

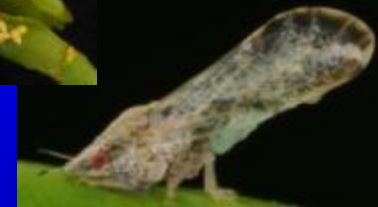
Scouting Citrus for Pests and Beneficials

Phil Stansly and J. Qureshi

UF-IFAS, Immokalee: <http://swfrec.ifas.ufl.edu/entomology/>



Psyllids



CLM



Thrips

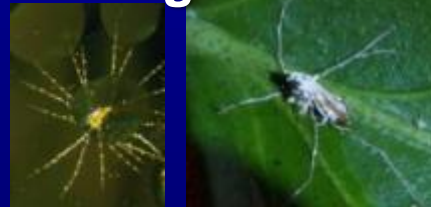
Parasitoids



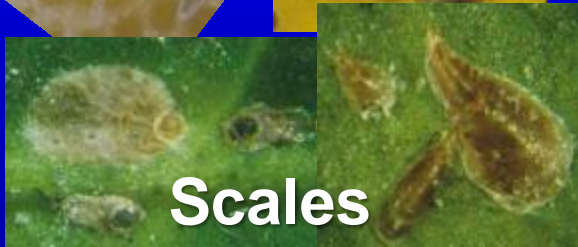
Predators



Pathogens



Scales



Mites



Pesticide Use in Florida Citrus Before HLB

- Most pests under biological control
- Most process fruit received 1 or 2 oil sprays, primarily for greasy spot
- Copper 2nd most used pesticide
- Acaracides used primarily on fresh fruit

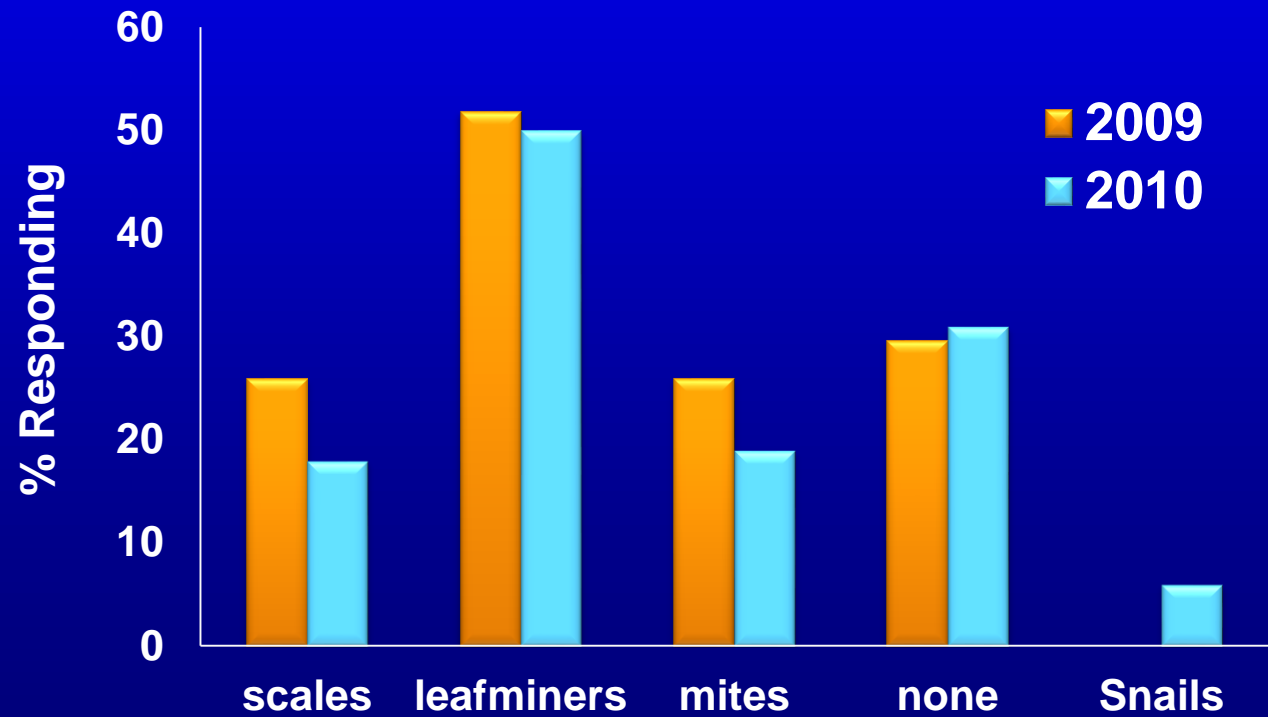
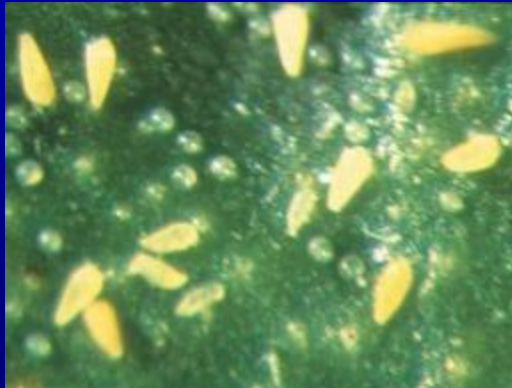
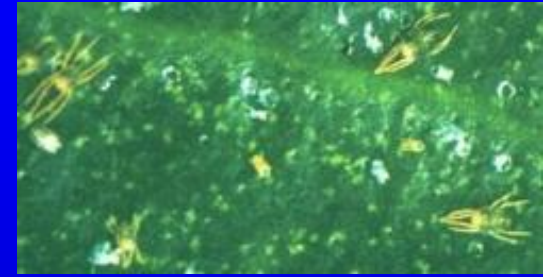
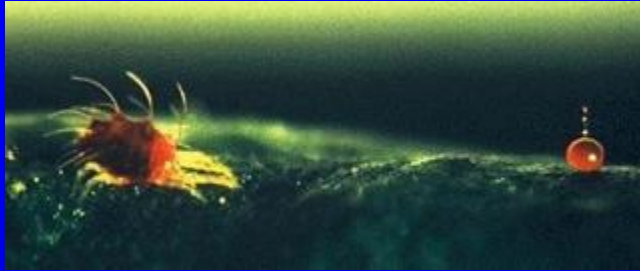


Insecticide Use Now in SW Florida Citrus

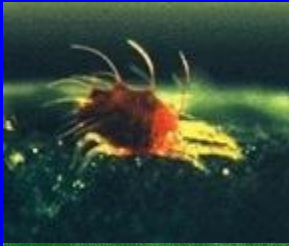
Average applications per year: 7.3

MOA www.irac-online.org	MOA	% Total
Carbamates	1A	7.4
Organophosphates	1B	35
Pyrethroids	3A	26
Neonicotinoid	4A	7.4
Abamectin	6	13
Micromite	15	8.4
Movento	23	3.2
Total	4%	100%

Grower Survey: Increase of Secondary Pests:



Key Florida Citrus Pests and Their Biological Control Agents



- **Mites: spider (true & false), broad, spider**
 - *Hirsutella*, mites, ladybeetles
- **Thrips**
 - Minute pirate bugs, mites
- **Leafminer**
 - Ants, Spiders, *Ageniaspis*
- **Root weevils**
 - Nematodes
- **Scales: armored, soft**
 - Ladybeetles, *Aphytis* spp.
- **Asian Citrus Psyllid**
 - Ladybeetles, *Tamarixia*

