*Michigan Department of Natural Resources*
*Michigan Natural Features Inventory*
*2/2012*

# Black locust

*Robinia pseudoacacia*

Black locust is native to the southern Appalachians and the Ozarks, where it occurs on slopes and forest edges. It has been planted in 48 states and was noted as spreading in jack pine barrens in Michigan as early as 1888. It tolerates a wide range of soil conditions, and spreads clonally as well as by seed. Its dense thickets shade out native vegetation.

As a legume, black locust fixes nitrogen and soil nitrogen levels are higher under old trees. It produces more leaf litter and that litter has much higher nitrogen concentrations than most native tree species. Soils under black locust also have elevated levels of phosphorus and calcium.

In low nutrient habitats, this facilitates invasion by weedy, nitrogen-loving non-natives, which slows and sometimes alters patterns of succession. Although it initially invades disturbed areas, it also poses a particular threat to prairies, savannas and open woods.

Black locust contains several toxic components in its leaves, stems, bark and seeds. Ingestion results in both gastrointestinal and neurological effects which are particularly acute in horses and may be fatal.


Chris Evans, River to River CWMA, Bugwood.org

## Identification

**Habit:**
Black locust is a deciduous, medium-sized tree ranging in height from 12-25 m (40-82 ft) and 30-60 cm (12-24 in) in diameter, although trees in Michigan have reached 1.5 m (5 ft) in diameter. It has a narrow crown and an open, irregular form with contorted branches. Black locust has an extensive network of lateral roots and forms dense clones.

**Leaves:**
Black locust leaves are alternate and pinnately compound with 7-21 leaflets per leaf. The rounded leaflets are 2.5-5.0 cm (1-2 in) long and the leaves are up to 35.5 cm (14 in) long.


Paul Wray, Iowa State University, Bugwood.org

**Bark/Stems:**


Paul Wray, Iowa State University, Bugwood.org

Black locust has green stems, smooth brown bark when young. It has paired spines on the twigs at the leaf bases. As it ages, the bark of mature trees becomes thick, tan to gray-brown, scaly and deeply furrowed with flat ridges.

**Flowers:**


Paul Wray, Iowa State University, Bugwood.org

Black locust flowers are white and very fragrant, with five irregular petals. They are arranged in a long, dangling cluster of 10-25 flowers. They are insect pollinated and compete with native plants for pollinators. They bloom in May and June.

**Fruits/Seeds:**
Seedpods form in the fall but persist over winter, pods are smooth, dark-brown, flat, and contain 4-8 flat, brown seeds. The seeds have a highly impermeable seed coat and can remain viable in the seed bank for many years.


Paul Wray, Iowa State University, Bugwood.org

**Habitat:**
Black locust is very shade intolerant. It can grow in many soil types except those with a high water table. It was widely planted in Michigan and is now colonizing old fields, disturbed woodlands, prairies, pine barrens and oak savanna. It establishes well in early-successional communities.

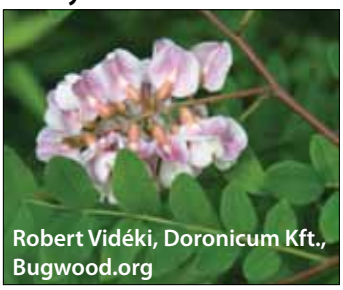
## Similar species

### Honey locust

The native honey locust (*Gleditsia triacanthos*) has leaves with smaller, more numerous leaflets. Leaves may be doubly compound; a single leaf has multi-leafletted leaflets branching off a central axis. Its clustered flowers are not conspicuous or showy.


John D. Byrd, Mississippi State University, Bugwood.org

### Bristly locust


Robert Vidéki, Doronicum Kft., Bugwood.org

The southern native bristly locust (*Robinia hispida*) is a shrub, with brushlike hairs on its stems and fruit. Its showy flowers are pink, not white and its leaves have 13 or fewer leaflets, while black locust may have up to 21.

### False indigo

Although the non-native false indigo (*Amorpha fruitcosa*) has compound leaves with rounded leaflets, it is shrublike and its leaves are smaller. It also has purple flowers, rather than white. False indigo appears to be spreading in some parts of Michigan.


Leslie J. Mehrhoff, University of Connecticut, Bugwood.org

## Reproduction/Dispersal

Black locust reproduction is primarily vegetative, although it can also reproduce by seed. It sprouts from the roots and forms clones, particularly in sandy soils. It also sprouts easily from stumps in response to damage.

Black locust grows rapidly and matures early; some trees may produce seed at six years of age. Heavy seed crops occur at one or two year intervals.

The seeds have a hard, impermeable coat and require scarification to germinate. They are heavy and fall close to the parent tree, although birds may move them over longer distances. *Michigan Flora* notes that seeds may remain viable in the ground for up to 88 years. Seeds can accumulate in the soil a density of 29,817 seeds/acre in second-growth mixed forest. Densities are much lower in mature forest.

Trees begin suckering at four or five years of age. A fibrous network of roots connects a black locust grove, with the oldest trees in the center and younger trees around the periphery, In late-successional communities, black locust becomes rare, as the species is shade-intolerant.

