Whiteflies

- Many species in Florida (> 75)
- Whiteflies are NOT flies
- Adults
  - Small, white, moth-like
- Piercing-sucking mouthparts
- Excrete honeydew

Photos: H. Glenn, UF/IFAS
Typical Whitefly Lifecycle
Recent Whiteflies

Bondar’s Nesting Whitefly

Rugose Spiraling Whitefly

Ficus Whitefly

Photo: H. Glenn, UF/IFAS
Bondar’s Nesting Whitefly

- First detected in Dec 2011, Lee County
- Three other species known in Florida
- Not known as economic pest
- Nuisance ??

Photo: H. Glenn, UF/IFAS
Bondar’s Nesting Whitefly

Currently in:
- Miami–Dade, Broward, Palm Beach, Lee and Collier Counties

Hosts
- Ficus (Banyan, weeping fig, Indian laurel)
- Avocado, canary laurel, guava, lemon, orange, sapote, surinam cherry, sweetsop, Chinese hibiscus, tilo (stinkwood),
- Palms (Coconut, Chamaedorea)
Whitefly “nest”

Photo: H. Glenn, UF/IFAS
Natural Enemies

- Beetle predator, *Nephaspis oculatus*
- Wasp parasitoid, *Encarsia variegata*

Photo: H. Glenn, UF/IFAS
Bondar’s Nesting Whitefly

- White wax
- Honeydew
- Sooty mold
Not whitefly
Powdery Mildew

Photo: H. Glenn, UF/IFAS
Ficus Whitefly

- ONLY feeds on ficus species

- Damage
  - Yellowing leaves
  - Leaves fall
  - Branches die (highly variable)
**Ficus Whitefly Life Cycle**

- **Adult Whitefly** (2–4 days)
- **Eggs** (10 days)
- **1st instar** (4.2 days)
- **2nd–3rd instars** (2nd instar – 3.7 days; 3rd instar – 3.3 days)
- **2nd instar**
- **3rd instar**
- **4th instar** – puparia (5.8 days)

*Constant temperature (80º F)*

Photo: H. Glenn, UF/IFAS
Natural Enemies Observed in the Landscape

- *Harmonia axyridis*
- *Olla v-nigrum*
- *Exochomus childreni*
- *Chilocorus nigriris*
- *Curinus coeruleus*

- *Encarsia protransvena*
- *Amitus bennetti*

Photo: H. Glenn, UF/IFAS
Live whitefly
Parasitized whitefly
White ovals on the leaves - adult whiteflies come from these.
Ficus Whitefly – Trapping Adults

Mean No. Whitefly per Trap

- 2009
- 2010
- 2011
- 2012

- up
- down
- east
- west
Continued Ficus Decline

- Are there whiteflies – ???
- Breakdown of pesticides (i.e. resistance) – ???
- Cumulative stress
  - Poor planting, age, drought, whiteflies and other insects, disease
- Importance of nutrition
  - Fertilization; micronutrients (ex: 2 lb N per 1000 sq ft)
- Disease management
- Other factors
  - Drought, low use rates
Rugose Spiraling Whitefly

• First found in Miami on gumbo limbo – Spring 2009

• Adult is relatively large and docile
Eggs

1st Instar

Adult

Rugose Spiraling Whitefly

4th Instar

3rd Instar

2nd Instar

Photo: H. Glenn, UF/IFAS
Rugose Spiraling Whitefly – Common Ornamental Host Plants

