



# An Entomological Perspective for Emergency Agricultural Response

## Training Guide





# **An Entomological Perspective for Emergency Agricultural Response Training Guide**

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Florida Department of Agriculture and Consumer Services  
Division of Plant Industry

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**SART Training Media** are available for download from the Florida SART  
Web site <[www.flsart.org](http://www.flsart.org)>.

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## **About Florida SART**

- SART is a multi-agency coordination group.
- SART is made up of over 25 partner agencies (state, federal and non-governmental organizations).
- SART provides preparedness and response resources for Emergency Support Function 17 [(ESF 17) Animal and Agricultural Issues].
- SART statutory authority
  - State Emergency Management Act (Section 252.3569, Florida Statutes)

### **SART Mission**

Empower Floridians through training and resource coordination to enhance all-hazard disaster planning and response for animal and agricultural issues.

### **SART Goals**

- Support the county, regional and state emergency management efforts and incident management teams.
- Identify county resources available for animal and/or agricultural issues.
- Promote the cooperation and exchange of information of interested state, county and civic agencies.

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## Specific Learning Objectives

At the end of this training module, participants will be able to:

- Understand some of the exotic agricultural pests currently present and those which pose a significant potential threat to Florida
- Be able to discuss the nature of the threat associated with significant pests
- Be able to identify steps taken to mitigate effects of current exotic agricultural pest infestations, and to prevent the introduction of additional threats
- Be able to identify key resources that participants can easily access for further information and assistance

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## Resources

The following are sources of additional information about the subjects mentioned in this introduction.

**United States Department of Agriculture (USDA)**

[www.usda.gov](http://www.usda.gov)

**Florida Department of Agriculture and Consumer Services (FDACS)**

<https://www.freshfromflorida.com>

**FDACS-Division of Plant Industry**

<https://www.freshfromflorida.com/Divisions-Offices/Plant-Industry>

**FDACS Division of Animal Industry**

<https://www.freshfromflorida.com/Divisions-Offices/Animal>

**Industry Florida Agriculture Statistical Directory 2004**

[https://www.nass.usda.gov/Statistics\\_by\\_State/Florida/Publications/Annual\\_Statistical\\_Bulletin/FL\\_Agriculture\\_Book/2015/2015\\_FL\\_Ag\\_by\\_the\\_Numbers.pdf](https://www.nass.usda.gov/Statistics_by_State/Florida/Publications/Annual_Statistical_Bulletin/FL_Agriculture_Book/2015/2015_FL_Ag_by_the_Numbers.pdf)

**Bemisia Pest Alert issues by FDACS-DPI**

[https://www.freshfromflorida.com/content/download/68503/1614891/Pest\\_Alert\\_-\\_Bemisia\\_tabaci\\_Gennadius\\_Q\\_biotype\\_.pdf](https://www.freshfromflorida.com/content/download/68503/1614891/Pest_Alert_-_Bemisia_tabaci_Gennadius_Q_biotype_.pdf)

**Florida Department of Agriculture Annual Report**

<https://www.freshfromflorida.com/Forms-Publications/Publications/FDACS-Annual-Reports>

**FDACS' Division of Marketing and Development Internet site provides information to agribusinesses and the general public about Florida agriculture**

<https://www.freshfromflorida.com/Divisions-Offices/Marketing-and-Development>

**USDA, Animal and Plant Health Inspection Service, National Center for Import and Export**

[www.aphis.usda.gov/vs/ncie](http://www.aphis.usda.gov/vs/ncie)

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## Resources, continued

**Pests.org**

<https://www.pests.org/killer-bees/>

**Florida State Agricultural Response Team**

<https://flsart.org/>

**Integrated Pest Management, IFAS Extension, University of Florida**

<http://sfyl.ifas.ufl.edu/>



# An Entomological Perspective for Emergency Agricultural Response

## Appendix A - Training Slides







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**An Entomological Perspective  
for Emergency Agricultural Response**

Prepared by  
Bureau of Entomology, Nematology, and Plant  
Pathology  
(Entomology Section)  
Florida Department of Agriculture and Consumer Services,  
Division of Plant Industry

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**Learning Objectives**

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## Division of Plant Industry

Identify Economically Important Agricultural Pests

- Inspectors and the public send samples for expert identification
- Identification leads to response:
  - Public Outreach
  - Risk and Pathway Analysis
  - Surveillance
  - Mitigation (Eradication or Management)



