



GARLIC MUSTARD

Alliaria petiolata**CONTROL**

This Best Management Practice (BMP) document provides guidance for managing Garlic Mustard in the Oak Openings Region of Northwest Ohio and Southeast Michigan. This BMP was developed by the Green Ribbon Initiative and its partners and uses available research and local experience to recommend environmentally safe control practices.

INTRODUCTION AND IMPACTS— Garlic Mustard (*Alliaria petiolata*) is native to Europe and was first brought to North America in the mid 1800s for use in cooking and medicine. Garlic Mustard is now widely distributed in North America and is found throughout OH and MI.

The Midwest Invasive Species Information Network (MISIN) has over 230 reports of Garlic Mustard (black dots) in or within 5 miles of the Oak Openings Region (OOR, green line). It is currently found in each of the OOR's 7 counties and is present in many natural areas. Garlic Mustard has demonstrated the ability to establish and spread in healthy and disturbed habitats of the OOR. This includes quality habitats such as wet, nutrient-rich soils of floodplains and (less abundantly) sandy, acidic habitats of dunes and oak savannas. Garlic Mustard prefers shaded areas, in neutral to alkaline woods, especially near edges.



Garlic Mustard has many characteristics that contribute to its classification as an invasive, pest species. It is self-fertile and a single plant can give rise to a colony. Garlic Mustard spreads rapidly (20-120' per year) and produces copious amounts of seed. It physically crowds out native plants while also inhibiting their growth chemically through allelopathy. Chemical compounds produced by Garlic Mustard (one of which is cyanide) discourage herbivory and suppress mycorrhizal fungi in the soil.

Through its inhibition of native plants and its alteration of soil chemistry and microbiota, Garlic Mustard severely degrades the quality of the habitats in which it becomes established. Garlic Mustard also threatens populations of several butterfly species that lay eggs on toothworts. Butterflies mistakenly lay eggs on Garlic Mustard, but the caterpillars cannot survive on the foliage.

SIMILAR SPECIES

Non-natives: Garlic Mustard's basal rosettes resemble Creeping Charlie (*Glechoma hederacea*), but Creeping Charlie grows in runners, not rosettes, and its crushed leaves smell minty. Garlic Mustard's flowering-form can resemble Dame's Rocket (*Hesperis matronalis*), (treatment methods are similar). Dame's Rocket has larger, showier flowers, which may be white, purple or pink, more lance-shaped leaves, and has no garlic smell. Hairy Bittercress (*Cardamine hirsuta*), a similar mustard, differs with compound leaves.

Natives: Violets (*Viola* spp.), Toothworts (*Cardamine* spp.), and members of the Saxifrage family (*Saxifragaceae*) may be mistaken for Garlic Mustard. The leaves of these species do not have its characteristic garlic odor. Further, Toothwort leaves are highly dissected and Saxifrage only have leaves at the base. Violets have single flowers

with 5 petals, often purple in color.

HABITAT—Garlic Mustard prefers shaded areas with **moist, calcareous soils** and is often found in upland and floodplain forests. However, it can tolerate full sun and drier sites. In the OOR, Garlic Mustard has been found in floodplain, flatwood and deciduous forests.

IDENTIFICATION—**Habit:** Biennial herb. Grows as a basal rosette its 1st year; develops a 1'- 4' tall flowering stalk during its 2nd year.



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Leaves: Leaves of first year rosettes are kidney-shaped with scalloped edges, 2-4" in diameter. Leaves of second year stems are triangular, alternate, and sharply-toothed. Second year leaves are largest near the ground (2-4" wide and long), becoming smaller as they approach the top of the stem. All leaves have long, hairy petioles (1/2-2" long) and a garlic-like smell when crushed (though odor fades with leaf age). Rosettes stay green year-round.

Stems: Smooth, occasionally with sparse hairs; unbranched. Usually 1-2 stems per plant, but sometimes more.

Flowers: Small (1/4" wide), white and 4-petaled. Grow in clusters mainly at the apex of each stem; occasionally the leaf axils.



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Fruits: Slender, green capsules, 1-5" long (aka "pods"). Turn brown with age. Burst at maturity, dispersing ~16 seeds per capsule. Large plants can produce over 150 pods.

Seeds: Black and oblong, 1/4" long and 1/8" in diameter. 20-month dormancy period and can persist in the soil for 10 years. Dispersed by animals, water, and humans. Up to 22 seeds per capsule. Dense patches can produce 20,000+ seeds per square foot each year!

Roots: Slender, white taproot. Characteristic "crook" or "s-shape" just below the base of the stem.