- Acalypha wilkesiana (Copperleaf)
- Bauhinia sp. (Orchid tree)
- Bischofia javanica (Javanese bishopwood)
- Bougainvillea sp.
- Bucida buceras (Black olive)
- Bursera simaruba (Gumbo limbo)
- Calophyllum species
- Catharanthus roseus (Madagascar periwinkle)
- Ceiba sp.
- Chrysobalanus icaco (Cocoplum)
- Chrysophyllum oliviforme (Satinleaf)
- Coccoloba diversifolia (pigeon plum)
- Coccoloba uvifera (seagrape)
- Conocarpus erectus (Buttonwood)
- Cordyline fruticosa (Hawaiian ti)
- Dracaena marginata
- Duranta erecta (Golden dewdrops)
- Ficus aurea (Strangler fig)
- Ficus benjamina (weeping fig)
- Ficus carica (Edible fig)
- Ficus microcarpa (Cuban laurel)
- Ixora sp. (Jungleflame)
- Jasminum multiflorum (Star jasmine)
- Jatropha integerrima (Peregrina)
- Laurus nobilis (Sweet bay, bay laurel)
- Lysiloma latisiliquum (False tamarind)
- Lysiloma sabicu (Horseflesh mahogany)
- Myrica cerifera (Wax myrtle)
- Ochrosia elliptica (Elliptic yellowwood)
- Parthenocissus quinquefolia (Virginia creeper)
- Plumeria pudica (White frangipani)
- Plumeria rubra (Frangipani)
- Podocarpus sp.
- Pongamia pinnata (Karum tree, poonga–oil tree)
- Quercus virginiana (Live oak)
- Rosa sp. (Rose)
- Schefflera actinophylla (Umbrella tree)
- Simarouba glauca (Paradise tree)
- Strelitzia nicolai (White bird of paradise)
- Strelitzia reginae (Bird of paradise)
- Syzygium cumini (Java plum)
- Syzygium jambos (Malabar plum, rose apple)
- Tabebuia species (trumpet tree)
- Terminalia catappa (Tropical almond)

From: I. Stocks, DPI, May 2012
Rugose Spiraling Whitefly – Palm Hosts

- **Adonidia merrillii** (Christmas palm)
- **Archontophoenix cunninghamiana** (Bangalow or King palm)
- **Chamaedorea sp.** (Bamboo palm)
- **Cocos nucifera** (Coconut palm)
- **Cocothrinax sp.**
- **Dictyosperma album** (Hurricane palm)
- **Dypsis lutescens** (Areca palm)
- **Hyophorbe verschaffeltii** (Spindle palm)
- **Manilkara roxburghiana**
- **Manilkara zapota** (Sapodilla)
- **Phoenix roebelenii** (Pigmy palm)
- **Pinanga coronata** (Ivory cane palm)
- **Sabal palmetto** (Sabal palm)
- **Veitchia sp.**
- **Veitchia arecina** (Montgomery palm)
- **Washingtonia robusta** (Washington fan palm)
- **Wodyetia bifurcata** (Foxtail palm)

From: I. Stocks, DPI, May 2012
Annona sp. (Sugarapple)  
Basella alba (Malabar spinach)  
Brassica rapa (Turnip)  
Citrus sp. (citrus)  
Cnidoscolus chayamansa (Tree spinach)  
Cocos nucifera (Coconut palm)  
Eugenia uniflora (Surinam cherry)  
Ficus carica (Edible fig)  
Inga sp.  
Leea guineensis (West Indian holly)  
Mangifera indica (Mango)  
Manilkara roxburghiana  
Manilkara zapota (Sapodilla)  
Melicoccus bijugatus (Spanish lime)  
Musa sp. (Banana)  
Ocimum basilicum (Sweet basil)  
Persea americana (Avocado)  
Psidium guajava (Guava)  
Saccharum officinarum (sugarcane)  
Spondias sp.  
Spondias mombin  
Spondias purpurea (Purple mombin)  
Syzygium cumini (Java plum)  
Syzygium jambos (Malabar plum, rose apple)  
Vitis rotundifolia (Muscadine)

From: I. Stocks, DPI, May 2012
Rugose Spiraling Whitefly – Host Plants
(Weeds, native, invasive and less common plants)

- Albizia lebbeck (Woman’s tongue)
- Araucaria heterophylla (Norfolk island pine)
- Catharanthus roseus (Madagascar periwinkle)
- Cissus verticillata (Seasonvine)
- Cnidoscolus chayamansa (Tree spinach)
- Myrcianthes fragrans (Simpson’s stopper)
- Ocotea coriacea (Lancewood)
- Pithecellobium keyense (Florida Keys blackbead)
- Pluchea carolinensis (Cure-for-all)
- Rapanea punctata (Myrsine)
- Schinus terebinthifolius (Brazilian pepper)
- Sideroxylon salicifolium (Willow bistic)
- Sideroxylon foetidissimum (False mastic)
- Smilax auriculata (Earleaf greenbrier)
- Thespesia populnea (Portia tree)
- Zanthoxylum fagara (Wild lime)
- Zeuxine strateumatica

From: I. Stocks, DPI, May 2012
White, waxy substance
Honeydew and sooty mold
Honeydew and sooty mold
Rugose Spiraling Whitefly Spiraling Eggs

