid

imidacloprid

imidacloprid

imidacloprid
Neonicotinoids act on the nervous system of insects with very low toxicity to mammals and minimal environmental impact and therefore, considered a reduced-risk pesticide.

Neonicotinoids are among the most widely used insecticides worldwide.

The mode of action of neonicotinoids is similar to the natural insecticide nicotine. In insects, neonicotinoids cause paralysis which leads to death, often within a few hours.

They bind at a specific site, the nicotinic receptor, and there are no records of cross-resistance to the carbamate, organophosphate, or synthetic pyrethroid insecticides, thus making them important for management of insecticide resistance.
## Neonicotinoid Insecticides

### Spectrum of Insect Control

<table>
<thead>
<tr>
<th><strong>Sucking insects</strong></th>
<th><strong>Chewing insects</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Aphids</td>
<td>Beetles</td>
</tr>
<tr>
<td>Lace Buzgs</td>
<td>Borers</td>
</tr>
<tr>
<td>Leafhoppers</td>
<td>Mole Crickets</td>
</tr>
<tr>
<td>Mealybugs</td>
<td>Gall Wasps</td>
</tr>
<tr>
<td>Plant Bugs/ Hoppers</td>
<td>Grubs</td>
</tr>
<tr>
<td>Psyllids</td>
<td>Leafminers</td>
</tr>
<tr>
<td>Scale Insects</td>
<td>Termites</td>
</tr>
<tr>
<td>Spittlebugs</td>
<td>Weevils</td>
</tr>
<tr>
<td>Thrips</td>
<td></td>
</tr>
<tr>
<td>Whiteflies</td>
<td></td>
</tr>
</tbody>
</table>
Different types of neonicotinoids have unique UV resistance, water solubility, binding with soil, and pest spectrum characteristics.
TriStar is registered for foliar use only, and the most UV stable of all neonicotinoids.
TriStar and Flagship Against the Coconut Mealybug, *Nipaecoccus nipae*

TriStar = acetamiprid

Flagship = thiamethoxam

(Not sold in Hawaii)
Relative Water Solubility of Neonicotinoids:

**Water Solubility (Active Ingredient)**

<table>
<thead>
<tr>
<th>Milligrams A.I./liter</th>
<th>Clothianidin</th>
<th>Imidacloprid</th>
<th>Acetamiprid</th>
<th>Thiamethoxam</th>
<th>Dinotefuran</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>327</td>
<td>500</td>
<td>2950</td>
<td>4100</td>
<td>39830</td>
</tr>
</tbody>
</table>

**Information sources**
Clothianidin (Celero), Acetamiprid (TriStar), Dinotefuran (Safari) – EPA Pesticide Fact Sheet
Imidacloprid (Marathon), thiamethoxam (Flagship) – MSDS for Products

**Slide information courtesy J. Chamberlin**
Neonicotinoid Uptake in Hemlock
12-24” DBH Hemlock, Cashiers, NC

Applied October 3, 2006
Drench volume: 1 qt/indbh

Days after application

ng a.i./gm foliage

Safari 20SG 1.2 gmai/indbh (Drench)
Safari 2G 1.2 gmai/indbh (Granule)
Merit 75WP 1.5 gmai/indbh (Drench)

Oct. 24
Aug 28
Safari (dinotefuran) as compared with Merit (imidacloprid)

* Safari is similar to Merit/Marathon, but more water-soluble for quicker systemic uptake in plants.
* Systemic activity is not as long-lasting.
* Effective against whiteflies, aphids, soft scale, wax scales, thrips, fungus gnats, similar to Merit.
* Also effective against armored scales and mealybugs.
* Apply as a foliar or drench application.
Safari (dinotefuran) against Mealybugs at a Hilo nursery

Foliar and drench applications of Safari tested at the labeled rate on these infested plants.
Results of Safari Trial
Jan 2005

* Foliar application resulted in mealybug-free marketable plants 6 weeks after application in 8 of 10 plant cultivars tested.

* Drench application resulted in mealybug-free marketable plants 6 weeks after application in 10 of 10 plants cultivars tested.
**Soil Adsorption Coefficient**

A measure of how tightly the pesticide binds or sticks to soil particles.

**K_{oc} Values of Neonicotinoids:**

- **Arena**: 166
- **Merit**: 440
- **TriStar**: 267
- **Flagship**: 245
- **Safari**: 26

High value means it is strongly adsorbed onto soil and organic matter and does not move throughout the soil (Source: EPA Pesticide Fact Sheets).
Merit (Marathon) is highly effective against aphids, Chinese rose beetle, azalea lacebug, soft scales and whiteflies. Moderately effective against mealybugs.

