



# Common buckthorn

*Rhamnus cathartica*

Common buckthorn is native to Eurasia and was introduced to North America in the 1880s as an ornamental plant. Its abundant fruit is dispersed by birds and it spreads rapidly, replacing native vegetation and lowering species diversity. Like many non-native shrubs, common buckthorn leafs out early in spring and retains its leaves late into fall, shading out spring wildflowers and tree seedlings.

There is some evidence that common buckthorn is allelopathic, producing chemicals that inhibit the growth of other species.

Buckthorn alters ecosystem processes in complex ways. Its leaves and fruit are high in nitrogen. Invasive earthworms, which need rich litter, break it down rapidly, destroying beneficial fungi and exposing bare soils in the process. These soils provide ideal conditions for buckthorn germination and seedling growth but many native trees and shrubs need the beneficial fungi and will not reproduce without it.

Common buckthorn is a primary overwintering host for the soybean aphid. It is also an alternate host for alfalfa mosaic virus and crown fungus, which causes oat rust disease.

## Identification

### Habit:

Common buckthorn is a deciduous woody shrub or small tree that ranges from 3 to 7.5 m (10-25 ft) in height. When young, it has multiple stems but with age it becomes a tree with a single trunk that may reach 25 cm (10 in) in diameter.

### Leaves:

Common buckthorn has simple, dark green leaves, with toothed margins and 3 to 5 pairs of prominent leaf veins, which curve as they approach the leaf tip. The leaves are alternate, but some may appear opposite.



Paul Wray, Iowa State University, Bugwood.org

### Bark/Stems:



Chris Evans, River to River CWMA, Bugwood.org

Common buckthorn twigs often have thorns at their tips, between the terminal buds. Branches are dotted with light-colored vertical raised marks. The bark is brown to gray and peels with age. The inner bark is orange.



Chris Evans, River to River CWMA, Bugwood.org

### Flowers:



Robert Vidéki, Doronicum Kft., Bugwood.org

Common buckthorn has small, green-yellow, four-petaled flowers that are clustered along the stem. Male and female flowers are borne on separate shrubs. The fragrant flowers appear in May and June.

### Fruits/Seeds:

Common buckthorn has abundant small, round fruits that ripen from green to purplish black. They are only produced on female plants but have high germination rates. Unripe fruits contain emodin, which has a laxative effect.



Suzan Campbell, MNFI

### Habitat:

In its native range, common buckthorn occupies a surprising range of habitats: dry open forests, alkaline fens, sunny open sites and alvar. In North America, it occurs in disturbed and undisturbed habitats including roadsides, old fields, prairie fens, savannas and a variety of woodlands.

## Similar species

### Glossy buckthorn

The related invasive glossy buckthorn (*Frangula alnus*) has untoothed leaves and flowers with five petals rather than four. It lacks a thorn at the tip of its branches and its terminal buds are not covered by scales. It has 8 or 9 leaf veins rather than the 3 to 5 of common buckthorn.



### Alder-leaved buckthorn



The native alder-leaved buckthorn (*Rhamnus alnifolia*) is less than 1 m (3 ft) tall and has leaves with tiny rounded teeth and 6 or 7 pairs of veins. Its flowers lack petals but have five sepals, rather than four. It often grows in fens and other wetlands.

### Dogwoods

Dogwoods (*Cornus* spp.) have opposite leaves rather than alternate and their leaf margins are untoothed. The fruit and flowers are arranged in clusters on reddish stems. The fruit is blue or white, rather than deep purplish black.



## Reproduction/Dispersal

Reproduction in common buckthorn is by seed, although it can also regenerate from root and stump sprouts. It is usually dioecious, with male and female flowers on separate plants. Female plants are far more numerous than male plants and bear abundant fruit. In ideal conditions, it can produce fruit at four years of age although this varies tremendously depending on light and moisture availability.

Buckthorn fruits are widely dispersed by animals. Also, many fruits fall directly beneath the parent shrubs, resulting in a dense carpet of seedlings. Although the fruit is apparently bitter and persists on the shrub through winter, many species including birds, deer and elk eat and transport fruit.

Seeds are also dispersed by mice, which eat and store them; some may germinate from abandoned caches. Seed will not germinate until the fleshy fruit is eaten or rots away. Seed that has been eaten may germinate without overwintering, but germination rates are higher for seeds that overwinter.

