Workbook

Three Exotic Plant Diseases Threatening Florida

SART Training Media

Three Exotic Plant Diseases Threatening Florida

Workbook

Prepared by: Tim Schubert, PhD, FDACS, Division of Plant Industry
Rick Sapp, PhD, Florida SART Technical Writer

Published February 2007

SART Training Media are available for download from the Florida SART web site at www.flsart.org

CONTENTS

ABOUT FLORIDA SART

SART is a multi-agency coordinating group consisting of governmental and private entities dedicated to all-hazard and disaster preparedness, planning, response and recovery for the animal and agricultural sectors in the state of Florida.

SART operates at the local level through county SART organizations.

SART utilizes the skills and resources of many agencies, organizations and individuals with its multi-agency coordination group structure.

SART supports the county, regional and state emergency management efforts and incident management teams.

SART Mission

Empower Floridians through training and resource coordination to enhance all-hazard disaster response and response for animals and agriculture.

SART Goals

- Promote the active engagement of each county coordinator who is responsible for animal and agricultural issues.
- Provide assistance in the development and writing of county ESF 17 plans.
- Promote the establishment of a county SART to work as a multi-agency coordination group to support emergency management and incident management teams.
- Provide training for all SART and animal and agriculture personnel.
- Identify county resources available for an emergency or disaster.
- Work to comply with the National Incident Management System (NIMS) document.

SUBJECT:	Introduce participants to three exotic plant diseases threatening Florida.
GOAL:	To provide team members with a basic understanding of three exotic plant diseases now threatening Florida agriculture – citrus greening, soybean rust and sudden oak death – and to recognize the consequences of their spread.

LEARNING OBJECTIVES

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

1. Name three exotic plant diseases threatening Florida.
2. Describe citrus greening and how it may be introduced.
3. Discuss options for combating citrus greening and identify the best one.
4. Describe one effect of soybean rust and tell how it was introduced
5. Identify the best option for combating soybean rust.
6. Identify the most important plant vector for the spread of soybean rust.
7. Name two syndromes of sudden oak death.
8. Name the SOD syndrome found in Florida and describe how it was introduced.
9. Identify three nursery species that serve as vectors for the leaf/twig blight syndrome of sudden oak death.
10. Identify key resources available for more information.

Slides 1-3


STATE AGRICULTURAL RESPONSE TEAM
S. A. R. T.
FLORIDA


Three Exotic Plant Diseases
Threatening Florida
State Agricultural Response Team
2


Three Exotic Plant Diseases
Threatening Florida
Prepared by
Tim Schubert, PhD
Florida Department of Agriculture and Consumer Services
Division of Plant Industry
Rick Sapp, PhD
Florida Department of Agriculture and Consumer Services,
Florida SART Technical Writer
State Agricultural Response Team
3

Slides 4-6

Acknowledgements

- **Photographs and diagrams**
  - Department of Bacteriology, University of Wisconsin-Madison
  - Florida Dept. of Agriculture & Consumer Services
  - Institute of Food & Agricultural Sciences, University of Florida
  - Steve Koenning
  - Tim Schubert, PhD
  - Rick Sapp, PhD
  - US Department of Agriculture and USDA Forest Service

Learning Objectives

- To provide team members with a basic understanding of three exotic plant diseases now threatening Florida agriculture – citrus greening, soybean rust and sudden oak death – and to recognize the consequences of their spread.

The Value of Agriculture in Florida

- 1.25 million residents earn livings in agriculture producing billions in market value crops
- Florida's top agricultural sectors:
  - Cane for sugar
  - Citrus
  - Dairy
  - Forest products
  - Greenhouse/nursery products
  - Tomatoes

Slides 7-9

Importance of citrus in Florida

- Florida produces 80 percent of all US citrus
- Florida ranks 2nd in the world, following Brazil, in citrus production
- In total, citrus accounts for about 90,000 jobs in Florida and $900 million in taxes at all government levels

State Agricultural Response Team 7

Diseases threatening Florida citrus

- citrus greening
- citrus variegated chlorosis
- citrus chlorotic dwarf virus
- sweet orange scab
- black spot of citrus
- citrus leprosis virus
- lime witches' broom
- citrus sudden death

