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Integrating Biocontrol Agents into Hydrilla Management Plans in Florida

Presented at Southwest Florida CISMA Invasive Species Workshop, Jan 23rd, 2014

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HYDRILLA IPM PROJECT

Acknowledgements

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Outline

- Introducing hydrilla (distribution, problems)
- Options for hydrilla biocontrol
- Current status of research
- Why is IPM important?
- Summary

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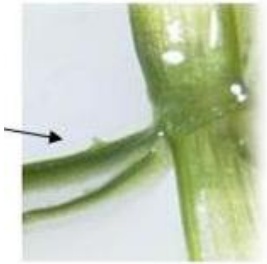
Introducing Hydrilla

- Submersed, rooted aquatic plant, propagates by tubers, turions, <u>fragments!</u>
- Monoecious and dioecious forms
- Stems – long and slender with some branching

- Leaves – small (max. 4/5 inch long, 1/6 inch wide), lanceolate, in whorls of 3-8
- Midrib – bears small spines



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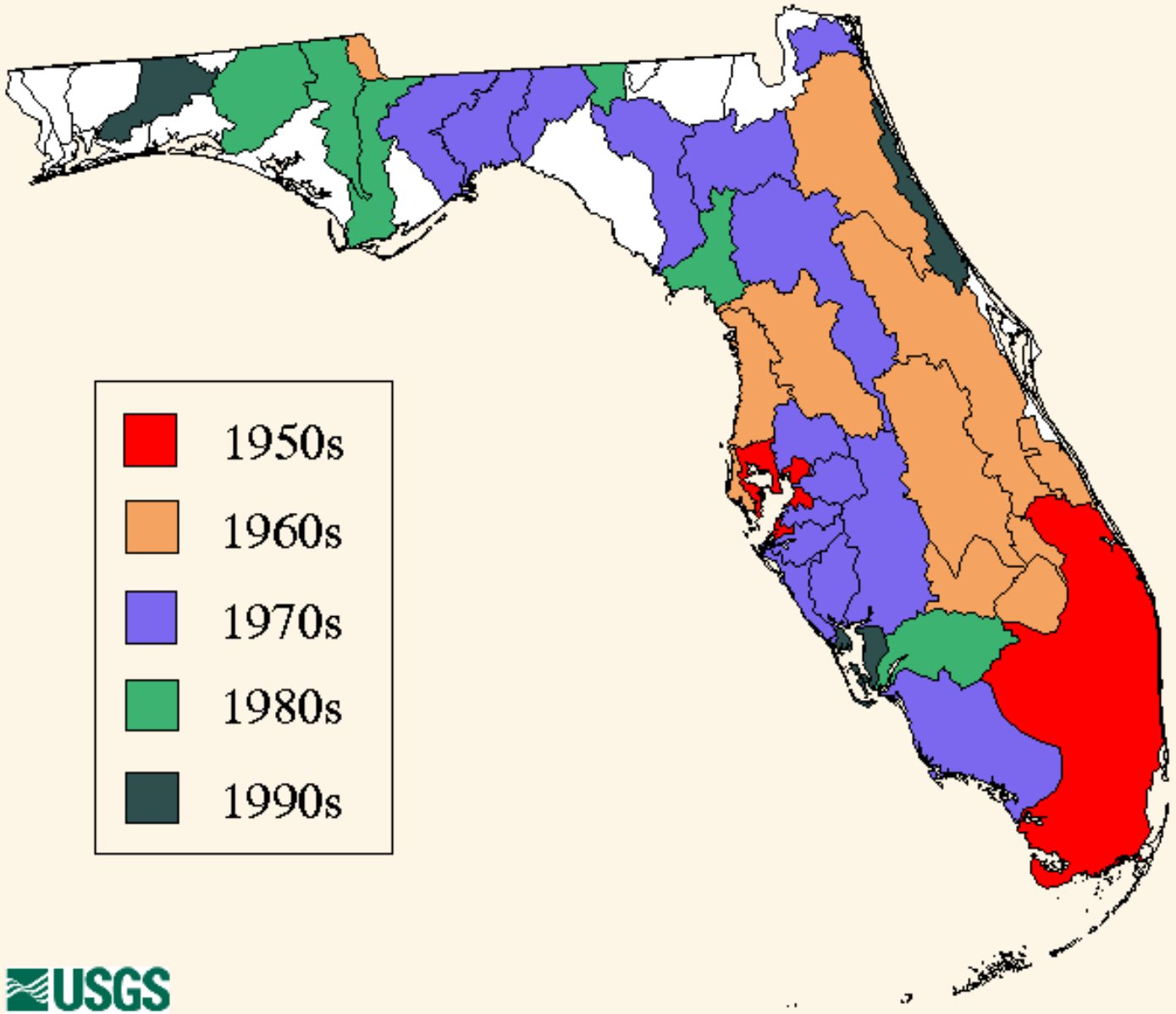
Spread of Hydrilla Through Florida Watersheds



USGS
science for a changing world

Why is hydrilla such a problem?