Common buckthorn seed remains viable in the soil from two to six years. The seedbank beneath mature buckthorn may have 500-1,000 seeds per meter in the top few inches of soil. Following removal of mature shrubs, thousands of seedlings rapidly germinate and must be considered when formulating control strategies.

## Planning a control program

Resources for invasive species control invariably fall short of the actual need, so it is important to prioritize sites for treatment and plan carefully. Assessing both the scope of the problem and any available resources is a critical first step:

- Map known populations. Is the species widely distributed throughout the region? Or is it just beginning to appear?
- Does it occur on high value sites? Important hunting or recreational lands? High quality natural areas? Sites with high cultural value?
- How is it distributed? Is it sparsely scattered in otherwise native vegetation? Does it cover large expanses of low quality habitat?
- Is there the potential to utilize volunteers?

Given this information, develop a strategy for control:

1. Prioritize high value sites where success can be achieved for treatment.
2. Choose appropriate control methods, given site conditions and available resources.
3. If using herbicide, be sure to read the product label before finalizing plans. Is there potential for harm to non-target species? Have you made adequate provisions to minimize damage?
4. Do these control methods require any permits (i.e. herbicide application in wetlands, prescribed burning)?
5. Focus on mature female plants, particularly those in full sun with abundant fruit.
6. Eradicate smaller satellite populations.
7. Treat larger core infestations of lower value as resources permit.
8. Monitor to ensure desired results are being achieved; adapt management to improve success.

### Best survey period

Because common buckthorn leafs out early and retains its leaves late in fall in much of the state, it is often easiest to locate for mapping or control efforts in early spring or late fall when the leaves of native vegetation are absent or have changed color. Female plants are also conspicuous in fruit, though male plants are not.

### Documenting occurrences

In order to track the spread of an invasive species on a landscape scale, it is important to report populations where they occur. The Midwest Invasive Species Information Net-

work (MISIN) has an easy-to-use interactive online mapping system. It accepts reports of invasive species' locations from users who have completed a simple, online training module for the species being reported. It also offers the potential for batch uploading of occurrence data for any invasive species. Herbaria also provide a valuable and authoritative record of plant distribution. The University of Michigan Herbarium's database can be searched online for county records of occurrence, for example. When common buckthorn is first encountered in a county where it had not been known previously, specimens should be submitted to the Herbarium to document its presence. Check the "Online Resources" section for links to both of these resources.

## Control

A primary goal in controlling this species is to prevent seed production and dispersal. A variety of techniques including both mechanical and chemical controls may be most effective and should be tailored to the specific conditions on the site. It is critical to monitor the site to ensure that cut stumps or treated plants do not resprout and the seedbank is exhausted. Where abundant seed sources are present nearby, monitoring may be required indefinitely.

### Mechanical control

In the very earliest stages of invasion, when only seedlings and young plants are present, mechanical controls such as pulling and repeated cutting may be adequate to control or eradicate common buckthorn. Mechanical control methods are particularly useful where volunteers are available. These methods are impractical in larger, established infestations, with mature shrubs, but may effectively supplement the use of herbicide.

### Hand-pulling

Common buckthorn seedlings can be hand-pulled easily, particularly when the soil is moist and the population is small. Pull steadily and slowly to minimize soil disturbance and tamp down the soil afterwards. Tools such as the Weed Wrench® or Root Talon® provide additional leverage, facilitating the removal of somewhat larger plants.

### Cutting/Mowing

Cutting or mowing mature common buckthorn shrubs stimulates resprouting unless the cut surfaces are treated with herbicide. Mowing may be helpful in maintaining open areas by preventing the establishment of seedlings.

### Chemical control

In most cases, effective control of common buckthorn requires the use of herbicide. Factors that should be considered when selecting an herbicide for use on a particular site include proximity to water or wetlands, presence or absence of desirable native vegetation, potential for erosion and the

effectiveness of the herbicide under consideration on common buckthorn. Because buckthorn typically remains green much later than many native species, fall treatment may minimize damage to desirable plants.

### General considerations

Anyone applying herbicides as part of their employment must become a certified pesticide applicator. In addition, certification is required for the use of some herbicides under any circumstances. The certification process is administered by the Michigan Department of Agriculture and Rural Development and a link to their website is included in the "Online Resources" section.

