Biological control of Chinese tallowtree and air potato

Rodrigo Diaz, Veronica Manrique, Greg Wheeler
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Background on biological control, and updates of agents for Chinese tallowtree and air potato

- Biological control
  - Definition, steps “pipeline”
  - Importance of host specificity

- Chinese tallowtree
  - Recognition, distribution
  - Flea beetle, and moth

- Air potato
  - Recognition, distribution
  - Air potato leaf beetle available in AL
What is Biological Control?

The use of **populations** of natural enemies to suppress pest populations to lower densities, either permanently or temporarily.
Classical Biological Control: Importation of NE from native range of the pest
Steps during a Biological Control program

1. Select target weed
2. Surveys/Research in native range
3. Quarantine (selection of agent)
4. Field releases/Establishment
5. Technology transfer

‘Pipeline’

5 to 10 years to complete
Host range testing: **Centrifugal Phylogenetic Method**

Test plant list: close related native species, economic importance, and threatened or endangered species

- Other species in the same genus
- Other species in the same family
- Other tribes, same family
- Other families
- Plants of economic importance
Examples of weed biological control programs in Southeastern USA

- Giant salvinia
- Alligator weed
- Tropical soda apple
- Melaleuca
Giant salvinia is the most important aquatic weed in Louisiana
Salvinia weevil is an effective control agent
Chinese tallowtree
Chinese tallow is a rapidly growing tree, mature trees produce 100K seeds per year.
Native range of Chinese tallow goes from southern China

- Cultivated species
- Possibly 200 spp. of herbivore pests that are potential biological control agents
Tallow is one the worst weeds of natural areas in southeastern US

• The dominant woody sp in many forests & wetlands

• Infestations impact endangered Whooping crane

• Expanding range, $200-$400 million to control over next 20 yrs
Tallow is widespread in Southeastern United States

Source: EDDMaPS
Tallow is managed using chemical, fire, and mechanical control

Labor intensive and costly
We need another tool to help plant managers

*Bikasha collaris* (Coleoptera: Chrysomelidae)
Life cycle of *Bikasha*
*Bikasha* adults feed on the leaves and larvae on the roots.
Bikasha has a narrow specificity to tallow

- High degree of specificity where *B. collaris* was unable to sustain a population on any non-target species.

- Limited feeding occurred in no-choice tests on non-target species, *D. fructicosa* and *G. lucida*.

Damage, longevity, fecundity by tallow fed-adults was minimal on non-targets.

Spillover risk of *Bikasha* adults was found to be unlikely.

Why? Adults are unable to feed and exploit other species to complete their life cycle.
Experiments in China demonstrated that larvae and adults decrease biomass of saplings

- Larvae 0, 5, 10/plt
- Adults 0, 5, 10/plt
- Both larvae & adults decrease biomass
- Greatest impact from both larval & adult feeding
Gadirtha fusca adults have a wingspan of about 1.8 inches and a body length of about 0.8 inches.
**Gadirtha** moths lay pale, cylindrical eggs on new leaves in the spring

- 4-5 generations in native range
- Adults emerge and disperse to find mates
- Eggs overwinter and hatch in May
- Larvae **pupate underground**
Gadirtha larvae are aggressive defoliators

Leaves fed to one late instar larva

Leaf damage of one larva after 2 days (135 cm²)
Dramatic defoliation under caged conditions

- Feeding Infested saplings ~ 50 cm tall
- 0, 1, 5 larvae
- 2 generations
- about 15 d feeding/generation
How about host specificity?

• **No-choice** test 78 spp *G. fusca* larvae
• All larvae died within 3 days on non-target spp except:

<table>
<thead>
<tr>
<th>Species</th>
<th>% survival</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Triadica sebifera</em></td>
<td>81.6</td>
</tr>
<tr>
<td>tallow</td>
<td></td>
</tr>
<tr>
<td><em>Gymnathes lucida</em></td>
<td>8.3</td>
</tr>
<tr>
<td>Native - oysterwood</td>
<td></td>
</tr>
<tr>
<td><em>Euphorbia hypericifolia</em></td>
<td>6.7</td>
</tr>
<tr>
<td>Native – graceful spurge</td>
<td></td>
</tr>
<tr>
<td><em>Euphorbia hyssopifolia</em></td>
<td>14.3</td>
</tr>
<tr>
<td>Native – hyssopleaf sandmat</td>
<td></td>
</tr>
<tr>
<td><em>Euphorbia milii</em> (red)</td>
<td>9.1</td>
</tr>
<tr>
<td>Ornamental - crown of thorns</td>
<td></td>
</tr>
</tbody>
</table>
Dual-Choice test results

• Dual-choice test of *Gadirtha fusca* larvae on non-target 4 spp.
• Larvae nibbled *G. lucida* only.
When these agents might be available?

