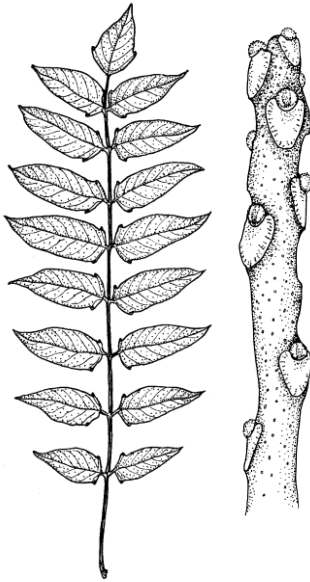


## Tree-of-heaven

*Ailanthus altissima* (Mill.) Swingle  
Quassia Family (Simaroubaceae)



### DESCRIPTION

Tree-of-heaven, also known as ailanthus, Chinese sumac, and stinking sumac, is a rapidly growing, deciduous tree in the mostly tropical Quassia Family. All parts of the tree, especially the flowers, have a strong, offensive odor, which some have likened to peanut butter or cashews. Correct identification of tree-of-heaven is essential. Several native trees and shrubs also have pinnately compound leaves, including sumac, ash, and black walnut and could be confused with tree-of-heaven. Staghorn sumac (*Rhus typhina*), native to the eastern U.S., is distinguished from ailanthus by its fuzzy, reddish-brown twigs, erect, red, fuzzy fruits, and leaflets with toothed margins.

**Height** - Mature trees can reach 80 feet or more in height.

**Stems** - Tree-of-heaven has smooth trunks with pale gray bark, and twigs that are smooth and light chestnut brown, especially in the dormant season. The wood of ailanthus is soft, weak, coarse-grained, and creamy white to light brown in color.

**Leaves** - Its large, alternately arranged compound leaves are 1–4 feet in length, and are composed of 11–25 leaflets. Each leaflet has one to several glandular teeth near the base, a characteristic that can be used to distinguish tree-of-heaven from other species with alternate, pinnately compound leaves.

**Flowers** - In late spring, clusters of small, yellow-green flowers appear near the tips of branches. The male flowers are particularly malodorous.

**Fruits and seeds** - Seeds are produced on female trees from late summer to early fall in flat, winged fruits called samaras. The fruits, which are in large conspicuous clusters, are reddish-orange when they first mature, but become tan as they age. They may remain on the trees for long periods of time but are eventually dispersed by the wind.

**Roots** - Tree-of-heaven spreads by root shoots; roots remaining in the ground after pulling or cutting are capable of producing new trees.



*samaras*

## **DISTRIBUTION AND HABITAT**

Tree-of-heaven was first introduced to America, from central China, by a gardener in Philadelphia, PA, in 1784; by 1840 it was commonly available from nurseries.

In Pennsylvania, and throughout the northeastern United States, tree-of-heaven has become widely naturalized. It is common in disturbed urban areas, where it sprouts up just about anywhere including vacant lots, alleys, sidewalks, parking lots, along railroad tracks, and streets. Away from cities, it is commonly seen in fields, roadsides, fencerows, and forest edges and openings.

## **EFFECTS OF INVASION**

Nationally, *Ailanthus* has become an agricultural pest and may occur as seedlings that pop up by the hundreds in recently planted fields, or as persistent thickets in rocky, untillable areas. Tree-of-heaven is a prolific seed producer, grows rapidly, and can overrun native vegetation. Once established, it can quickly take over a site and form an impenetrable thicket. *Ailanthus* trees also produces toxins that prevent the establishment of other plant species. The root system is aggressive enough to cause damage to sewers and foundations.

## **REPRODUCTION AND METHODS OF DISPERSAL**

Tree-of-heaven reproduces both sexually, through seeds, and asexually by vegetative sprouts. Flowering occurs late in the spring (June in the mid-Atlantic region of eastern United States). The species is dioecious, with male and female flowers on separate trees. Fruits are papery, somewhat twisted, winged samaras that are reddish in color at first. Samaras occur in large clusters from September to October and may persist on the tree through the following winter. One study reported that an individual tree can produce as many as 325,000 seeds per year. Established trees also produce numerous suckers from the roots and resprout vigorously from cut stumps and root fragments.

Tree-of-heaven has been shown to produce a chemical (ailanthone), which inhibits the growth of many other plants under experimental conditions and may contribute to its ability to form large pure stands. The use of ailanthone as an herbicide is also being investigated. Other plants in the Quassia family are known to produce chemicals that are fungicidal or insecticidal; activity against viruses and cancer cells has also been documented.

## **CONTROLS**

**Mechanical** - Tree-of-heaven is probably best controlled by manual removal of young seedlings. Seedlings are best pulled after a rain when the soil is loose. This facilitates removal of the entire root system, which may resprout if left in the ground. Plants should be pulled as soon as they are large enough to grasp; after the taproot has developed, pulling is extremely difficult.

The removal of rootstocks by hand digging is a slow but sure way of destroying plants like tree-of-heaven that re-sprout from their roots. The work must be thorough to be

effective as every piece of root that breaks off and remains in the soil may produce a new plant. Such a technique is only suitable for small infestations and around desirable species of trees and shrubs where other methods are not practical.

Manually operated tools such as brush cutters, power saws, axes, machetes, loppers, and clippers can be used to cut ailanthus. This is an important step before many other methods are tried, as it removes the aboveground portion of the plant.

Girdling involves manually cutting away bark and cambium tissues around the trunks of undesirable trees such as ailanthus. This is a relatively inexpensive method and is done with an ordinary ax in the spring when the trees are actively growing. Hardwoods are known to resprout below the girdle unless the cut is treated with herbicides. Although it may be undesirable to leave standing dead trees in an area, this technique has been shown to reduce stump sprouting in live oaks, and may be a useful technique for controlling tree-of-heaven.

Saplings may be trimmed back by tractor-mounted mowers on level ground, or by scythes on rough or stony ground. Unwanted vegetation can be removed faster and more economically in these ways than by manual means and with less soil disturbance. However, these methods are non-selective weed eradication techniques. They reduce the potential for biological control through plant competition and open up new niches for undesirable vegetation. In addition, wildlife forage is eliminated.

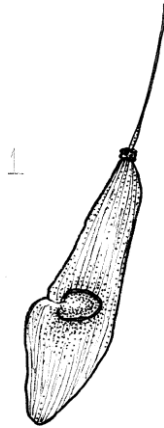
Saplings usually require several cuttings before the underground parts exhaust their reserve food supply. If only a single cutting can be made, the best time is when the plants begin to flower. At this stage the reserve food supply in the roots has been nearly exhausted, and new seeds have not yet been produced. After cutting or chopping with mechanical equipment, tree-of-heaven resprouts from root crowns in greater density if not treated with herbicides.

**Chemical** - Glyphosate, either sprayed onto the leaves or painted onto a freshly cut stump will kill the plant. Herbicides are directly applied to the cambium area around the edges of freshly cut stumps. Application must occur within 5–20 minutes of cutting to ensure effectiveness. To make sure that the herbicide gets into the root system, it is best to apply this herbicide in late summer or early autumn while the plant is translocating nutrients to its roots.

**Biological** - No biological controls are known at this time.

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