State Agricultural Response Team 8

Citrus Greening

- Known in China for 100 years where it was called "yellow dragon disease"
- Has probably been in Brazil for 6-7 years where it is widespread possibly due to propagation sloppiness
- Now documented in Florida

State Agricultural Response Team 9

Slides 10-12

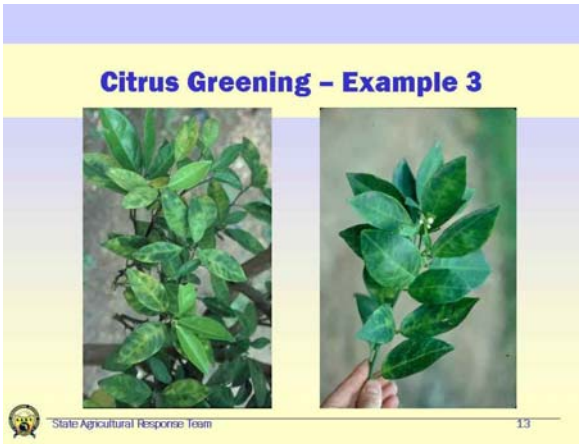
What does citrus greening do?

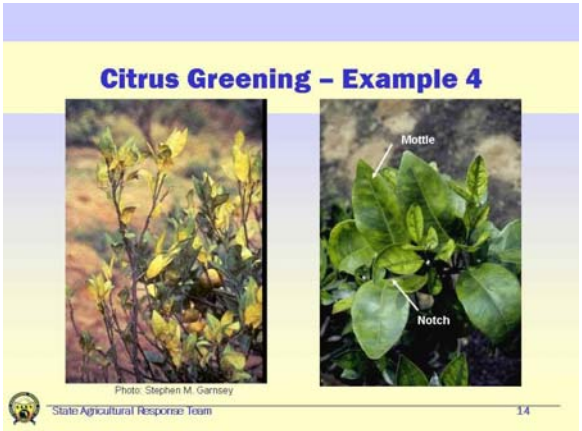
- The first sign of infection may be leaf mottling or the yellowing of entire tree sectors. This sectoring will not usually be uniform and it can affect one branch without affecting others.
- Progressive yellowing of the entire canopy follows sectoring. Citrus trees may fruit for 20 – 25 years. After infection, they frequently succumb within one to three years: fruit ripens unevenly (remains "green") and may become misshapen; seed growth is often aborted.

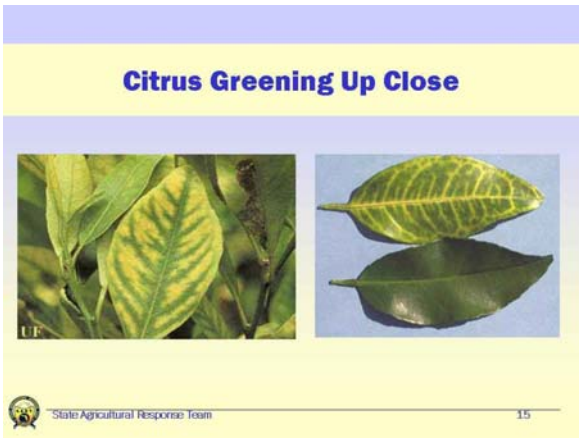
Citrus Greening – Example 1

Citrus Greening – Example 2

Slides 13-15


Citrus Greening – Example 3
State Agricultural Response Team
13


Citrus Greening – Example 4
Mottle
Notch
Photo: Stephen M. Garnsey
State Agricultural Response Team
14

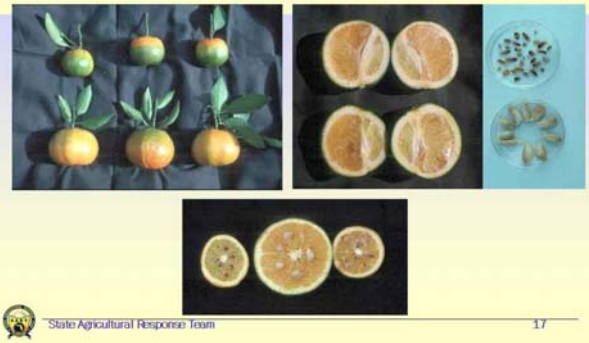

Citrus Greening Up Close
State Agricultural Response Team
15

Slides 16-18

Citrus Greening – The Fruit #1

State Agricultural Response Team 16

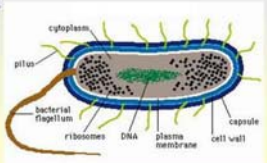
Citrus Greening – The Fruit #2



State Agricultural Response Team 17

How is citrus greening spread?