## 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; do they consist of scattered single specimens? Or are extensive clones present?
- Note where spread is clonal or by single plants.
- 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?

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 the growth habit of the species, 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. Where clones are present, always treat the entire clone.
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

Black locust is most readily identified in May and June while in flower but its bark is distinctive year-round.

### 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 Network (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 black locust is first encountered in a county where it had not been known previously, specimens should be submitted to the Herbarium to docu-

ment its presence. Check the "Online Resources" section for links to both of these resources.

# Control

Black locust can be difficult to control. Because this species is strongly clonal, all stems in a clone must be treated. It is critical to monitor the site to ensure that cut and treated stumps do not resprout—if a single stem survives, the entire clone may regenerate.

## Mechanical control

Control of established black locust populations generally requires the use of herbicide although mechanical control may occasionally enhance the effectiveness of other methods.

### Hand-pulling/Digging/Bull-dozing

Since most black locust spread is vegetative, and saplings are connected underground, hand-pulling is not useful.

In general, damage to the root causes sprouting also. On highly disturbed sites, cutting trees and removing the roots with a bulldozer has been suggested but does not appear practical in most settings.

### Cutting/Mowing

Cutting without the use of herbicide produces prolific sprouts and is not advised. In a comparison of cut and uncut sites, those that had been cut had twice the growth rates of those that had not been cut, and began to flower in half the time.

### Grazing

In a North Carolina effort, browsing by a combination of cattle and domestic goats effectively controlled the height growth of black locust. After 4 seasons, all black locust were dead. Since black locust can be toxic to cattle, caution is advised. Black locust is raised specifically to feed domestic goats in Pakistan and New Zealand, and they appear to be a better choice for control.

## Chemical control

In most cases, effective control of black locust 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 black locust.

### 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, although spraying is generally used to control resprouts following other methods such as cut-stump treatment. The ester formulation should be used with a vegetable oil based multi-purpose adjuvant (e.g. SprayTech® Oil) and the amine formulation should be used with a wetland-approved non-ionic surfactant (e.g., Cygnet Plus®).

Triclopyr can also be used in conjunction with cut surface

treatments; cut-stump 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 black locust because the triclopyr persists in the plant until it dies. The ester formulation should be used with a penetrating oil (e.g., AX-IT®), 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. It can also be used for drill and fill techniques.

Triclopyr is often used in combination with imazapyr (e.g., Arsenal®). 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.

Triclopyr can also be used in combination with aminopyralid, which is lethal to legumes—an advantage in the case of black locust. Aminopyralid is particularly useful in providing effective control of black locust in grassland habitats. It controls broad leaf plants but does not harm grasses. It remains active in the soil for a long period of time and should not be used around trees. It is available in a formulation that includes the amine form of triclopyr (e.g., Milestone® VM Plus), for use in cut-stump treatment, frilling and injection. Since this product incorporates the amine form of triclopyr, it must be applied immediately or it will not be effective.

Aminopyralid (e.g., Milestone® VM) can also be mixed with the ester form of triclopyr for use in basal bark treatment as well as cut-stump treatment and frilling. Because it is water based and the ester form of triclopyr is oil based, they should be mixed with a penetrating oil that includes an emulsifier (e.g., Aquamix® Oil Plus). Periodic agitation of the mixture may be required also.

**Foliar application**

Foliar application of herbicide can be useful on sites with extensive black locust populations and few desirable natives. Herbicide should be applied after the leaves are fully expanded 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/ Frilling/Hack and squirt**

Cut-stump treatment may be used in any season except during periods of heavy sap flow in spring. It is useful for species like black locust that normally resprout after cutting. After the stems have been cut, they are painted with concentrated herbicide, using a spray 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. 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.

Frilling and "hack and squirt" are useful for larger trees. Downward cuts are made around the circumference of the trunk and the resulting cavity is immediately treated with herbicide, using a squirt bottle or backpack sprayer. Because the cambium is exposed and treated immediately, an amine formulation can be used.

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 of year 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 it is most useful during the dormant season. Typically, ester formulations of triclopyr are used with penetrating oils. When they are mixed with water-soluble herbicides such as aminopyralid, an emulsifier may also be helpful to aid in mixing. Some herbicide formulations may already include basal oils or dyes—refer to the product label for specifics.

In basal bark treatment, concentrated herbicide is applied to a band of bark around black locust 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 very easy to exceed the annual per acre amount that is allowed for a given product. Consult the product label for specifics.

## Prescribed burning

In fire-adapted communities, prescribed burning may enhance control of black locust over the long term, but should always 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**

Prescribed burning alone does not usually provide effective control of common black locust as it will only top-kill mature plants and stimulate resprouting. Black locust seeds also germinate more readily on bare soils that have been exposed by fire.

Burning can be useful in fire-adapted communities once mature black locust 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. Once trees have been top-killed by burning, the resprouts can be treated with herbicide. Similarly, burning following herbicide treatment can injure or kill any resprouts. Although resprouts may require additional treatment with herbicide, repeated burns will help deplete their root reserves.