Green scale, *Coccus viridis*

- Applied as a drench, by 21 DAT >90% mortality of green scales observed on gardenia plants. Control lasted for approximately one year.
- Growth difference of gardenia due to control of green scale.
Imidacloprid against Red Ginger Pests

WEEKS OF EFFECTIVE CONTROL (>95%):

<table>
<thead>
<tr>
<th>FIELD TREATMENT</th>
<th>MEALYBUGS</th>
<th>BANANA APHIDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>MERIT (1 APPL.)</td>
<td>17</td>
<td>53</td>
</tr>
<tr>
<td>DURSBAN (3 APPL.)</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Banana aphid
*Pentalonia nigronervosa*

Mealybugs
*Pseudococcus* spp.
Imidacloprid against Chinese Rose Beetle

Chinese rose beetles dying after feeding on rose plant drenched with Merit about 2 weeks earlier.

New growth with no beetle damage
Application Methods for Systemic Insecticides

Injecting  – invasive to trees; create wounds for entry of pathogens.

Drenching  – Must reach feeder roots with adequate moisture.

Bark Treatment – Must penetrate bark to move into the vascular system.

Tablets  – More suitable for potted plants
Injecting
Drilling
Drenching
Trenching
Applying Treatments
* Drench application must be applied to the feeder roots that have adequate soil moisture.
* Subsequently must be irrigated to assure uptake.
* Liquid fertilizer added to insecticide may assist uptake.
* Competition by groundcovers or turf contributes to effective uptake.
“Is doing something better than doing nothing?”

Giant Whitefly, *Aleurodicus dugesii*

* First discovered in HI heavily infesting hibiscus, fiddlewood, plumeria in May 2002.

**Merit drench – (Best Guess)**

* Applied to infested fiddlewood trees by City in Chinatown.
* Not effective (improper application at base of trunk and not canopy drip line to feeder roots).
* No reports of Merit being highly effective.
Injection Systems Evaluated

- **Sidewinder Tree Injector**
- **Mauget Tree Injectors**

- **Wedgie Direct Inject**
  
  - **NEW! FORESTRY PACK**
  - **Dose Adjustment**
    - Preset to release a 1 ml dose of chemical with each full stroke of the handle. Can be adjusted to deliver 1/2 ml dose where needed.
  - **Patented Wedgie Tip**
    - Releases chemical where it can be easily absorbed by the tree.
  - **Manual Operation**
    - You control the pressure needed to inject the tree.
Bark Application of Safari to King Protea for mealybugs at 18 oz/gallon

Bark application of Safari to Telopea sp. for armored scales, *Pseudaulacaspis brimblecombei*
A mealybug *Delottococcus confusus* infesting King protea, *Protea cynaroides*, Kula, Maui, HI

* First discovered in CA in Nov. 2006 on *Leucadedron argenteum* tree and soon after in Hawaii (2009).
* Infestations also on mink protea in Kula, HI.
* Infested flowers are unmarketable due to sooty mold and feeding damage to bracts.
* Mealybug destroyer, *Cryptolaemus* observed under bracts with mealybug infestations.
* Control strategies: Control ants & systemic insecticides: Safari, Kontos, Tri-Star, Discus as a drench, bark, or foliar (Kontos) application for mealybugs

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Egg sac

09/01/11

feeding damage

sooty mold and ants
Papaya Mealybug
Paracoccus marginatus

* First discovered in HI in June 2004 on Maui.
* Native to Mexico and found on Guam, Florida, Caribbean Islands.
* Mealybug injects a toxin as it feeds and causes chlorosis, stunting, deformation, leaf and fruit drop.
* Heavy infestations observed on papaya, hibiscus, jatropha; also, avocado, citrus, tomato, eggplant, peppers, beans, peas, sweet potato, mango, plumeria.
* Lady beetles found feeding on the papaya mealybug on Maui and the Big Island.
* A parasitic wasp, Anagyrus loecki, has provided excellent biological control on in HI.
Reduced-Risk Insecticides Against Papaya mealybug

**Foliar applications**
- Applaud (buprofezin; 12 oz/acre)
- Provado (imidacloprid; 8oz/acre)

**Drench Application**
- Admire (imidacloprid; 32 oz/acre) was applied in 5 gal of water to the tree roots by applying the solution to the area 3ft in all directions from the base of the tree.