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## Entomology Section

- Responsible for Identification of Insects, Mites, & Mollusks
- Manage the Florida State Collection of Arthropods (FSCA)
  - Collection of 10,000,000 Arthropods from around the world
  - Used as a reference for identification of all native and non-native species



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## Entomology Section: Additional Identification Resources

- Library
  - Provides access to reference information to support identification and regulatory activities
- Molecular Laboratory
  - Provides analyses of species complexes



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## Major Groups of Agricultural Pests

- Scales
- Mealybugs
- Whiteflies
- Aphids
- Stink Bugs
- Psyllids
- Hoppers
- Mites
- Beetles
- Butterflies & Moths
- Thrips
- Mollusks
- Fruit Flies



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## Scales

- Divided into three groups: armored, soft, and mealybugs.
- Armored scales secrete a waxy covering resembling a plate of armor; it is not an integral part of the insect's body, the scale lives and feeds beneath it
- Soft scales also secrete a waxy covering, but it is an integral part of their body.



Armored scale



Soft scale



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## Mealybugs

- Common pests of greenhouses and stored plants, feeding on plants by inserting long, straw-like mouthparts deep into plant tissue
- Mealybugs secrete sticky honeydew that adheres to leaf surfaces and attracts dust and molds.
- In large numbers, they cause leaf yellowing, leaf curling, and/or leaf drop.
  - Difficult to eradicate because crawlers wedge themselves in plant roots, crotches and leaf folds where pesticides cannot reach.



Madeira mealybug on branches



Papaya mealybugs on fruits



Long tailed mealybug on leaves



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## Whiteflies

- Most common and perhaps most difficult to control insect pests in greenhouses and interior landscapes
  - Difficult to control due to small size and cryptic nature
- Feed by sucking plant juices; heavy feeding can give plants a mottled look, causing yellowing and eventually death
- Excrete sticky honeydew, which permits the development of black sooty mold fungus, which retards plant growth and often causes leaf drop.



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## Aphids

- Many serious pests can cause severe yield loss in crop plants by feeding damage alone; some are also vectors of devastating plant pathogens
- Reproduce asexually (some exceptions), enabling populations to rapidly increase in number
- Easily move around
  - Winged migrant forms can disperse far, aided by wind
  - Transportation of infested plants by people



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## Stink Bugs

- Most are plant pests, some are predators
- Damage caused by feeding can be severe: they may feed directly on fruit, causing discoloration, disfigurement, yield loss
- Feeding damage becomes a point of entry for plant pathogens



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## Psyllids

- Damage: stunted growth, leaf curl, and can transmit plant pathogens
- Host Range: mostly specialists, some generalists
- Sampling Methods: beating, visual surveys, traps



Asian citrus psyllid nymph



Asian citrus psyllid adult



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## Hoppers

- Damage: leaf chlorosis, general decline, and can transmit plant pathogens
- Host Range: some specialists, some generalists
- Sampling Methods: sweeping. Often males are needed for species ID, so submit as many as possible



Green leafhopper



Brown planthopper



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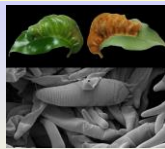
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## Mites

- Important pests of a wide variety of plants. Many species, especially gall mites, will target only one or two species of plant.
- Difficult to control or eradicate because they:
  - Can quickly build up to large numbers due to small size and short life-cycles
  - Disperse rapidly via wind or phoresy (attachment to insects, humans, etc.)
  - Often go undetected until their populations have increased to levels that are hard to contain



Lychee erineose mite (gall mite)



Red palm mite (flat mite)



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## Beetles

- Extremely diverse, hundreds of thousands of species
  - Some specialized to specific hosts, some generalists
- Sampling Method: inspect host and associated damage
  - Often extremely difficult to identify from damage or larvae alone
- Damage: foliage, fruit, roots; many wood-boring species



Damage from *Anthonomus eugeni*



Pupa of *Anoplophora glabripennis*



*Myllocerus undecimpustulatus*,  
the Sri Lanka weevil



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## Moths & Butterflies

- 3,000 species in Florida, >160,000 worldwide
- Most eat plants; there are generalists and host specialists.
- Sampling Methods:
  - Look for caterpillars associated with damage
  - Pheromone traps for adult moths
- Caterpillars directly consume plant tissue
  - Damage to any plant part.