Photo: H. Glenn, UF/IFAS
Parasites and Predators

Wasp parasite

Beetle predator

Lacewing predator
Nephaspis oculata

- Coccinellid predator
- Feeds on many whitefly species
- Well established in Florida for > 25 years
- Been introduced to other places for control of spiraling whitefly
- Currently found feeding on Rugose spiraling and Bondar’s nesting whiteflies
Delphastus species

- Another common predator
- Feeds on many whiteflies
- Commercially available
- NOT commonly seen feeding on Rugose spiraling whitefly indicating it may not be a suitable natural enemy

Photos: BugGuid.net
Whitefly Management
Biological Control

- Important and necessary component for long-term control

- Potential natural enemies
  - For each whitefly there are beetle predators and wasp parasitoids currently feeding on the whitefly
  - Potential of predators/parasitoids for closely related whiteflies

MUST MATCH THE CORRECT NATURAL ENEMY WITH THE APPROPRIATE PEST
Management of Whitefly in the Landscape

- Cultural control
  - Alternative plant choices (difficult for rugose spiraling whitefly)
- Washing plants off with water
  - Small infestations or small plants
  - Must remove the immature stages and eggs.
Management of Whitefly in the Landscape

- Soaps and oils
  - Strictly contact so thorough coverage is required
  - Several applications are required 7–10 days
  - Phytotoxicity under high temperatures
Management of Whitefly in the Landscape

- Insecticides
  - Sometimes important in the early management of a pest
  - Appropriate choices of insecticide, formulation, methods of application and frequency of application
  - Effects on natural enemies
Management of Whitefly in the Landscape

- Insecticides
  - Misuse or overuse can cause problems such as insect resistance, secondary pest problems, environmental contamination, and detrimental effects on non-target organisms
  - Follow label instructions – The site and method of application must be on the label (i.e. landscape, nursery, etc.)
Management Options

Foliar Insecticide Application

- Whitefly should be present
- Foliar insecticides may provide quick control, most will not provide long-term control.
- Some foliar insecticides (i.e. pyrethroids) may disrupt the natural enemies and should be used very selectively.
- It is not recommended to use the same insecticide on both the foliage and in the soil
Insecticide Selection
Foliar Application
Professional Use (Landscape and Nursery)

Abamectin (Avid)
Acetamiprid (TriStar)
Azadirachtin (Azatin XL)
Bifenthrin (Talstar)
Buprofezin, (Talus)
Clothianidin (Arena)
Endosulfan (Endosulfan; Thiodan)

Flonicamid (Aria)
Horticultural oil
Imidacloprid (Merit, Marathon, Discus, Allectus)
Pymentrozine (Endeavor)
Pyriproxyfen (Distance)
Spiromesifen (Judo)

Beauveria bassiana
(BotaniGard)
<table>
<thead>
<tr>
<th>Trade Name(s)</th>
<th>Active Ingredient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flower, Fruit &amp; Vegetable Insect Killer (Ortho)</td>
<td>Acetamiprid</td>
</tr>
<tr>
<td>Bug-B-Gon Max Lawn &amp; Garden Insect Killer (Ortho)</td>
<td>Bifenthrin</td>
</tr>
<tr>
<td>Rose &amp; Flower Insect Killer (Bayer Advanced); Lawn &amp; Garden Insect Killer (Schultz)</td>
<td>Cyfluthrin</td>
</tr>
<tr>
<td>Triazicide Once &amp; Done Insect Killer (Spectracide)</td>
<td>Lambda-cyhalothrin</td>
</tr>
<tr>
<td>Indoor/Outdoor Broad Use Insecticide (Hi-Yield)</td>
<td>Permethrin</td>
</tr>
<tr>
<td>Yard &amp; Garden Insect Killer (Bonide); Rose &amp; Flower Insect Spray (Spectracide)</td>
<td>Pyrethrin</td>
</tr>
</tbody>
</table>
Management of Whitefly in the Landscape