A permit from the Michigan Department of Environmental Quality is usually required to apply herbicide where standing water is present—in wetlands, along streams, rivers or lakes, or over open water. A permit is also required for herbicide use below the ordinary high water mark along the Great Lakes or Lake St. Clair shoreline, whether or not standing water is present. A link to their website is included in the "Online Resources" section.

A number of adjuvants or additives may be used with herbicides to improve their performance including mixing agents, surfactants, penetrating oils and dyes. Some are included in premixed products while others must be added. Adjuvants do not work with all products; consult the product label to determine which adjuvants may be used with a specific herbicide formulation.

Dyes are useful in keeping track of which plants have been treated and making spills on clothing or equipment apparent. Some premixed herbicide include them or they can be added to others. Clothing dyes such as Rit® can be added to water soluble herbicides, while other products require oil-based dyes. Consult the product label for specific instructions.

Crop Data Management Systems, Inc. (CDMS) maintains a database of agro-chemicals that includes herbicide labels for specific products. Herbicide labels contain information on application methods and rates, specific weather conditions, equipment types, nozzles etc. to provide the desired coverage and minimize the potential for volatilization or drift. They also contain critical information about the potential for damage to valuable non-target species. A link to the CDMS website is included in the "Online Resources" section.

**Read the entire pesticide label before use. Follow all directions on the label.**

### Herbicide specifics

Triclopyr provides effective control of broad-leaved plants but does not kill grasses or some conifers. It is available in both amine (e.g., Garlon 3A®) and ester (e.g., Garlon 4 Ultra®) formulations. The amine formulation can be safely used in wetlands.



Triclopyr can be used as a foliar spray once buckthorn is fully leafed out in spring until just before it changes color in fall. The ester formulation should be used with a vegetable oil based multi-purpose adjuvant (e.g. SprayTech<sup>®</sup> Oil) and the amine formulation should be used with a wetland-approved non-ionic surfactant (e.g., Cygnet Plus<sup>®</sup>).

Triclopyr can also be used in conjunction with cut surface treatments; cut-stump, girdling and frilling. Treatments may be applied throughout the year including when snow is present, however control may be reduced in early spring when the sap is beginning to flow or during periods of drought in summer.

Ester formulations are particularly effective for root or stem-sprouting species such as common buckthorn because the triclopyr persists in the plant until it dies. The ester formulation should be used with a penetrating oil (e.g., AX-IT<sup>®</sup>), which improves effectiveness and increases the amount of time after cutting in which treatment can occur. Penetrating oil also facilitates absorption in basal bark treatment.

In non-target plants, triclopyr residues in the soils can damage non-target species via root uptake. Use caution in high-quality forests.

In wetlands or other sensitive areas, the amine formulation may be used for cut-surface treatments but must be painted onto the cut surface immediately or it will be ineffective. It can also be used for drill and fill techniques.

Triclopyr is particularly effective when used in conjunction with imazapyr (e.g., Stalker<sup>®</sup>). Imazapyr acts over an extended period of time and can persist in the soils—an advantage in providing greater control. However, since it is non-selective it can also kill valuable non-target species. Imazapyr is considerably more expensive than triclopyr.

### **Foliar application**

Foliar application of herbicide can be useful on sites with extensive common buckthorn populations and few desirable natives. Herbicide should be applied after heavy spring sap flow to actively growing plants, although during periods of drought or other stress, it may not be effective. It can be applied to buckthorn foliage with squirt bottles, backpack sprayers or boom-mounted sprayers.

The product label for the specific herbicide being used provides essential information on coverage; how much of the foliage should be treated and how wet it should be. Herbicide labels also contain information on specific weather conditions, application modes, equipment types, nozzles etc. to provide the desired coverage and minimize the potential for volatilization or drift.

The herbicide applicator is responsible for managing drift and damage to non-target vegetation. Wind speeds between 3 and 10 miles per hour are best for foliar herbicide spraying. At higher wind speeds, herbicide may be blown

onto adjacent vegetation or water bodies.

At lower wind speeds, temperature inversions can occur, restricting vertical air movement. Under these conditions, small suspended droplets of herbicide can persist in a concentrated cloud and be blown off-target by variable gusts of wind. Ground fog indicates the presence of a temperature inversion, but if no fog is present, smoke movement on the ground can also reveal inversions. Smoke that layers and remains trapped in a cloud at a low level indicates an inversion, while smoke that rises and dissipates indicates good air mixing.