Predators: Ladybeetles – Lacewings, Spiders



Funnelweb

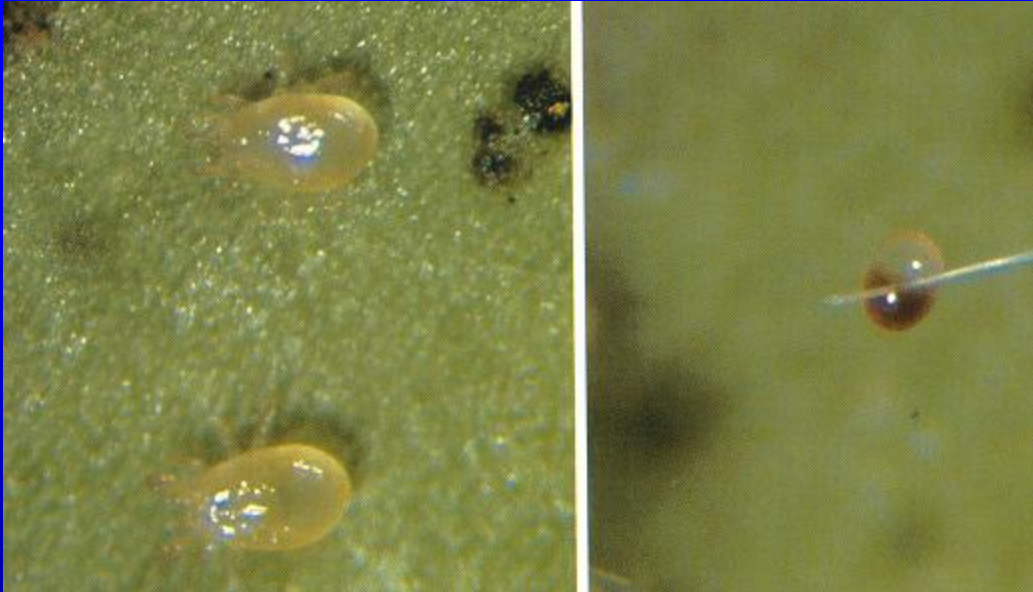
Jumping

Spitting

Velox

Widow

Predaceous mites: Phytoseiids



Parasitoids: Parasitic wasps



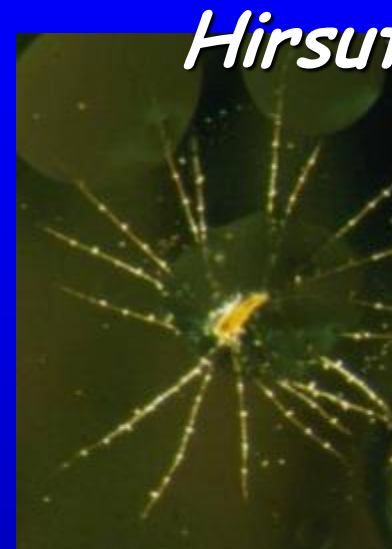
Pathogens: Fungi



Aschersonia



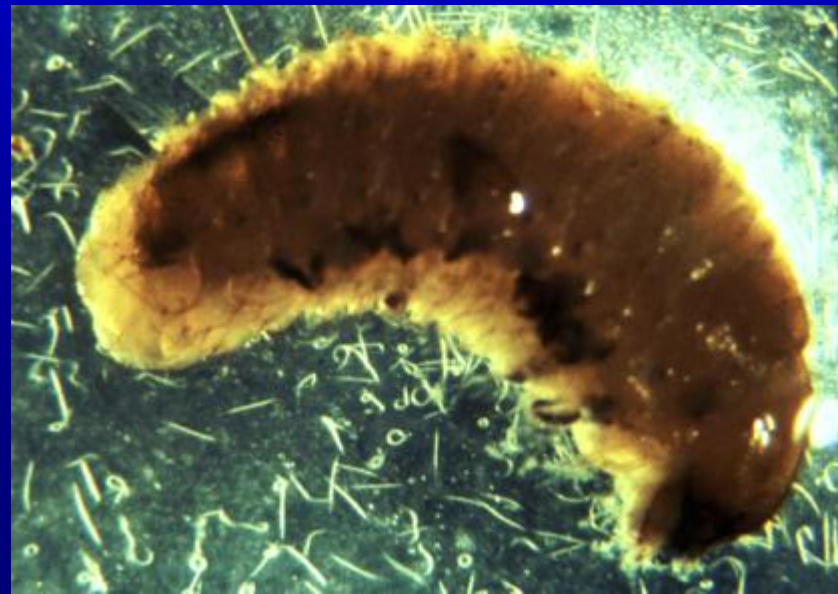
Beauveria



Hirsutella



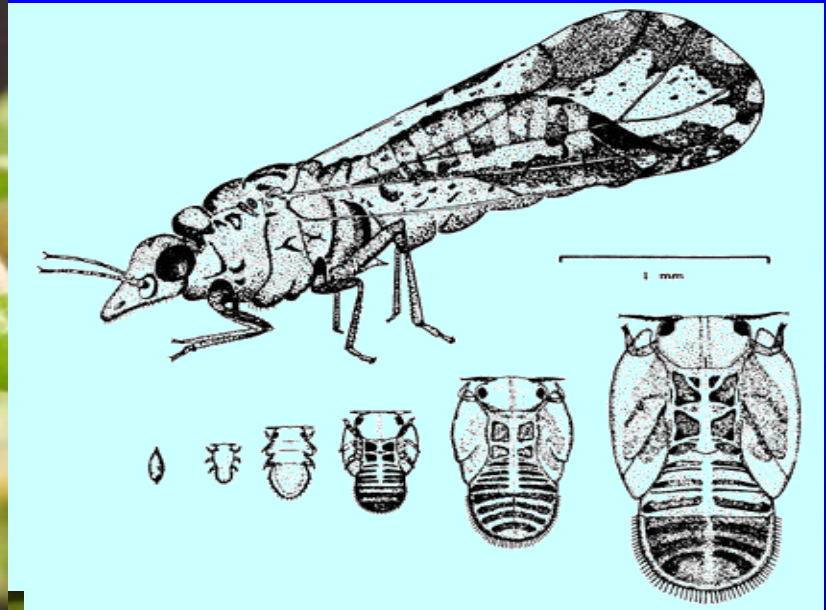
Nematodes



Hemiptera: Sucking Insects

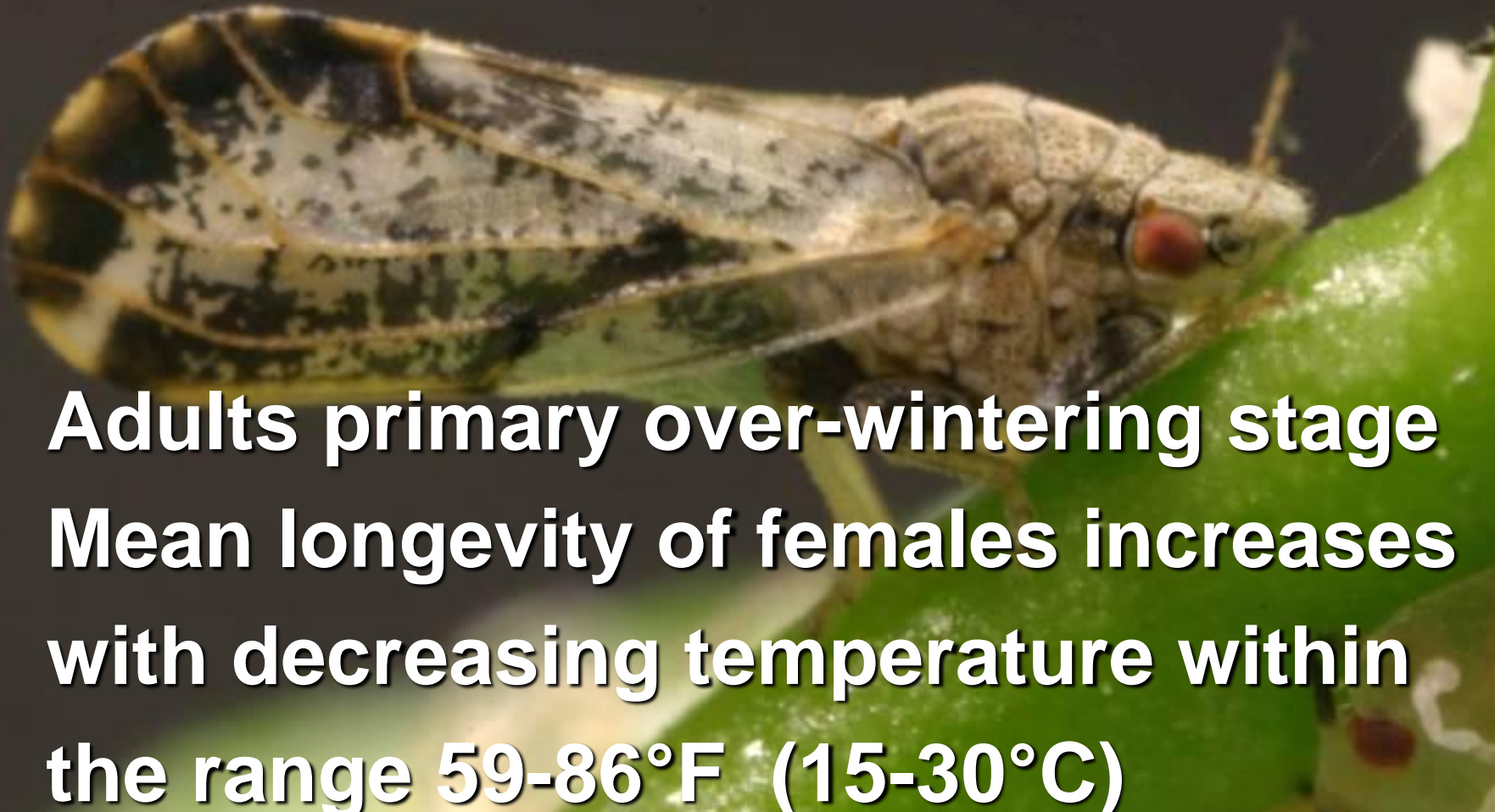
	Nymphs	Adults	Honey-Dew?
Psyllids	Wingpads only Stay on flush	Males and females alike	Yes, waxy secretion (nymphs)
Aphids	Like adults	Usually no males. Some winged	Yes
Whiteflies	Immobile after crawler- scalelike	Males and females winged	Yes
Armored Scales	Only crawler mobil	Cover separates, Males winged	No
Soft Scales	Can move when disturbed and at molts	Cover attached, Males winged	Yes
Mealy bugs	Retain mobility	Waxy filaments. Males winged	Yes
Stinkbugs	Like adults except for wings	Males and females alike	No

Asian citrus psyllid, *Diaphorina citri* (ACP) first detected SE Florida June 1998. Presently found throughout FL and TX, Mexico, and S. America.



Adult Feeding, Longevity

- Adults can feed on both new and mature leaf flushes



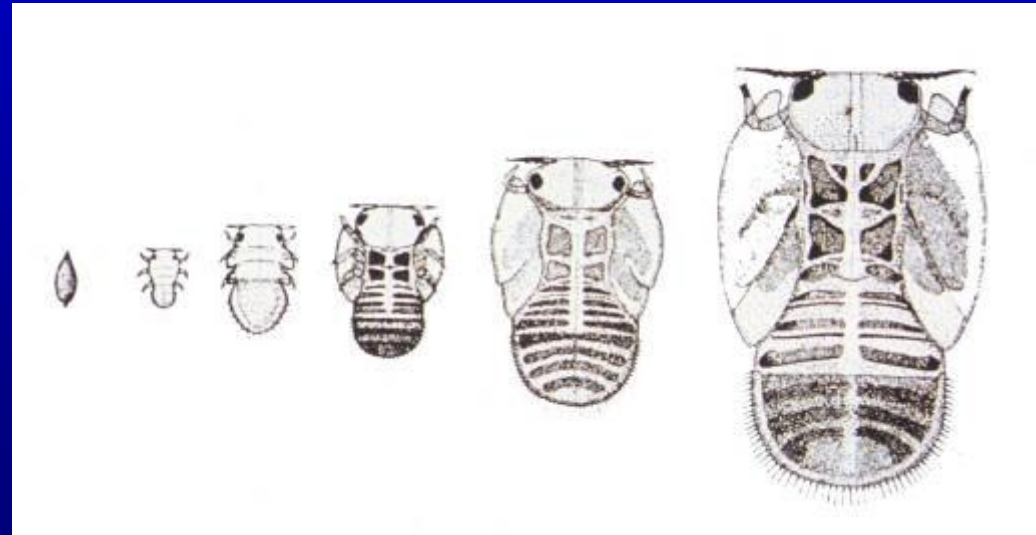
- Adults primary over-wintering stage
- Mean longevity of females increases with decreasing temperature within the range 59-86°F (15-30°C)

- Adults need to feed on young flush to mature eggs. Feeding of both adults and nymphs causes leaf distortion.
- Eggs are laid ONLY in young flush, are about 0.3 mm long and almond shaped.
- Eggs are pale when laid, turn yellow then orange as they mature. Often difficult to see.



