

# Update: Biological Control of Florida's Arthropod Pests and Weeds

**James P. Cuda, Ph.D.**

**Associate Professor  
Entomology & Nematology Dept.  
Gainesville, FL 32611-0620  
[jcuda@ufl.edu](mailto:jcuda@ufl.edu)**



# Contributors

- **Steven Arthurs**
- **Ron Cave**
- **Ted Center**
- **R. Charudattan**
- **Rodrigo Diaz**
- **Howard Frank**
- **Phil Kaufman**
- **Norm Leppla**
- **Bruno Le Ru**
- **Oscar Liburd**
- **Julio Medal**
- **Russ Mizell**
- **Lance Osborne**
- **Bill Overholt**
- **Jorge Pena**
- **Sanford Porter**
- **Jawwad Qureshi**
- **Phil Stansly**

# Outline

- Introduction
- Overview of Current BioControl Projects
  - Arthropods
  - Weeds
- Questions & Comments

# Outline

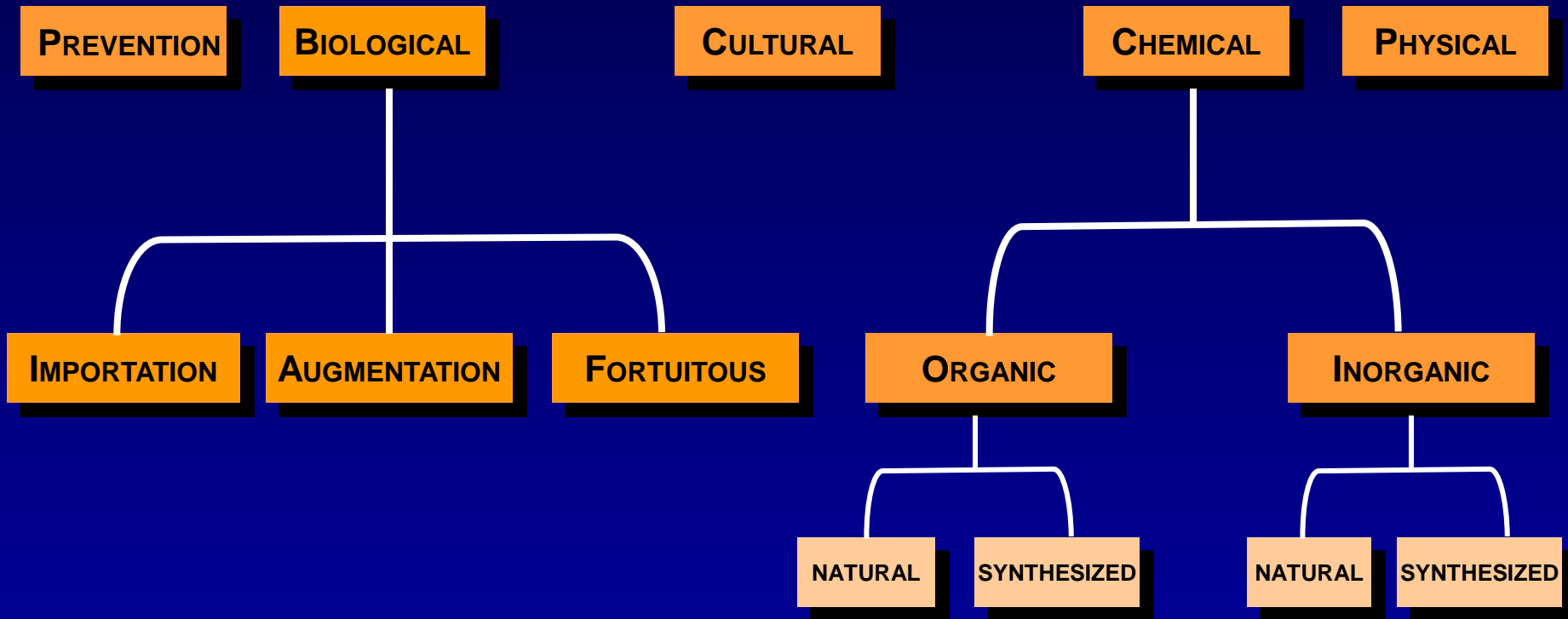
- **Introduction**
- **Overview of Current BioControl Projects**
  - Arthropods
  - Weeds
- **Questions & Comments**

# Integrated Pest Management

- **IPM: Sustainable Approach to Managing Pests by Combining Appropriate *Biological*, Cultural, Physical & Chemical Tools;**
- **Control Methods Selected & Applied in Manner that Minimizes Risks to Human Health, *Beneficial* Non-target Organisms, & Environment**

(USDA ERS Definition)

# TACTICS OF INTEGRATED PEST MANAGEMENT



*Relative Degree of Sustainability*

PERMANENT

TEMPORARY

# Rationale for IPM

- Reduces Pests Problems More Effectively by Saving \$\$ and Protecting the Environment
- Decreases Pesticide Use
- Increases Successful Establishment & Impact of Biological Control Agents

# Biological Control

- **Use of Living Organisms, Such as Insects, Nematodes, Bacteria, or Fungi to Reduce Pest Populations**
- **Three Approaches:**
  - **Augmentation (Arthropods, Pathogens, Grass Carp)**
  - **Fortuitous (Adventive Organisms)**
  - **Importation or Classical (Arthropods, Pathogens)**
- **Classical Approach**
  - **Most Widely Used Method for Weeds**
  - **Highly Regulated**



# Augmentative BioControl

- **Release of Large Numbers of a Biological Control Agent to Achieve a Rapid Effect**
- **There is No Expectation the Biological Control Agent will Establish a Permanent (= Reproducing) Population**