• Regulators are in the final stages of the review process
• According to Dr. Greg Wheeler, possibly in one year
Educational materials available on LSU AgCenter website

• Identification of the plant, and impacts

• Biology and host range information of both agents

• Links to scientific papers

• https://www.lsuagcenter.com/topics/environment/invasive%20species/chinese%20tallow%20tree
Air potato
Air potato (*Dioscorea bulbifera*) is an invasive vine native to Asia and Africa. Introduced into Florida in 1905.
Severe infestations of air potato smother native vegetation
Scientists from the USDA found the air potato leaf beetle in Asia

Lilioceris cheni
The beetle develops from egg to adult in 31 days
The safety of this beetle was studied in quarantine from 2006 to 2009

Results demonstrated the beetle can only complete development on air potato (Pemberton and Witkus, BST 20: 567-587).

41 plant species in 24 families. 15 species in the Dioscoreaceae.
Once the safety was confirmed, the federal government approved the release of the beetle in October 2009.
Beetle releases in Florida started in November 2011

Beetles released (2012-2014), total: 322,076

Number of locations: 1010

Several agencies are involved.
After Florida, other states were interested on the air potato leaf beetle

- Release in 2016 in LA and in 2017 in TX
- Releases in 2018 in Alabama by Dr. Chris Kerr
- Seen in 2018, probably migrated from Pensacola
Results demonstrated that the beetle is controlling air potato
Damage observed in Louisiana after one year of the beetle release
Jean Lafitte National Park, near New Orleans
Shriever in south Louisiana
After 4 years, bulbil density and size decreased due to beetle damage.

Min et al. 2019. Biological Control. 130: 1-8
We have prepared several outreach materials

**Factsheet about the beetle**

Air Potato Leaf Beetle

*Scientific name: Lillocoris cheni Gressitt and Kimoto (Coleoptera: Chrysoidea)*

Introduction

Air potato, *Dioscorea bulbifera* L. (*Dioscoreales: Dioscoreaceae*), is a fast-growing perennial vine native to Asia and Africa. It has been introduced into the southeastern United States on multiple occasions and has become established in Hawaii, Florida, Georgia, Alabama, Mississippi, Louisiana and Texas. Currently air potato is registered as a noxious weed in Florida and Alabama (USDA 2015). In Louisiana, populations of *D. bulbifera* have been recorded in 13 parishes (Figure 1). The air potato vine quickly grows to cover large areas and outcompetes native vegetation. It proliferates freely from vegetative bulbs formed in the leaf axils and is difficult to remove, requiring repeated mechanical and herbicidal treatments.

A successful biological control program against *D. bulbifera* was initiated in Florida in 2011 using the air potato leaf beetle, *Lillocoris cheni* (Rayamah et al., 2014). Extensive laboratory and open field studies showed *L. cheni* to be extremely host-specific, feeding and developing only on *D. bulbifera* and not on related species of *Dioscorea* found in Florida including *D. floridana*, *D. villoso* and *D. sensibilis* (Lake et al., 2013). Rearing and release of *L. cheni* on public and private lands is currently conducted by the United States Department of Agriculture (USDA), the Florida Department of Agriculture and Consumer Services (FDACS) and the University of Florida. Establishment of the beetle has been confirmed across Florida. Based on its success in Florida, there is reason to believe that *L. cheni* will be an effective biocontrol agent against *D. bulbifera* in Louisiana.

**Website- AP issue, BC program, Beetle, and Resources**
Do you want air potato beetles?

- Contact Dr. Chris Kerr at Florida Department of Agriculture

- Air Potato Beetle Request Form

www.freshfromflorida.com/APB
Summary
Biological control is a suitable approach for invasive weed management in natural areas

- **BC:** Several steps involved, including rigorous host specificity tests

- **CT:** Flea beetle and defoliating moth could become available in one year

- **AP:** Beetle established in southeastern USA, seems effective at control AP

Thanks for your attention!