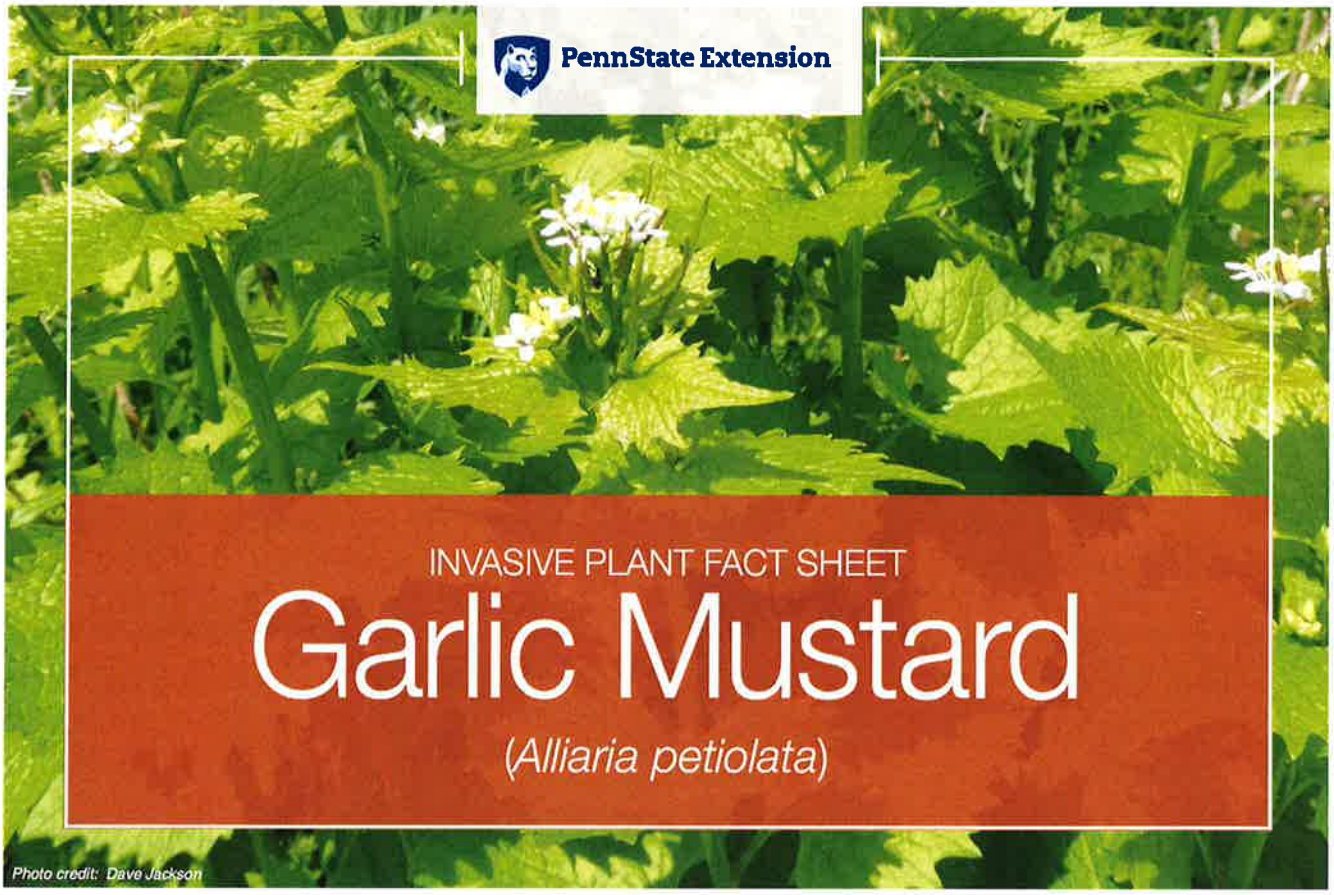


Background

Garlic mustard (*Alliaria petiolata*) is an herbaceous member of the mustard family (Brassicaceae) brought over by early European colonizers. First documented in New York in 1868, it was used as a source of food and medicine. This plant's biennial life cycle consists of a ground-level, or "basal," year and a reproductive, or "bolt," year. Garlic mustard's vigorous reproduction has enabled it to spread from coast to coast, where it blankets habitats with moist, rich soils. A prolific seeder, it forms dense monocultures, leaving little room for native plants.

