HERE'S THE DIRT

The Newest Recommendations for Garlic Mustard Management

Why Should I Remove Garlic Mustard from My Property?

Garlic mustard (*Alliaria petiolata*) is a biennial plant from Eurasia that has rapidly become a problematic invasive species in North America. The formation of dense monocultures enables it to invade forest interiors, threatening native plant community composition.[1] Garlic mustard reduces native plant diversity through competition for resources and through the chemical suppression of beneficial fungal symbioses.[2] Although individual garlic mustard populations can be self-limiting over time, the species' total North American range is continuing to expand,[3] and the effects of its disruption of plant and soil communities can last for years.[4] Despite the complex uncertainties of managing this system, thoughtful removal of garlic mustard is key. Recent scientific findings are summarized here to provide clear, up-to-date management recommendations.

How Should I Remove Garlic Mustard?

• REMOVE ADULT PLANTS

Removing adult plants is more effective and efficient than removing first-year plants, as adult plants are easier to identify and easier to treat. Removing adult plants also guarantees seed removal.

• PULL, DON'T SPRAY

Of all the management options tested to date (including burning, herbicides, clipping, and pulling), clipping and pulling are most effective for treating adult plants and can result in 71–99% mortality.[5]

• AVOID ADDING TO THE SOIL SEED BANK

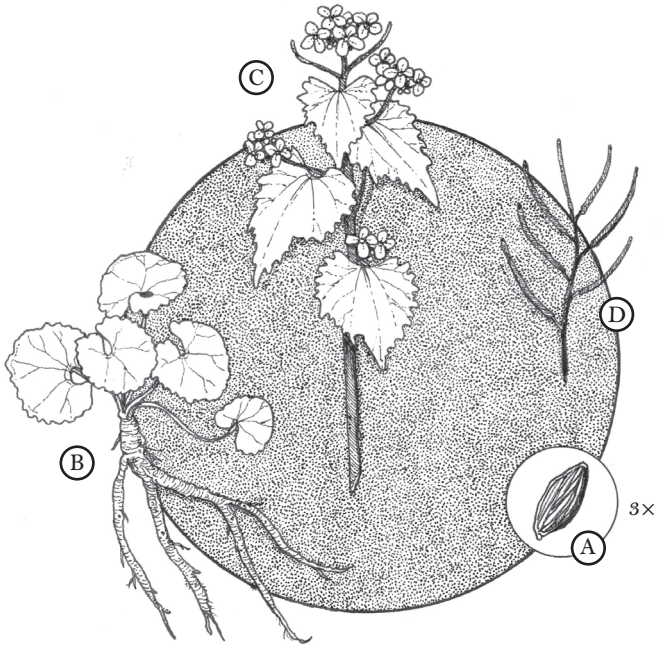
Garlic mustard plants can produce hundreds of seeds that can remain viable in the soil for a long time.[6] Additions to the seed bank can maintain populations of garlic mustard even after removal of aboveground adults. Removal of the flowers, seed heads, or entire plants from the site can help prevent adding to the seed bank.[7]

• REMOVE PLANTS IN THE SPRING

Adult plants are best pulled in early spring at the budding or flowering stage, but prior to the production of seeds. Cutting is best done in the late spring or early summer, when the plants are in full bloom, to avoid the production of new flowers—garlic mustard may have the resources to regrow and reflower from buds or root crowns if cut too early in the season.[8]

• PULL EARLY AND OFTEN

Prioritize removal of garlic mustard at younger invasion sites. If garlic mustard can be removed early in the inva-



Above: Garlic Mustard's lifecycle is biennial, meaning that it's completed in two years. Garlic mustard grows from seed (A). In its first year, it is a low-growing plant with heart-shaped leaves (B). In its second (adult) year (C) it grows taller (12-40 inches), its leaves are more triangular, and it produces white flowers and a distinctive seed head (D). Garlic mustard releases its seeds and dies in its second year.

UMassAmherst

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sion process, effects on the soil fungal community and the native plant community may be minimized.[9] Full control of populations in smaller, more important areas should be prioritized over partial control of garlic mustard across larger areas.[10] Remember that it might take many years to completely eradicate a garlic mustard population, and even longer to notice recovery of native plant communities.[11] Regular monitoring should be part of a management plan in order to track progress.

• RESTORE NATIVE COMMUNITIES

Restoration of native plant species may be needed to ensure native plant richness and recovery.[12] If possible, white-tailed deer and other browsers should be excluded from areas where native plant restoration is the goal, as herbivores browse selectively on native plants while avoiding garlic mustard.[13]

Soil fungal communities, which native plants such as trout lily, Canada mayflower, and white ash and red maple seedlings depend on for survival,[14] are altered by garlic mustard, and may be slow to recover.[15] In sites invaded by garlic mustard, there tends to be less symbiotic fungi (arbuscular mycorrhizal fungi and ectomycorrhizal fungi) and more saprotrophic fungi (fungi that feeds on decaying organic matter) and pathotrophic fungi (plant fungal pathogens and parasites). Garlic mustard-invaded soils also have higher pH and nutrient availabilities and lower soil carbon contents. These soil properties do not recover to uninvaded levels for at least three years post-eradication, and the fungal community may not fully recover until these soil properties return to pre-invasion levels. It may be helpful to actively restore beneficial fungi to the soil,[16] but this area needs further research.