# Fortuitous (Adventive) BioControl

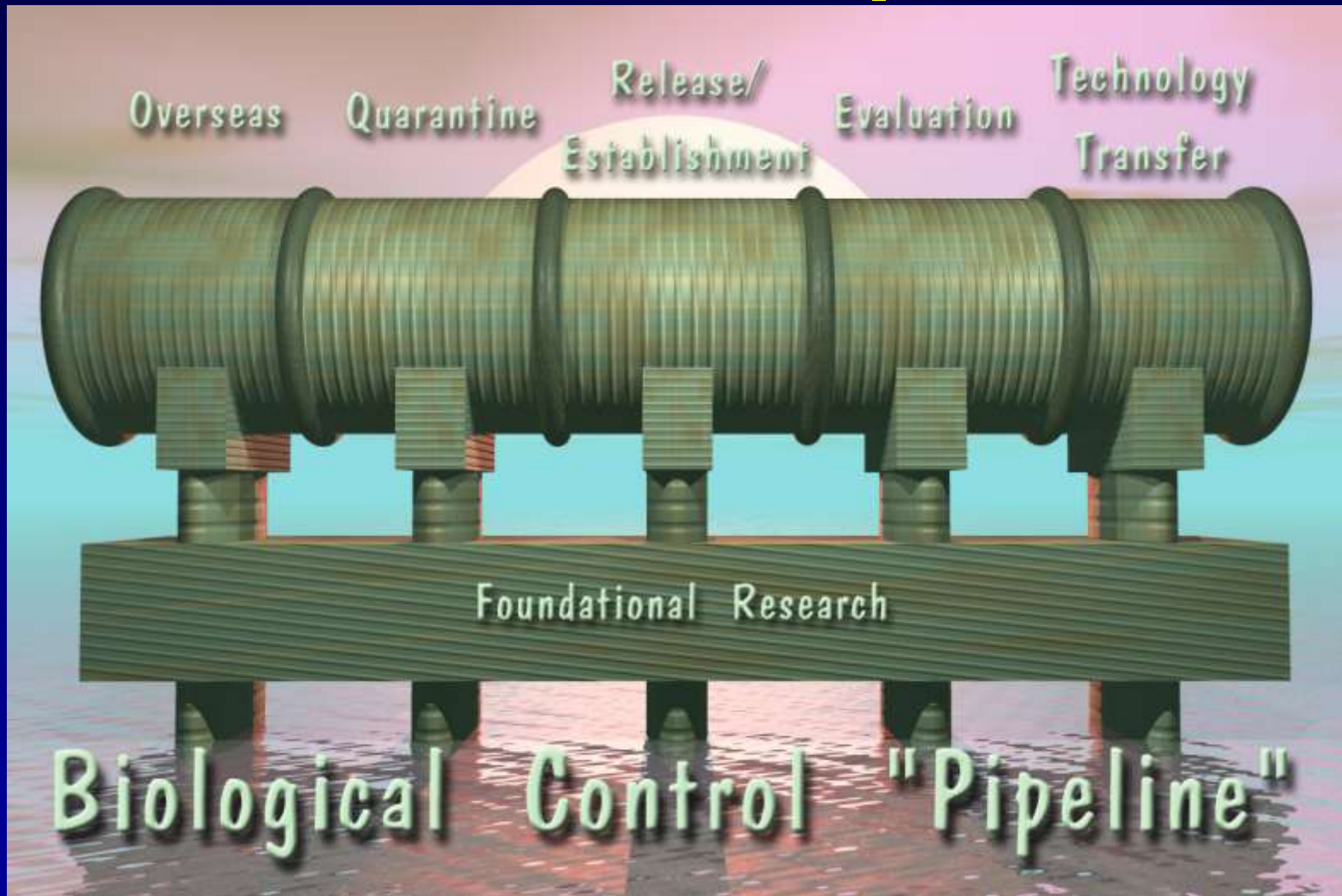
- Regulation of a Pest Population by a Natural Enemy that Has Arrived from Elsewhere *Without* Deliberate Introduction
- No Active Human Involvement

# Importation (Classical) BioControl

- Introduction and Release of *Host Specific* Natural Enemies from the Pest's Native Range to Reduce Its Population Density in the Adventive<sup>1</sup> Range

<sup>1</sup>Arrived into a specified geographical region from elsewhere by ANY means.

# BioControl "Pipeline"



Credit: USA ,COA

# FL Quarantine Facilities

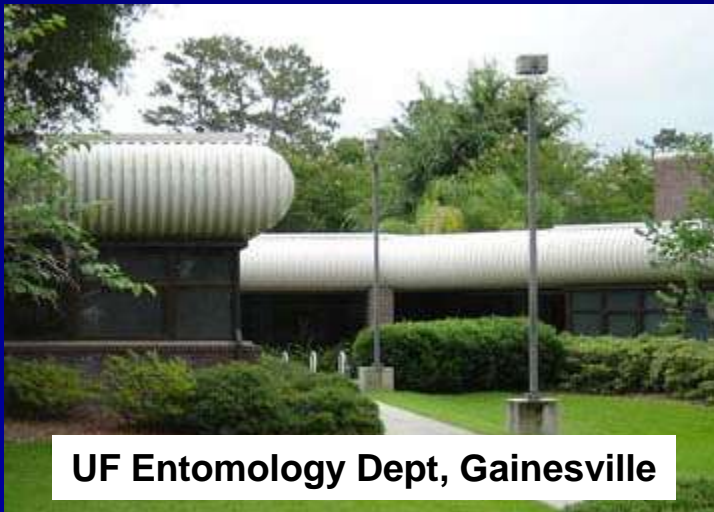
**USDA-ARS Laboratory, Ft. Lauderdale**



**FL BioControl Lab, Gainesville**



**UF Entomology Dept, Gainesville**



**UF/DACS Laboratory, Ft. Pierce**



# Risk Assessment Procedure



United States  
Department of  
Agriculture

Marketing and  
Regulatory  
Programs

Animal and  
Plant Health  
Inspection  
Service

Plant Protection  
and Quarantine

First Edition

**Reviewer's Manual for  
the Technical Advisory  
Group for Biological  
Control Agents of  
Weeds**

**Guidelines for  
Evaluating  
the Safety of Candidate  
Biological Control  
Agents**

# Rationale for Importation BioControl

- Once established, non-native invasive pests often develop high populations in Florida
- Why?
  - Suitable climate & geography
  - Escape from natural enemies that regulate organisms in native range

# Goal of Importation BioControl

- Reunite Natural Enemies with their Hosts (Broad Sense)
- Natural Enemies Introduced to Suppress & Maintain the Density of the Pest at “ACCEPTABLE” Levels
- Important Caveat
  - Biological Control is NOT Eradication
  - Creates Opportunity to Combine w/ Other Tactics



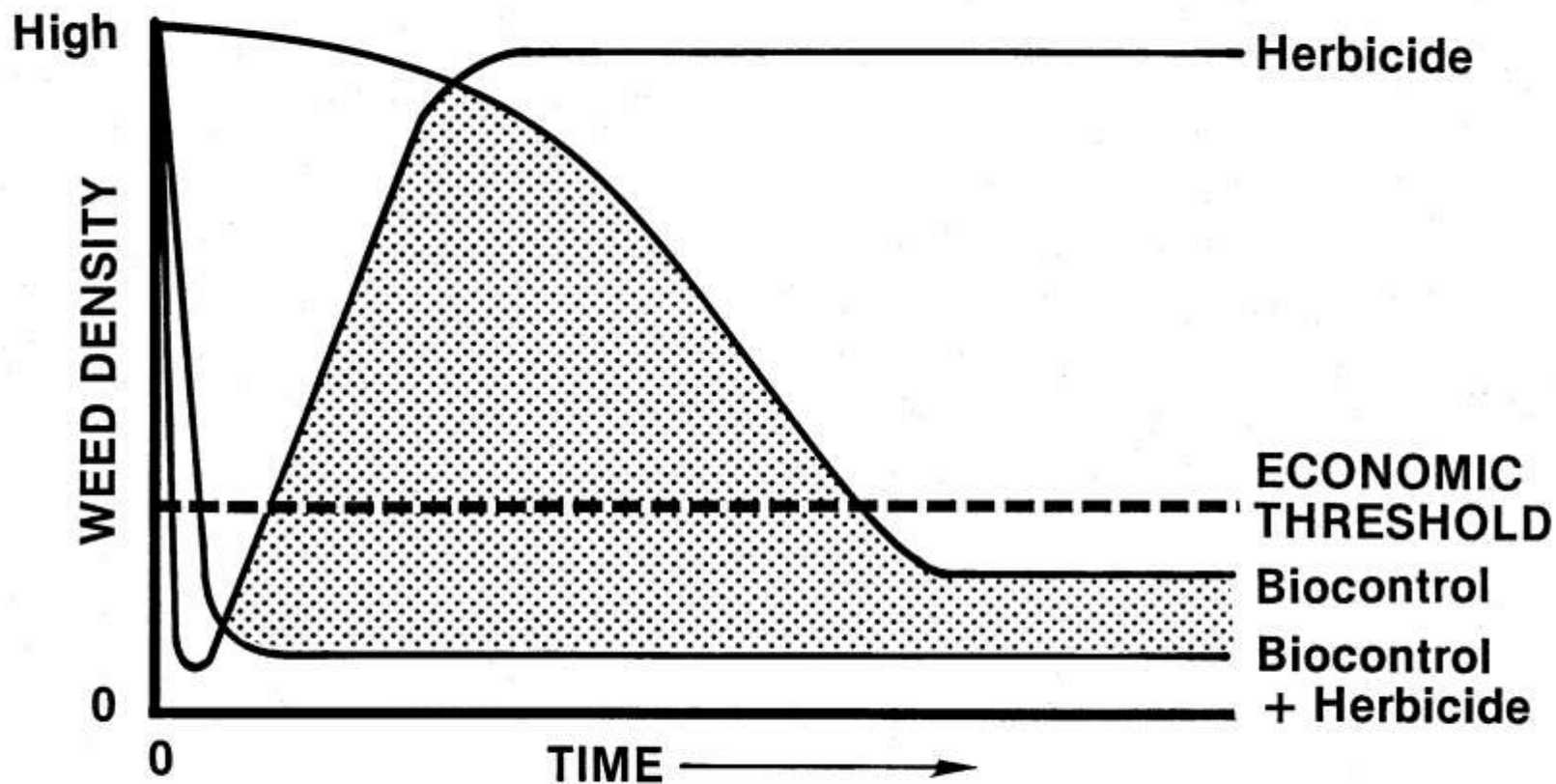
# Defining BioControl Success (in Operational Terms)