*Spodoptera latifascia*



*Eoreuma loftini*, Mexican rice borer



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## Thrips

- Tiny insects (usually less than 5 mm), with sucking mouthparts, which they use to feed on plant juices
- About 90 species of economically important pest thrips, many capable of feeding on many different plant species
- Damage is done by directly feeding on foliage, flowers and fruit, or by vectoring plant pathogens called tospoviruses



*Anaphothrips sudanensis*



*Frankliniella occidentalis*



*Echinothrips americanus*



*Caliothrips fasciatus*,  
slide mounted



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## Mollusks

- Damage: foliage
- Sampling Methods: inspect foliage, flowers, trunks, soil
- Potential disease vector (rat lung worm)



Giant African Land Snail



Succinea sp.



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## Fruit Flies

- Nearly 100 major fruit and vegetable pests worldwide, such as Mediterranean fruit fly and Oriental fruit fly
- Fruit flies are highly invasive, frequently triggering expensive eradication programs and quarantines when discovered in fly-free areas
- Proactive and intensive port-of-entry inspections, field surveillance, and mating interference (sterile insect technique) programs are necessary to protect agriculture



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## Florida: A "Sentinel State"

- Climate
  - Sub-tropical to temperate
- Geography
  - unique position as a north-south peninsula
  - In close proximity to diverse tropical countries



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## Florida: A “Sentinel State”

Multiple pest pathways:

- Trade
  - 28 ports of entry
  - Over 85% of plants imported into U.S. go through Miami
  - Over six million tons of perishable cargo enter FL annually
- Tourism
  - More than 100 million people visit each year



The major source of new pests is movement by people.



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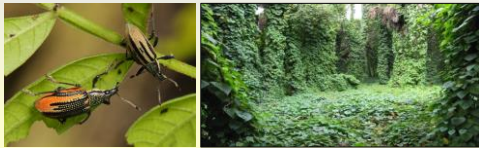
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## Florida – A “Sentinel State”

Florida experiences a constant invasion of exotic species

What is meant by “exotic”?

- Not native to the Florida ecosystem
- Has potential to cause harm to Florida’s environment
- Has potential to move to other parts of the United States



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## Some Interceptions

- *Chlorophorus strobilicola*
  - Found in scented pine cones from India
  - Packaged with potpourri, December 2003
  - Not known to be established



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## Some Interceptions

- *Coccographis nigrorubra*
  - Found in pet chew sticks from China
  - Not known to be established



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## Some Interceptions

- *Anastrepha ludens* (Mexican fruit fly)
  - With Manzano peppers originating from Mexico in May 2003 (Pinellas County)
  - Potential pest of citrus
  - No lures for this pest



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## Exotics Recently Discovered In Florida: Sugarcane Thrips



- First detected in January 2017
- Damage caused by direct feeding on leaves
- Hosts: usually found on sugarcane, may also be found in certain grass species



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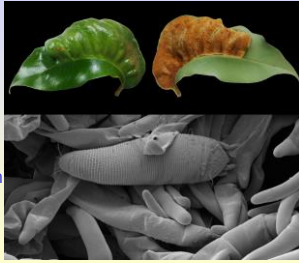
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## Exotics Recently Discovered In Florida: Lychee Erinose Mite

- Originated in China on host plant, lychee
- Detected in Lee County in 2018.
- Damage through erineum galls, which eventually cover much of the plant.
- Hosts: Almost always only on lychee, but there is a single report of damage on longan in Taiwan.



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## Exotics Recently Discovered In Florida: *Prepona laertes*

- Butterfly native to tropical South and Central America
- Found established in August 2013
- Many hosts including cocoplum, cabbagebark tree, genip



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## Exotics Recently Discovered In Florida: Hibiscus bud weevil

- Found on hibiscus in May 2017
- Causes bud drop and is known from various species of malvaceous plants
- Native to northeastern Mexico and southern Texas



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## Not Present in Florida: Suni Bug

- *Eurygaster integriceps*
- The world's worst agricultural pest
- Feeds on wheat, perhaps the world's most important food crop
- Not found in western hemisphere
- Unlikely to be a problem in Florida, although an insect of this genus has been intercepted in Florida on European tile



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## Not Present in Florida: Brown planthopper

- *Nilaparvata lugens*
- One of the world's most serious rice pests
- Delphacid planthopper
- Migratory pest in Asia
- Plant virus vector
- Does not occur in the Western Hemisphere



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## Not Present in Florida: Cotton Seed Bug

- *Oxycarenus hyalinipennis*
- Serious pest of cotton
- Established now in the Caribbean
- A small population was discovered in Monroe County in 2010, and has since been eradicated from Florida