- Non-native plant, introduced without its natural enemies, outcompetes native vegetation → invasive
- Fast vegetative growth, forming dense vegetation mats
- Resistance development to certain herbicides
- Infestations in Florida far beyond possible eradication → innovative maintenance control methods needed

Withlacoochee River, FL, 1997

Lake Tohopekaliga, FL, 2008

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What are the options for management?

- Physical control (drawdowns, limited use)
- Mechanical removal (harvesting)
- Chemical control (herbicides)
- Biological control (herbivores, pathogens)
- **Integrated pest management (IPM)**

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Biological Control

- **Classical Biological Control**
  - Searching for host-specific natural enemies in the native range of the weed species
  - Long process of testing in quarantine and approval
  - Releasing the natural enemies in the invasive range of the weed
- **Augmentative Biological Control**
  - Mass rearing and releasing endemic natural enemies to supplement natural populations
  - Natural enemies can be native or naturalized

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Classical Biological Control of Hydrilla

- Researched since the 1970s
- Foreign exploration in Asia, Africa, and Australia
- Four insect species approved for release – only one established populations with significant impact
- Sterilized Asian grass carp – successful in closed systems (first release in FL in 1972)

Hydrellia pakistanae

Hydrellia balciunasi

Bagous hydrillae

Bagous affinis

Asian grass carp

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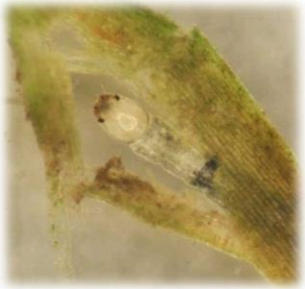
Augmentative Biological Control of Hydrilla

- Two insect species (native ranges unknown)
  - *Cricotopus lebetis*, the hydrilla tip miner
    1976: First record in Florida (SW, specific location unknown)
    1992: Detected in Crystal River, Florida
  - *Parapoynx diminutalis*, a moth
    1976: First record in Florida
- A fungal pathogen, *Mycoleptodiscus terrestris* (Mt), discovered in the 1970s and isolated from several hydrilla populations in the U.S.



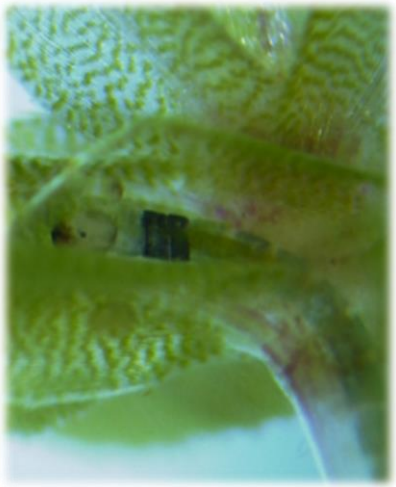
Cricotopus lebetis

Parapoynx diminutalis

Mycoleptodiscus terrestris

Hydrilla Tip Miner

- Tip-mining midge
  - Larvae feed on living plant tissue
  - Rare occurrence
- Prevents “topping out”
- Naturalized in Florida
  - No swarms
  - Low dispersal distance
  - Easily mass reared



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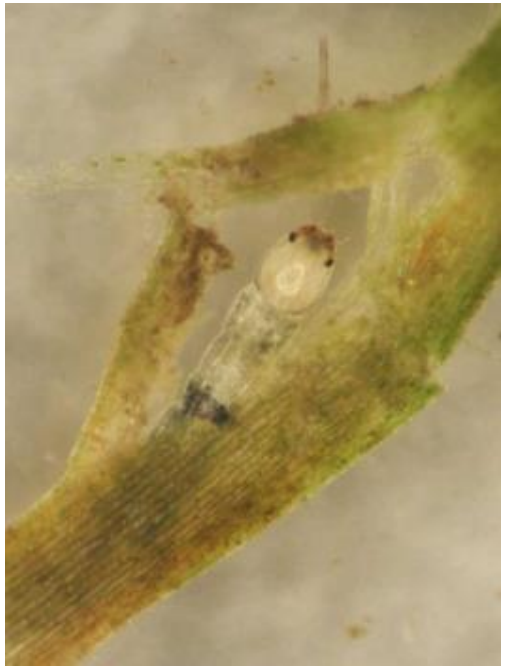
Tip Miner Larva and Associated Tip Damage



Credit: D. Denson, RCID

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Cuda et al. (2011)

Tip Miner "at Work"