Nymphs and nymphal feeding

- Nymphs feed **ONLY** on new developing flush, flower stems and shoots
- There are 5 nymphal stages (“instars”), recognized by size and development of wing buds.
- Nymphs can be readily identified by their yellow to orange coloration, large lateral wing pads in later stages and red eyes.

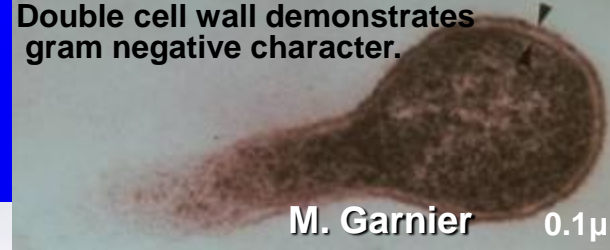




Nymphs secrete honeydew packaged in wax tubes normally removed by wind and/or ants.

Huanglongbing (Yellow Shoot Disease) HLB, or Greening Disease caused by *Candidatus liberibacter asiaticus*

Double cell wall demonstrates gram negative character.



First Appearance

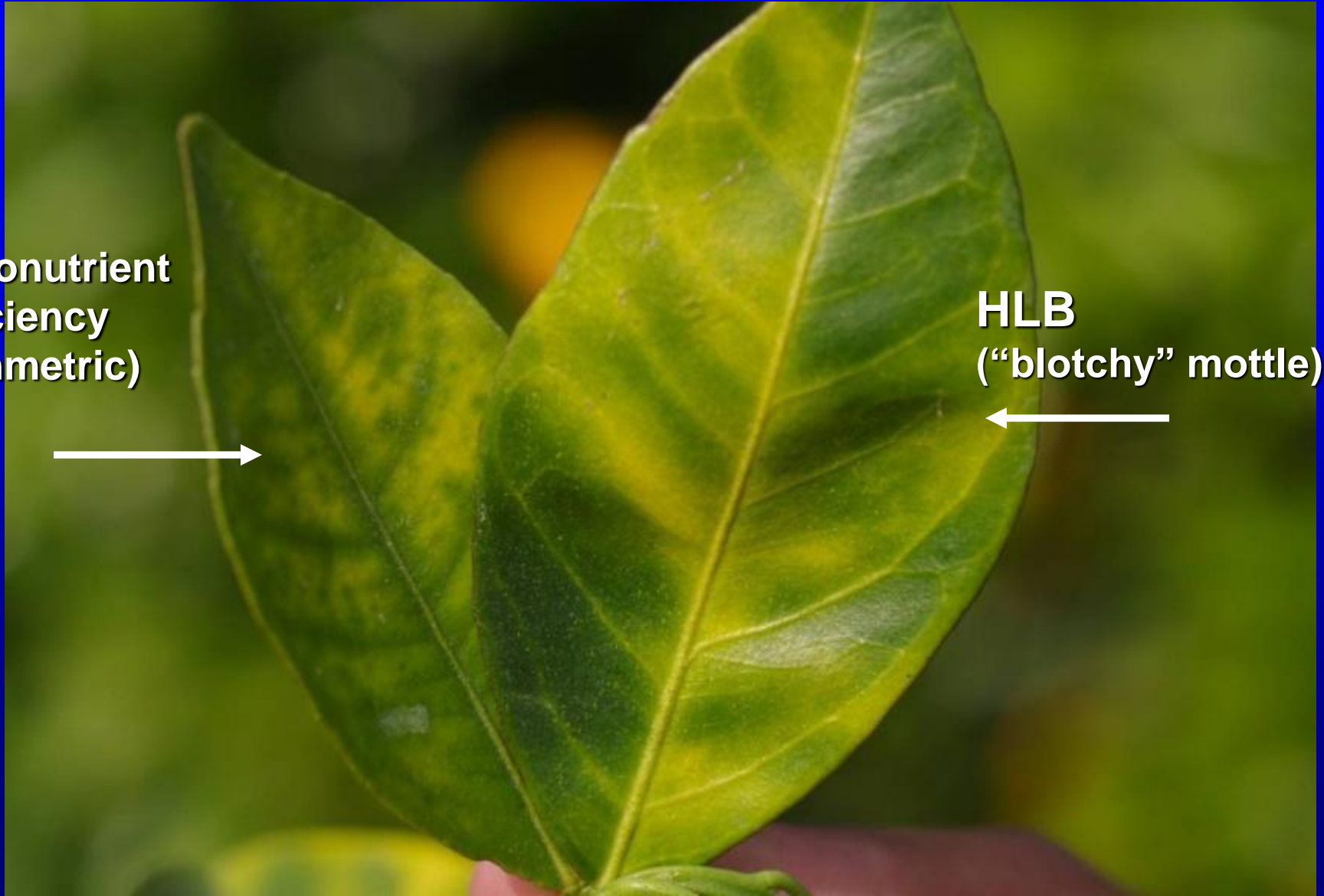


Recognizing HLB

**Micronutrient
deficiency
(symmetric)**



**HLB
("blotchy" mottle)**

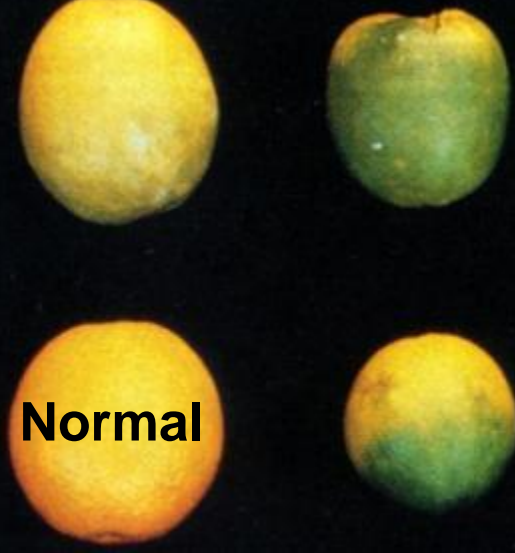


Disease Progression



Evolution of Symptoms





**Small, asymmetrical,
green fruit, aborted
seeds, fruit drop.**



Fruit Drop



Coccinellid Predators of *D. citri* in Florida



Harmonia axyridis



Curinus coeruleus



Cycloneda sanguinea



Olla V-nigrum

Psyllid Predators Lacewings

Chysoperla



Ceraeochrysa



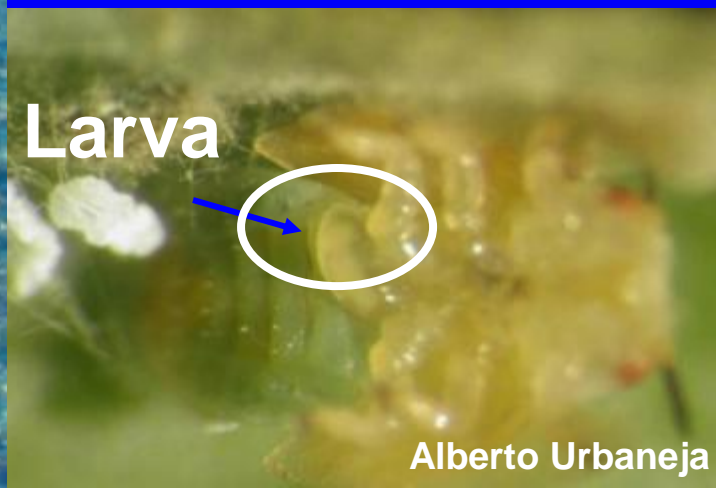
Parasitoid: *Tamarixia radiata*



Adult



Egg



Larva

Alberto Urbaneja



Prepupa



Mummies

Scouting Principles

- **“Random” Sample**
- **Representative Sample**
- **Deliberate Method**
- **Uniform & Thorough Reporting**