- **Complete-** No other control methods are needed
  - **Substantial-** Other methods needed but at reduced level
- \* Goal of IPM**
- **Negligible-** Other methods are required

(Hoffmann 1998)

# Rationale for Integrating BioControl with Pesticides

- **Control is Not Immediate**
- **Unpredictable**
  - **Some Natural Enemies Fail to Establish**
  - **Some Natural Enemies are Ineffective**
    - **Abiotic and Biotic Interference**



Messersmith and Adkins. 1995. Weed Technol. 9:199-208.

# Integrating BioControl Agents with Pesticides

- **Must Be Sure That Pesticide (or Biopesticide) Does Not Negatively Impact BioControl Agent**
  - **Directly- Causes Mortality**
  - **Indirectly- Herbicide Reduces Plant Density (= Food Source) Below Critical Level**
- **Must Time Applications to Maximize BioControl Agent Impact**

# Outline

- **Introduction**
- **Overview of Current BioControl Projects**
  - Arthropods
  - Weeds
- **Questions & Comments**

# Outline

- Introduction
- Overview of Current BioControl Projects
  - Arthropods
  - Weeds
- Questions & Comments

# Thrips

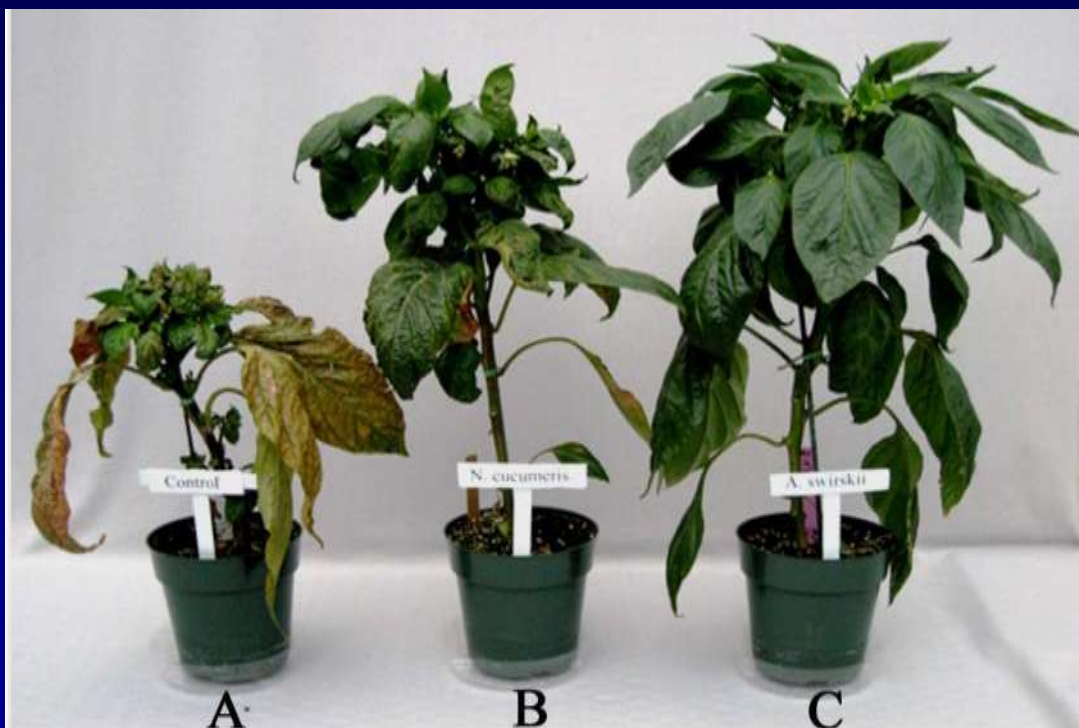
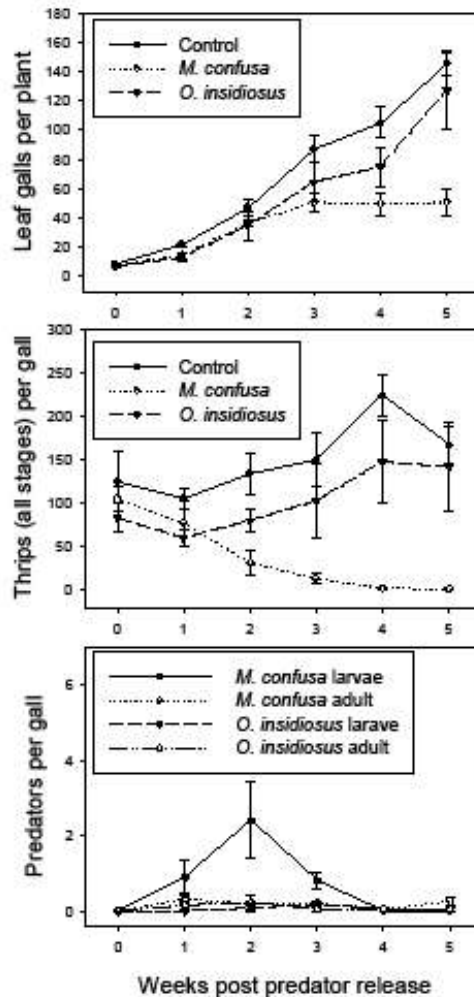


Fig. 4. Greenhouse grown sweet pepper 35 days after infestation with *S. dorsalis* (30 adults per plant) and 28 days after release of predatory mites (30 adults per plant). Plants without predatory mite protection (A), with *N. cucumeris* (B), and *A. swirskii* (C).