Block 1: Control

Block 2: Tip miner

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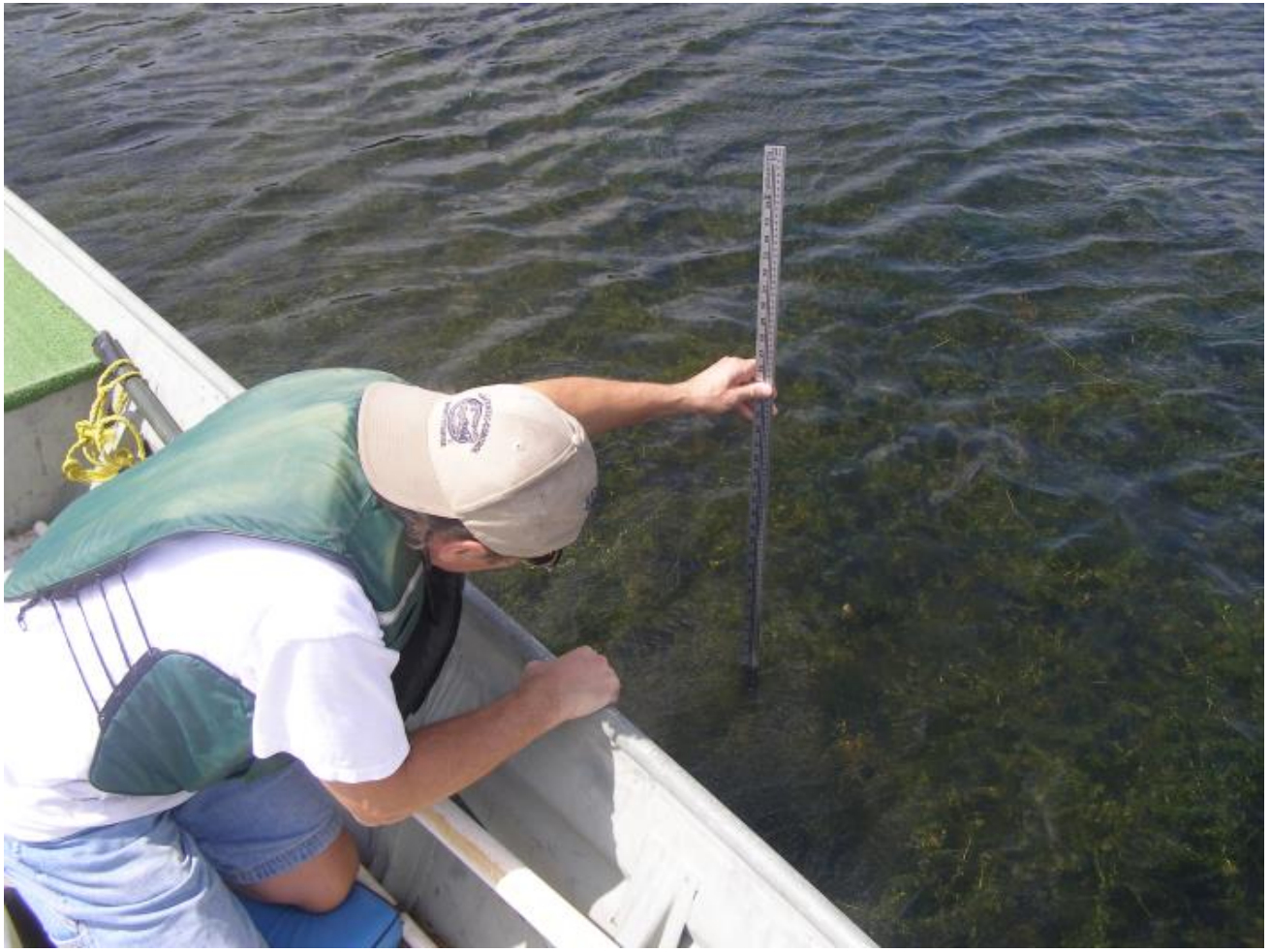
Lake Rowell, Bradford Co., FL

September 2010



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Combining Control Agents/Tactics

<u>Compatibility tests:</u>

- Mt fungus and chemical herbicides
- Mt fungus and tip miner
- Chemical herbicides and tip miner
- Harvesting and tip miner