In hot, dry weather, herbicide can evaporate rapidly. Setting equipment to produce large droplets can help compensate for this. In general, follow all directions on the label of the specific herbicide being used, in order to prevent damage to non-target vegetation or water bodies.

### **Cut-stump**

Cut-stump treatment may be used in any season except during periods of heavy sap flow in spring. Some chemicals are less effective at lower temperatures or when plants are dormant. Refer to the herbicide label for specific details. Product labels list what adjuvants may be used to increase effectiveness of the herbicide; penetrating oils only work with ester formulations, for example. Similarly, dyes, which are useful in keeping track of which stems have been treated, work with specific herbicide formulations.

Cut-stump treatment is useful for species like common buckthorn that normally resprout after cutting. After the stems have been cut, they are painted with concentrated herbicide, using a squirt bottle or wicking applicator. Small stems can be cut several inches above the ground so that both the sides and the cut surface may be treated.

On large stems, cuts should be made as close to the ground as possible and only the cambium—the thin layer where active growth occurs, just inside the bark—should be treated.

Treated plants should be monitored for at least a year as they may still resprout. New stems may be treated with a foliar spray, or cut and retreated.

### **Basal bark**

Basal bark treatment can be used on stems that are less than six inches in diameter at any time except during heavy sap flow in spring. It should not be used when snow or water prevent herbicide from being applied at the ground level or when stems are saturated. It is most useful during the dormant season. Typically, ester formulations of herbicide are used with penetrating oils.

In basal bark treatment, concentrated herbicide is applied to a band of bark around common buckthorn stems extending up 18 inches from the ground. Basal bark treatment is most effective on younger stems with thin bark.

## Drill and fill/Injection

Drill and fill, and injection techniques are useful on larger trees. They leave the tree in place to break down over time, providing valuable habitat and structure at the same time. They can be used any time of year except during spring sap flow.

The drill and fill technique entails drilling holes into the tree at a downward angle and filling them with a measured amount of concentrated herbicide using a squirt bottle. One hole should be drilled for each inch of diameter.

Specialized injection tools are also available to inject herbicide pellets below the bark. They are precise and require little preparation or clean-up. They are also expensive, however and may be unwieldy in dense brush.

Because concentrated herbicide is used it is possible to exceed the annual per acre amount that is allowed for a given product on sites with large common buckthorn infestations. To use this technique safely and legally, calculate the maximum volume of herbicide (at the required concentration) that can be used without exceeding the per acre maximum in advance. Consult the product label for specifics.

## Prescribed burning

In fire-adapted communities, prescribed burning may enhance control of common buckthorn over the long term, but should be considered as part of an integrated management plan for the site as it will stimulate the species over shorter time spans. When prescribed burning is initiated, it should be supplemented with other control methods.

### General considerations

A permit is required before implementing a prescribed burn. The Michigan Department of Natural Resources (DNR) is responsible for issuing burn permits in the Upper Peninsula and Northern Lower Peninsula unless a municipality wishes to do so. Municipalities located in the Southern Lower Peninsula issue burn permits under authority of the state law. A link to the DNR local fire contacts web page is included in the "Online Resources" section. In the Southern Lower Peninsula, contact the local Fire Marshall for permits and more information. Some municipalities require insurance coverage before a permit is issued, to cover the cost of damages if the fire should escape.

Before initiating a program of prescribed burning, a written burn plan establishing the criteria necessary for starting, controlling, and extinguishing a burn is required. The burn plan includes details such as specific weather conditions, locations of control lines, ignition pattern, equipment and personnel needed, contingency plans, and important phone numbers. The burn plan is essentially the "prescription" for how to conduct the burn safely while accomplishing the management objectives.

If other invasive species that are stimulated by burning are present on the site, planning should incorporate additional control methods to eradicate them.

### Prescribed burning specifics

Burning alone does not usually provide effective control of common buckthorn as it will only top-kills mature plants and stimulate resprouting. Common buckthorn seeds also germinate more readily on bare soils that have been exposed by fire.

Prescribed burning can be useful in fire-adapted communities once mature buckthorn has been removed and the native vegetation that provides fuel recovers. When adequate fuel is present, burning will kill seedlings and help exhaust the seedbank. A five second treatment with flame from a propane torch around stems that are less than 4.5 cm ( 1.75 in) in diameter will also kill young plants.