'swirskii mite' feeding on thrips



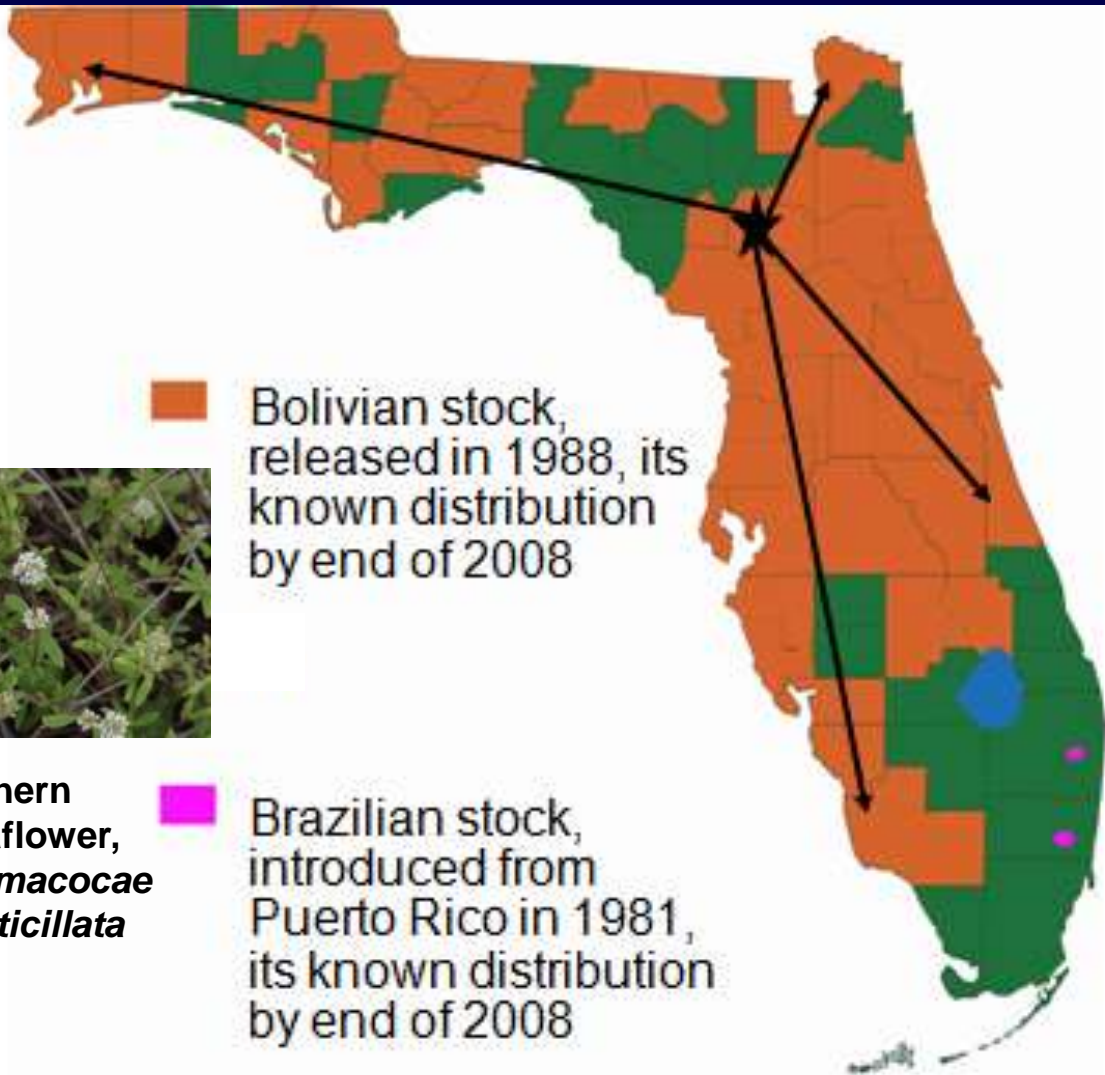
- Weeping fig thrips, *Gynaikothrips uzeli*, severely damages *Ficus benjamina* plants through leaf galling
- A newly described predatory anthocorid bug, *Montandoniola confusa*, effectively controls *G. uzeli* within 5 weeks



# Mole Crickets



- Braconid wasp *Larra bicolor* attacking a mole cricket
- Larvae are ectoparasitoids
- Biotype from Bolivia better adapted to Florida's environment than Brazilian biotype



**Southern Larraflower, *Spermacocae verticillata***

**FLORIDA RANCHERS**

Don't let MOLE CRICKETS destroy your pastures. Your county livestock Extension agent is ready to help you fight mole crickets using beneficial wasps and nematodes. Ranchers may rent nematode application machinery and get free advice.

**CONTACT YOUR LOCAL LIVESTOCK EXTENSION AGENT**  
[www.FLORIDALIVESTOCKAGENTS.com](http://www.FLORIDALIVESTOCKAGENTS.com)

UF UNIVERSITY OF FLORIDA IFAS Extension | IPM Florida

# Cycad Aulacaspis Scale



- Scale is killing ornamental cycads throughout Florida & other parts of the US
- A predatory lady beetle, *Phaenochilus* n. sp., from Thailand is being studied as a candidate biocontrol agent

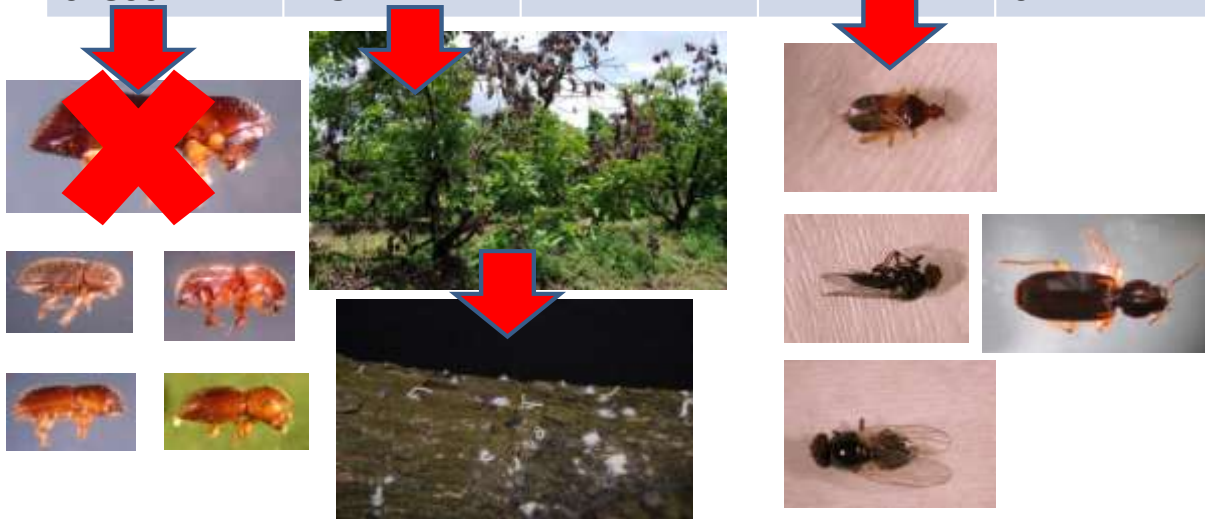
# Red Palm Mite



- Predatory mite *Amblyseius largoensis* completes life cycle & reproduces when feeding exclusively on red palm mite
- Development time is shorter and survival/reproduction higher compared to other prey items