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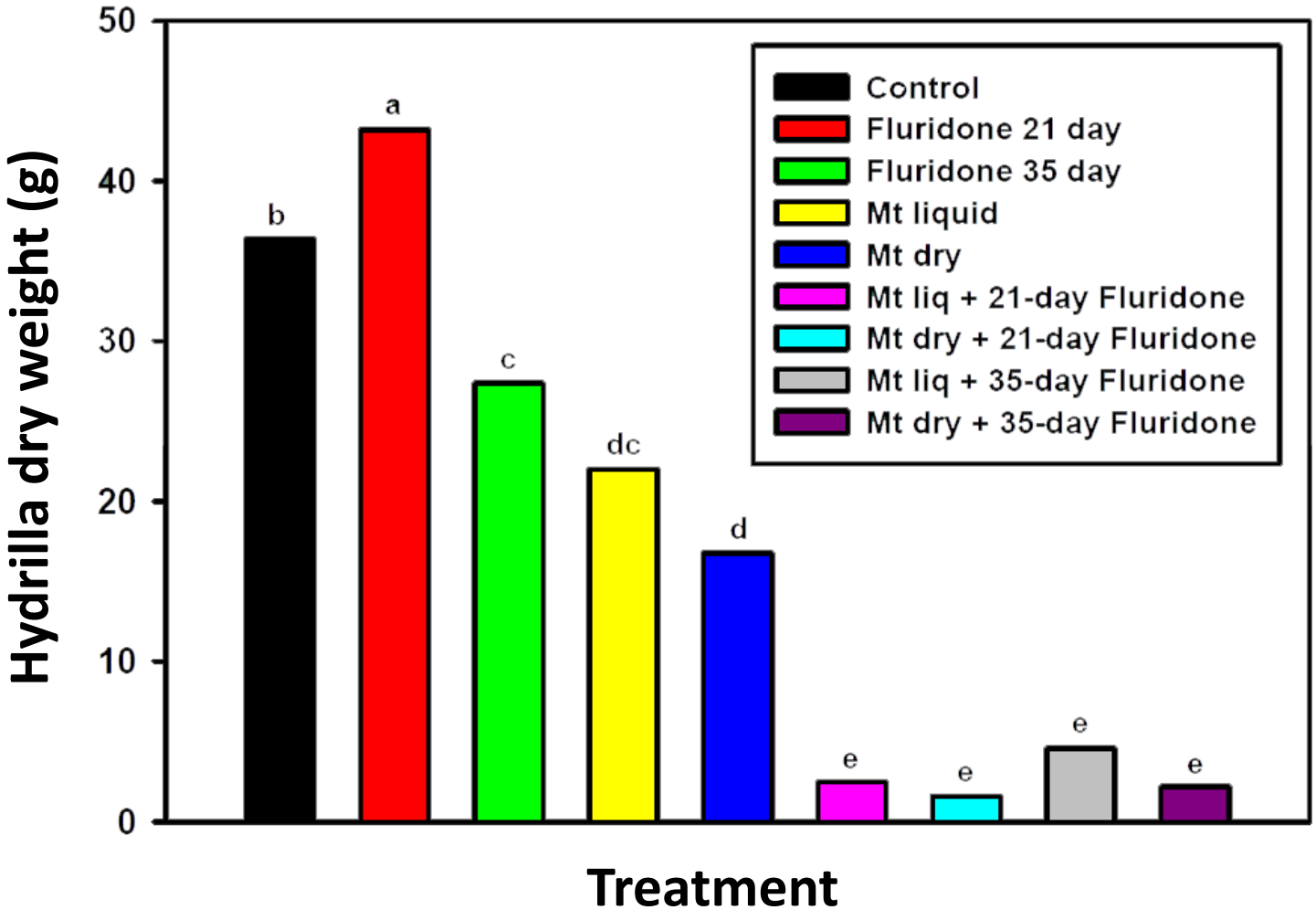
US Army Corps of Engineers®

Mt Fungus and Chemical Herbicide (30 DAT)

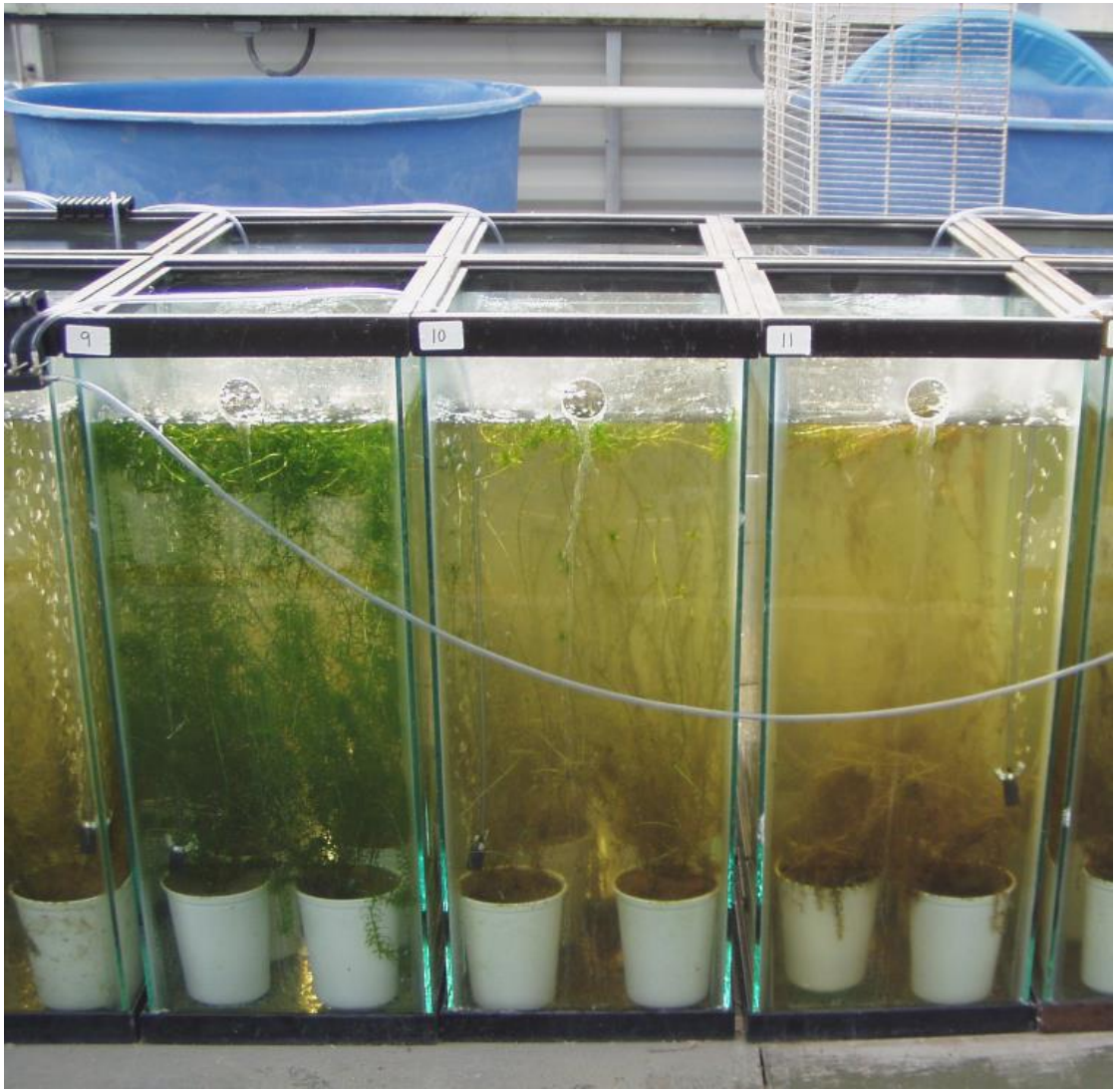
More details available online at:
http://www.icais.org/pdf/2009abstracts/Linda_Nelson.pdf



