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Illinois Nature Preserves Commission

VEGETATION MANAGEMENT GUIDELINE

Tree-of-Heaven (*Ailanthus altissima* [Miller] Swingle)

SPECIES CHARACTER

DESCRIPTION

Tree-of-heaven, also occasionally referred to as stink tree or Chinese sumac, is a medium-sized, deciduous tree, averaging 60 feet (18m) tall, with recorded heights of over 100 (30m) feet. Leaves are alternate, pinnately compound, with paired, lanceolate leaflets that taper to a pointed tip. Leaves may contain from 11 to 41 leaflets. Leaflets are up to 6 inches (15cm) long, smooth to lightly pubescent and often coarsely toothed near the base of the leaflet. *When crushed, leaflets emit an unpleasant odor.* Bark is light gray or brown to darker brown, and smooth, with occasional vertical, shallow furrowing. Twigs are generally quite stout and contain caramel-colored, continuous pith. The tree-of-heaven is a member of the Simaroubaceae family. The tree's 1/4 inch, yellowish-green flowers occur in showy, branched clusters from late spring to early summer. Yellowish-orange to reddish-brown, winged fruits up to 2 inches (5cm) in length appear in clusters from late summer through autumn. Each fruit contains one seed.

SIMILAR SPECIES

Tree-of-heaven may be easily confused with some native Illinois trees and shrubs that have compound leaves. In particular, black walnut (*Juglans nigra*), butternut (*Juglans cinerea*), winged sumac (*Rhus copallina*), smooth sumac (*Rhus glabra*), and staghorn sumac (*Rhus typhina*) may be mistaken for tree-of-heaven. One characteristic that distinguishes tree-of-heaven from all these similar species is the foul odor produced when crushing its leaves or scraping its bark.

Black walnut leaves, on the other hand, will often emit a fragrant odor when crushed. Black walnut may also be distinguished from tree-of-heaven by its chocolate brown to black, deeply furrowed bark, large hairy buds, leaflets that are toothed completely from base to tip, and large (2 inch or 5cm) rounded fruits containing a hard nut. Butternut can be differentiated from tree-of-heaven by its bark, which is deeply furrowed, producing scaly, elevated ridges; its completely toothed leaflets, and its rust-colored, pubescent fruit up to 2 inches long. Both black walnut and butternut also have chambered piths, unlike the continuous pith of tree-of-heaven.

Winged sumac can be separated from tree-of-heaven by the sumac's winged stalk that connects the leaflets. Staghorn sumac's extremely pubescent twigs easily distinguish it from tree-of-heaven's smooth ones. Staghorn sumac and smooth sumac can also be distinguished by their fully toothed leaves. All three of the sumacs may be separated from tree-of-heaven by their autumn clusters of crimson to bright red, round fruits.

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Tree-of-heaven may also be confused with Chinese sumac (*Rhus chinensis*), another nonnative species. Chinese sumac grows to 25 feet

in height and has a spreading growth form. The pinnately compound leaves are arranged alternately on the stems and have a winged rachis similar to the native winged sumac. Chinese sumac bears showy white flowers in summer and has round, hairy, red or orange fruits in fall.

Tree-of-heaven should be accurately identified before attempting any control measures. If identification of the species is in doubt, the plant's identity should be confirmed by a knowledgeable individual and/or by consulting appropriate books.

DISTRIBUTION

Tree-of-heaven is native to China, and was introduced to the eastern U.S. via Europe in the late 1700's for ornamental purposes. It is also reported to have been brought to the U.S. because it is a host tree for the silk-producing insect known as the Cynthia moth (*Samia cynthia*). Additionally, Chinese immigrants widely imported the tree, particularly in the western U.S., for medicinal and cultural purposes. Due to tree-of-heaven's rapid growth and high adaptability to a wide range of conditions, it became a common commodity in commercial nurseries by the mid-1800's. Tree-of-heaven's rapid growth, prolific seed production and tolerance to a wide-range of conditions, particularly disturbed areas, caused it to escape quickly and become widely established. The tree is found from Canada to Argentina, including the majority of the continental U.S., although it is more abundant in the eastern half of our country. Tree-of-heaven can be found throughout Illinois.

HABITAT

Tree-of-heaven is well-adapted to highly disturbed areas and is often abundant in urban areas left fallow, such as fencerows, alleys, vacant lots, railroad yards, and even in cracks between sidewalks and in highway medians. Because it has become so widespread, tree-of-heaven has also invaded rural areas that have been subjected to some excessive disturbance, including forests, prairies, and rocky bluffs and glades.

Tree-of-heaven can tolerate a wide variety of soil conditions, including droughty, highly compacted, and highly acidic (pH below 4.1) soils. It also appears to thrive in highly polluted and very dusty conditions. It is intolerant of complete shade, but can thrive well enough to form dense colonies in as much as 50-60% shade.

LIFE HISTORY

The life span of tree-of-heaven is short, generally less than 50 years, although individual trees have been known to survive three times that long. Tree-of-heaven reproduces by both dispersed seed and root suckers. Seedlings emerging from seed become quickly entrenched, forming a deep taproot in just 3 months. Tree-of-heaven also regenerates aggressively with root suckers at distances of up to 50 feet (15m) from the parent plant, allowing for the swift colonization of favorable areas. Young tree-of-heaven can reach a height of 8 feet (2.4m) in the first year if in moderate to full sun. Tree-of-heaven is also known to be allelopathic; in one study, toxins in the leaves were analyzed and found to be toxic to at least 45 other plants.