- A spreading disease requires a "**pathogen**," a means of transmission or "**vector**" and a **host**.
- The pathogen for citrus greening is *Candidatus* Liberobacter, a bacterium similar to the generalized form below.



State Agricultural Response Team 18

Slides 19-21

A "vector" carries the bacterium

- The bacterium is carried to its citrus host by a vector, in this case, a psyllid.
- This psyllid first appeared in Florida in 1998.
- Today, they are found throughout the state (adult pictured, right.)

State Agricultural Response Team 19

Florida's Citrus Host

- No citrus is immune to citrus greening.
- It affects the entire plant: leaves, stems, roots, growing points, inflorescence, fruit and seeds.

State Agricultural Response Team 20

Who will help control citrus greening?

State Agricultural Response Team 21

Slides 22-24

Identifying citrus greening

- Yellow sectoring in trees
- Mottled, yellowing leaves
- Small, lopsided fruit
- Aborted, misshapen seed
- Notches in leaves
- Psyllids in the air

Results of feeding by citrus psyllids.

Biological controls

- Two Asian parasites are planned for release in Florida:
  - *Tamarixia radiata* can reduce populations of citrus psyllid.
  - In the photo below, *Diaphorencyrtus aligarhensis* inserts an egg into a citrus psyllid nymph.

Chemical controls

- Because the bacterial pathogen *Candidatus* Liberobacter has been found on pysllids in Florida, chemical controls will almost certainly be a part of the psyllid control equation.

Slides 25-27

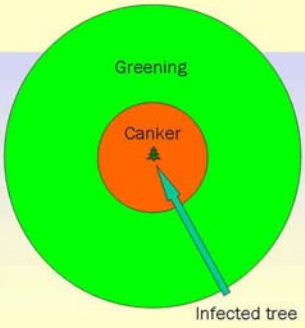
Cultural controls

- The only effective means of controlling an outbreak of citrus greening is the complete removal of infected trees and plants as soon as possible.

State Agricultural Response Team 25

Red: An exposure radius of 1,900 feet is used for citrus canker.

Green: The estimated exposure radius for citrus greening is 0.9 mile (how far Asian citrus psyllids can fly.) This involves 6.8 times the area for canker.



State Agricultural Response Team 26

Orange jasmine

- Orange jasmine or *Murrava paniculata* is a preferred host of the Asian citrus psyllid. This insect has moved through Florida via sales of orange jasmine in large retail stores.

State Agricultural Response Team 27

Slides 28-30

Related - CVC
Citrus Variegated Chlorosis

- Like greening, CVC first appears as leaf mottling or yellow sectors in a tree. Symptoms resemble zinc or manganese deficiencies, which are common. Fruit are small and hard. A close up view of the symptomatic leaf with *intraveinal chlorosis* may show gummy-looking raised bumps in yellow areas on leaf undersides. Overall impact is the same as citrus greening.