- Apply a systemic (neonicotinoid) insecticide to the soil or trunk for longer control
  - Soil application (drench, granular, pellets)
  - Trunk application (basal spray, injection)
<table>
<thead>
<tr>
<th>Active Ingredient</th>
<th>Trade Names Professional Use</th>
<th>Trade Names Over-the-Counter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetamiprid</td>
<td>TriStar (no soil application)</td>
<td>Ortho Max Flower, Fruit and Vegetable Insect Killer; Ortho Rose Pride Insect Killer</td>
</tr>
<tr>
<td>Clothianadin</td>
<td>Arena, Aloft</td>
<td></td>
</tr>
<tr>
<td>Dinotefuran</td>
<td>Safari, Zylam</td>
<td>Green Light Tree &amp; Shrub Insect Control with Safari</td>
</tr>
<tr>
<td>Imidacloprid</td>
<td>Merit, Marathon, Coretect, Discus, Allectus, Bandit, several generic labels</td>
<td>Bayer Advanced Rose and Flower Insect Killer; Bayer Advanced Tree &amp; Shrub Protect &amp; Feed; Bonide Systematic Insect Control; Ferti-Lome Tree and Shrub Systematic Insect Drench; Ortho Max Tree &amp; Shrub Insect Control</td>
</tr>
<tr>
<td>Thiamethoxam</td>
<td>Flagship, Meridian</td>
<td></td>
</tr>
</tbody>
</table>
Whitefly Management

- Systemic insecticide – soil and trunk methods

- Drench
- Granular
- Injection
- Trunk spray

Photos: H. Glenn, UF/IFAS and J. Chamberlin, Valent, Inc.
UV Stability of Neonicotinoids

Cannot use in the soil

- Acetamiprid
- Imidacloprid
- Thiamethoxam
- Dinotefuran
- Clothianidin

Half life (days)

Aquatic Photolysis

Slide Credit: Presentation by C. Sclar, Longwood Gardens
Relative Water Solubility of Neonicotinoids

- Clothianidin (Arena): 327
- Imidacloprid (Merit): 500
- Acetamiprid (TriStar): 2950
- Thiamethoxam (Meridian): 4100
- Dinotefuran (Safari): 39830

Slide information courtesy C. Sclar. Longwood Gardens
Soil Binding Potential ($K_{oc}$)

- Dinotefuran (Safari)
- Clothianidin (Arena)
- Thiamethoxam (Meridian)
- Imidacloprid (Merit)

Source: Shetlar, Turfgrass Trends, July 2007
Safari Uptake into Foliage
Mexican Fan Palm (13” dbh)

Applied: May 7, 2011

- Safari drench 6 gm/indbh - Upper leaves
- Safari drench 6 gm/indbh - Lower leaves
- Safari bark spray 12 oz/gal - Upper leaves
- Safari bark spray 12 oz/gal - Lower leaves

14 days after application vs. 28 days after application

Buzz Uber (Crop Inspection Service), Walter Albeldano (Valent USA Corp.)
Length of Control

- Important to monitor for active pest populations to determine time of re-application
  - Rule of Thumb: Do not retreat until the pest population is observed to be increasing again

- Neonicotinoids (applied as soil or trunk treatments)
  - Generally provide long-term control (6 – 12 months)
  - Consider a.i., use rate, formulations, timing and environmental conditions
Neonicotinoids

Application to fruits
  ◦ Must be on the label to use on edible plants

Application to coconuts
  ◦ Landscape: ornamental vs edible plant
  ◦ If the label states you cannot use on edible plant – cannot legally use
  ◦ Some labels state – can eat fruit one year after application
Neonicotinoids

Affects on pollinators (particularly bees)

- Recent study
- Neonicotinoid insecticides are toxic to bees
- High rate – foliar sprays most toxic
- Systemic applications – longer residual
  - Should use lowest effective dose
- Avoid use on tree species that are highly attractive to pollinators
  - Use after bloom
- Consider impact of other types of insecticides
Whitefly Management

- Whatever control method you use, there will be impact on natural enemies
- Insecticide use
  - Only use when necessary
  - Use appropriate insecticides and methods of application
  - Only use insecticides as a final option

- DO EVERYTHING POSSIBLE TO CONSERVE NATURAL ENEMIES
Remember – the below symptoms do not stop or go away immediately even if you are controlling the pest

Leaf drop

Sooty mold

White, waxy flock

Do not apply additional insecticide unless you are sure it is necessary
Web Resources

- http://www.pbcgov.com/coextension/horticulture/whitefly/
  (consolidated a lot of the whitefly information)
- http://trec.ifas.ufl.edu/mannion
- http://mrec.ifas.ufl.edu/Iso/IAWG/
- http://edis.ifas.ufl.edu/
- http://creatures.ifas.ufl.edu/
Catharine Mannion
Research and Extension Specialist
Ornamental Entomology

University of Florida, IFAS
Tropical Research and Education Center
18905 SW 280th Street
Homestead, FL 33031

305-246-7000
cmännion@ufl.edu
http://trec.ifas.ufl.edu/mannion