Monitoring Commercial Groves for Psyllids



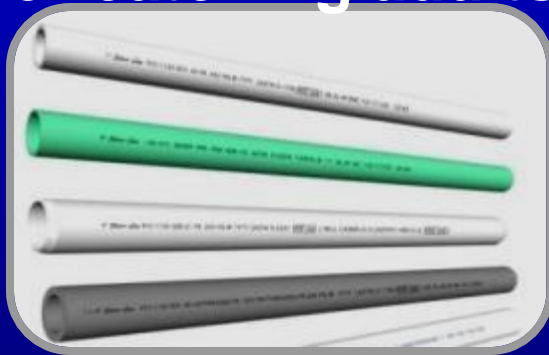
- Tap Sample
 - Do first
 - 10 per stop

- Visual inspection
 - Do next
 - 10 flush per stop

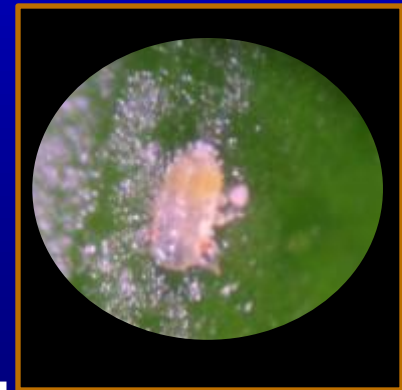
Equipment



Clipboard:
For catching adults and recording data



Piece of PVC (optional)
For hitting branch



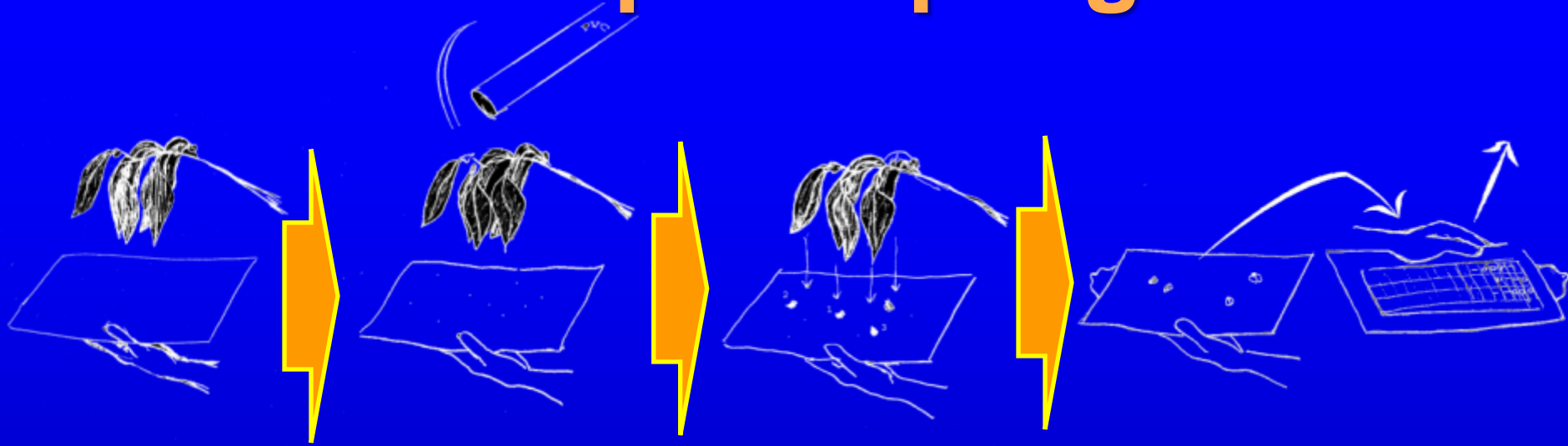
Hand lens:
For seeing small eggs and nymphs

Sample location

- **1 Block**
- **10 Stops**
 - 5 border
 - 5 inside
- **10 trees**



Tap Sampling



- 3 taps per sample
- 1 tap sample per tree
- 10 trees per stop
- 10 stops per block (5 in the borders + 5 inside)



Visual inspection



- Look for young flush (shoots)
- Observe 10 flush per stop
 - If 10 not available record number found in 20 trees
- Record
 - # of infested flush (any psyllid stage)
 - # of observed flush
 - # of trees needed to find 10 flush (Max 20)

Scouting for Psyllids: Summary

- **Adults first priority**
 - Responsible for spread of HLB
 - Target of most sprays
 - Can scout whether or not there is flush
 - Tap test rapid and effective
 - 10 trees per location, 10 locations per block
- **Flush evaluation**
 - Percentage infested any stage
 - 10 flush per location if possible
 - Note number of trees searched.

Other Sucking Insects

	Nymphs	Adults	Honey-Dew?
Aphids	Like adults	Usually no males. Some winged	Yes
Whiteflies	Immobile after crawler-scalelike	Males and females winged	Yes
Armored Scales	Only crawler mobil	Cover separates, Males winged	No
Soft Scales	Can move when disturbed and at molts	Cover attached, Males winged	Yes
Mealy bugs	Retain mobility	Waxy filaments. Males winged	Yes
Stinkbugs	Like adults except for wings	Males and females alike	No

**Green
citrus
aphid:
*Aphis
spireacola***



**Citrus
Aphids**

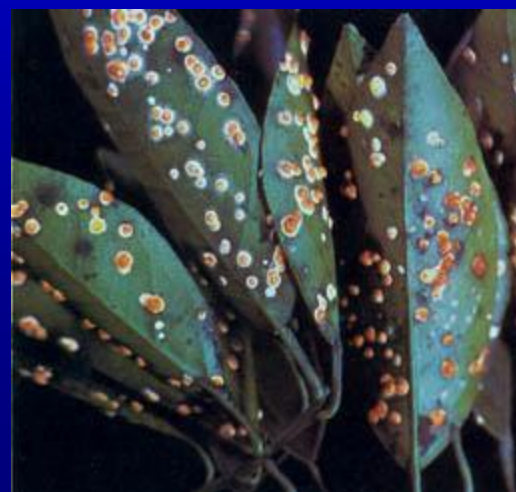
**Brown
citrus
aphid:
*Toxoptera
citricida***



Citrus Tristeza Virus

Citrus Whitefly and Cloudywing Whitefly

Dialeurodes
spp.



Parasitic wasp

Parasitized

“Friendly” Fungus

Woolly Whitefly

*Aleurothrixus
floccosus*



Nesting Whitefly

*Paraleyrodes
minei*

Citrus Blackfly

*Aleurocanthus
woglumi*



*Amitus
hesperidum*

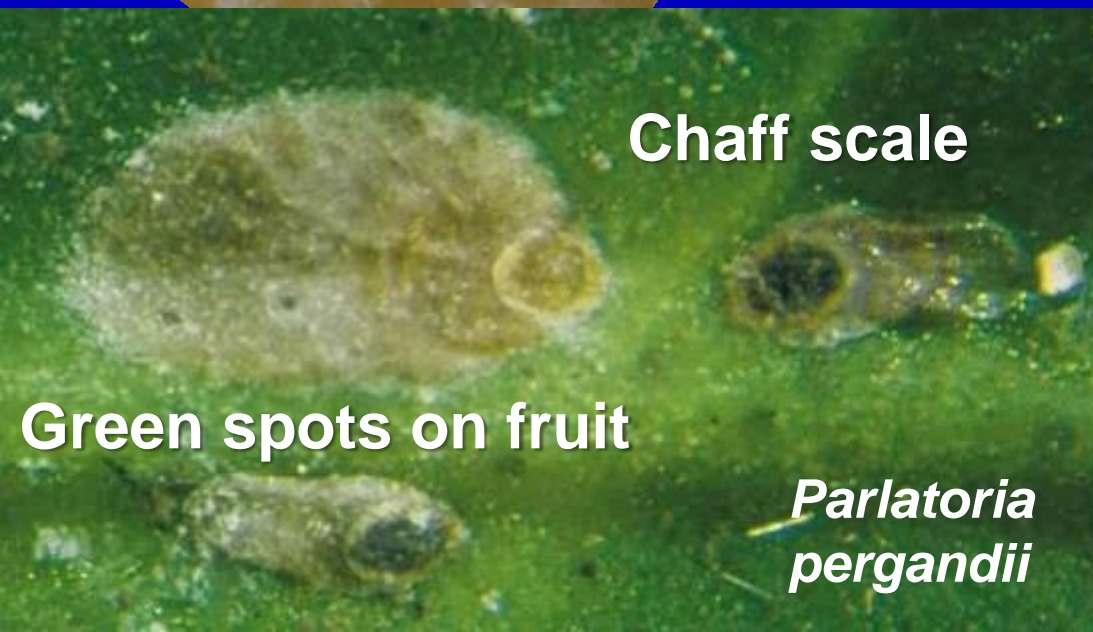
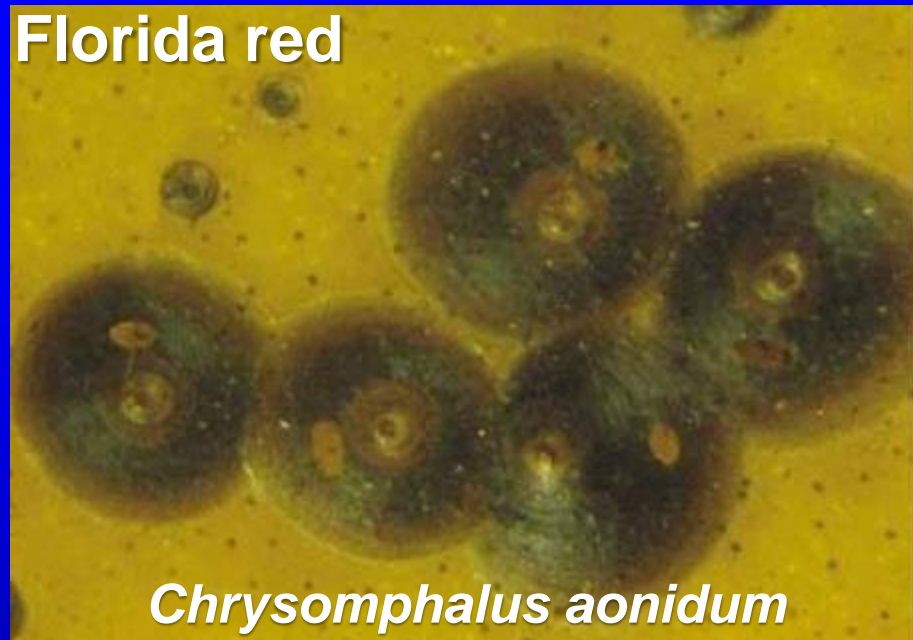


