

Controlling Non-Native Invasive Plants in Ohio Forests: *Ailanthus*



Kathy Smith, Extension Program Director–Forestry
School of Environment and Natural Resources
The Ohio State University

Annemarie Smith, Invasive Species Forester
Ohio Department of Natural Resources
Division of Forestry

Ailanthus (*Ailanthus altissima*), also known as tree-of-heaven, is a moderate sized (60 to 80 feet in height), deciduous tree first introduced into the United States from Asia in the late 1700s for use as an urban landscape tree and in strip mine reclamation in the Eastern United States. In many ways ailanthus is an ideal invasive—it grows rapidly (sprouts can attain a height of 6 to 12 feet the first year and grow 3 feet or more per year), is a prolific seeder, a persistent stump and root sprouter, and an aggressive competitor that thrives in full sunlight. It also produces an allelopathic compound

that suppresses the growth of many native woody and herbaceous species. It will grow in relatively infertile, shallow soils of varying pH, and is highly tolerant of poor air quality.

Identification

Ailanthus trees may be commonly mistaken for black walnut, sumac, or butternut. To correctly identify a tree as ailanthus look for a tree with:

- **Leaves**—pinnately compound, 12 to 36+ inches long, with 11 to 27 leaflets that are green on upper side and grayish green on lower side; leaflets



Figure 1. *Ailanthus* twig, leaf, bark, and glandular teeth.

long and tapered with lobed bases and smooth edges. Each leaflet has one to several glandular teeth near the base (Figure 1).

- **Twigs**—stout, light chestnut brown, smooth to velvety with large tan bumps (lenticels) and a spongy pith, heart-shaped leaf scars; easily broken.
- **Bark**—pale gray and smooth with vertical streaking that develops into light tan fissures with age.
- **Flowers**—in large terminal clusters (up to 20 inches) of small yellowish green flowers, appearing from April to June. Male and female flowers commonly on separate trees.
- **Fruit**—winged fruit (samara), color ranges from yellow green to reddish brown, containing single seed, born in clusters (panicles) visible from mid to late summer and often persistent until following late winter or spring (Figure 2).

*Note: All parts of *ailanthus* have a strong offensive odor (particularly the male flowers), often described as smelling like rotting peanuts or cat urine.*



Figure 2. Immature winged fruit.

Control Methods

Methods effective in controlling *ailanthus* depend on plant size, the size of the infestation, potential non-target impacts, and a landowner's comfort level with those methods. While not always easy to control, *ailanthus* less than 8 inches in diameter have proven considerably easier to control than larger trees. Small *ailanthus* trees, perhaps up to ½ inch to 1 inch in diameter, can be controlled by physical means or with foliar herbicides. Larger trees, up to about 8 inches in diameter, can be effectively controlled using basal herbicide application, with the need for occasional follow-up to control sprouting. Trees larger than 8 inches are commonly more difficult to control whether by basal spraying, cut stump herbicide application, or herbicide injections as all of these methods may result in a need for follow-up treatments to control sprouting. Frilling or girdling is not commonly recommended for killing *ailanthus*, as it almost always results in prolific sprouting. **Whatever method is used, it will be important to monitor treated areas to make sure that 100% control is achieved.** Any trees that survive the initial treatment should be re-treated along with any new sprouts or seedlings that appear. For a more detailed description of the methods covered below see OSU Extension fact sheet *Controlling Undesirable Trees, Shrubs, and Vines*, OSU Extension Forestry Fact Sheet F-45, and *Herbicides Commonly Used for Controlling Undesirable Trees, Shrubs, and Vines in Your Woodland*, F-45 Supplement-06.

Environmental note: Many of the following herbicides are labeled to be mixed with a penetrating basal oil, diesel fuel, or kerosene as their carrier agent. The choice to utilize basal oil (particularly a methylated seed oil) instead of diesel fuel or kerosene will result in a more environmentally friendly practice.

Mechanical Control

Small infestations of small plants can be pulled, dug, cut, or mowed. Because none of these methods remove the entire tree (including roots) they must be repeated until food reserves are exhausted and

the tree dies. Pulling or digging of small plants is most effective if done when the ground is moist. Cutting and mowing is most effective when initiated in early summer when food reserves are at their lowest. Again, the key to any mechanical control is to repeat frequently until the food reserves are exhausted.

Mechanical control is generally not the best choice when dealing with larger trees. Cutting large stems often stimulates the production of hundreds of sprouts. Control methods that follow are more effective in controlling larger plants or larger populations of smaller plants.