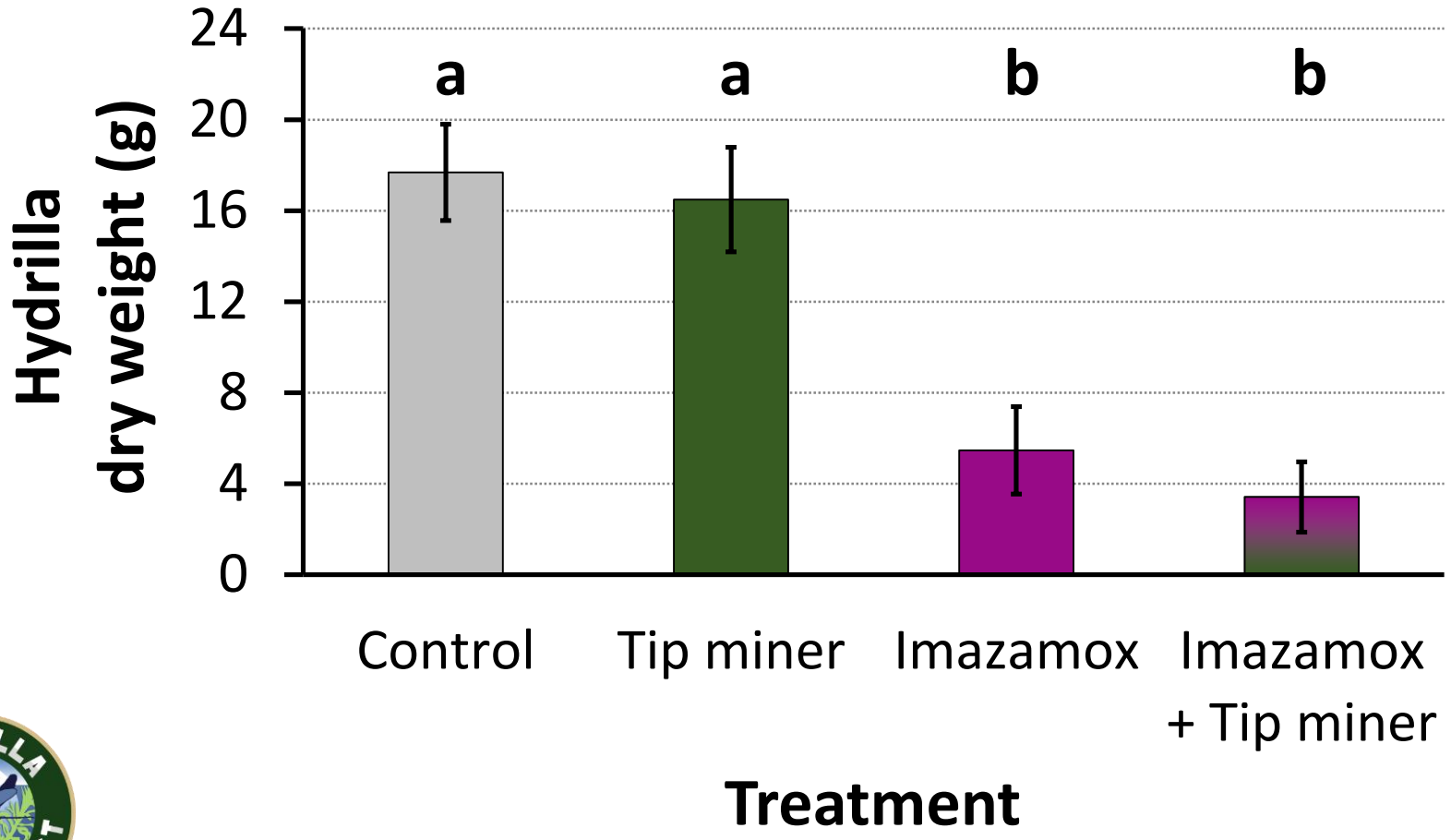

Courtesy of L. Nelson & J. Shearer, US ACE ERDC
ERDC
US Army Engineer Research and Development Center
Untreated
Fluridone alone
Dry Mt
Fluridone + Mt dry

