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Reprinted from the *Wild Ones Journal*, July/August 2006 issue.

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Garlic Mustard: Odiferous Invader

What You Need to Know

Looks like mustard, doesn't it? Crush the leaves and it smells like garlic. Now you know where the name comes from – read on to find out why you don't want it around.

By Maryann Whitman

Garlic mustard has spread at a nightmarish pace throughout the Northeast, and has now been seen in Oregon. It's important to recognize it at various life stages. *Photo: Chris Evans, The University of Georgia, www.forestryimages.org.*

Garlic mustard *(Alliaria petiolata)*, is an obligate biennial herb of the mustard family *(Brassicaceae)*. Seedlings emerge in spring and form basal rosettes by midsummer. Immature plants overwinter as basal rosettes that stay green and continue to grow during snow-free periods when temperatures are above freezing. All plants that survive the winter produce flowers in their second year, regardless of size, and subsequently die. An average plant produces 400-500 seeds that germinate readily. Maximum production on one plant with 12 stems is estimated at 7,900 seeds. Once dormancy has been broken, seeds will germinate in both light and dark.

Garlic mustard invades forested communities and edge habitat. A native of Europe, the plant has no known natural enemies in North America, is self-fertile and is very difficult to eradicate once established. Thus the best and most effective control method for garlic mustard is to prevent its initial establishment.

Methods of dealing with Garlic Mustard

In shaded and partially shaded communities lacking garlic mustard, the preferred method is to monitor annually, and remove all plants prior to seed production. Once it is established, the management goal is to *prevent seed production* until the seed bank is *Continued on page 2.*

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depleted, potentially two to five years. *Cutting of flowering stems at ground level* provides the most effective control with minimal or no side effects, but has a high labor cost. Burning and herbicide application both provide control at a lower labor cost, but each has potential drawbacks: fire without sufficient fuel may be too cool to have an effect and may actually increase total presence of garlic mustard, fire that is too hot may alter ground-layer composition; and herbicides may have a negative impact on some native ground-layer species. The method of choice depends on the size of infestation, the type of community invaded, and the work force available. In all cases, control must be continued annually until the seed bank is exhausted.

Toward exhausting the seed bank, *corn gluten* may be considered for some situations. The herbicidal action of corn gluten does not prevent germination, so the seed bank does suffer depletion. The presence of corn gluten prevents the establishment of secondary roots on seedlings which then die from lack of moisture and nutrients.

Another method of dealing with garlic mustard being discussed by members of the Iowa Native Plant Society involves intensive over-planting of moderately infested areas with shade-tolerant, fast-growing native plants. Jesse Bennett, of Driftless Land Stewardship in Glen Haven, Wisconsin, has submitted a most extensive list. Jewelweed *(Impatiens capensis* and *I. pallida)*, wood nettle *(Laportea canadensis)*, stinging nettle *(Urtica dioica)*, galiums (especially *aparine, asperullum, triflorum*) compete nicely against it she says. Yellow and wood violets *(Viola pubescens* and *V. papilionacea)*, white vervain *(Verbena urticifolia)*, sweet cicely *(Myrrhis odorata)*, stickseed *(Hackelia virginiana)*, and waterleaf *(hydrophyllum virginicum)* all hold their own rather well.

The flowers of *Alliaria petiolata* are either cross-pollinated by insects or can self-fertilize, depending on conditions. *Photo: Jody Shimp, Illinois Department of Natural Resources, www.forestryimages.org.*

She also suggests lopseed *(Phryma leptostachya)*, jumpseed *(Polygonum virginianum)*, honewort *(Cryptotaenia canadensis)*, cow parsnip *(Heracleum maximum)*, green headed coneflower *(Rudbeckia laciniata)*, and native ferns, especially ostrich *(Matteuccia truthiopteris)*, interrupted *(Osmunda claytoniana)*, lady *(Athyrium filix-foemina)*. *Carex grisea, C. blanda, C. rosea,* and *C. pensylvanica*, and grasses *Elymus virginiana, E. riparius, E. villosus* and *E. hystrix* and again the ferns, especially interrupted *(O. claytoniana)* will contribute to the fuel bank for a hotter burn.