Garlic Mustard Timeline	J	F	M	A	M	J	J	A	S	O	N	D
Life History	Rosette		Stalk Grows	Flowering			Seeds Ripen		Year 1—Rosette Year 2—Death, Seed Dispersal			
Hand Pull	Year round, ideally before plant goes to seed.											
Spray	Year round when temperature is above 32° F and area is dry.											
Mowing/Cutting	Best while blooming.											
Prescribed Fire	Burn						Burn					

REPRODUCTION AND DISPERSAL—Garlic Mustard is self-fertile and reproduces solely by seed. Seed is dispersed when the capsules split open, but this process rarely distributes seed more than 6' away from the parent plant. Long range dispersal can be facilitated by water, birds, rodents, deer, and humans. Mowers, automobiles, boots, and clothing may carry Garlic Mustard propagules from site to site. **Thoroughly cleaning equipment and footwear is a critical prevention measure for Garlic Mustard in the OOR. Land managers should incorporate pre- and post-project equipment cleaning into contracts.**

REPORTING—As a control species, reporting Garlic Mustard is essential for its control. Most critical reporting is for populations found in high-quality natural areas. Garlic Mustard is easiest to identify when it is flowering. Report Garlic Mustard at www.misin.msu.edu and to the county or local CWMA or CISMA.

CONTROL—The best control is integrated control. Management plans should focus on removing Garlic Mustard before it can contribute further to the seed bank, and exhausting the seed bank itself. Annual follow-up is essential in the treatment of Garlic Mustard, and monitoring should include at least 120' of the original patch. Control efforts should focus on high quality natural areas and areas adjacent to them.

Chemical: The following recommendations have been compiled from groups working in OH, IL, IN, WI, and Canada. It is the responsibility of the applicator to ensure compliance with herbicide labels and regulations when planning chemical treatment. Follow-up treatments should take place six weeks after initial application.

Foliar Spraying—Best for large, dense populations. Spring is the most effective time to spray since first year plants are in basal rosettes and second year plants are not flowering yet. Herbicides should be used with 0.5-1% of an appropriate non-ionic surfactant



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Herbicide	Trade Names	Concentration
Glyphosate	Glypro®, Rodeo®, Roundup®, AquaNeat®, Accord® XRT II	1-3%
Triclopyr	Garlon 3A® or 4 Ultra®, Pathfinder®, Tahoe 3A®, Vastlan®	1-2%
Imazapyr	Arsenal®	0.5-1%
Metsulfuron	Escort®	0.04 oz/gal
Sulfometuron	Oust®	0.25-1 oz/acre

Mechanical: Pulling Garlic Mustard is very effective for small populations and should be done before the plant goes to seed. Second-year plants are easier to pull than rosettes. Getting the taproot is important, otherwise Garlic Mustard can resprout. Pulled plants should be bagged and removed from the site since Garlic Mustard can continue to mature and set seed after being pulled. The soil disturbance will stimulate the Garlic Mustard seed bank, so new seedlings can be expected. Mowing/cutting Garlic Mustard close to the ground while it's flowering can kill the plant, but cut material must be collected and removed or cut into small pieces to keep it from maturing. Plants cut near ground level while flowering can resprout or flower again, so monitoring is essential. Cutting is not effective on rosettes. In all mechanical removal scenarios, ensure you clean your equipment and dispose of all plant material appropriately (see Disposal below).



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Biological: Several potential biological control agents (weevils and a flea beetle) are being investigated for use on Garlic Mustard. Animals avoid grazing on Garlic Mustard unless nothing else is available.

Prescribed Fire: Repeated spring or fall burns can control Garlic Mustard. Burning must happen annually for 3-4 years to deplete the seed bank. A mid-intensity, early spring fire is ideal. Low-intensity fires can encourage colonization.

Direct Torching: Direct flame treatment with propane torches has been used to control Garlic Mustard. Apply direct flame to the stems/ root crown until dead. Use only when surrounding fuels have high enough moisture content to keep from igniting.

Dense Native Plantings: Mayapple (*Podophyllum peltatum*), Bloodroot (*Sanguinaria canadensis*), and other native plants (see Ontario Invasive Plant Council BMP) have been able to outcompete Garlic Mustard when planted at densities of 9-11 plants per m². Best used in combination with other control measures.

DISPOSAL

- If Garlic Mustard plant material was cut or pulled before flowering, it can be left on site to decompose.
- If Garlic Mustard was cut or pulled while flowering or seeding, place material in heavy duty garbage bags and seal. Place bags in direct sunlight for at least 1 week. Dispose of in landfill or burn.
- Do not remove soil from the site unless it is being disposed of in a landfill.
- DO NOT COMPOST.