# Red Bay Ambrosia Beetle

Proportion Ambrosia Beetle: Other Beetles/log	Laurel Wilt?		Number of Predaceous Families	Number of Parasitoids
0: 800	NO		4	0



- Domestic surveys for natural enemies of scolytid beetles in Miami-Dade Co. for use against Ambrosia beetle, a pest of avocado

# Diaprepes Root Weevil



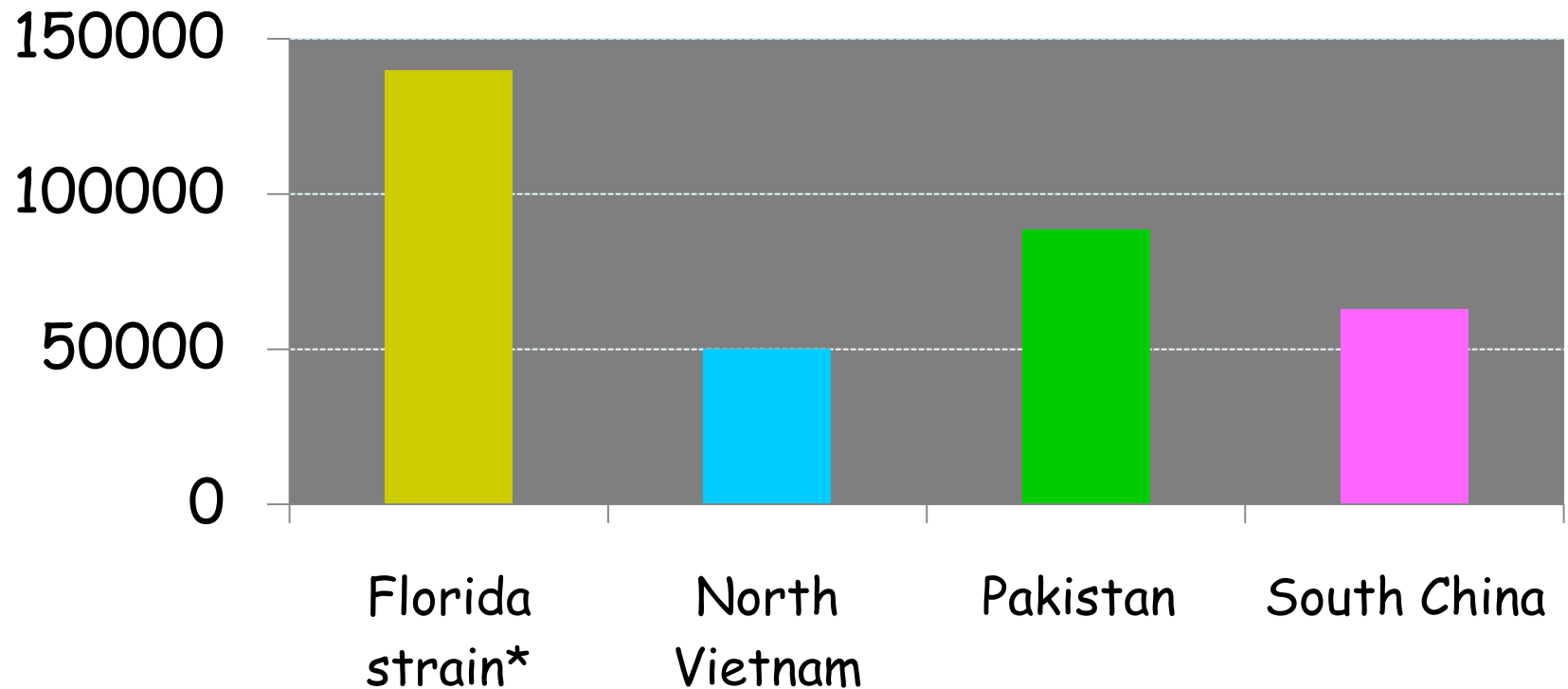
- Female DRWs deposit 5-10K eggs !!
- Suite of 5 egg parasitoids released since 1997
- Two additional species released in 2006
  - *Fidiobia dominica* n.sp. (Platygastridae)
  - *Haeckeliana sperata* n.sp. (Trichogrammatidae)

# Asian Citrus Psyllid



- Conservation & augmentation biological control of invasive psyllid pest, a vector of citrus greening disease, or Huanglongbing

# *T. radiata* released in Florida, 2009-2011

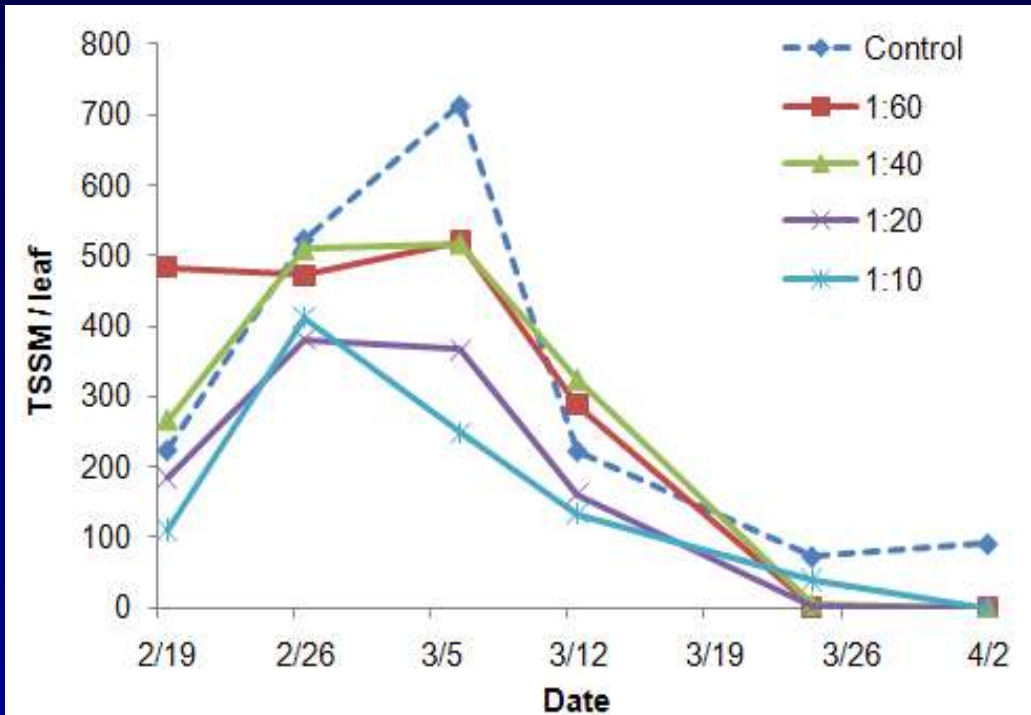


- Importation & release of new strains of *Tamarixia radiata* parasitoid from Pakistan, South China, and North Vietnam and their genetic characterization

\*Originally introduced from Taiwan and South Vietnam



# Spider Mites



- Control of Two Spotted Spider mite (TSSM) in strawberry production with the predatory mite *Neoseuilus californicus*
- Predators at all ratios reduced TSSM numbers to zero by the end of the experiment