Tank Test Methods

- Untreated Controls
- Treatments with agents:
  - Imazamox (herbicide)
  - Mt (pathogen)
  - Tip miner (insect)
  - Combination of two agents

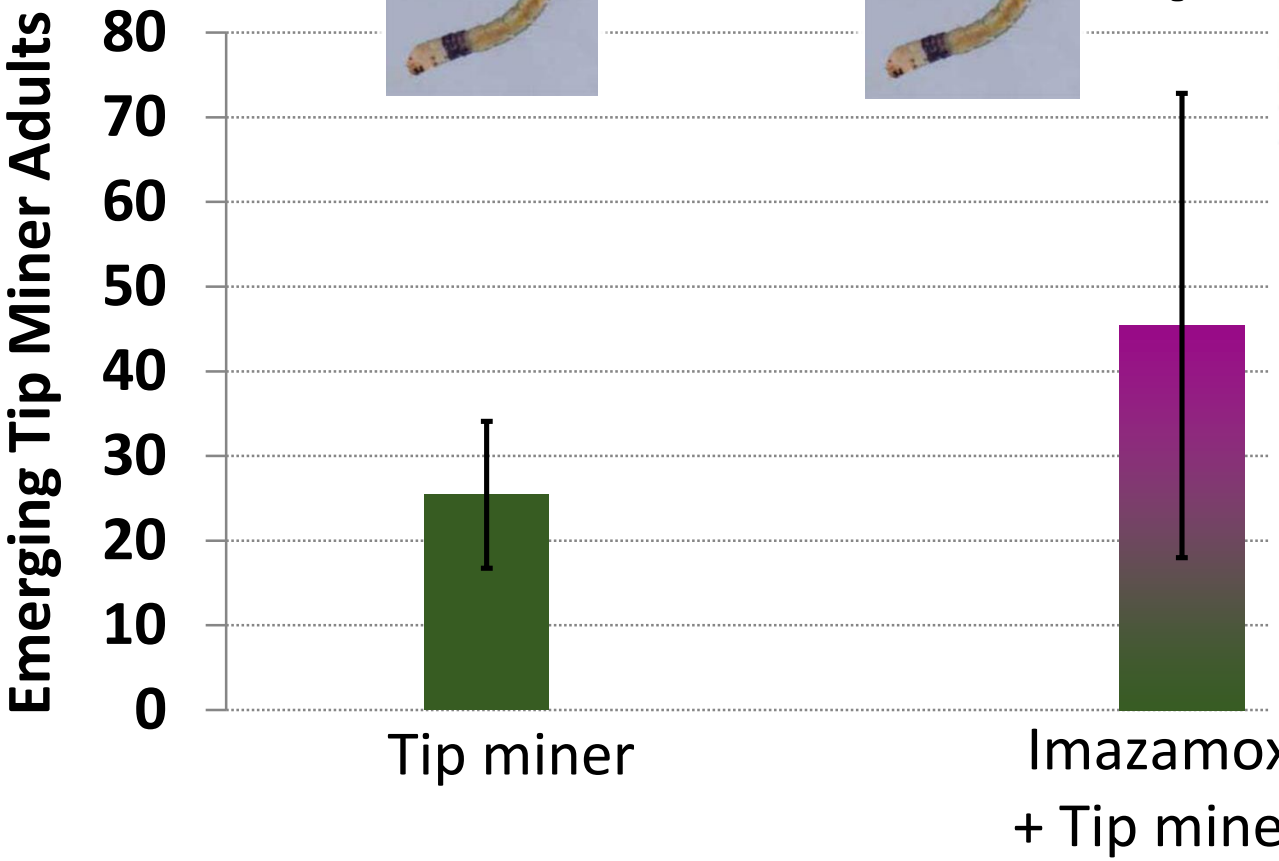


Tip Miner and Imazamox (30 DAT)