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## Not Present in Florida: South American Potato Psyllid



- *Russelliana solanicola*
- Found in South America (Peru)
- Causes serious damage to potato
- Transmits a plant pathogen



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## Not Present in Florida: Asian Longhorn Beetle



- *Anoplophorus glabripennis*
- Established in Chicago and New York
- Discovered during an agricultural "stake-out"
- Eradication effort involves cutting down large trees in residential areas



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## Not Present in Florida: Citrus Longhorn Beetle

- *Anoplophorus chinensis*
- Not established in United States, but intercepted on bonsai trees in Georgia and Washington
- Host plants are numerous hardwoods and *Citrus* spp., hibiscus, ficus, sycamore, willow, pear, oak, maple, Japanese red cedar



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## Florida – A “Sentinel State”

As a “sentinel state,” we often take action to mitigate the threat of exotic agricultural pests.



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## Emergency Responses

- Public Outreach
  - Press Releases
  - Pest Alerts
  - Press Conference
  - Interviews
  - Town Hall Meetings
- Risk and Pathway Analysis
  - Assess level of threat and response
  - Determine avenues of potential movement of infested material



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## Emergency Responses

- Surveillance
  - Delimitation to determine extent of infestation
  - Mapping
  - Trapping
  - Visual Inspection
- Mitigation (Eradication or Management)
  - Quarantine of infestation area
  - Regulation of agricultural products



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## Emergency Responses

- Preferred choice is eradication, which may not be possible in most cases.
- If eradication is not possible, several different approaches can be taken to limit threats and restrict movements, including, but not limited to:
  - Regulatory activity
  - Research
  - Management
  - Biocontrol



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## Emergency Responses

- When an agricultural pest emergency occurs for which there are eradication measures, the Division of Plant Industry uses the Incident Command System (ICS).
- ICS: a management system that integrates a combination of facilities, equipment, personnel, procedures, and communications operating within a common organizational structure
- Involves the US Department of Agriculture and the Florida Department of Agriculture and Consumer Services



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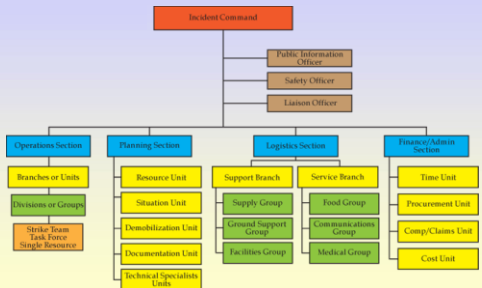
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## Emergency Responses ICS Structure



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## Emergency Response Example: Oriental Fruit Fly Eradication

- *Bactrocera dorsalis* is one of the world's most destructive fruit pests
- Not known to be permanently established in the continental United States
- Detection in Florida necessitates an eradication program



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## Oriental Fruit Fly Eradication: Trigger

When one fly is detected:

- Increase quantity of traps placed within 81 square miles around detection site

Trigger for Treatment

- Two flies within a 3 mile radius within one life cycle (~30 days); or one mated female; or immature stages

Trigger for Quarantine

- Six flies (male and/or female) in a commercial production area within a 3 mile radius during one life cycle



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## Oriental Fruit Fly Eradication: Public Education

- Response actions for pests and diseases can be very unpopular
- Keep the public informed
  - Timely and accurate communication with the press is very important
  - Communication of survey and eradication activities, and possible impact of the pest



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## Oriental Fruit Fly Eradication: Survey Activities



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## Oriental Fruit Fly Eradication: Regulatory Activities

- Establish Quarantine Zones
  - Prevent movement of fruit out of area by:
    - Public outreach
    - Monitoring airports, roadways
    - Compliance agreements
  - Daily monitoring of produce and procedures in Quarantine Zones



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## Oriental Fruit Fly Eradication: Control

- Male Annihilation Technique (MAT)
  - Male-attractant pheromone lure combined with pesticide applied within the treatment area to light poles or trees in infested area
- Remove and dispose of potentially infested fruits



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## Oriental Fruit Fly Eradication: Success

The eradication program is considered successful when all program activities are executed and a result of no flies for 3 life cycles after the last fly was detected.



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## Agricultural Issues Resulting From Invasive Species Introduction

### Citrus greening

- Caused by the bacterium *Liberibacter asiaticus*
- Vected by the Asian citrus psyllid
- Effects are spot/sector yellowing, notched leaves, misshapen, bitter fruit
- Has reduced Florida citrus production drastically
- No silver bullets for management.