# Blueberry Gall Midge



Family	# specimens	% of total
Aphelinidae	106	4.4
Bethylidae	89	3.7
Braconidae	54	2.2
Ceraphronidae	311	12.9
Encyrtidae	262	10.9
Eulophidae *	202	8.4
Eupelmidae	129	5.4
Ichneumonidae	27	1.1
Mymaridae	96	4.0
Ormyridae	71	2.9
<b>Platygastridae *</b>	<b>641</b>	<b>26.6</b>
Pteromalidae	154	6.4
Scelionidae	219	9.1
Trichogrammatidae	30	1.2

- Survey of parasitic wasps naturally occurring at blueberry farms
- Families Platygastridae and Eulophidae include confirmed parasitoids of blueberry gall midge

# Stink & Leaf-footed Bugs

*Euschistus servus*

*Nezara viridula*

*Acrosternum hilare*

*Leptoglossus phyllopus*



# Trap Crops for Bugs



- Four species of bugs are considered crop pests in Southeast.
- Manipulating habitats to serve as 'trap crops' for augmenting beneficials (=predators & parasitoids), pollinators, and wildlife

# Horn Fly



- Horn flies are resistant to most insecticides
- Biological control is lacking for this pasture pest
- Culture and evaluate 10 new strains of *Beauveria bassiana* from wild FL horn fly populations
- Project will aid in development of a new management tactic

# Stable and House Flies



- Pteromalid parasitoids purchased & released by farmers & ranchers
- Predominant genus: *Spalangia* (>99%), two dominant species
- Seasonality & searching efficiency of parasitoids examined
- Given field recovery & dominance, *Spalangia* spp. are best choice for release on farms

# Brown Dog Tick



- Tick establishes populations inside residential homes
- Resistant to common pesticides
- Project examining use of tick-killing fungal pathogens
  - *Beauveria bassiana* and *Metarhizium anisopliae*
  - Develop attract-and-kill devices for homeowners

# Fire Ants



- Fire ants have significant impacts on agriculture, human health, urban & natural areas
- Four parasitic decapitating flies, *Pseudacteon* spp., from South America have been released for fire ant control
- Two additional species currently being tested

USDA-ARS CMAVE  
Gainesville, FL



# Mexican Bromeliad Weevil



- Weevil is killing 12 of Florida's native bromeliads, many of which are threatened and endangered
- Parasitic fly, *Lixadmontia franki*, from Honduras is being released to bring the pest weevil under biocontrol

# Outline

- **Introduction**
- **Overview of Current BioControl Projects**
  - Arthropods
  - Weeds
- **Questions & Comments**

# Hydrilla



- Introduced from Asia as aquarium plant in 1950s, considered worst aquatic weed in Florida
- Resistant to some aquatic herbicides; developing novel bio-based approaches for controlling hydrilla

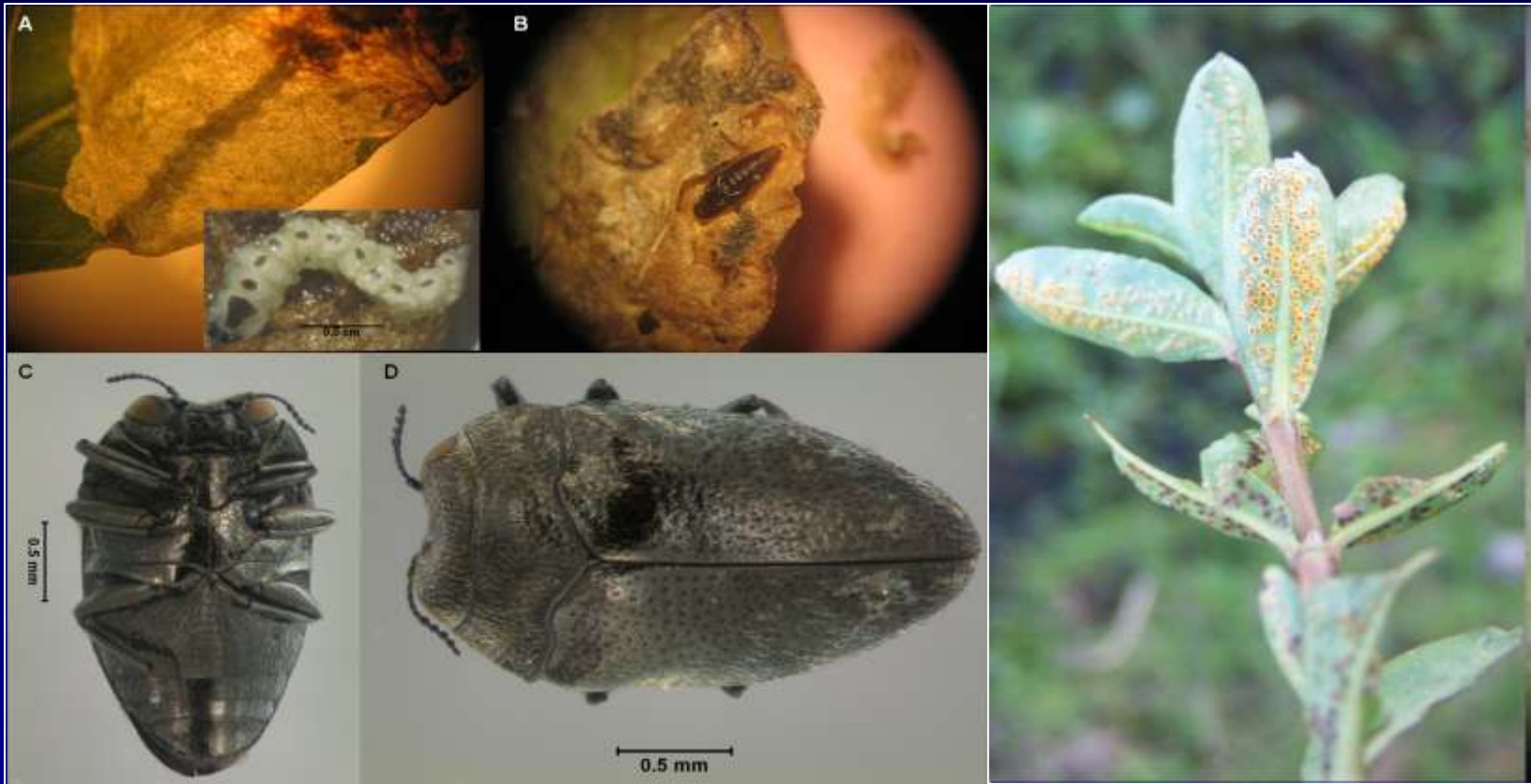


- Adventive hydrilla shoot tip miner *Cricotopus lebetis* naturalized in Florida & Louisiana
- Larvae feed on living plant tissue, a rare occurrence for Chironomids
- Change hydrilla's architecture by preventing it from "topping out?"

# Hygrophila



- Fast growing shoreline & submersed from India, Bangladesh & southern China
- Like hydrilla, this federal listed noxious weed introduced via aquarium trade
- Interferes with navigation, flood control, & displaces native spp.