EFFECT UPON NATURAL AREAS

Tree-of-heaven is rarely found in healthy natural communities where natural

processes such as fire are intact. Since it is intolerant of deep shade, it is usually not found in mature, closed- canopy forests. However, this opportunistic tree can become stubbornly entrenched in natural areas that have experienced even minor disturbance, such as grazing, logging, or natural acts like wind damage or flooding. Once the tree gets a foothold, it will often form dense colonies, preventing establishment by other species and thus preventing natural succession by native species that could occur after a disturbance event. Tree-of-heaven has been known to invade dry and dry-mesic upland forests, disturbed hill prairies, cliffs, rock outcrops and talus slopes along bluff lines.

CURRENT STATUS

Tree-of-heaven is not categorized as an exotic weed under the Illinois Exotic Weed Act (525 ILCS 10).

CONTROL RECOMMENDATIONS

RECOMMENDED PRACTICES IN HIGH-QUALITY NATURAL COMMUNITIES

Initial effort in areas of heavy and light infestation Efforts to control tree-of-heaven infestations have been poorly documented in the literature. The effects of burning on tree-of-heaven have not been explored. Mowing promotes vigorous re-sprouting, but may control the tree if done several times over a season to deplete root reserves. Seedlings may be hand pulled if done prior to taproot development. Be sure to remove the entire root, since any portion left in the ground can produce a new seedling. Cutting or girdling accompanied by herbicide application appears to be the best options for control of established saplings or mature trees in high quality natural communities.

Tree-of-heaven may be cut or girdled, followed immediately by an application of glyphosate herbicide (trade name Roundup). A 25.0% active ingredient solution in water has proven effective for many woody species. However, some managers' experiences indicate that a higher concentration may be necessary with tree-of-heaven to prevent re-sprouting. The herbicide should be applied by spraying cut surfaces with a hand sprayer or by using a sponge-type applicator to wipe the stump or girdled area. Herbicide treatment appears to be most effective in summer and late fall, but has also been proven satisfactory in the dormant season as long as the ground is not frozen. **Do not spray so heavily that the herbicide drips off the target species**. Roundup is a non-selective herbicide and will kill any plant it comes in contact with.

Garlon 3A and Tahoe3A, amine formulations of triclopyr, are also a very effective herbicide for controlling tree-of-heaven. Garlon 3A may be applied to cut surfaces at a 22.0% active ingredient solution rate in water, or undiluted. As with glyphosate, they should be applied immediately after cutting. Triclopyr amine may be more effective than glyphosate for dormant season applications. **Do not spray so heavily that the herbicide drips off the target species**. Triclopyr amine will kill non-target broadleaf plants it comes in contact with. Preferred season for using it in high quality natural areas is in the dormant season to reduce potential drift injury; however, best results may occur from fall applications.

Basal bark treatment of tree-of-heaven with a mixture of 10.0% active ingredient solution of ester formations of triclopyr (Garlon 4 or Tahoe 4E) in a plant-based or

mineral carrier oil has proven highly effective. Basal bark herbicide application can be done anytime during the year when the ground is not frozen, but dormant season application reduces the potential for drift injury. **Do not spray so heavily that herbicide drips off the target species**. Avoid using it if snow, ice, or water is present on the ground. Spray basal part of the tree, up to 2 feet above the ground, thoroughly wetting the bark, including any ground sprouts.

Both glyphosate and triclopyr should be applied while backing away from the treated stumps to avoid walking through the wet herbicide. By law, herbicides may only be applied according to label instructions and by licensed herbicide applicators or operators when working on public properties.

Maintenance control

When possible, hand pull new seedlings to prevent establishment of tree-of-heaven. Re-sprouting may occur after cutting and herbicide treatment; follow above procedures to eradicate new sprouts.

RECOMMENDED PRACTICES IN BUFFER AND SEVERELY DISTURBED SITES

Initial effort in areas of heavy and light infestation

Same as above, plus additional practices below:

A 1.0% active ingredient solution of glyphosate (trade name Roundup) applied as a spray to the foliage of seedlings will effectively eradicate tree-of-heaven. Roundup should be applied carefully by hand sprayer, and spray coverage should be uniform and complete. **Do not spray so heavily that herbicide drips off the target species**. Glyphosate is a non-selective herbicide and will kill any plant it comes in contact with.

Glyphosate should be applied while backing away from the treated area to avoid walking through the wet herbicide. By law, herbicides may only be applied according to label instructions and by licensed herbicide applicators or operators when working on public properties.

Maintenance control

When possible, hand pull new seedlings to prevent establishment of tree-of-heaven. Re-sprouting may occur after cutting and herbicide treatment; follow above procedures to eradicate new sprouts.

FAILED OR INEFFECTIVE PRACTICES

Mowing will cause vigorous re-sprouting actually causing vegetative spread. Mowing of tree-of-heaven is not recommended as a control measure in any natural areas.

Cutting without herbicide treatment will result in vigorous re-sprouting. Girdling without herbicide treatment during the spring, summer or winter will likely result in re-sprouting.

Some applications of glyphosate have not resulted in complete eradication of individual trees; if re-sprouting occurs after initial glyphosate treatment, a second application may be necessary.

Garlon 4 (triclopyr) mixed with diesel fuel and applied as a basal bark treatment has

been effective at eradicating tree-of-heaven but replacing diesel fuel with a plant-based oil is preferred to minimize damage to the environment.

The Cynthia moth, *Sambia cynthia*, feeds on tree-of-heaven. However, no research has been done into using this moth as a biological control for this tree species.

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PERSONAL COMMUNICATIONS

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