Eggs



Mummy

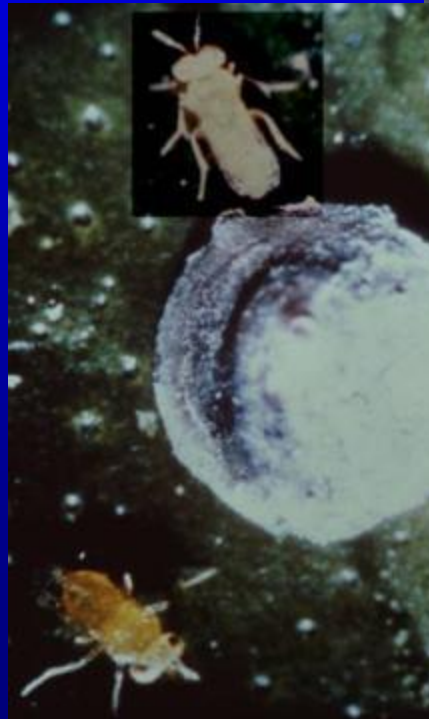
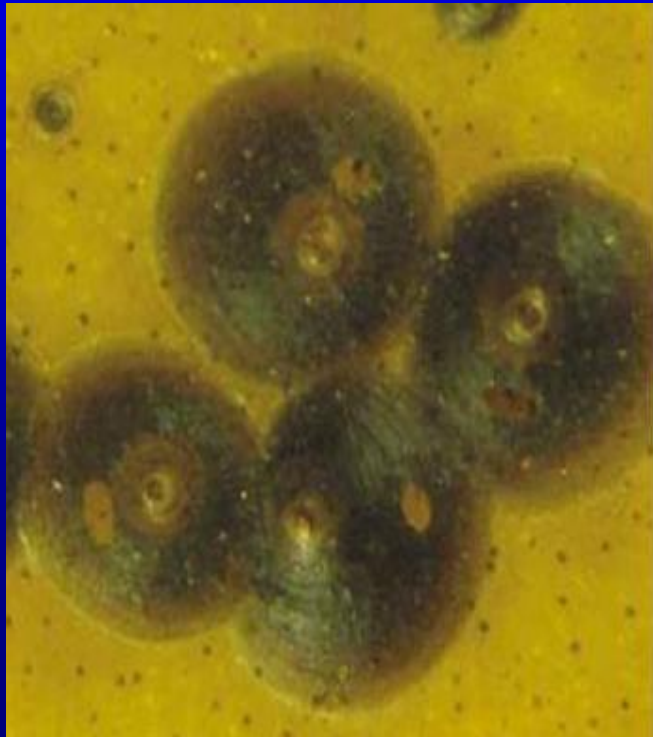
Armored Scales



**Armored scale predator
twice-stabbed ladybeetle
*Chilocorus stigma***



**Florida Red Scale Parasitoid
*Aphytis holoxanthus***

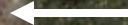


Other Armored Scales



Snow

Unaspis citri
Trunk, main
scaffold limbs



Fern

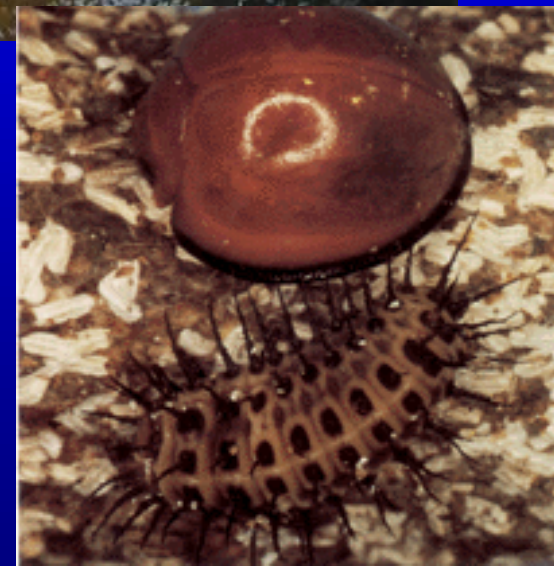
*Pinnaspis
aspidistrae*
Outer Canopy



Mid Canopy

**Lesser
Snow**
*Pinnaspis
strachani*

Lesser Snow Scale Havoc



Controlled by *Chilocorus circumdatus*

Soft Scales: Black Scale *Saissetia* spp

- “H” pattern
- Nymphs on leaves, twigs
- Adults on larger limbs
- Copious honeydew
- Ash ladybeetle



Azya orbigera





**Citrus
Mealybug
*Planococcus
citri***

Cryptolaemus montrouzieri



Mealybug destroyer

Stink Bugs and Leafhoppers



- Thin skinned varieties most susceptible (Hamlin)
- Perforate fruit, introduce pathogens
- Build up on weeds



Mite Pests of Citrus

- **Rust mites**
 - Citrus rust mite *Phyllocoptruta oleivora*
 - Pink rust mite *Aculops pelekassi*
- **Spider mites**
 - Citrus red mite *Panonychus citri*
 - Texas spidermite *Eutetranychus banksi*
- **False Spider Mites**
 - *Brevipalpus* spp
- **Broad mites**
 - *Polyphagotarsonems latus*



Pink Rust Mite
Aculops pelekassi

Rust Mites

- **Primarily problems in fresh fruit**
- **Flared by copper and broad spectrum insecticides, especially pyrethroids**



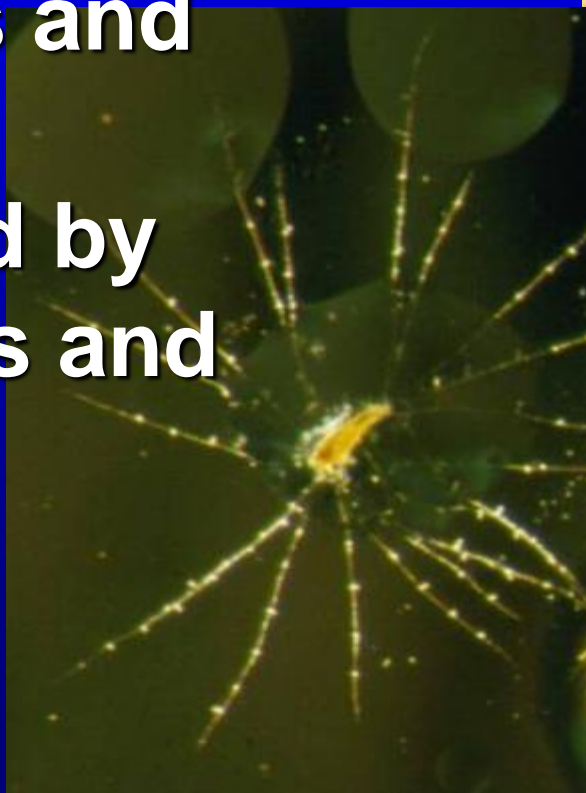
Citrus Rust Mite
Phyllocoptruta oleivora

Citrus Rust Mite

Phyllocoptruta oleivora

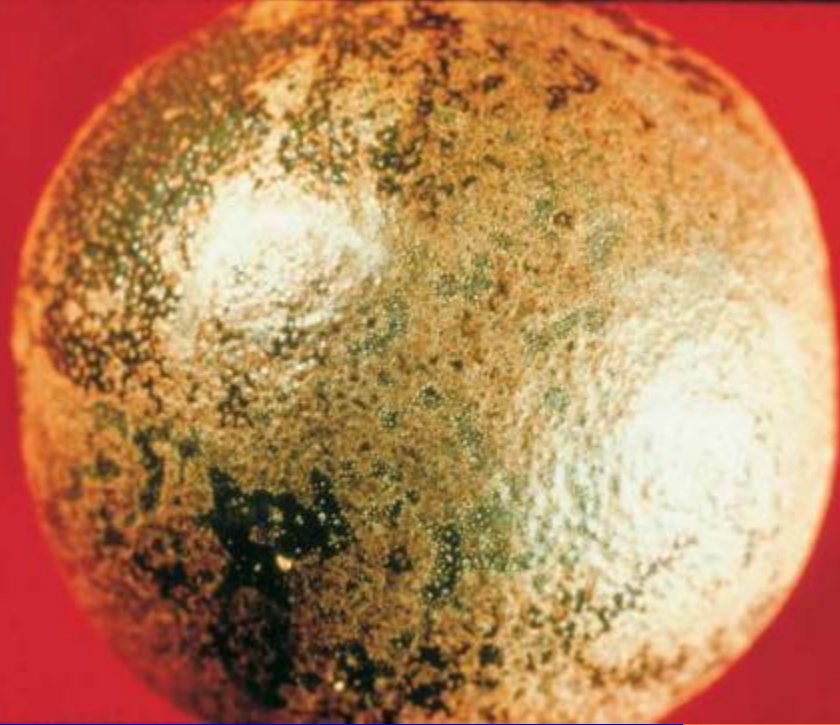
- Biological control by mites, ladybeetles and *Hirsutiella*

- Disrupted by insecticides and copper.