- Surveys for natural enemies in native range conducted in 2007-2008
- Discovered 3 promising insects, including the leaf mining buprestid beetle, *Trachys* sp.
- *Puccinia* rust fungus also found attacking *hygrophila*

# Wetland Nightshade



- Native to Mexico, Central America, Caribbean, this solanaceous weed invading Florida's riparian habitats
- ~ 6 natural enemies discovered in Costa Rica, Guatemala, & Mexico
- Flower bud weevil *Anthonomus elutus* promising candidate



**Tortoise Beetle**



**Stem Borer**



**WLNS-Weevil *A. elutus***



**Buprestid Beetle**



**WLNS-Mite**



**WLNS-Guatemala Weevil**



# Brazilian Peppertree



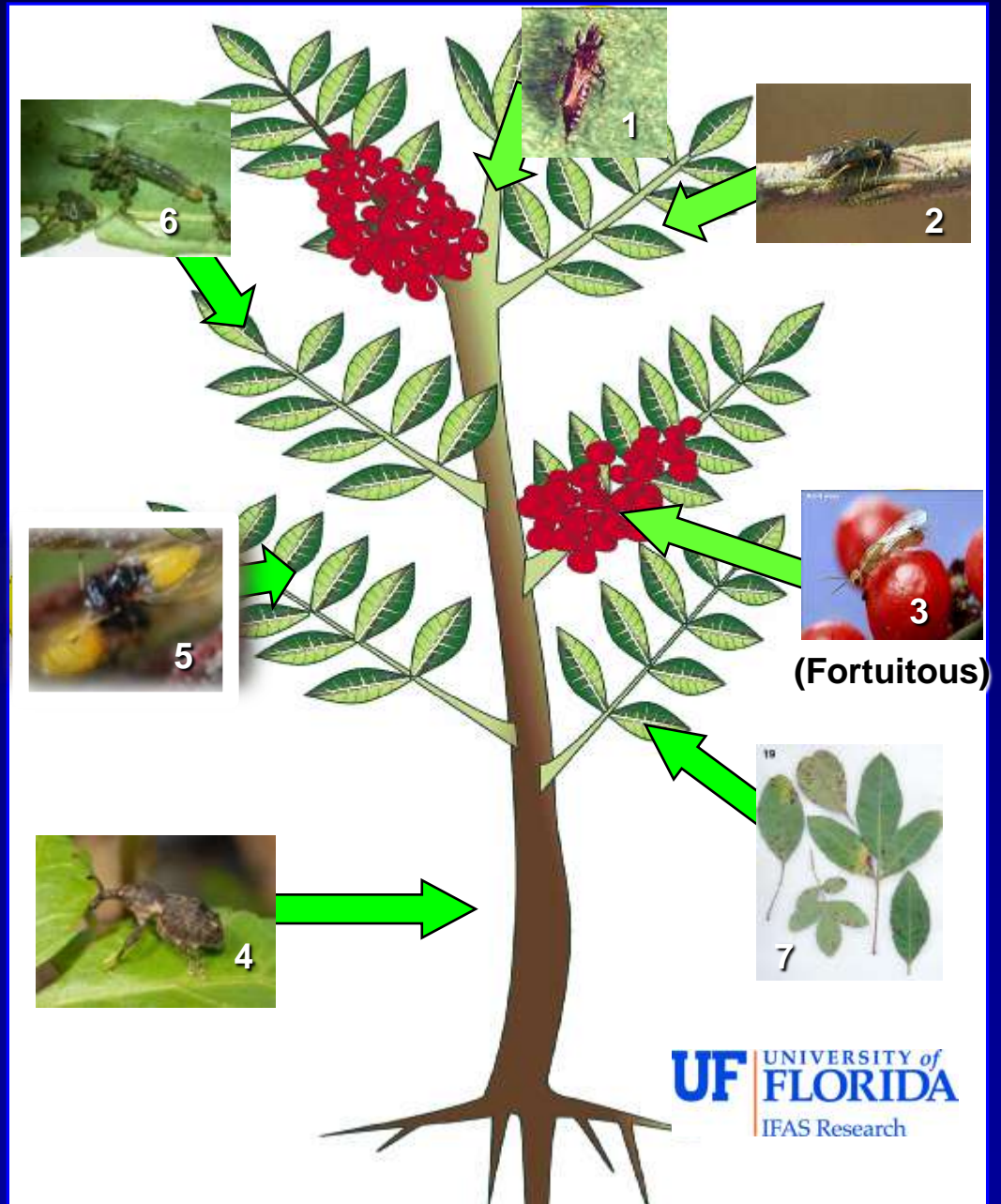
Bryan Harry NPS

Don Schmitz FWC

- Introduced to FL from South America as ornamental in 19<sup>th</sup> & 20<sup>th</sup> centuries; two distinct haplotypes resulted in novel hybrids
- Dominates entire ecosystems in peninsular FL & threatens Everglades restoration efforts; hybrid vigor exacerbating problem
- 6 natural enemies tested as candidate biocontrol agents
- Seed wasp *Megastigmus transvaalensis* adventive from South Africa

# BP Natural Enemies

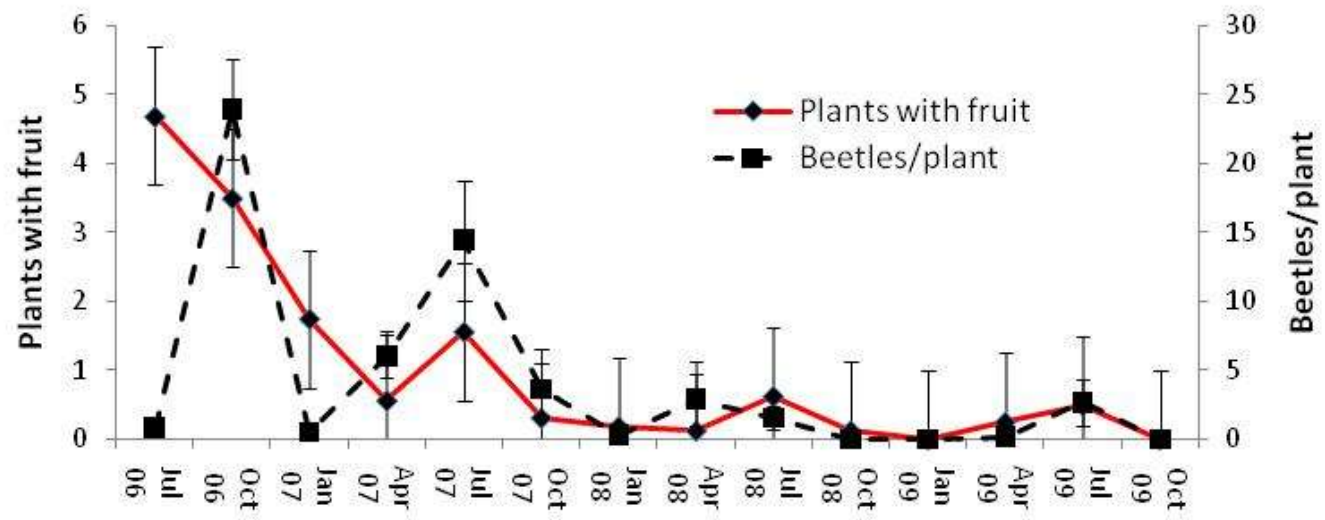
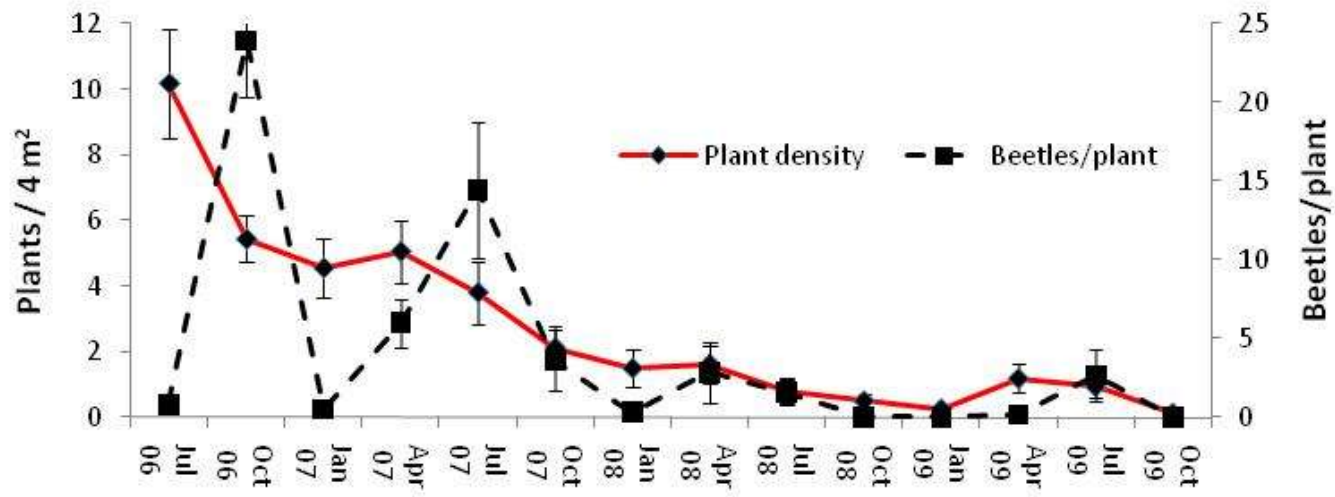
1. Thrips
  - Damages Shoots
2. Sawfly
  - Defoliator
3. Seed Wasp
  - Attacks Fruits
4. Weevil
  - Stem Feeder
5. Psyllid
  - Galls Leaves
6. Leafroller
  - Defoliator
7. Fungus
  - Leaf Spot



