Will native *dogbane beetles* (*Chrysochus auratus*) include *dog strangling vine* (*Vincetoxicum spp*) in its host-range?
Native insects impact on invasive plants: A case study on native dogbane beetles (*Chrysochus auratus*) and invasive dog strangling vine (*Vincetoxicum rossicum*).
Potential Relationships

• No direct relationship
• Oviposition sink
  – Eggs unable to develop
  – Poor larvae performance
• Adult food source
• Larvae food source
Native herbivores utilizing introduced plants

- **Colorado potato beetle** now feeds on *Solanum tuberosum & S. dulcamara* (Hare, 1990)
- **Soapberry bugs** feed on Asian goldenrain tree (Carroll, 2007)
- **Weevils** feed on Eurasian water-milfoil (Sheldon & Creed, 2005) and controlling spread.
- New species of **tephritid fruit fly** feeds on east Asian honeysuckles (Schwarz, 2005)
- **Mustard white** adapting to garlic mustard (Keeler & Chew, 2008)
Some Questions:

- Why do these native insects readily include invasive plants in their host-range?
  - Genetic change (adaptation)
  - Ecological fit (part of physiological host-range)
Methods to determine factors affecting relationship

- Conduct host-range testing (Physiological host-range vs. Ecological host-range)
- Use closely related insects with shared evolutionary history
- Phylogenies
- Damage potential
Dog strangling vine
(Vincetoxicum rossicum & V. nigrum)

Credit: Rhoda deJonge
Success Factors

- Phytochemical antofine – limits native plant growth, and is antifungal, antibacterial and cytotoxic (Gibson et.al, 2011).
- Minimal herbivory damage (Ernst & Cappuccino, 2005; Milbrath, 2010)
- High seed production (Cappuccino, 2004), polyembryony (Ladd & Cappucino, 2005 and Blanchard et. al 2010) and more effective dispersal than native vegetation (DiTommaso et al. 2004)
- High root-shoot ratio (Smith, 2006)
Current control methods

• Plant is resistant to chemical and mechanical controls (Douglass, 2011; Averill, 2008; Lawlor & Raynal, 2002).

• No classical bio-control agents permitted yet for release (Gassman, 2011; Sforza, 2011). Petition submitted for Hypena opulenta, a seed-feeding moth.
Dogbane beetle
(*Chrysochus auratus*)

- Specialist on dogbane plants (*Apocynum spp*).
- Univoltine
- Adults feed on leaves
- Larvae feed on roots
- Overwinters as prepupae (diapause not necessary)
Chrysochus genus

Coleoptera
Chrysomelidae

Chrysochus

cardenolide feeders

‘Eumolpus beetle’
*Chrysochus asclepiadeus*

Cobalt beetle
*Chrysochus cobaltinus*

Dogbane beetle
*Chrysochus auratus*

Credit: Rhoda deJonge
Credit: Calibus, en.wikipedia.org
Credit: Johan de Zoete
Family: *Apocynaceae*

- **Dog-strangling vine**
  *Cynanchum spp.*
  Credit: Rhoda deJonge

- **Milkweed**
  *Asclepias spp.*
  Credit: Rhoda deJonge

- **Dogbane**
  *Apocynum spp.*
  Credit: Rhoda deJonge
C. asclepiadeus

C. auratus

eastern

C. cobaltinus

western

Ecological & lab-tested host-ranges

Vincetoxicum

Apocynum

Asclepias
Host-range testing of dogbane beetle (*Chrysochus auratus*)

- To determine adult and larvae physiological host ranges
- Oviposition & diapause requirements
- Other factors that may affect ability to use DSV.
Methods: Adult Feeding Test

- Adult no-choice feeding test
  - Apocynum androsaemifolium
  - Vincetoxicum rossicum
  - Asclepias incarnata
  - Solidago canadensis
Results: Adult Feeding Test

- Highly specialized adults
- Gustational testing (nibbles)

*Asclepias incarnata* (swamp milkweed)  
*Apocynum androsaemifolium* (spreading dogbane)
Methods: Oviposition Tests

• Adult oviposition tests
  – Choice test
    • *Apocynum androsaemifolium*
    • *Vincetoxicum rossicum*
    • *Asclepias incarnata*
  – No-choice test
    • *A. androsaemifolium*
    • *V. rossicum*
    • *A. incarnata*
    • *Solidago canadensis*
Results: Oviposition Tests

<table>
<thead>
<tr>
<th></th>
<th>Dogbane</th>
<th>Dog strangling vine</th>
<th>Swamp milkweed</th>
<th>netting</th>
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<tbody>
<tr>
<td></td>
<td>A. androsaemifolium</td>
<td>V. rossicum</td>
<td>A. incarnata</td>
<td>n=80</td>
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<tr>
<td>Total</td>
<td>1481</td>
<td>64</td>
<td>169</td>
<td>775</td>
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<tr>
<td>Average</td>
<td>18.51</td>
<td>3.2</td>
<td>8.45</td>
<td>12.92</td>
</tr>
</tbody>
</table>

Other oviposition locations observed in field surveys:
- Grasses
- Goldenrod
- Queen Anne’s lace
- Soybean
- Corn
- Dry sticks

Credit: Rhoda deJonge
Egg masses laid on all tested species 2011

APA & AINC p=0.00184
Results: Oviposition Tests

• Adult oviposition choice test (2011)
• Larvae developed on different species

<table>
<thead>
<tr>
<th>Larval rearing root species</th>
<th># Larvae observed in April 2012</th>
<th># Beetles emerged by May 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Asclepias incarnata</em> (swamp milkweed)</td>
<td>76</td>
<td>9</td>
</tr>
<tr>
<td><em>Apocynum androsaemifolium</em> (spreading dogbane)</td>
<td>23</td>
<td>1</td>
</tr>
<tr>
<td><em>Apocynum cannibinum</em> (dogbane)</td>
<td>13</td>
<td>3</td>
</tr>
</tbody>
</table>
Larvae Tests

• No-choice tests and fitness
• Instar determination
• Choice tests
• Damage/impact on biomass
Some conclusions

- *Chrysochus auratus* larvae may have a host-range that includes *Vincetoxicum rossicum*.
- *V. rossicu*m likely not an oviposition sink for this insect.
Ongoing questions

- Ecological implications of a native biological control agent
  - Non-target impacts?
  - Will agent become ‘weedy’ itself?
- Inundative bio-control in cases of only partial host-plant acceptance?
- Can the process of identifying native herbivores be sped up?
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Sandy Smith, University of Toronto
Robert Bourchier, Agriculture and Agri-Food Canada

Thank you!

Marc Cadotte, University of Toronto
Chris Darling, Royal Ontario Museum
Peter Kotanen, University of Toronto
Rene Sforza, European Biological Control Laboratory
Franck Oukhouia, University de Bourgogne
Royal Botanical Gardens Staff, Hamilton
High Park Staff, Toronto