Stethorus





**Early damage:
Sharkskin**

**Late damage:
Bronzing**



Standardize the Lensfield

Lensfield size depends on:

- Magnification
- Distance between eye and eyepiece

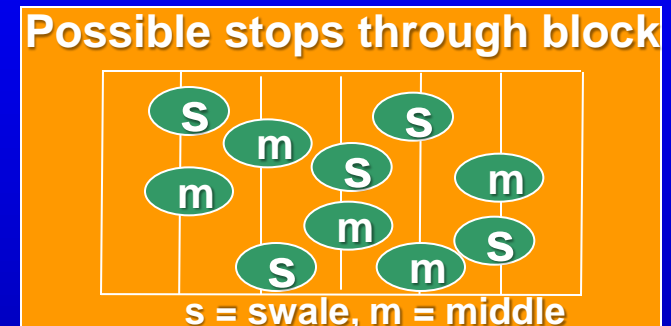


Scout and Note Middles and Swales



Florida Pest Management Guide*:

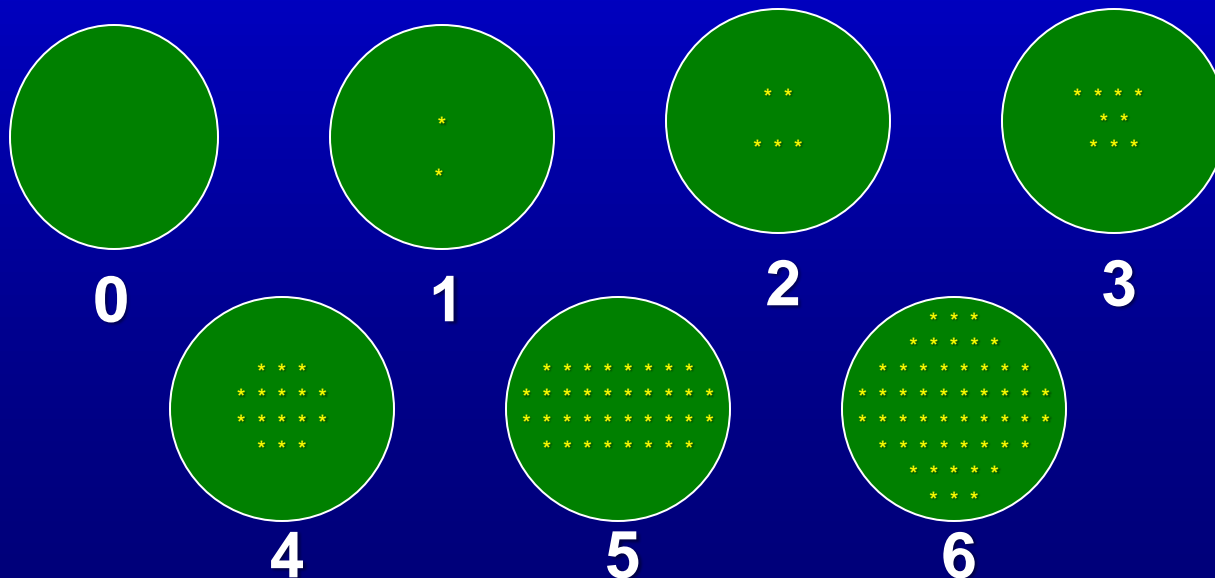
- Process: Every 2-3 Weeks Every
- Fresh: every 10-14 days
- 80 Lensfields /block (10-40 acres)
 - ✓ Stops/ per block = 10
 - ✓ Trees per stop = 4
 - ✓ Fruit/tree = 2
 - ✓ Lens fields per fruit = 1
 - Sun-shade transition
 - ✓ Location of Fruit: all 4 quadrants, midway in canopy
- Record Mites/lens field
- Provides < 25% variation if CRM > 10/cm²
- Thresholds process: 6 CRM/ LF - Caution
10 CRM/LF - Spray
- Threshold fresh: 2 CRM/LF - Spray



*2011 Florida Citrus Pest Management Guide, Publication SP-43, UF Gainesville
<http://edis.ifas.ufl.edu/cg002>

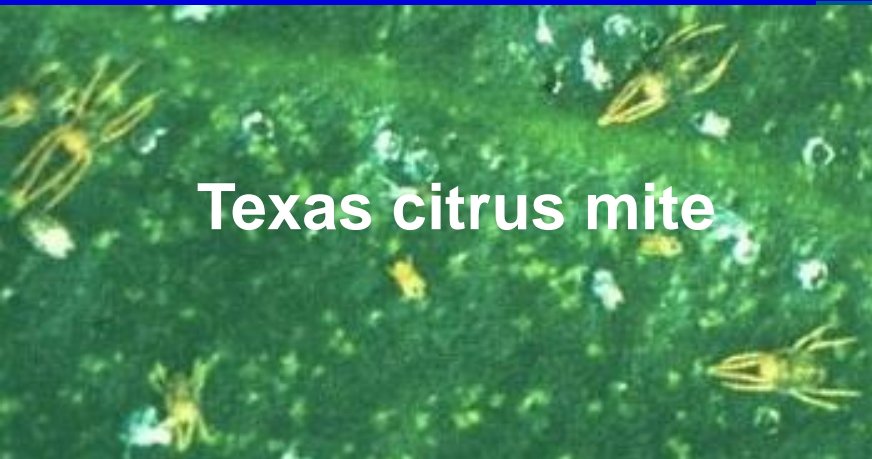
What the Heck is the H-B Rating System?

- Developed by Horsfall & Barratt (1945) to measure disease incidence.
- Based on density recognition rather than individual counts.



Spider Mites:

- Dry weather
- Upper surfaces of young hardened leaves
- Stippling, Firing



Texas citrus mite



Citrus red mite

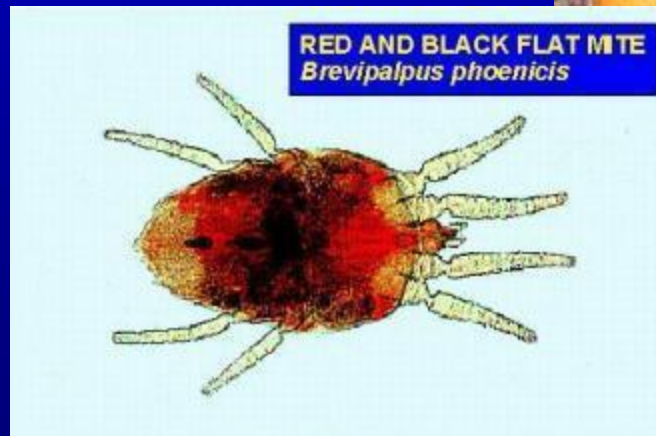
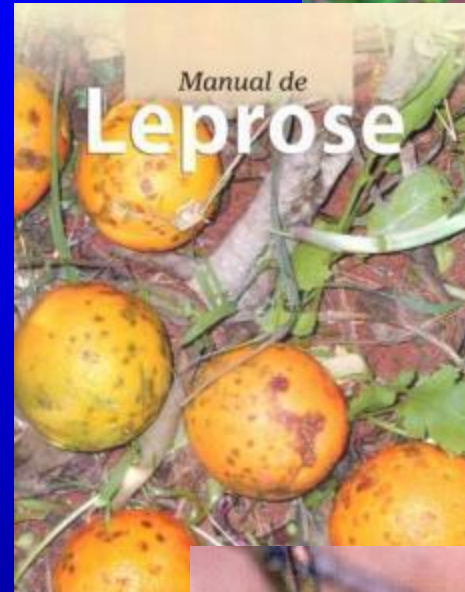
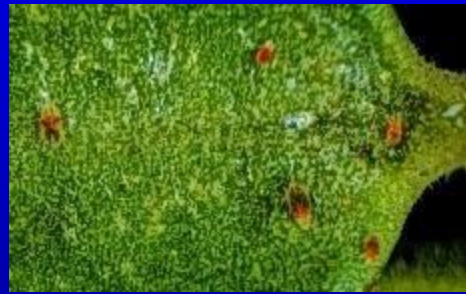
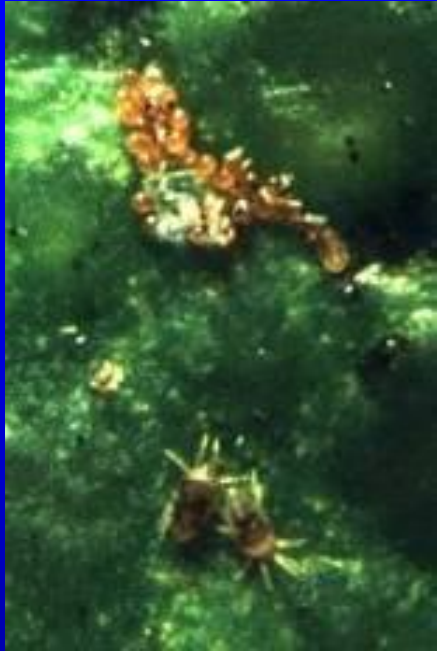


Firing

Scouting for Spider Mites

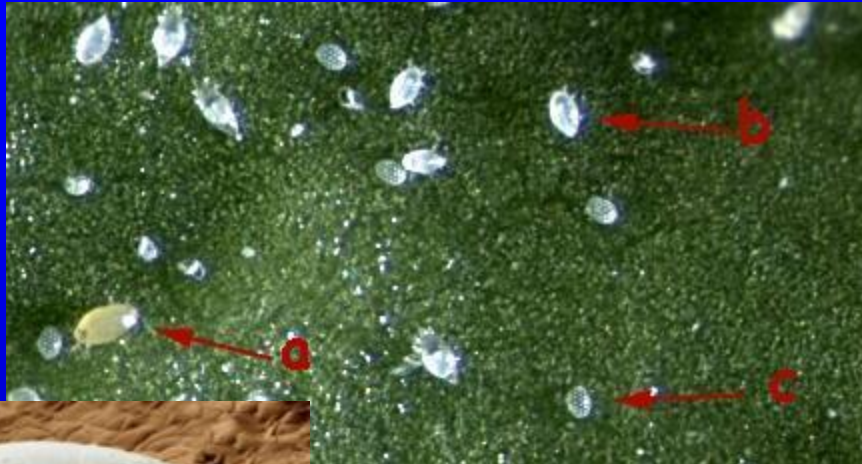
- Follow CRM sample pattern
- 4 leaves per tree
- Threshold 5-10/leaf, depending on :
- Population trends
 - ↓ Predominantly males
 - ↑ Nymphs and females
- Weather
- Tree Condition

False spider mite *Brevipalpus* spp: Vector of Leprosis (not yet in US)