Description

Year 1, basal year:

Size: Less than 8 inches tall

Leaves: Kidney bean shaped, rounded teeth, and highly variable in size, each leaf is usually less than 4 inches across. The leaves form a basal rosette, meaning all the leaves emerge around a central, underground stem. Produce a garlic odor when crushed.

Year 2, bolt year:

Size: Highly variable, up to 3 feet tall.

Leaves: Heart-shaped, each 2 to 4 inches across, with pointed, irregular teeth.

Flowers: Early in spring, clusters of four-petaled flowers emerge at the uppermost growing tip.

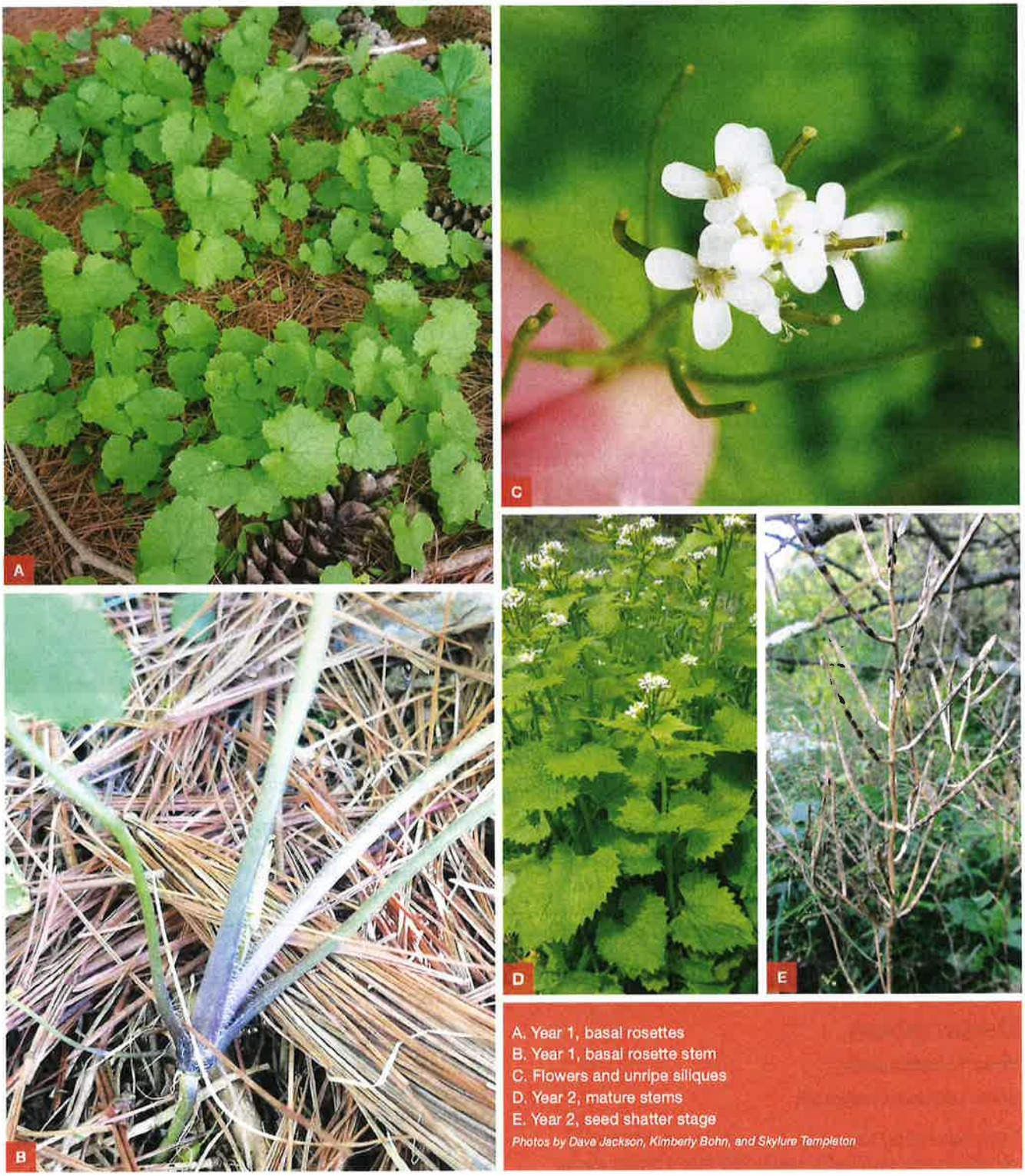
Fruit: By summer, the flowers are replaced by branched stems bearing the seed pods, or siliques. At first green, they become brown and brittle when ripe, a stage referred to as "seed shatter." There is wide variability in silique size and exact number of pods. The individual seeds are tiny and brown, each less than ¼ inch long.