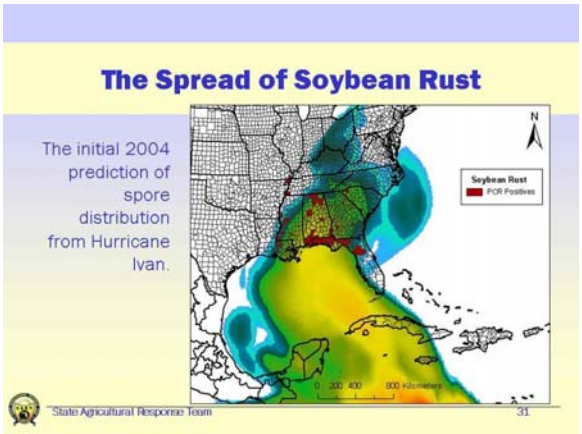
Part II: About Soybeans

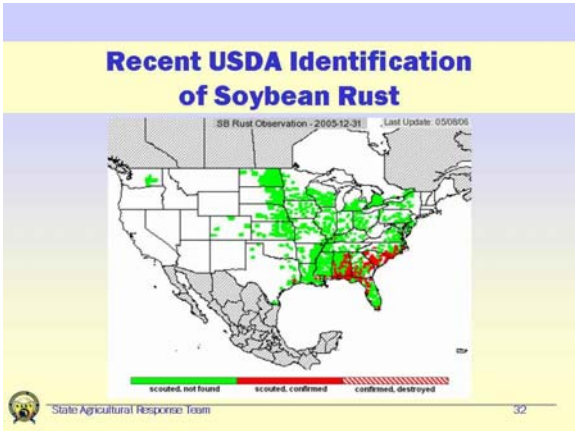
- A native Asian plant, Soybeans are an important international crop because 40% of a bean is oil, 20% is protein and 35% carbohydrates
- The US produces 55% of the world crop
- Less than 1% of Florida's agricultural crop is soybeans

What is soybean rust?

- Soybean rust is a fungus, either *Phakopsora pachyrhizi or P. meibomiae*. Of the two, only *P. pachyrhizi* is of real concern. Soybean rust is transmitted by wind-blown spores to host legumes.
- At least 31 legume species in 17 different genera, plus many more experimentally, can be infected.
- Like soybeans, soybean rust is native of Asia.
- Hurricane Ivan blew spores from Venezuela to the US in 2004.
- Today, rust is confirmed in Florida, Georgia, Alabama, Mississippi, Louisiana, North and South Carolina and Texas, as well as Mexico.

Slides 31-33


The Spread of Soybean Rust
The initial 2004 prediction of spore distribution from Hurricane Ivan.
N
Soybean Rust
PCR Positives
0 200 400 800 Kilometers
State Agricultural Response Team
31


Recent USDA Identification of Soybean Rust
SB Rust Observation - 2005-12-31
Last Update: 05/08/06
scouted, not found
scouted, confirmed
confirmed, destroyed
State Agricultural Response Team
32


Soybean Rust Detections in Florida 2004 -2005
2004 county
2005 county
Prepared: W.N. Dixon, T.S. Schubert
FDACS/DPI
5.2.2005
State Agricultural Response Team
33

Slides 34-36

Rust symptoms and impact

- Checking fields for soybean rust, pay attention to:
  - early planted fields with early maturing varieties,
  - low-lying or protected fields with prolonged dew periods and
  - fields with early canopy closure.

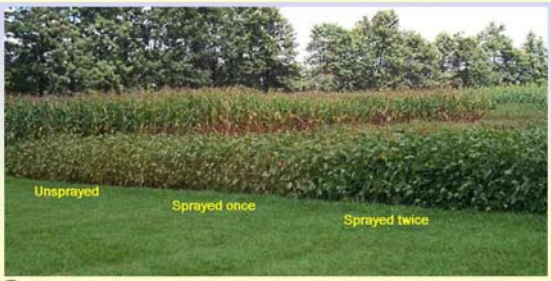
State Agricultural Response Team 34

Rust infection

- Look for small, necrotic raised pustules on the underside of leaves, eventually spreading to the entire plant.