In fire-adapted communities, if left untreated, black locust can alter fire ecology as fuels do not accumulate beneath it.

## Biological control

Black locust is susceptible to witches' broom disease caused by the virus *Chlorogenus robiniae* as well as fungal diseases that cause heart rot. It is also vulnerable to damage from two native insects, the locust borer (*Megacyllene robiniae*) and the locust leafminer (*Odontota dorsalis*).

## Online resources:

**CDMS - herbicide labels:**
*http://www.cdms.net/LabelsMsds/LMDefault.aspx?t=*

**Fire Effects Information System,** *Robinia pseudoacacia*
*http://www.fs.fed.us/database/feis/plants/tree/robpse/all.html*

**Invasive.org,** Black locust
*http://www.invasive.org/browse/subinfo.cfm?sub=3350*

**Invasipedia at BugwoodWiki,** *Robinia pseudoacacia*
*http://wiki.bugwood.org/Robinia_pseudoacacia*

**Invasive Plant Atlas of New England,** Black locust
*http://www.eddmaps.org/ipane/ipanespecies/trees/Robinia_pseudoacacia.htm*

**Midwest Invasive Species Information Network,** Black Locust
*http://www.misin.msu.edu/facts/detail.php?id=2*

**The Michigan Department of Agriculture and Rural Development—Pesticide Certification**
*www.michigan.gov/pestexam*

**The Michigan Department of Environmental Quality—Aquatic Nuisance Control**
*www.michigan.gov/deqinlandlakes*
*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*

**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—Black locust

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. In some cases, concentration is listed below as a percentage of the active ingredient (AI) to facilitate use of different products. Where this is not possible, the label recommendation for the example product is used. Always follow all directions on the product label including mixing instructions, timing, rate, leaf coverage and the use of personal protective equipment.

| | Herbicide | Conc. | Adjuvant | Timing | Pros | Cons |
|---|---|---|---|---|---|---|
| Basal Bark | **Triclopyr ester** (e.g., Garlon 4 Ultra®) + **Aminopyralid** (Milestone® VM) | 27% AI + 2% by volume | Use a penetrating oil with an emulsifier (e.g., Aquamix® Oil Plus). Some herbicide formulations may already include these. | Apply any time, including winter months, except when snow or water prevent applying to the ground or when stems are saturated. | Most useful in woods—doesn't change light levels, which helps inhibit resprouting. | Not approved for use in wetlands. |
| Cut-stump | **Triclopyr ester** (e.g., Garlon 4 Ultra®) + **Imazapyr** (e.g., Arsenal®) | 15-18% AI + 3% | Use a penetrating oil (e.g., AX-IT®). | Use any time EXCEPT during spring sap flow. | Very effective herbicide combination for this technique (in killing black locust—as well as many other plants). | Imazapyr is highly active in the soil and may kill adjacent plants.<br>Not approved for use in wetlands. |
| Girdle/Frill | **Triclopyr ester** (e.g., Garlon 4 Ultra®) + **Imazapyr** (e.g., Arsenal®) | 15-18% + 3% | Use a penetrating oil (e.g., AX-IT®). | Use any time EXCEPT during spring sap flow. | Useful in woods—doesn't change light levels, which helps inhibit resprouting. | Imazapyr is highly active in the soil and may kill adjacent plants.<br>Not approved for use in wetlands. |
| Injection | **Triclopyr amine** + **Aminopyralid** (Milestone® VM Plus) | Use undiluted product. | | Use any time EXCEPT during spring sap flow.<br>(Inject 1 ml into cambium at 3-4 inch intervals around trunk. | Extremely selective technique.<br>Safe for use in seasonably dry wetlands, sensitive areas. | Aminopyralid is highly active in the soil and may kill adjacent plants.<br>Somewhat labor intensive. |
| Foliar Spray | **Triclopyr ester** (e.g., Garlon 4 Ultra®) | 2-3% | Use a non-ionic surfactant (e.g. Cygnet Plus®, Nu-Film IR®). | Use on resprouts after cutting while plants are actively growing. | Useful tool for preventing regeneration of a clone. | May kill non-target species (broad-leaf natives).<br>Not approved for use in wetlands. |
| Cut-stump | **Triclopyr ester** (e.g., Garlon 4 Ultra®) | 27% | Use a penetrating oil (e.g., AX-IT®), unless it is already included in product, e.g. Michigan blend. | Use any time EXCEPT during spring sap flow. | Relatively selective herbicide and technique. | Not approved for use in wetlands. |
| Cut-stump | **Triclopyr amine** + **Aminopyralid** (Milestone® VM Plus) | Use undiluted product. | | Use any time EXCEPT during spring sap flow. | Relatively selective herbicide and technique.<br>Some formulations can be used in riparian areas around standing water or in seasonably dry wetlands. | Aminopyralid is highly active in the soil and may kill adjacent plants.<br>Cuts must be treated IMMEDIATELY. |

**Note:** Unless all stems in a clone are treated, black locust will regenerate.