The Garlic Mustard Biocontrol Story: Past, Present and Future

Garlic mustard is a problem in the forest understory where it can crowd out more desirable native species.

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Garlic mustard is also a problem along forest edges and pathways
Garlic mustard distribution by state
Garlic mustard is a biennial plant

Garlic mustard seedlings emerge early in the spring
Garlic mustard grows as a rosette during the first year
In the spring of the second season, garlic mustard rosettes bolt and flower.
Garlic mustard flower
Garlic mustard plants form seed capsules in early summer
Seeds mature by mid-July
Mature garlic mustard seeds
Potential Garlic Mustard Biocontrol Insects
Potential Biocontrol Insects for Garlic Mustard

- *Ceutorhynchus scrobicollis* - crown miner
- *Ceutorhynchus roberti* – stem miner
- *Ceutorhynchus alliariae* – stem miner
- *Ceutorhynchus constrictus* – seed feeder
Ceutorhynchus scrobicollis
C. scrobicollis Life Cycle

**Summer**
Adult Aestivation

**Fall**
Oviposition

**Winter**
Oviposition and Larval Development

**Spring**
Soil pupation
Adult emergence
Adult Feeding
Life Stages

- Single egg
- Frass

(Side View)
Larval Tunnel

- light-brown frass
- 3 instars (head capsule size)
- Exit plant to pupate
Main Root Crown

New Lateral Growth

Larval Damage
Impact of *C. scrobicollis* on garlic mustard plants

- Increased plant mortality
- Reduced above ground biomass
- Reduced seed output
Shoot Miners
*C. alliariae* and *C. roberti*
Spring
Weevils lay eggs and larval development in shoots

Summer
Larvae leave plant to pupate in soil
Adults emerge

Fall
Weevils not active

Winter
Weevils overwinter as adults

C. alliariae and C. roberti Life Cycle
Impact of *C. alliariae* and *C. roberti* on garlic mustard plants

- Reduced plant height
- Fewer flowers
- Reduced seed output
Seed feeder

_Ceutorhynchus constrictus_

- lays eggs from mid-May to mid-June (approx. 170 eggs/female)
- pupates in soil, emerges the following spring
- widely distributed
- seed loss in the field up to 18%
Ceutorhynchus constrictus
Ceutorhynchus scrobicollis

C. roberti

C. alliariae

1

2

3

..not to forget Ceutorhynchus constrictus..
Host Range

Set of plant species on which a biological control insect can feed and develop (McEvoy, 1996)
The ideal biological weed control insect would only complete its life cycle on the target weed
CABI-Bioscience, Switzerland
Centrifugal phylogenetic approach for test plant selection
Garlic mustard and a test plant are both presented to a mating pair of weevils.
Larval Development Tests

Weevils placed on test plant to see whether they can complete their life cycle on plant.
Results of Host Range Testing

*C. scrobicollis*

- 78 plant species included in no-choice testing
- 48 plant species included in larval development tests.
Results of Host Range Tests

*C. scrobicollis*

- No plant species outside of the Brassicaceae family were attacked by *C. scrobicollis*.
- Within the Brassicaceae family, many plant species were accepted for oviposition but did not support larval development.
- In larval development testing, only one native mustard species (*Rorippa sinuata*) supported the development of adults.
- When both garlic mustard and *Rorippa sinuata* were included in single choice testing, only garlic mustard was attacked. We believe that under field conditions, the risk of attack to *Rorippa sinuata* is very low.
Current Status of Host Range Testing Program

- Host range testing completed for *C. scrobicollis*
- We will be submitting a petition to the Technical Advisory Group for Biological Control Agents of Weeds (TAG).
- TAG approval is required before *C. scrobicollis* can be released into the field
- We anticipate that the TAG review will take approximately 6 months to a year to complete.
C. scrobicollis Rearing

• Developing rearing protocols in quarantine lab at University of Minnesota
• Will work cooperatively with New Jersey Department of Agriculture’s insect mass rearing facility to expedite mass rearing of C. scrobicollis
• Want to develop “rearing kits” for land managers to rear their own weevils
We would like to thank the following for funding this project:

- USDA Forest Service
- Minnesota Department of Natural Resources
- Wisconsin Department of Natural Resources
- Illinois Natural History Survey
We would like to thank the following people for collecting plants used in our host range testing:

- Richard Dunbar, Michael Homoya, Cliff Chapman – Indiana Department of Natural Resources
- Dave Crawford, Minnesota Department of Natural Resources
- Judy Parrish, Millikin University
- Michael Penskar, Michigan Department of Natural Resources
- Susan Trull, Ottawa National Forest, USDA-Forest Service
- Peggy Traver
- Mark Feider, Milwaukee Audubon/Glendale Natural Areas Group
Sequential No-Choice Testing

A single mating pair is placed on leaf and later checked to see if eggs are laid.
Garlic mustard, *Alliaria petiolata*

Biocontrol

- Why is garlic mustard a problem?
- Biology of garlic mustard
- Biology and life cycle of potential biocontrol insects of garlic mustard
- Host range testing program for potential biocontrol insects
- Current status of host range testing program
- Potential timeline for field release of biocontrol insects