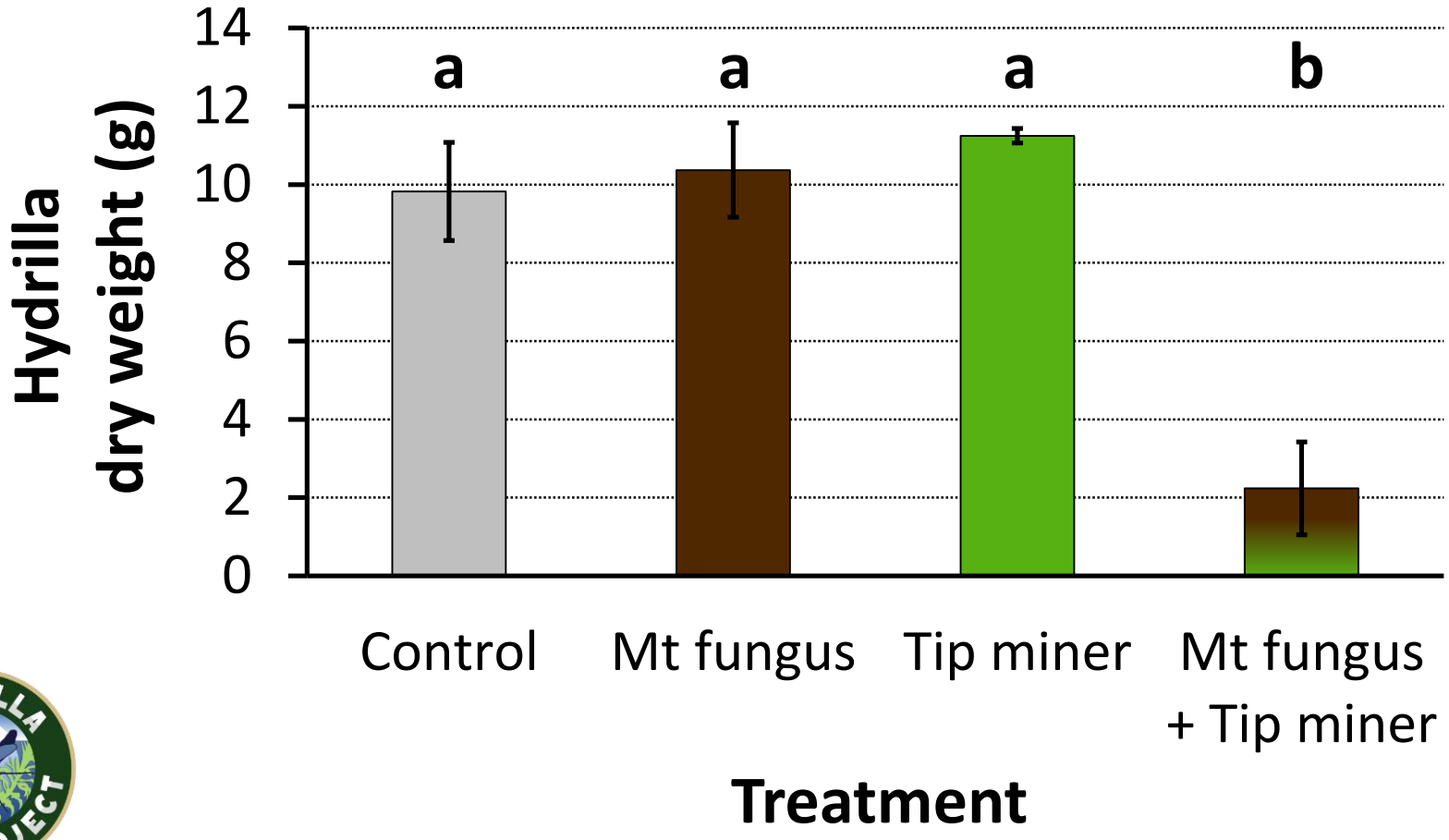


Tip Miner and Imazamox: Compatibility

+



Mt Fungus and Tip Miner (30 DAT)



Harvesting and Tip Miner (2014)

Test Setup:

Step 1: Mechanical harvesting

Step 2: Releasing the hydrilla tip miner

Goal: Suppressing regrowth of hydrilla

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Why Combining (Integrating) Methods?

Potential benefits of IPM

- Increased efficacy
- Decreased use rates
- Reduced contact time requirements
- Improved selectivity
- Reduced reliance on herbicides alone
- Resistance management