An added benefit of removing garlic mustard is a reduction in the spread of invasive earthworms. Forests in the northeastern and mid-Atlantic regions have historically had no native earthworms since the last glaciation, and, as ecosystem engineers, non-native earthworms can drive changes in forest plant community composition and diversity. Garlic mustard invasion of forest ecosystems is associated with an incease in invasive earthworms, so removing garlic mustard may also reduce numbers and spread of invasive earthworms.[17]

MANAGEMENT SUMMARY

Garlic mustard is most effectively removed by pulling or cutting adult plants in the spring. Be sure to remove any seeds from the site, and repeat treatments annually. Consider active restoration of native communities.

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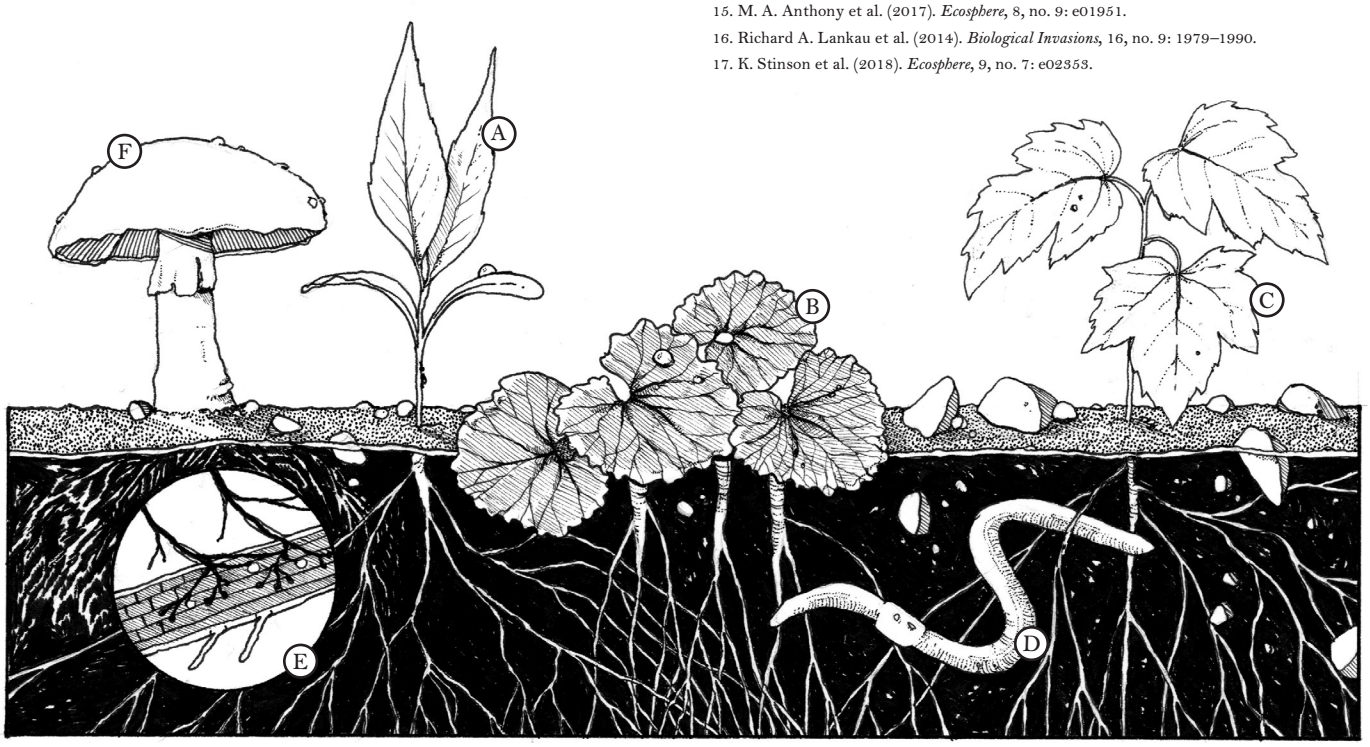

A. Ash (*Fraxinus americana*) seedling. B. Garlic mustard rosettes (first-year plants). C. Red maple (*Acer rubrum*) seedling. D. Non-native earthworm. E. Magnified ash seeding root and symbiotic mycorrhizal fungi interaction: fungal hyphae integrating into root through root hairs and forming arbuscules. F. Mycorrhizal fungus (*Amanita muscaria* var. *guessowii*).