Foliar Herbicide

Foliar spraying is a method of control in which a dilute herbicide is sprayed directly on the leaves. Herbicides need to be applied sometime after the plant is in full leaf and before the onset of fall color in order to maximize effectiveness. Generally herbicides are applied to wet the leaves but not to the point of runoff.

Exercise caution when applying foliar herbicide. This method should only be used when the target plants are within easy reach of the sprayer. Spraying directed at taller or otherwise less accessible plants can damage or kill valuable non-target plants through herbicide drift or overspray. Herbicides recommended for foliar spraying of *ailanthus* in a forest setting are listed in Table 1.

Basal Bark Application of Herbicide

Basal bark applications are commonly used to control small to medium sized *ailanthus* by spraying the circumference of the lower 12–18 inches of the trunk with an herbicide in an oil carrier. This method is very effective in controlling trees up to



Figure 3. Basal bark application.

Table 1. Herbicides recommended for foliar spraying of *ailanthus*.

Herbicide	Example Brand Names	Comments ¹
glyphosate	Roundup herbicides, Accord herbicides, and other herbicides containing at least 41% glyphosate	Apply solution of 2% herbicide in water (vol/vol) when leaves are green; add a surfactant if not in herbicide.
	Groundwork Ready to Spray Foam Weed and Grass Killer and others	Ready to use formulations should be at least 1% glyphosate. Follow directions on label.
triclopyr	Garlon 3A, Tahoe 3A	Apply 2% solution (vol/vol) of herbicide in water when leaves are green.*
	Garlon 4, Garlon 4 Ultra, Tahoe 4E, Remedy	Apply 1.5% solution (vol/vol) of herbicide in water.*

*A surfactant at .25% vol/vol rate may be added to the various triclopyr formulations when foliar spraying.

¹These comments are not intended to be a substitute for the herbicide labels. To ensure the safe and effective use of the herbicides recommended in this publication read the label and MSDS (Material Safety and Data Sheet).

8 inches in diameter; larger trees can be controlled but research and experience is limited in regards to the success rate; therefore, follow-up treatments will be necessary if sprouting occurs.

Current research and experience suggests that basal bark treatments can be applied effectively May through October, and may be most effective in the later part of that window. Herbicides recommended for basal spraying are listed in Table 2. To avoid the unintentional killing of desirable plants when basal spraying, special care should be taken to avoid over-spraying (spraying that does not strike the targeted trunk) or excessive spraying to run-off. Basal bark treatments should only be applied when the trunk is dry.

Cut Stump Herbicide Treatment

Traditionally cut stump treatments have been an effective method for controlling larger *ailanthus*, though sprouting may occur and require one or more follow-up treatments.

Table 3 contains both water carried and oil carried herbicides for cut stump application. Herbicides carried in water should be applied to the outer 1/3 of the top of the stump within minutes of making the cut. These herbicides have proven to be most effective on *ailanthus* when applied late May through September.

Oil soluble herbicides should generally be applied to the entire cut surface and sides of the stump. When using an herbicide carried in oil, immediate application is not as crucial as when using an herbicide carried in water. These herbicides have proven to be most effective on *ailanthus* when applied from late May through November.

Hack & Squirt (herbicide injection)

Hack & squirt (or herbicide injection) involves introducing an herbicide into an *ailanthus* tree through spaced cuts made around the trunk of the tree with an ax, hatchet, or tree injector. When using an ax or hatchet, small amounts of herbicide

Table 2. Herbicides recommended for basal treatment of *ailanthus*.

Herbicide	Example Brand Names	Comments ¹
triclopyr	Pathfinder II RTU	Ready to use formulation; do not dilute.
	Garlon 4, Garlon 4 Ultra, Tahoe 4E, Remedy	Apply solution of 20% herbicide in a basal or penetrating oil, diesel, or kerosene.
imazapyr	Stalker, Chopper	Mix 8 to 12 ounces in enough basal oil or diesel fuel to make one gallon.
triclopyr + imazapyr	Garlon 4, + Stalker or equivalent	Mix 15 to 20% Garlon 4 + 3 to 5% Stalker in a basal or penetrating oil, diesel fuel, or kerosene.

Table 3. Herbicides recommended for cut stump treatments of *ailanthus*.