If left untreated, common buckthorn can alter fire ecology in fire-adapted communities as fuels do not accumulate beneath it.

## Biological control

In recent years, investigators from CABI Bioscience Center in Switzerland and Minnesota DNR and the University of Minnesota have surveyed for suitable agents to control buckthorn in both Europe and the United States. Initial efforts to find biological controls for common buckthorn were combined with those for glossy buckthorn. It now appears that the two species are not as closely related as once believed and share few specialized arthropod pests. A number of insect species have been prioritized for further investigation and preliminary host specificity studies.

Buckthorn phytoplasma, a disease that affects buckthorn has been noted in Europe. It causes "witches brooms"—clusters of thin twigs that arise from a single point on a stem. Researchers at the University of Minnesota are looking for phytoplasma here in the United States, to see if it has already been introduced.

## Disposal of plant parts

When seedlings or young shrubs are pulled, they should be disposed of in a manner that will ensure that their roots will dry out completely. In addition, if fruit is present, it should be burned or bagged and placed in a landfill. Where this is not possible, any resulting seedlings will require monitoring and control.

Although landscape waste cannot generally be disposed of in land fills, Michigan law permits the disposal of invasive species plant parts. See the "Online resources" section for a link to the relevant legislation.



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## Online resources:

### CDMS - herbicide labels:

<http://www.cdms.net/LabelsMsds/LMDefault.aspx?t=>

### Fire Effects Information System, *Rhamnus cathartica*, *R. davurica*

<http://www.fs.fed.us/database/feis/plants/shrub/rhaspp/all.html>

### Invasive.org, European buckthorn

<http://www.invasive.org/browse/subinfo.cfm?sub=3070>

### Invasipedia at BugwoodWiki, *Rhamnus cathartica*

[http://wiki.bugwood.org/Rhamnus\\_cathartica](http://wiki.bugwood.org/Rhamnus_cathartica)

### Invasive Plant Atlas of New England, Common buckthorn

[http://www.eddmaps.org/ipane/ipanespecies/shrubs/Rhamnus\\_cathartica.htm](http://www.eddmaps.org/ipane/ipanespecies/shrubs/Rhamnus_cathartica.htm)

### Midwest Invasive Species Information Network, Common Buckthorn

<http://www.misin.msu.edu/facts/detail.php?id=12>

### The Michigan Department of Agriculture and Rural Development—Pesticide Certification

[www.michigan.gov/pestexam](http://www.michigan.gov/pestexam)

### The Michigan Department of Environmental Quality—Aquatic Nuisance Control

[www.michigan.gov/deqinlandlakes](http://www.michigan.gov/deqinlandlakes)

[http://www.michigan.gov/deq/0,4561,7-135-3313\\_3681\\_3710---,00.html](http://www.michigan.gov/deq/0,4561,7-135-3313_3681_3710---,00.html)

### Michigan Department of Natural Resources—Local DNR Fire Manager contact list

[http://www.michigan.gov/dnr/0,4570,7-153-30301\\_30505\\_44539-159248--,00.html](http://www.michigan.gov/dnr/0,4570,7-153-30301_30505_44539-159248--,00.html)

### Michigan's Invasive Species Legislation

Natural Resources and Environmental Protection Act 451 of 1994, Section 324.4130

<http://legislature.mi.gov/doc.aspx?mcl-324-41301>

### Michigan Legislation—landscape waste, disposal of invasive species plant parts

Natural Resources and Environmental Protection Act 451 of 1994, Section 324.11521, 2 (d)

<http://legislature.mi.gov/doc.aspx?mcl-324-11521>

### The Nature Conservancy's Weed Control Methods Handbook: Tools and Techniques for Use in Natural Areas

<http://www.invasive.org/gist/handbook.html>

### University of Michigan Herbarium - Michigan Flora Online

<http://michiganflora.net/>



## Quick reference - Common buckthorn

This chart has been provided as a convenience, to summarize the pros and cons of each herbicide and to present details on adjuvants, concentrations, etc. that do not fit into the discussion in the preceding sections. Although every attempt has been made to ensure accuracy, the product labels for the listed herbicides are the ultimate authority for their usage. Where there are conflicts, always follow the label directions. Techniques are listed in order of general preference by MDNR Wildlife Division staff but not all are suitable for wetlands or sensitive sites. Site conditions vary—choose a method that is best suited to conditions on the site being treated.