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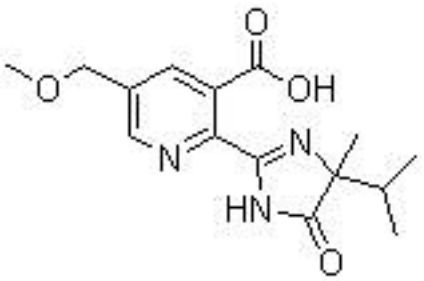
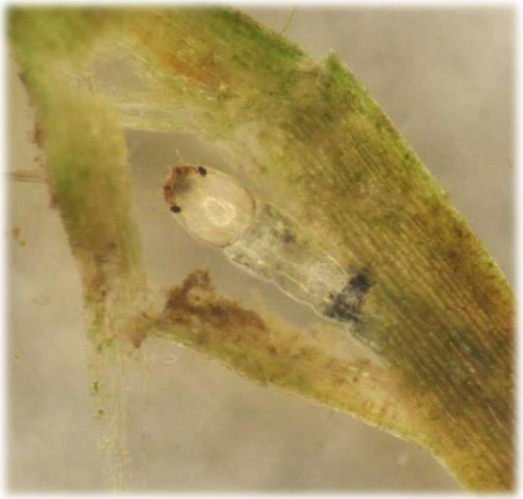
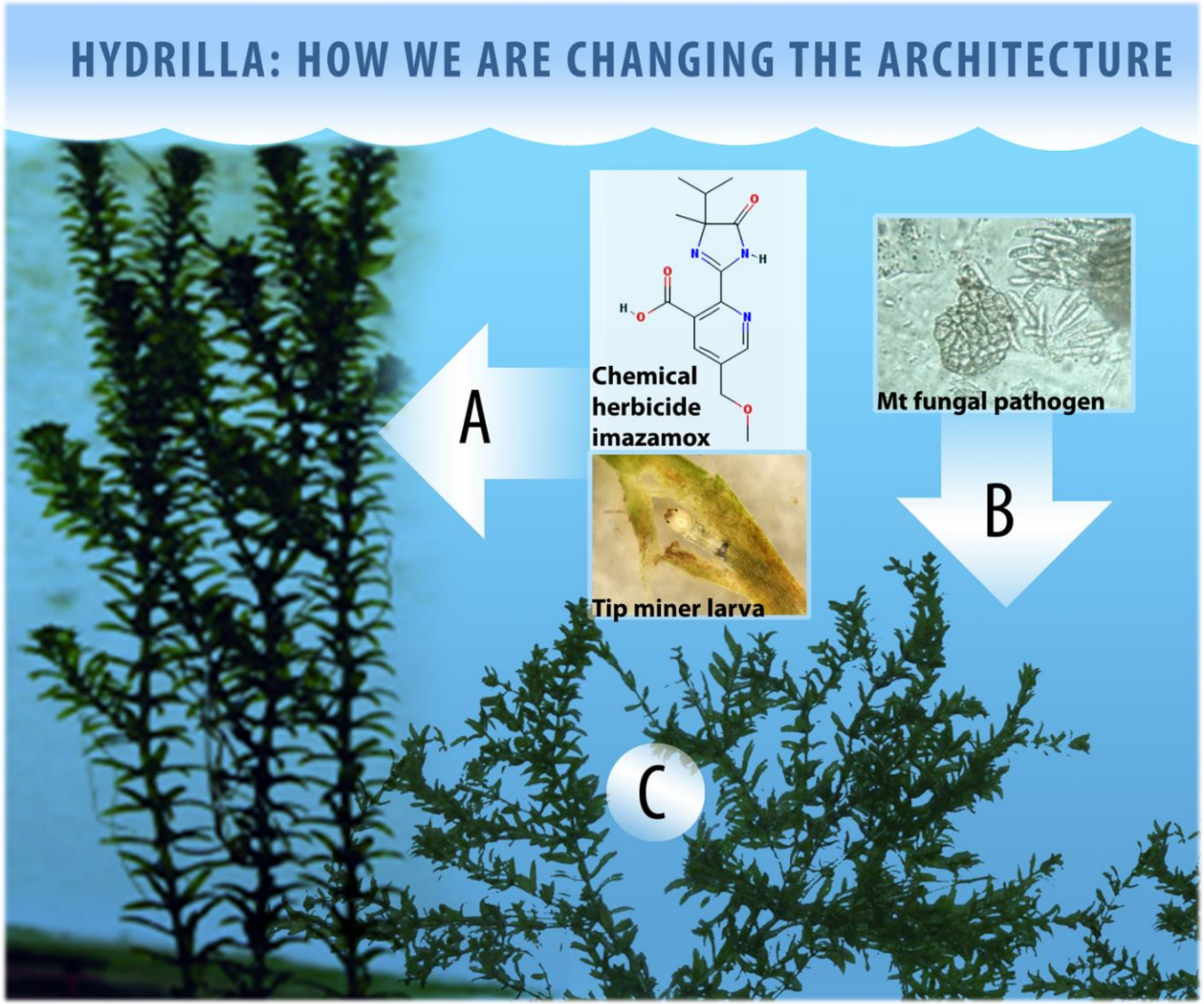
Possible Hydrilla IPM



- Imazamox → branching
- New shoot tips → breeding sites for hydrilla tip miner



- Larvae develop within plant tissue (mining)
- Damage kills growing tips & increases susceptibility to infection by Mt



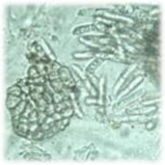
- Combining these three tactics will reduce hydrilla growth (no “topping out”)
- Consequence: plants are not chopped up by boat propellers (no spread)
- Reduced risk of resistance development towards any of the individual tactics

Summary:
Natural Enemies of Hydrilla
(Potential Biocontrol Agents)

Insect species:

- indigenous or adventive
  (hydrilla tip miner, Parapoynx moth)


- Introduced
  (hydrilla leaf-mining fly, hydrilla tuber weevil)



Pathogenic fungus (Mt):

- isolated from hydrilla in the U.S.
  but: state import permits required!

Asian grass carp:

- very effective in closed systems

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Remember:

TIME → Evaluating the efficacy of biocontrol agents takes years (rearing the organism; testing in the laboratory, then in the field; getting permits).

IPM → Integrating two or more tactics (biological, chemical, mechanical) produces better control than individual tactics.

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Our website: http://entomology.ifas.ufl.edu/hydrilla

Hydrilla IPM Online CEU Course: http://pesticide.ifas.ufl.edu

Thank you for your attention!