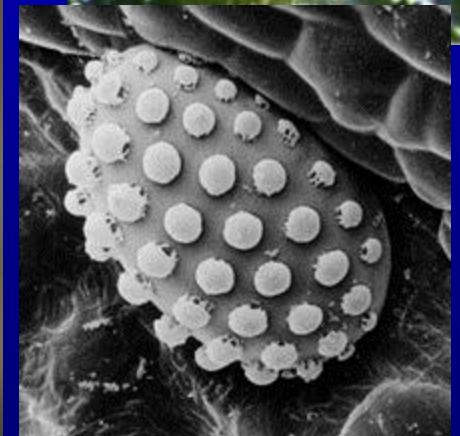


Broad mite

Polyphagotarsonemus latus



Mostly a pest
of lemons
and limes



Other Citrus Pests

- Citrus leafminer
- Thrips
- Fruit flies
- Grasshoppers and the like
- Root weevils

Citrus Leafminer, *Phyllocnistis citrella*

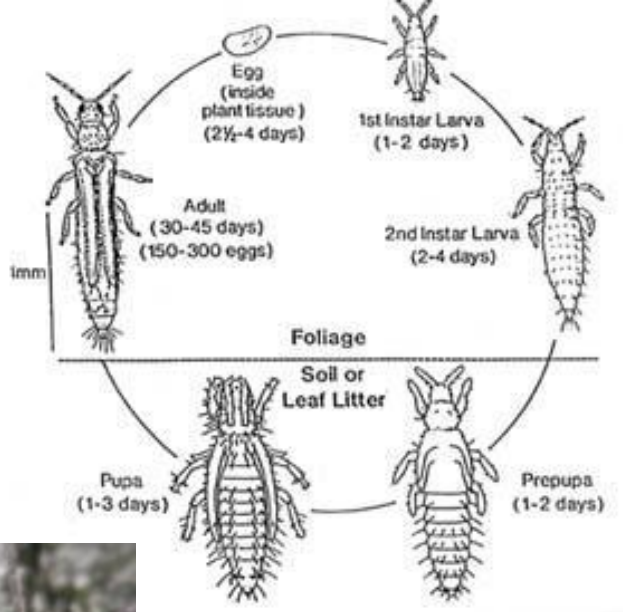


Predators
Ants
Spiders
Lacewings



Indigenous ectoparasitoids

Flower Thrips



Orchid thrips

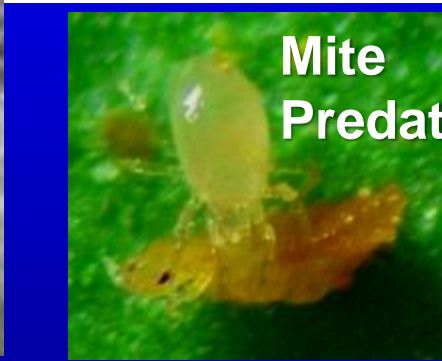


Ring spot



Grapefruit

Mite Predator



Minute pirate bug



Fruit Flies



Caribfly

Anastrepha suspensa

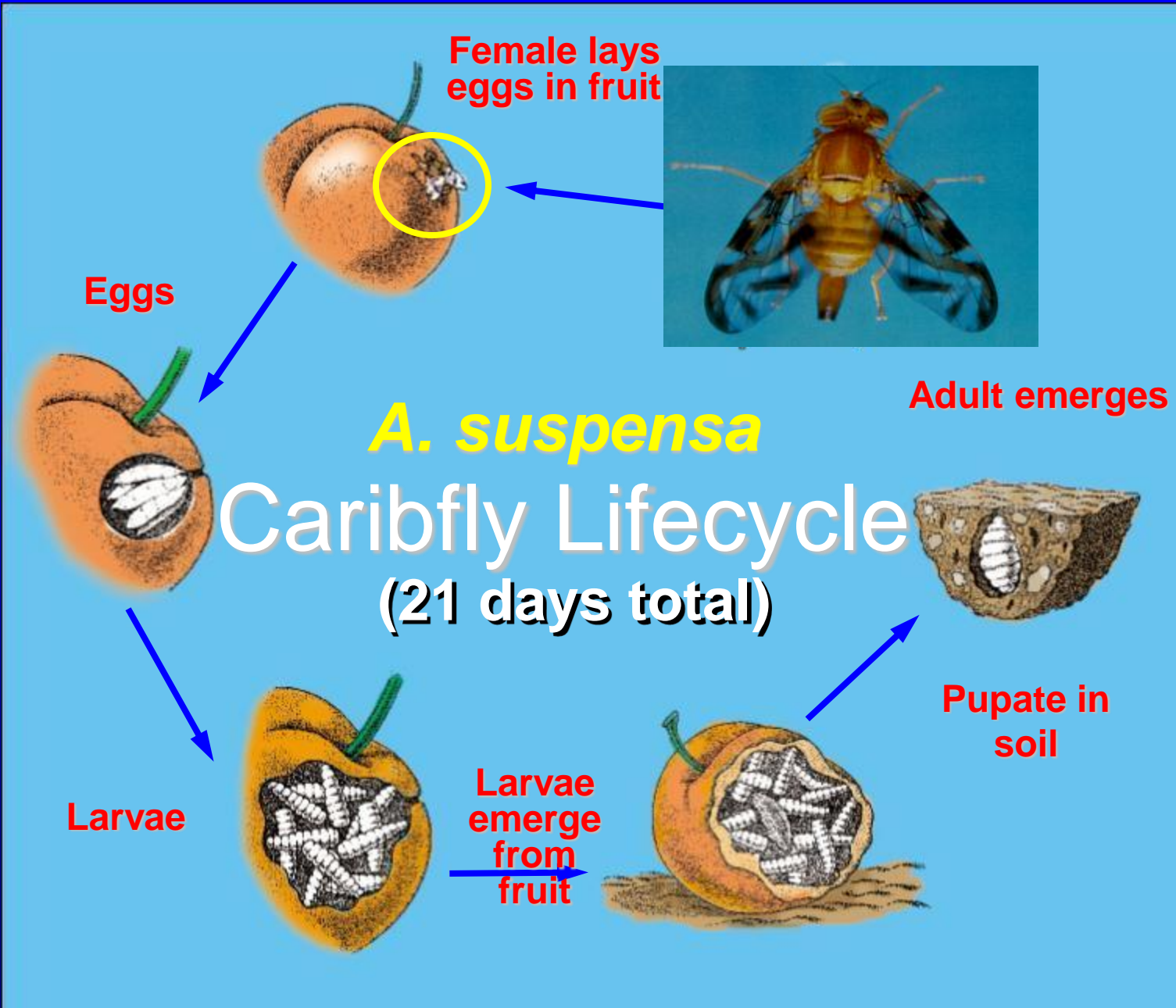
Present in Florida



Medfly

Ceratitis capitata

**Not presently known
to be in Florida**



Medfly *C. capitata*

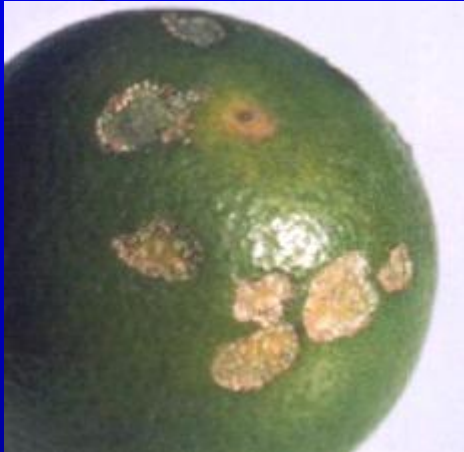


- Many hosts
- Few effective natural enemies
- Control with toxic baits, Mass trapping, sterile male release
- Baits disruptive to biological control



Grasshoppers, Katydid, Crickets

- Build up on weeds.
- Large nymphs most damaging
- Foliar damage irregular (like orange dog)
- Occurrence usually localized in grove



Stink Bugs and Leaffooted Bugs

- Thin skinned varieties most susceptible (Hamlin)
- Perforate fruit, introduce pathogens
- Build up on weeds



Root Weevils:

