

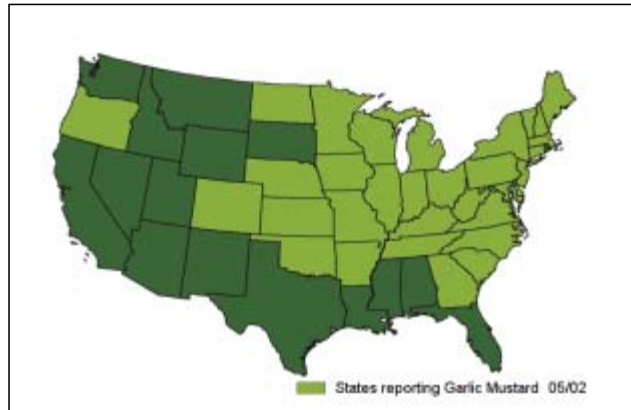


**FHTET**  
Forest Health Technology Enterprise Team

## BIOLOGICAL CONTROL OF GARLIC MUSTARD

PROVIDING TECHNOLOGY FOR FOREST HEALTH PROTECTION

Garlic mustard (*Alliaria petiolata*) (M. Bieb.) Cavara and Granda (below) is a member of the family Brassicaceae and native to Europe. It was first recorded in North America on Long Island, New York in 1868. An analysis of the genetic variation indicates that North American populations may have originated from multiple introductions from Europe, most likely the British Isles, as well as from Belgium and the Netherlands. Garlic mustard is currently one of the most serious invaders of forested areas in southern Ontario and the northeastern and mid-western United States (above). Isolated occurrences are known in western states, and populations established in the Pacific Northwest appear to be spreading. Garlic mustard is currently one of the most serious invaders of forested areas in southern Ontario and the northeastern and mid-western United States (above). Isolated occurrences are known in western states, and populations established in the Pacific Northwest appear to be spreading.



### Native Ecological Damage

Garlic mustard is a cool-season, shade-tolerant, obligate biennial herb. It is one of the few non-indigenous herbaceous species able to invade and dominate the understory of North American upland and floodplain forests, both in shaded areas and in open woods and savannas, not just into disturbed areas. Garlic mustard invades sites independent of presence or cover of native species, and species-rich sites are more likely to be invaded than species-poor sites. Garlic mustard alters habitat suitability for native insects and thereby birds and mammals.

### Biology/Traditional Control

*Alliaria petiolata* is the only species in the genus *Alliaria* in North America. Seeds germinate in early spring and seedlings form basal rosettes of leaves the first year. The rosettes continue to grow in winter during snow-free periods when temperatures are above freezing. In the spring of the second year, the rosettes (new adult plants) produce flower stalks, set seed, and subsequently die. Plants usually produce a single unbranched or few-branched flower stalk and can be self- or cross-pollinated. Flowers that are not insect-pollinated automatically self-pollinate. Seeds are dormant at maturity and require 50 to 105 days of cold stratification to come out of dormancy. Once garlic mustard is established, the management goal is to prevent seed production until the seed bank is depleted-in 2 to 5 years. Cutting of flowering stems at ground level provides the most effective control with minimal side effects, but has a high labor cost. Burning and herbicide (e.g., 2% glyphosate) application provide control but have associated side effects and cannot be implemented on an area-wide basis.

## Overview of Proposed Biological Control Program

In 1998, a project to search for natural enemies of garlic mustard was initiated by Bernd Blossey (Cornell University). Funding was provided by the Departments of Natural Resources in MN, IL, IN, KY; Hoosier National Forest; Native Plant Societies of IL, IN; Department of Defense; and others.



In 1998 and 1999, field sites in Germany, Switzerland, and Austria were surveyed for their herbivore fauna associated with garlic mustard. Field investigation revealed that 69 insect herbivores and seven fungi are associated with garlic mustard in Europe. Most of these species are polyphagous. Based on information on their restricted host-range and their damage, five weevils and one flea beetle were selected as potential biological control agents. The host specificity of all six insect species is being evaluated using about 50 plant species in Europe.

Field sites in eastern North America were surveyed in spring and summer 2000. In North America, two stem mining weevils, a stem mining fly, a scale insect, two fungi, and aphids were found attacking garlic mustard. However, their attack was of little consequence to plant growth or reproduction. Also, plots were established in New York State to collect baseline data on garlic mustard and its natural enemies before any introduction of control agents. A standardized protocol was developed to measure (1) garlic mustard abundance, (2) abundance and impact of biological control agents, and (3) changes in native plant communities and associated fauna. This protocol is sophisticated enough to allow statistical analysis, yet simple enough to allow widespread use by natural areas managers.

In 2002, the Forest Health Technology Enterprise Team, in cooperation with representatives from many of the initial funding agencies, organized an informal working group to develop a 3- to 5-year plan for continuing the project to develop a biological control program for garlic mustard. In 2002 and 2003, the consortium will cooperatively provide technical and financial assistance to continue the host range testing in Europe, establish laboratory colonies of promising agents in a quarantine facility in the US, and establish permanent plots in several states. In 2004 and 2005, technical and financial assistance will continue for host range testing and monitoring in the permanent plots, developing rearing techniques for promising species, and release of promising species.

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