Herbicide	Example Brand Names	Comments ¹
glyphosate	Roundup Pro, Accord, and others	Apply solution of 60% herbicide in water. Effective at killing juvenile stems that are less than 2 inches in diameter. Not effective against larger stems.
triclopyr	Pathfinder II RTU	Apply full strength, do not dilute.
	Garlon 4, Tahoe 4E, Remedy	Apply solution of 20% herbicide in basal oil, diesel fuel, or kerosene.
imazapyr	Stalker, Chopper	Apply solution of 20% herbicide in basal oil, diesel fuel, or kerosene.
triclopyr + imazapyr	Garlon 4, + Stalker or equivalent	Mix 15 to 20% Garlon 4 + 3 to 5% Stalker in a basal or penetrating oil, diesel fuel, or kerosene.

¹These comments are not intended to be a substitute for the herbicide labels. To ensure the safe and effective use of the herbicides recommended in this publication read the label and MSDS (Material Safety and Data Sheet).



Figure 4. Cut stump application.



Figure 5. Hatchet used for spaced cuts (hack) with herbicide applied in cut (squirt).

are applied to each cut using a pint or quart spray bottle (such as those available at garden stores). When using an injector, the herbicide is automatically applied to the cut when the cut is made. Several types of injector systems are available including one that utilizes an herbicide shell. The choices between using an ax or hatchet versus an injector, and the type of injector, depend on individual preference, the herbicide to be used, and the size

of the job. Because the herbicide is applied to only a small area, this method minimizes the potential for non-target effects through overspray, drift, or runoff. However, non-target species can still be impacted if they are connected to the targeted plant through root grafts. This method can result in extensive sprouting and requires follow-up treatments. Herbicides recommended for hack & squirt or injection systems are listed in Table 4.

Table 4. Herbicides recommended for hack & squirt or injection treatments of *ailanthus*.

Herbicide	Example Brand Names	Comments ¹
Triclopyr	Garlon 3A, Tahoe 3A	Leave 3 to 4 inches between hack mark centers. Apply 1 ml (0.03 ounces) of undiluted herbicide per hack mark.
Imazapyr	Habitat	Dilute solution: Mix 8–12 fl. oz. herbicide with 1 gal. of water. Apply 1 ml of dilute solution per hack mark at 1 inch intervals. Concentrated solution: Mix 2 qts. of herbicide with no more than 1 qt. of water. Apply 1 ml of concentrated solution per hack mark at 3 inch intervals.
	Stalker, Arsenal	Mix 8–12 fl. oz. of herbicide with 1 gal. of water. Apply 1 ml of diluted herbicide per hack mark—hack marks are no more than 1 inch between edges.
	Arsenal AC	Dilute solution: Mix 6 fl. oz. of herbicide with 1 gal. of water for a dilute solution. Apply 1 ml of solution per hack mark at 1 inch intervals. Concentrated solution: Use undiluted product or mix with up to 75% water, by volume. Apply 1 ml of solution per hack mark at 3 inch intervals.

¹These comments are not intended to be a substitute for the herbicide labels. To ensure the safe and effective use of the herbicides recommended in this publication read the label and MSDS (Material Safety and Data Sheet).

Summary

Label recommendations should be followed to maximize the potential for successful control. **At a minimum, monitor treated ailanthus trees for two years to determine if complete control is achieved.** Trees that resprout or are not completely killed by the first treatment will require a follow-up treatment.

Herbicides, like all pesticides, are approved (labeled) for specific uses by the Environmental Protection Agency. Approved uses and application

methods are listed and described on the pesticide's label. The herbicides listed in this fact sheet were appropriately labeled at the time of publication. Because pesticide labeling may change at any time, you should verify that a particular herbicide is still labeled for your intended use. At the time of this writing, copies of most herbicide labels and MSDS could be obtained online at the Crop Data Management System web site [http:// www.cdms.net/manuf/manuf.asp](http://www.cdms.net/manuf/manuf.asp). Others are available through the individual manufacturer's web site.

Ohio State University Extension and the Ohio Division of Forestry do not endorse any of the products mentioned in this fact sheet and assume no liability resulting from the implementation of these recommendations.

EMPOWERMENT THROUGH EDUCATION

Visit Ohio State University Extension's web site "Ohioline" at: <http://ohioline.osu.edu>

Ohio State University Extension embraces human diversity and is committed to ensuring that all research and related educational programs are available to clientele on a nondiscriminatory basis without regard to race, color, religion, sex, age, national origin, sexual orientation, gender identity or expression, disability, or veteran status. This statement is in accordance with United States Civil Rights Laws and the USDA.

Keith L. Smith, Ph.D., Associate Vice President for Agricultural Administration and Director, Ohio State University Extension

TDD No. 800-589-8292 (Ohio only) or 614-292-1868