# Tropical Soda Apple



- Introduced to FL from South America in 1988; > 400K ha infested
- Discovered chrysomelid beetle *Gratiana boliviana* from Paraguay that feeds & reproduces only on TSA
- Released in Florida 2003- 2009; beetle significantly impacts density & fruit production of TSA where it has established



# SolviNix<sup>TM</sup> Bioherbicide



- TMGMV, naturally occurring plant virus, has been developed commercially as a bioherbicide
- Effective at concentrations as low as 200 mg / acre
- TSA plants of all ages highly susceptible & die within 3 weeks post-treatment
- Two formulations: liquid concentrate & wettable powder

Lygodium



25 Sept 2008

Waterhyacinth



June 2010



Melaleuca

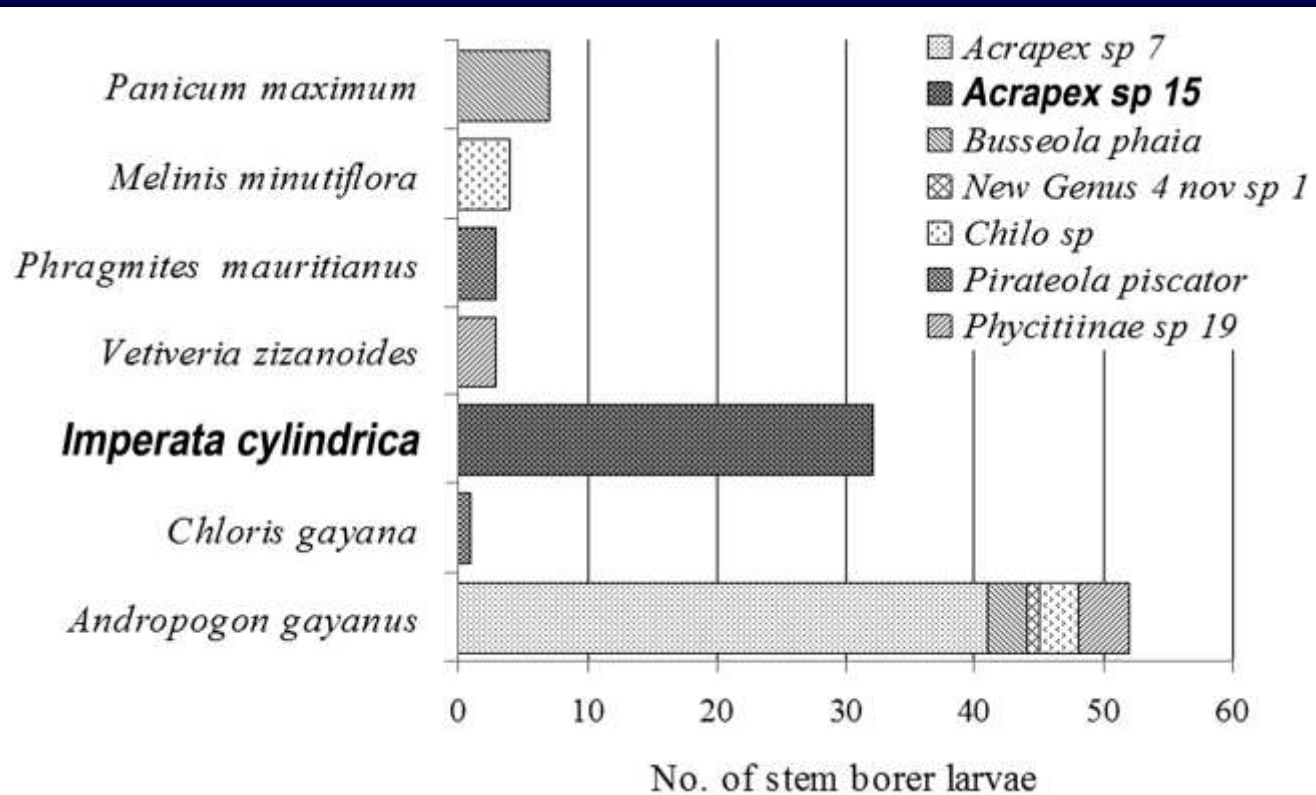
May 2008

USDA-ARS Invasive Plant Research Laboratory Fort Lauderdale, FL

# Cogongrass



- Federal listed noxious weed introduced into southeast US from Japan (Alabama) & Philippines (Mississippi) as livestock forage in early 20<sup>th</sup> century
- In 2009, Alabama dedicated \$6.3 million of federal stimulus funds exclusively for chemical control
- Targeted for biological control in 2011 pending USDA funding





# Summary

- **Florida's Agriculture, Landscape, Turf & Natural Resources Benefitting From UF & USDA Biological Control Programs**
- **Biggest challenges:**
  - **Securing Dedicated Funding for Overseas Exploration**
  - **Rio Convention on Biodiversity (1992)**
    - **Complicating Collection & Export of Natural Enemies From Many Signatory Countries**

# Outline

- **Introduction**
- **Overview of Current BioControl Projects**
  - **Arthropods**
  - **Weeds**
- **Questions & Comments**