Look-alikes

Many native members of the mustard family, such as cut-leaf toothwort (*Cardamine concatenata*), also have cross-shaped white flowers with four petals. However, garlic mustard leaves are unique with their simple, kidney- or heart-shaped leaves in contrast to the compound leaves of the native species.

Dispersal

As an herbaceous biennial, it propagates solely through seed. In the spring of their second year, garlic mustard rosettes rapidly elongate their stems and produce a flowering head. Each plant will release many, sometimes thousands, of highly mobile seeds. Light enough to be carried by wind, they can also travel in water or by soil movement. The seeds also remain viable for long periods—over five years in optimal conditions.



A. Year 1, basal rosettes
B. Year 1, basal rosette stem
C. Flowers and unripe siliques
D. Year 2, mature stems
E. Year 2, seed shatter stage

Photos by Dave Jackson, Kimberly Bohn, and Skylure Templeton

Site

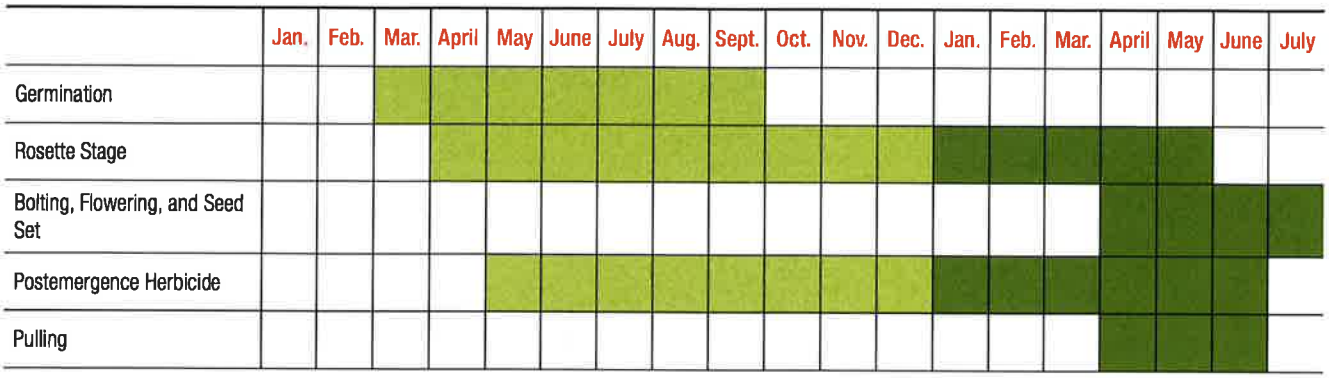
Suited to a wide range of habitat types, garlic mustard thrives especially well in areas with a disturbed overstory and basic soil pH. They are shade tolerant and will often spread from forest edges and openings to mature forest understories.

Control

Garlic mustard has a taproot, and unlike some invasive herbaceous perennials, it does not regenerate from root fragments. Therefore, this is one of the few invasive plant species that can be controlled manually by pulling. Manual operations that completely remove shoot tissue will prevent regrowth. Plants should be pulled before the seed shatter stage. Individuals hold

Management Calendar

The management calendar for garlic mustard emphasizes treatment prior to seed shatter. The rosette stage represents a year-long window for herbicide treatment.