Close examination of the root and crown reveals an S-shaped section that lies both above and slightly below ground, from which all stems emerge. *Photo: Chris Evans, The University of Georgia, www.forestryimages.org.*

Biological control for this species is in development. Berndt Blossey, of Cornell, is coordinating a project in Europe that started by testing 69 weevils that feed on various parts of the garlic mustard plant. The search has been narrowed to four weevils that appear to feed only on garlic mustard. Once their feeding habits are determined and USDA standards are met they will be introduced into the United States for continued testing.

Whether you pull it, cut it, burn it, or use a herbicide, each action that you take must be understood and carefully timed. Garlic mustard is not a plant that easily gives up the ghost. In any control efforts, several critical idiosyncrasies of the plant must be kept in mind for efficiency's sake:

• The ground level area of the *S-shaped section of the taproot* must be removed in its entirety, or the plant will resprout from this section. Any damage to the primary flower stem stimulates growth of additional stems from axillary buds at the stem base and along the root crown. So just picking off the flowers to prevent seed set is not enough. *Continued on page 3.*

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• *Once the flowers have opened the plant no longer needs to be attached to the root in order to set seeds.* As long as the flowers have access to sugars stored in the stem they can continue to achieve their goals. Therefore it is imperative to bag and send the pulled plants to the landfill. Most compost piles do not heat up enough to kill the seeds.
• Individual plants can continue producing flowers at leaf axils into August. Because of this long blooming time, constant monitoring is necessary.
• An infestation of garlic mustard spreads out from the core through multiple small populations. When a choice must be made whether to attack the core group or the outlying small numbers, most experienced stewards say "go for the outliers" and try to limit the spread.

Vigilance. There is no other way to say it. Keep checking back when you think you are rid of it.

Impacts of Garlic Mustard

Garlic mustard displaces native species of plants by several means. Several compounds isolated from garlic mustard have been shown to depress growth of both grasses and forbs in laboratory experiments. Researchers concluded that release of these phytotoxic compounds from garlic mustard root systems might account for its dominance in forest ecosystems.

In a May, 2006, peer-reviewed publication, researchers report that garlic mustard interrupts the mutually beneficial relationships that many forest trees have with specifically arbuscular mycorrhizal fungi (AMF) [*see sidebar on page 4*] by interfering with germination of fungal spores. Tree seedlings depend strongly on AMF. The researchers comment: "By killing off native soil fungi, the appearance of this weed in an intact forest could stifle the next generation of dominant canopy trees. It could also invite other native and non-native weedy plants that currently grow in low-AMF habitats, such as those disturbed by logging or development."

The researchers plan to study which phytochemicals in garlic mustard may kill AMF, how these chemicals interact with other beneficial soil microbes, and how plants and fungi in garlic mustard's native European habitat coexist with the noxious species. •

The tiny seeds of garlic mustard form in long, cylindrical pods called siliques. The pods dry and split open – dehisce, spreading the seed over many square feet. *Photo: Chris Evans, The University of Georgia, www.forestryimages.org.*

References

http://tncweeds.ucdavis.edu/esadocs/allipeti.html
An extensive summary of information about garlic mustard. The Nature Conservancy also has information on many other invasive plants.

http://tncweeds.ucdavis.edu/esadocs/documnts/allipet.rtf
Element Stewardship Abstract on garlic mustard, by Victoria Nuzzo

Stinson KA, Campbell SA, Powell JR, Wolfe BE, Callaway RM, et al. (2006) Invasive plant suppresses the growth of native tree seedlings by disrupting belowground mutualisms.
PLoS Biol 4(5): e140. DOI: 10.1371/journal.pbio.0040140

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Garlic Mustard, Butterflies, and Other Fauna

Mariette Nowak

Before the 1860s, the mustard white *(Pieris napi oleraceae)* was one of the most common native butterflies. But when the cabbage butterfly arrived from Europe, possibly as larvae or pupae on cabbages brought in with the early settlers, the mustard white was forced to retreat to shaded forests, and the cabbage took over the meadows and open country it preferred. Today another alien – this time a plant, garlic mustard – is threatening the mustard white in its woodland refuge.