Anyone using herbicides in the course of their employment is required to be a certified pesticide applicator. Treatment in wetlands or over open water requires a permit from the Michigan Department of Environmental Quality.

These chemicals are available in a variety of formulations and concentrations. Concentration is listed below as a percentage of the active ingredient (AI) to facilitate use of different products. Always follow all directions on the product label including mixing instructions, timing, rate, leaf coverage and the use of personal protective equipment.

	<b>Herbicide</b>	<b>% A.I.</b>	<b>Adjuvant</b>	<b>Timing</b>	<b>Pros</b>	<b>Cons</b>
<b>Basal Bark</b>	Triclopyr ester (e.g., Garlon 4 Ultra <sup>®</sup> )	22-30%	Use a penetrating oil (e.g., AX-IT <sup>®</sup> ), unless it is already included in product, e.g. Michigan blend.	Use any time of year, including winter months EXCEPT during heavy spring sap flow OR when snow or water prevent application at ground level OR when stems are wet.	Relatively selective herbicide and technique. Less labor-intensive than many other techniques if conditions are appropriate.	Use only on stems that are >1/4 inch and <6 inches in diameter. Not approved for use in wetlands.
<b>Foliar Spray</b>	Triclopyr ester (e.g., Garlon 4 Ultra <sup>®</sup> )	2-3%	Use a vegetable oil based multi-purpose adjuvant (e.g. SprayTech <sup>®</sup> Oil).	After spring sap flow, while plant is actively growing but before leaves change color. Fall ideal as many natives go dormant earlier.	Kills buckthorn very effectively. Broad-leaf specific—will not harm sedges and grasses.	Since it must be used during the growing season, it is not a suitable technique for high-quality sites with many broad-leaf natives. Not approved for use in wetlands.
<b>Foliar Spray</b>	Triclopyr amine (e.g., Garlon 3A <sup>®</sup> , Renovate <sup>®</sup> )	2-3%	Use a wetland-approved non-ionic surfactant (e.g. Cygnet Plus <sup>®</sup> ).	After spring sap flow, while plant is actively growing but before leaves change color. Fall ideal as many natives go dormant earlier.	Safe for use in wetlands. Kills buckthorn very effectively. Broad-leaf specific—will not harm sedges/grasses.	Since it must be used during the growing season, it is not a suitable technique for high-quality sites with many broad-leaf natives.
<b>Cut-stump</b>	Triclopyr ester (e.g., Garlon 4 Ultra <sup>®</sup> ) + Imazapyr (e.g., Stalker <sup>®</sup> )	15-18% + 3%	Use a penetrating oil (e.g., AX-IT <sup>®</sup> ).	Use any time EXCEPT during spring sap flow.	Most effective herbicide combination for this technique (in killing buckthorn—as well as many other plants). Can be used on stems > 6 inches in diameter.	Imazapyr is highly active in the soil and may kill adjacent plants. Not approved for use in wetlands.
<b>Cut-stump</b>	Triclopyr ester (e.g., Garlon 4 Ultra <sup>®</sup> )	31-44%	Use a penetrating oil (e.g., AX-IT <sup>®</sup> ), unless it is already included in product, e.g. Michigan blend.	Use any time EXCEPT during spring sap flow.	Relatively selective herbicide and technique. Can be used on stems > 6 inches in diameter.	Not approved for use in wetlands.
<b>Cut-stump</b>	Triclopyr amine (e.g., Garlon 3A <sup>®</sup> , Renovate <sup>®</sup> )	31-44%		Use any time EXCEPT during spring sap flow.	Safe for use in wetlands. Relatively selective herbicide and technique. Can be used on stems > 6 inches in diameter.	Cuts must be treated IMMEDIATELY—will not mix with penetrating oil.
<b>Injection</b>	Triclopyr amine (e.g., Garlon 3A <sup>®</sup> , Renovate <sup>®</sup> )	27%		Use any time EXCEPT during spring sap flow.	Extremely selective herbicide and technique for large specimens. Safe for use in wetlands.	Labor intensive. (Inject 1 ml into cambium at 3-4 inch intervals around entire trunk).