Diaprepes



Blue-green weevil



Little leaf
notcher



Sri Lanka Weevil

Generalized Lifecycle of Citrus Root Weevils

1. Adults Feeding on Leaves



2. Egg Masses on Leaves



3. Neonate Larvae on Leaves

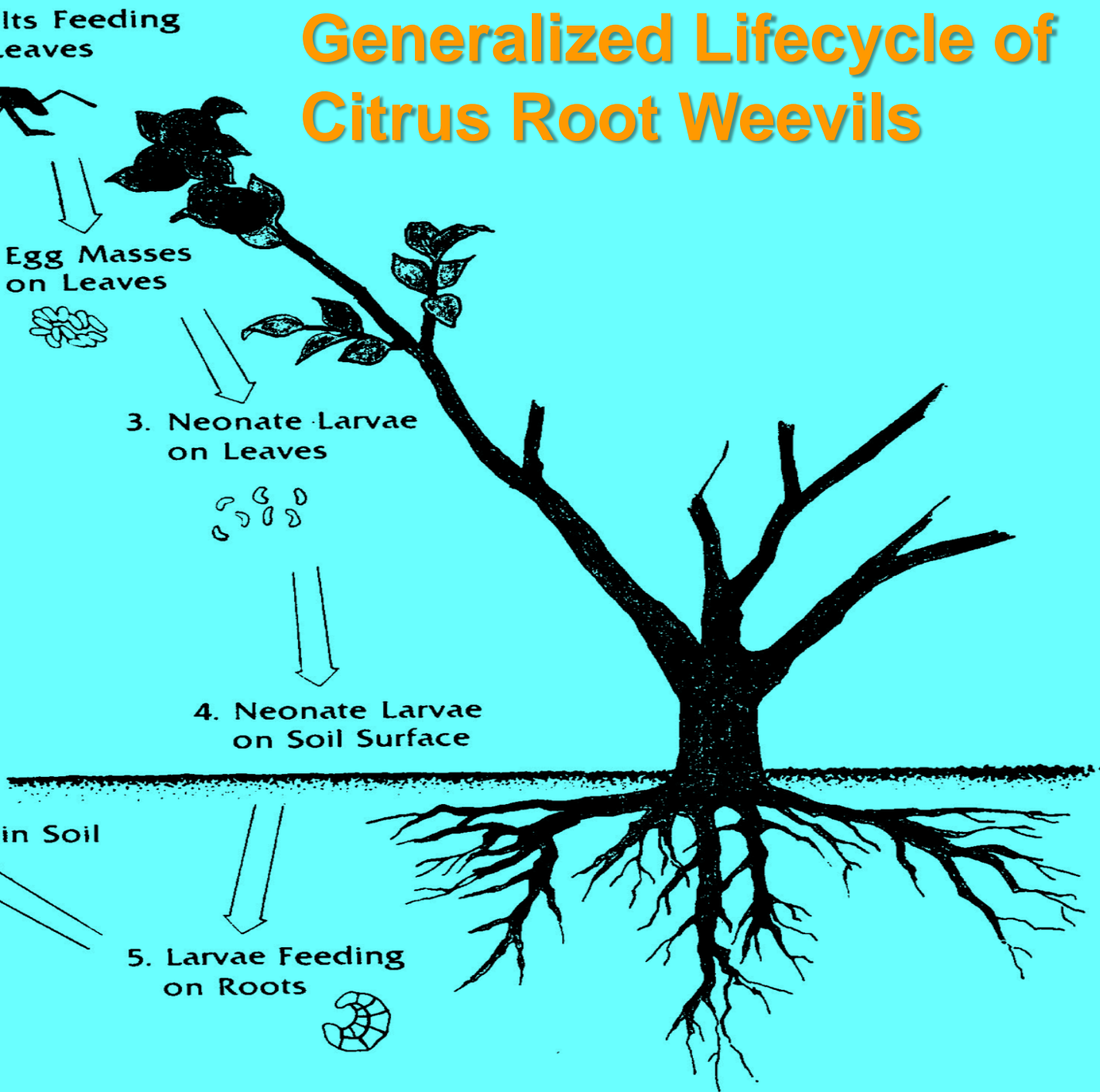
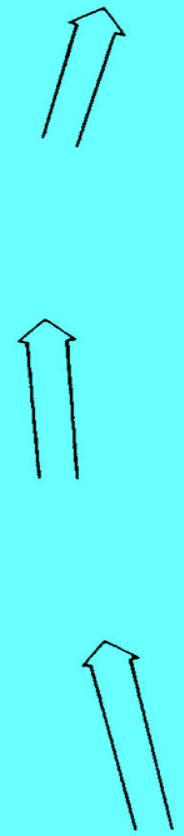


4. Neonate Larvae on Soil Surface

6. Pupae in Soil



5. Larvae Feeding on Roots

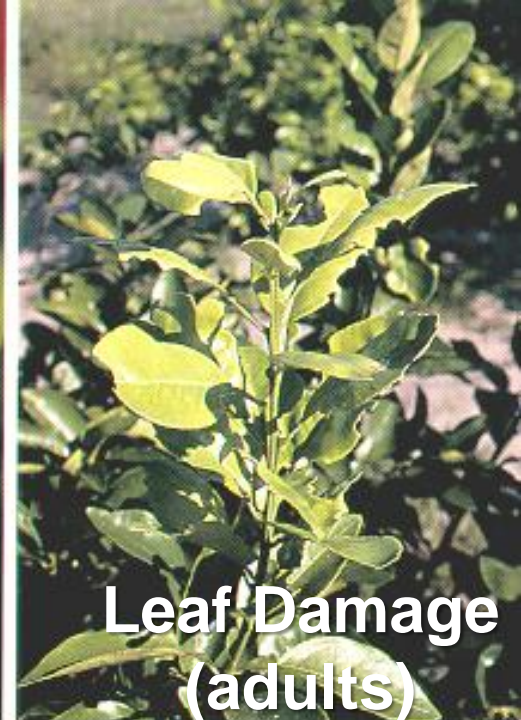


Diaprepes:
Life cycle and
damage to
citrus roots

Adult



Leaf Damage
(adults)



Root damage
(larvae)



Eggs



Larvae

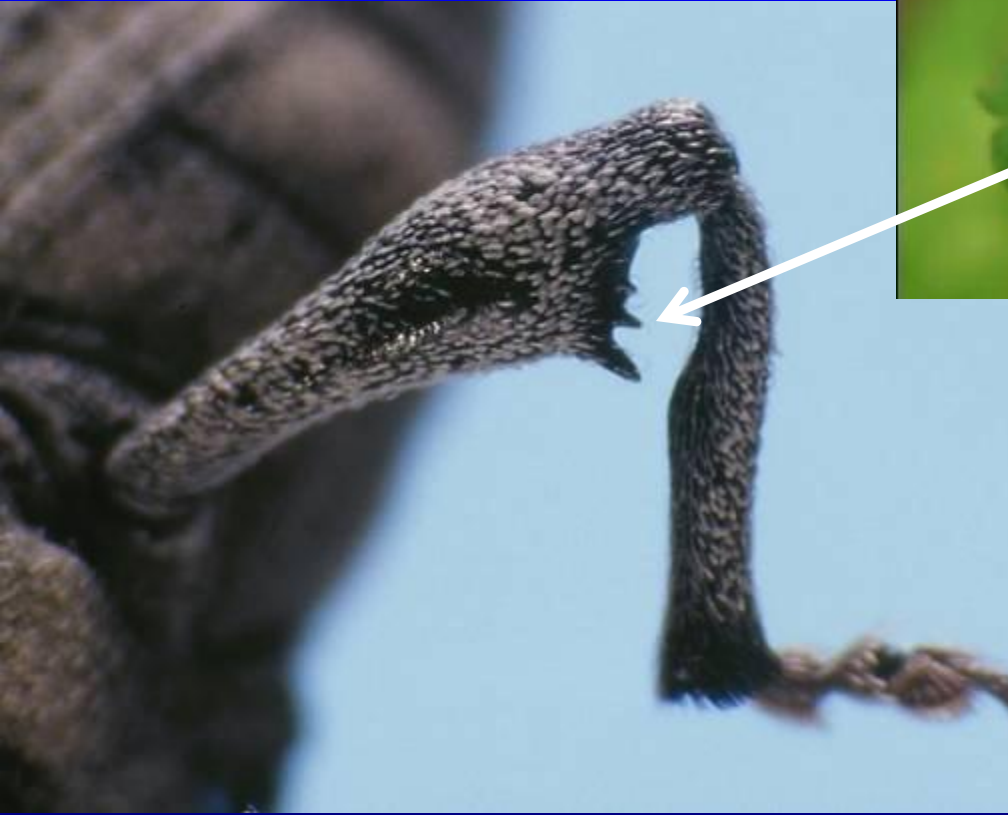


Sri-Lanka Weevil: *Myllocerus undatus*

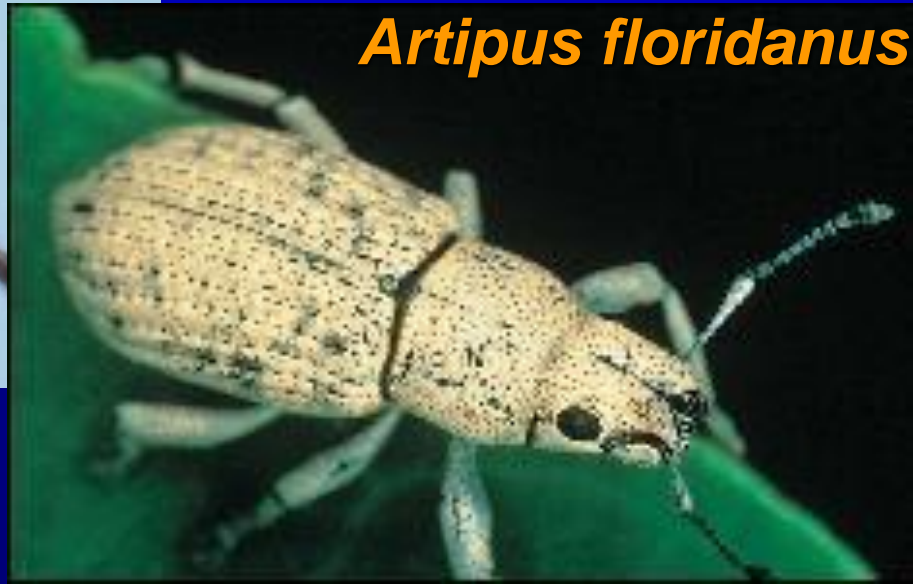


Similar to Little Leaf Notcher (Artipus) but...

Mylocherus undatus



Artipus floridanus





Jawwad Qureshi



José Castillo



César Monzó



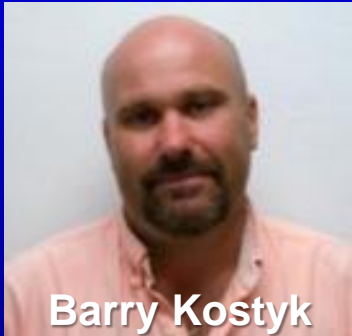
Moneen Jones



H. A. Arevalo

Acknowledgements

- Citrus Research and Development Foundation (\$\$)
- Industry partners (many)
- SWFREC Entomology Team



Barry Kostyk



Benny Peña



Scott Croxton



Monica Triana



Ted Stansly



Zach
Lahey



Cameron Brennan



Mauricio Pinto



Robert Riefer



Joel Mendez

Questions? ¿Preguntas?