Treatment and Timing

Treatment	Timing	Herbicide	Product Rate	Comments
Pulling	Before seed shatter stage	N/A	N/A	Small infestations are effectively controlled by hand pulling. Grasp the leaves and stem, remove the entire taproot, bag, and destroy. This can be done anytime before the seed has ripened and dried, called the seed shatter stage.
Selective Postemergence	Before flowering	Garlon 3A or Vastlan (triclopyr) plus DMA 4 IVM (2,4-D)	1.5 quarts/acre or 1 quart/acre plus 68 ounces/acre	Postemergence applications of water-soluble triclopyr formulations plus 2,4-D amine are useful when target plants are growing among desirable grasses or other monocots. This broad-spectrum combination will leave most grasses unharmed and has little soil activity. This mix can also be used to control most broadleaf herbaceous species. A surfactant (e.g., Alligare 90) needs to be added.
Nonselective Postemergence	Before flowering	Aquaneat (glyphosate) plus Garlon 3A or Vastlan (triclopyr)	3 quarts/acre plus 2 quarts/acre or 1.5 quarts/acre	This is a nonselective combination that would be effective when there is no advantage to using the selective mixture described above or when you are also treating invasive grasses or woody species. An additional benefit is that this mix will effectively control most any species you encounter during the operation. Glyphosate has been shown to be effective even in the dormant season, as long as temperatures are above freezing. A surfactant (e.g., Alligare 90) needs to be added. If using a different glyphosate product from the one listed here, check the label to see if a surfactant should be added; some come premixed.

their flowers for several weeks, giving the population staggered blooming periods. For this reason, it is a "best" practice to bag and remove pulled plants from the site, as even early pulling treatments probably include some plants that have viable seed.

Though garlic mustard must reproduce using seed, relying on preemergent herbicides to target the seed bank is rarely advisable for this species because of the season-long germination window. Preemergent herbicides lose efficacy quickly and are nonselective, making them a poor choice of treatment. Treating during the rosette stage with spot foliar spray is a more targeted approach and can be done anytime during the basal year. Foliar applications can be applied anytime the aboveground temperature is above freezing. Applying in the late fall through winter and early spring of the basal year avoids accidental overspray on nontarget species.

A selective mix useful for treating biennials is water-soluble triclopyr plus 2,4-D amine. This combination does not injure grasses or most other monocots. Preserving native groundcover is desirable, as the garlic mustard seed bank will quickly take advantage of open niche space. This mix is useful for most broadleaved plants, but it will not be effective against woody species.

If targeting both grasses and woody species, such as the various invasive shrubs, in addition to garlic mustard on the same site, a nonselective herbicide mix is advised. A mixture of glyphosate plus triclopyr (2:1 ratio) will be effective against almost any species you encounter, whether grass, forb, or woody. The application rate provided here is more concentrated than needed to kill garlic mustard. To retain the ability to control difficult species and apply an appropriate

dose to less resilient targets, dilute the mixture by half and adjust your spray pattern. Apply as normal to garlic mustard, and twice as heavy for more difficult targets, such as invasive shrubs. In this manner, you can use one mix to treat many species, and dose each as needed.

The approach to treating garlic mustard is to target it early in its cycle and as selectively as is practical. By targeting these plants selectively, either through pulling or spot herbicide treatment, the greatest amount of nontarget plants can be preserved to prevent reinfestation by garlic mustard. Though individual plants are easy to control, due to their huge seed banks and season-long germination period, clearing one flush of garlic mustard may simply invite another. Persistence and a long-term approach to control is key with this species.

Prepared by Skylure Templeton, Art Gover, Dave Jackson, and Sarah Wurzbacher. Reviewed by Norris Muth, Amy Jewitt, and Andrew Rohrbaugh.

extension.psu.edu

Penn State College of Agricultural Sciences research and extension programs are funded in part by Pennsylvania counties, the Commonwealth of Pennsylvania, and the U.S. Department of Agriculture.

Produced by Ag Communications and Marketing

Code EE0379

03/20pod