The mustard white, as well as the endangered Virginia white butterfly, use several native wildflowers in the mustard family, the toothworts *(Dentaria laciniata* and *Dentaria diphylla)*, as food plants during the caterpillar stage. The toothworts produce a chemical (sinigrin) which attracts the butterflies, an attractant also found in garlic mustard. When garlic mustard displaces the toothworts, or grows taller than the toothworts in mixed stands, the butterflies resort to laying their eggs on garlic mustard. Chemicals in the garlic mustard appear to be toxic to the butterflies. The eggs of the Virginia white die, while those of the mustard white hatch, but the caterpillars soon die.

The mustard white is apparently already extirpated in Illinois. In southern Wisconsin, the butterfly survives at The Nature Conservancy's Lulu Lake Preserve, where garlic mustard has been kept in check. However, in nearby areas where garlic mustard thrives, the butterfly has lost out.

Garlic mustard also adversely affects habitat for several species of salamanders and mollusks through changes in forest litter layer depth and composition. The impact of garlic mustard on other animals has not been studied, but is likely to affect other insects, as well as ground-foraging birds, amphibians, and reptiles, due to a reduction in the abundance and diversity of native plants used by these animals for their foliage, pollen, nectar, seeds, and roots. •

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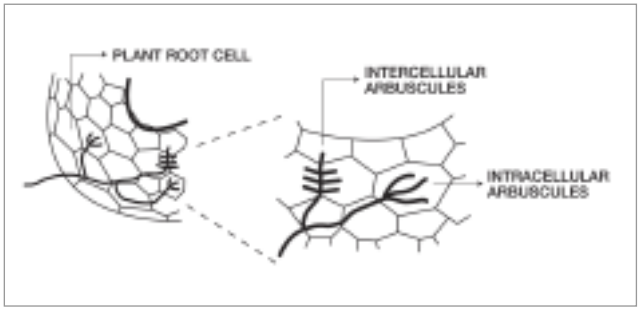

Mycorrhiza: What Is It?

Mycorrhiza (plural, -zae or zas) refers to an association, or symbiosis, between plants and the fungi that colonize the cortical tissue of roots during periods of active plant growth. The association is characterized by movement of: plant produced carbon to the fungus; fungal acquired nutrients to the plant.

The mycorrhizal fungi form a critical linkage between plant roots and the soil. The fungi usually proliferate both in the root and in the soil. The soil-borne, or *extramatrical hyphae* are able to extend significantly farther into the soil environment and interact with this environment differently than do plant root hairs. The hyphae take up nutrients from the soil solution and transport them to the root. By this mechanism, mycorrhizae increase the absorptive surface area of the plant.

Mycorrhizal associations vary widely in structure and function. In a very broad generalization about groupings of mycorrhizal types it can be said that there are *ectomycorrhizae* and *endomycorrhizae*. Ectomycorrhizae occupy the spaces between the plant root cells – endomycorrhizae actually appear to enter the plant root cell in many-branched, or arbuscular structures. The "entry" is only apparent – neither the fungal cell wall nor the host cell membrane is breached.

Most vascular plants form mycorrhizal associations with arbuscular mycorrhizal fungi (AMF), with variable dependency on this association for their growth and survival. Woody perennials and other plants found in late-successional communities are particularly dependent. Naturalized exotic plants have been found to be poorer hosts and depend less on native AMF than native plants. They often colonize areas that have been disturbed, and disturbances to soil have been shown to negatively affect AMF functioning. •

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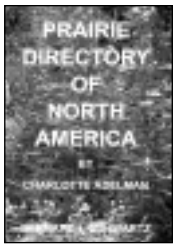

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Reprinted from the *Wild Ones Journal,* July/August 2006 issue.