State Agricultural Response Team 35

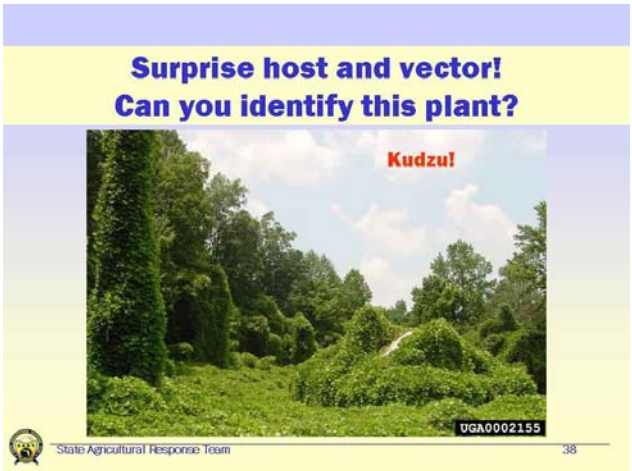
Soybean rust treatment

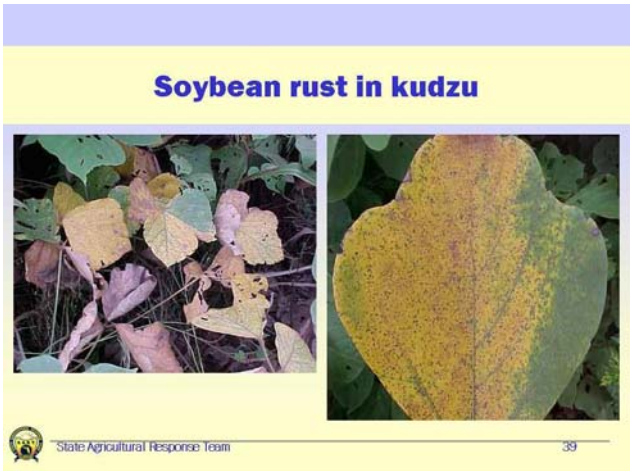


State Agricultural Response Team 36

Slides 37-39


The natural cure
Biologists hope that host resistance will minimize rust impact.
State Agricultural Response Team
37


Surprise host and vector!
Can you identify this plant?
Kudzu!
UGA0002155
State Agricultural Response Team
38


Soybean rust in kudzu
State Agricultural Response Team
39

Slides 40-42

Part III: Sudden oak death

SOD – Greatest Potential Impact

- Sudden oak death has greatest potential for harming Florida's booming nursery and greenhouse industry, an even larger sector of private industry jobs than citrus!

What is sudden oak death?

- The pathogen: a fungus-like organism called *Phytophthora ramorum* probably arrived in the US on rhododendron imported from Asia.
- This infection has two "syndromes:"
  - Bark canker, established on the West Coast, is lethal to some trees, but has not been found in Florida.
  - Leaf-and-twig blight is not normally lethal, but is detrimental to plant health and was found in Florida in the Spring of 2004 and in 2006.

Slides 43-45


SOD – Bark Canker Syndrome
• The SOD bark canker kills trees. Trimming away the bark can reveal the severity of the infection. It is not found in Florida.
State Agricultural Response Team
43


SOD – Leaf-&-Twig Blight Syndrome
• Camellia japonica was the host when SOD leaf-and-twig blight entered Florida from a California nursery in 2003.
State Agricultural Response Team
44


What does SOD look like?
• SOD foliar stage of the leaf-and-twig blight syndrome on camellias. It is the only known host for P. ramorum in Florida ... so far!
State Agricultural Response Team
45

Slides 46-48

Ultimate leaf-and-twig syndrome.

Leaf and twig blight syndrome on *viburnum* have killed this plant.

State Agricultural Response Team 46

SOD on other hosts.

State Agricultural Response Team 47

Additional sources of information and support

- US Department of Agriculture, Animal and Plant Health Inspection Service www.aphis.usda.gov/. APHIS' on citrus greening www.citrusgreening.net. USDA's soybean rust web sites are www.usda.gov/soybeanrust/ or www.sbrusa.net/. APHIS web site is www.aphis.usda.gov/ppq/ep/soybean_rust/. The USDA on sudden oak death www.na.fs.fed.us/spfo/pubs/pest_al/sodeast/sodeast.htm.
- Florida Department of Agriculture and Consumer Services www.doacs.state.fl.us/
- Integrated Pest Management, IFAS Extension, University of Florida http://ipm.ufl.edu/
- Southern Plant Diagnostic Network http://spdn.ifas.ufl.edu/Citrus%20_Greening.htm
- Soybean rust www.aphis.usda.gov/ppq/ep/soybean_rust/
- California Oak Mortality Task Force http://nature.berkeley.edu/comtf/
- The Nature Conservancy, Global Invasive Species Initiative http://tncweeds.ucdavis.edu/products/gallery/phyra1.html

State Agricultural Response Team 48

Slides 49-51

Florida and The World

State Agricultural Response Team 49

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

The End

State Agricultural Response Team 50

Now, Test Your Knowledge and Awareness (1 of 4)

1. Name two of the top sectors (in terms of dollars) of Florida's agricultural economy.
2. Name the plant disease that is considered the greatest potential threat to Florida citrus.
3. (True/False) Called *huanglongbing* in China where it originated in the 19th century, citrus greening disease is carried by the Mediterranean fruit fly.
4. (True/False) In an orange grove, one result of citrus greening disease is green oranges.

