Integrating Biocontrol Agents into Hydrilla Management Plans in Florida

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Outline

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

- Submersed, rooted aquatic plant, propagates by tubers, turions, **fragments**!
- 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
Spread of Hydrilla Through Florida Watersheds

- **1950s**
- **1960s**
- **1970s**
- **1980s**
- **1990s**
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
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)
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
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)

Insect images copyright USDA-ARS
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.
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
Tip Miner Larva and Associated Tip Damage

Credit: D. Denson, RCID
Tip Miner “at Work”

Block 1: Control

Block 2: Tip miner
Lake Rowell, Bradford Co., FL
September 2010
Combining Control Agents/Tactics

Compatibility tests:

• Mt fungus and chemical herbicides
• Mt fungus and tip miner
• Chemical herbicides and tip miner
• Harvesting and tip miner
Mt Fungus and Chemical Herbicide (30 DAT)

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)

Hydrilla dry weight (g)

Control  Tip miner  Imazamox  Imazamox + Tip miner

Treatment
Tip Miner and Imazamox: Compatibility

Emerging Tip Miner Adults

- Tip miner
- Imazamox + Tip miner
Mt Fungus and Tip Miner (30 DAT)

Hydrilla dry weight (g)

- Control
- Mt fungus
- Tip miner
- Mt fungus + Tip miner

The graph shows the dry weight of Hydrilla for each treatment. The bars are labeled with letters (a and b) indicating significant differences among treatments.
Harvesting and Tip Miner (2014)

Test Setup:

Step 1: Mechanical harvesting

Step 2: Releasing the hydrilla tip miner

Goal: Suppressing regrowth of hydrilla
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
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
Remember:

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

→ Integrating two or more tactics (biological, chemical, mechanical) produces better control than individual tactics.
Our website: http://entomology.ifas.ufl.edu/hydrilla

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

Thank you for your attention!