### Africanized bees

- Originally from Africa
- Introduced to Americas in 1956: very aggressive, easily agitated, pursues 1/4-mile to continue attack, can easily kill.



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## A Take-Home Message...

The major source of new pests is movement by people.

HELP PROTECT OUR FOOD AND NATURAL RESOURCES  
AYUDA A PROTEGER NUESTRA RESERVA AGRÍCOLA Y RECURSOS NATURALES

When you travel...  
Cuando usted viaje...

Declare agricultural items  
Declare los productos agrícolas

Don't pack a pest  
No empaque plagas

[dontpackapest.com](http://dontpackapest.com)

Logos for USDA, EPA, and other agencies.



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## Working Together To Protect Florida's Agriculture & Way of Life



Thank You!



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## Key Resources

- United States Department of Agriculture (USDA)  
[www.usda.gov](http://www.usda.gov)
- Florida Department of Agriculture and Consumer Services (FDACS)  
<http://www.fdacs.com>
- FDACS-Division of Plant Industry  
<https://www.freshfromflorida.com/Divisions-Offices/Plant-Industry>
- FDACS Division of Animal Industry  
<https://www.freshfromflorida.com/Divisions-Offices/Animal>
- Industry Florida Agriculture Statistical Directory 2004  
[https://www.nass.usda.gov/Statistics\\_by\\_State/Florida/Publications/Annual\\_Statistical\\_Bulletin/FL\\_Agriculture\\_Book/2015/2015\\_FL\\_Ag\\_by\\_the\\_Numbers.pdf](https://www.nass.usda.gov/Statistics_by_State/Florida/Publications/Annual_Statistical_Bulletin/FL_Agriculture_Book/2015/2015_FL_Ag_by_the_Numbers.pdf)
- *Bemisia* Pest Alert issues by FDACS-DPI  
[https://www.freshfromflorida.com/content/download/68503/1614891/Pest\\_Alert\\_-\\_Bemisia\\_tabaci\\_Gennadius\\_Q\\_biotype\\_.pdf](https://www.freshfromflorida.com/content/download/68503/1614891/Pest_Alert_-_Bemisia_tabaci_Gennadius_Q_biotype_.pdf)



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## Key Resources

- Florida Department of Agriculture Annual Report  
<https://www.freshfromflorida.com/Forms-Publications/Publications/FDACS-Annual-Reports>
- FDACS' Division of Marketing and Development Internet site provides information to agribusinesses and the general public about Florida agriculture <https://www.freshfromflorida.com/Divisions-Offices/Marketing-and-Development>
- USDA, Animal and Plant Health Inspection Service, National Center for Import and Export [www.aphis.usda.gov/vs/ncie](http://www.aphis.usda.gov/vs/ncie)
- Pests.org <https://www.pests.org/killer-bees/>
- Florida State Agricultural Response Team <https://flsart.org/>
- Integrated Pest Management, IFAS Extension, University of Florida <http://styl.ifas.ufl.edu/>



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- Jeff Lotz, Gary Steck, Steve Garnsey, Julieta Brambila, Paul Skelley, Avas Hamon, Susan Halbert, Russ Mizell, Jim Cuda, Michael Thomas, Natasha Wright, David Nicholls, Zee Ahmed, Felipe Soto-Adames, Jim Hayden, Sam Bolton
- USDA: APHIS, Forest Service
- FDACS-DPI, SPDN/NPDN
- University of Florida/IFAS, University of Georgia, University of Illinois at Urbana-Champaign (Beckman Institute)
- Virginia Cooperative Extension Service, Pennsylvania Dept. of Agriculture, Washington State Dept. of Agriculture, Minnesota Dept. of Agriculture
- AnimalWire
- Bugguide.net
- Michael Bohne, USDA Forest Service, Bugwood.org
- Wikipedia: The Free Encyclopedia



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## Acknowledgements

**Prepared by:** Kate Fairbanks, Paul Skelley, Leroy Whitby

**Slide Contribution:** Zee Ahmed, Sam Bolton, Andy Boring, Susan Halbert, Jim Hayden, Kyle Schnepf, Felipe Soto-Adames, Gary Steck, Elijah Talamas

**Florida Department of Agriculture and  
Consumer Services,  
Division of Plant Industry  
Bureau of Entomology, Nematology, and Plant  
Pathology  
(Entomology Section)**



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