Controlling Spiraling Whitefly in the Landscape

CPS Seminar
May 13, 2011

Arnold H. Hara
University of Hawaii at Manoa
College of Tropical Agriculture & Human Resources
875 Komohana St. Hilo, Hawaii
E-mail: arnold@hawaii.edu
Phone: 808 981-5199
Website: http://www.ctahr.hawaii.edu/haraa/index.asp

There are 31 total slides.
Click on “Outline” to close left pane.
Use navigational buttons at the bottom of the slide
OR
Click on “Slide Show” at bottom right, then click on each slide to advance or right-click mouse to back up to previous slide or close slide show.
What will this presentation cover?

* Host Range of Spiraling Whitefly (SWF)
* Seasonality and Outbreaks
* Life Cycle
* Insecticides against SWF
  - Evolution, Neonicotinoids, Insect Growth Regulators
  - Applications: Spray, Drench, Injection
* Classical Biological Control of SWF
* Other Pests of Plumeria
* Conservation of Natural Enemies
* Biological/Microbial Products
* Summary
* Conclusion
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, sugarapple), 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 favorite 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).
Spiraling Whitefly (SWF)  
**Aleurodicus dispersus**

Egg to adult: 34 to 41 days

- Adult stage: 39 days
- Pupal stage: 10 to 11 days
- Nymphal stage
  - Eggs laid in spiral: 9 to 11 days
  - 6 to 7 days
  - 4 to 5 days
- Egg to adult: 34 to 41 days
- >1549 eggs in 37 days
- First Instar: eggs and crawlers
- 2nd Instar: nymphal stage
- 3rd and 4th Instars: last nymphal stage (pupa)
- 5 to 7 days
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

**Arena®**
- Clothianidin

**Optigard Flex®**
- thiamethoxam

**Acetamiprid**

**Dinotefuran**

**Optigard Flex®**

**Marathon**

**Premise**

**ADMIRE® PRO**
- Systemic Protectant

**imidaclorpid**

**imidaclorpid**

**imidaclorpid**

**imidaclorpid**
**Neonicotinoid Insecticides**

**Spectrum of Insect Control**

<table>
<thead>
<tr>
<th>Sucking insects</th>
<th>Chewing insects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aphids</td>
<td>Beetles</td>
</tr>
<tr>
<td>Lace Bugs</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>
**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.*
Foliar Sprays

*In general, inefficient, prone to drift, and poor coverage to pests under plant canopy.

*Harmful effects to natural enemies, especially with broad spectrum: carbamates, organophosphates, synthetic pyrethroids
“Doing nothing is better than an improper drench application”

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.
*Drench application must be applied to the feeder roots that has 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.
Injection Systems Evaluated

Wedgle Direct-Inject

Sidewinder Tree Injector

Mauget Tree Injectors
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 Ornanzin

3. **Chitin synthesis inhibitors**
   - Citation (cyromazine)
   - Adept (difu benzuron)
   - Pedestal (novaluron)
   - Talus (buprofezin)
Buprofezin
Insect growth regulator

Talus = ornamentals, Sepro
Applaud = food crops, Nichino

*Inhibits chitin synthesis which interrupts molting, suppresses oviposition & 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 individuals)

Also effective against fungus gnats and armored scales
## 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 (Sevin)</td>
<td>carbamate</td>
<td>Broad (insects, mites)</td>
<td>Moderate/</td>
<td>High</td>
<td>High</td>
<td>Long</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>High</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>chlorpyrifos (Dursban)</td>
<td>OP</td>
<td>Broad (insects, Mites)</td>
<td>Moderate</td>
<td>High</td>
<td>High</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>High</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>fenpropathrin (Tame)</td>
<td>Pyrethroid</td>
<td>Broad (insects, Mites)</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Moderate</td>
</tr>
<tr>
<td>similar To (Talstar)</td>
<td></td>
<td></td>
<td>High</td>
<td></td>
<td></td>
<td>Long for Talstar</td>
</tr>
<tr>
<td>Imidacloprid (Merit as a Drench)</td>
<td>Neonicotinoid</td>
<td>Narrow (sucking, insects)</td>
<td>-</td>
<td>Low</td>
<td>Low</td>
<td>-</td>
</tr>
<tr>
<td>Imidacloprid (Merit as a Foliar)</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 (M-Pede)</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
First discovered in 1978, importation of ladybeetles and whitefly parasites from Trinidad in 1979 brought SWF under control.

*Heavy infestations were only observed where these natural enemies are not present due to insecticide or windy, ocean salt condition.

Classical Biological Control of the Spiraling Whitefly

Nephaspis

Encarsia

Aleuroctonus

Fortuitously Discovered In 2007 & more effective.
“Before” & “After” Introducing Natural Enemies of the Spiraling Whitefly

Guava
Honolulu, HI 1979

Before

After 1980
Heavy Spiraling Whitefly Infestation
Mauna Lani
09/2010

Stems infested with White Peach Scale
Immature Lady Beetle

Adult Lady Beetle

No natural enemies present

Plumeria at Keahole Ag Park (09/2010)
Parasitic wasp, very effective against spiraling whitefly in windy, coastal areas in Hawaii. (Kumashiro HDOA)
Spiraling Whitefly heavily parasitized by parasitic wasps
(Note 4th Instar pupae with round exit holes)
Treatments against SWF at Islands at Mauna Lani

*Pressure water wash on 10/04/2010
*Treated with insecticidal soap on 10/05 and 10/12.
*Treated with insect growth regulator, Distance 11/02 and 11/16.

*On 10/20/10 noted control of early instar nymphs, but adults, pupae, late instar nymphs and eggs are present.
*Minimal to no parastism and no predators present.
Whitefly 4\textsuperscript{th} Instar Pupae on Plumeria at Islands at Mauna Lani

*Overall, untreated had more dead and parasitized pupae and was as effective as treated.*

*Wash, Soap and Distance lowered live pupae on 11/18 to 12/05.*
Predatory beetle feeding on whitefly

Kings’ Shop 4/26/11
Kamani Leaf
Biological Control:

4 species of ladybeetles.
3 species of tiny parasitic wasps
  providing excellent control in most situations
  in Hawaii.
Biological Control of Mealybugs

Mealybug destroyer

Immature ladybeetles

http://www.youtube.com/watch?v=l69sltGaZW0
Parasite for Aphids  Parasite for whiteflies  Ladybeetle for mealybugs  Nematodes for Root weevils  Predatory Mite

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

*Most importantly, recognize natural enemies (parasitic wasps and predators) of whiteflies.
*Avoid the use of broad-spectrum insecticide, such as OP’s carbamates and pyrethroids, to conserve natural enemies.
*Use more selective insecticides and application methods, such as drench application of neonicotinoids (Merit, Safari, Optigard), 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.
Conclusion

Comments from Insect Taxonomist, Bernarr Kumashiro, HDOA

“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!

For assistance:

Pete Ballerini
Kris Aoki
Brian Bushe
Susan Cabral
Pat Conant
Christopher Jacobsen
Ruth Niino-DuPont
Reggie Hasegawa
Clyde Hirayama
George Nakashima
Kyle Onuma

08 Feb 14