State Agricultural Response Team 51

Slides 52-54

Test continued (2 of 4)

5. (True/False) Citrus greening and the related plant disease CVC can not spread to humans who consume infected fruit.
6. (Circle one) Soybean rust arrived in Florida in 2004 as a result of:
   - A terrorist cell
   - A hurricane
   - A homeowner planting exotic soybeans
   - The greenhouse effect

Test continued (3 of 4)

7. (Fill in the blank with the best answer) Soybean rust can rapidly destroy as much as _____ of a soybean crop.
   - 100% the first year
   - About half every year
   - 10-80% depending on conditions
8. (True/False) Sudden oak death is a terrible infestation that threatens to destroy all of Florida's forests.
9. (Fill in the blank) _____ What common flowering species has been most prominent in the spread of sudden oak death through America's network of plant nurseries?

Test continued (4 of 4)

10. (Fill in the blank) _____ is primarily responsible for preventing the introduction and spread of noxious plants and diseases in Florida.

BONUS QUESTION – If you suspect a plant disease, whether an established and well-understood disease such as citrus canker or an emerging threat such as *citrus variegated chlorosis*, you should contact _____.

Slides 55-57

Test Answer Key

1. Any combination of the following: cane for sugar, citrus, dairy, forest products, greenhouse/nursery products or tomatoes
2. Citrus greening
3. False. Citrus greening is spread by an exotic psyllid.
4. True. It also causes plants to yellow and fruit to shrivel.
5. True. Citrus greening and CVC cannot be spread to humans.
6. A hurricane (Ivan in November 2004)
7. 10-80% depending on conditions
8. False.
9. Camellia
10. All Floridians have a responsibility.

Bonus: Contact your county agricultural extension office or the Dept. of Agriculture & Consumer Services Help Line: 1-888-397-1517.

State Agricultural Response Team 55

GLOSSARY

- Host: A living plant or animal from which a parasite obtains nutrition.
- Pathogen: Any disease-producing agent, such as a virus, bacterium or fungus.
- SART: Florida State Agricultural Response Team. A multi-agency coordination group consisting of governmental and private entities dedicated to all-hazard disaster preparedness, planning, response and recovery for the animal and agricultural sectors in Florida.
- Vector: Something, often an insect, that carries and transmits a disease-causing organism.

State Agricultural Response Team 56

Three Exotic Plant Diseases Threatening Florida

- That concludes our presentation on "Three Exotic Plant Diseases Threatening Florida." Thank you for attending and for participating!

State Agricultural Response Team 57

KEY RESOURCES

US Department of Agriculture, Animal and Plant Health Inspection Service (www.aphis.usda.gov/) The APHIS public citrus greening web site (www.citrusgreening.net). The USDA soybean rust web sites are (www.usda.gov/soybeanrust/ or www.sbrusa.net/) and the APHIS web site is (www.aphis.usda.gov/ppq/ep/soybean_rust/). Look at (www.na.fs.fed.us/spfo/pubs/pest_al/sodeast/sodeast.htm) for the USDA sudden oak death pest alert.

Florida Department of Agriculture and Consumer Services (www.doacs.state.fl.us/)

Florida State Agricultural Response Team (www.flsart.org)

Integrated Pest Management, IFAS Extension, University of Florida (http://ipm.ufl.edu/)

Southern Plant Diagnostic Network (http://spdn.ifas.ufl.edu/Citrus%20_Greening.htm)

Soybean rust (www.aphis.usda.gov/ppq/ep/soybean_rust/)

California Oak Mortality Task Force (http://nature.berkeley.edu/comtf/)

The Nature Conservancy, Global Invasive Species Initiative (http://tncweeds.ucdavis.edu/products/gallery/phyra1.html)