**Bark Application**
- Pentra-Bark surfactant (2% of solution) and Admire (imidacloprid; 32 oz/acre), which was applied to the tree trunks with a sprayer until runoff (200ml/tree).
**Pentra-Bark surfactant (2% of solution) & Admire (imidacloprid; 32 oz/acre)**

* Applied to the tree trunks with a hand sprayer until runoff (200 ml/tree)

[http://www.questproducts.us/](http://www.questproducts.us/)
Samples consisted of one “finger” (approx 12 inch$^2$) from mature palmate papaya leaves.
Application of Merit as a “Tablet”

* Insert the “pill” in the pot media and solve your pest problem.

- Imidacloprid 20%
- NPK 12-9-4

- >20 weeks of whitefly control
- >12 weeks of thrips control
Types of Insect Growth Regulators

1. **Juvenile hormone (JH) mimics**
   - Enstar (kinoprene)
   - Distance (pyriproxyfen)
   - Precision (fenoxy carb)?

2. **Ecdysone inhibitors**
   - Azadirachtin = Aza-Direct, Azatin and Ornazin

3. **Chitin synthesis inhibitors**
   - Citation (cyromazine)
   - Adept (diflubenzuron)
   - Pedestal (novaluron)
   - Talus (buprofezin)
Buprofezin
Insect growth regulator
Talus = ornamentals, Sepro
Applaud = food crops, Nichino

* Inhibits chitin synthesis which interrupts molting, suppresses oviposition, and reduces egg viability.
* High level of activity against most homopteran insect pests including whiteflies, mealybugs, soft scales, armored scales, leafhoppers and planthoppers.
* Vapor activity allows buprofezin to reach the undersides of leaves and new growth.

<table>
<thead>
<tr>
<th>Whiteflies</th>
<th>Mealybugs</th>
<th>Soft Scales</th>
<th>Armored Scales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silverleaf</td>
<td>Longtailed</td>
<td>Black</td>
<td>Coconut</td>
</tr>
<tr>
<td>Greenhouse</td>
<td>Citrus</td>
<td>Brown</td>
<td>Cockerell</td>
</tr>
<tr>
<td>Sweet potato</td>
<td>Mexican</td>
<td>Hemispherical</td>
<td>Fern</td>
</tr>
<tr>
<td>Ash</td>
<td>Obscure</td>
<td>Wax</td>
<td>Boisduval</td>
</tr>
<tr>
<td></td>
<td>Comstock</td>
<td>Tessellated</td>
<td>White peach</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cycad</td>
</tr>
</tbody>
</table>

Pests of Ornamentals in Hawaii
Distance (Juvenile Hormone mimic) is effective against whiteflies

Untreated  27 Days After Treatment  Treated
Adult whiteflies present

No adult whiteflies present; Dead nymphs (black centers)

Also effective against fungus gnats and armored scales
New Class of Insecticide
Tetronic / Tetramic Acid

* Movento or Kontos (spirotetramat) moves up and down within the plant to provides excellent pest control in dense crop canopies and on plant roots.
* High level of residual efficacy and protection of new plant growth.
* Minimal risk to natural predators when used as directed, making it an ideal addition to Integrated Pest Management (IPM) programs.

Key Pests:
- Aphids
- Mealybugs
- Whiteflies
- Scales
- Spider mites
- Psyllids/Psylla

Crop Use
- Vegetables
- Fruits
- Nuts

Ornamental use:
- Greenhouse
- Field grown ornamentals
- Outdoor ornamentals
Acelepryn (chlorantraniliprole) = grubs, weevils, caterpillars
Aria (flonicamid) = aphids, mealybugs, thrips
Kontos (spirotetramat) = aphids, leafhoppers, mealybugs, whiteflies, mites
Safari (dinitofuran) = aphids, whiteflies, scale insects, mealybugs, midges, thrips, caterpillars
Most Importantly, recognize natural enemies (parasitic wasps and predators) of whiteflies.

Avoiding the use of broad-spectrum insecticide, such as OP’s carbamates and pyrethroids, will conserve natural enemies.

Use more selective insecticides and application methods, such as drench application of neonicotinoids (Merit, Safari), insect growth regulators (Distance, Talus), to avoid negative effects on natural enemies.

Use of commercial biological control agents in mass numbers is only effective in enclosed greenhouses and requires permit.

Continuously monitor whitefly infestations for natural enemies.
“Plumeria is probably the most favorite host of Spiraling Whitlefly (SWF).”

“Plumeria is also a favorite host of papaya mealybug, many other mealybugs, scales, whiteflies, and aphids which love to feed on plumeria.”

“We should encourage resort landscapers to choose other plants, since planting plumeria is just asking for trouble.”
A BIG THANK YOU!

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