Black Locust

(*Robinia pseudoacacia* L.)

Best Management Practices in Ontario

Ontario Invasive Plant Council

Environment and Climate Change Canada

Environnement et Changement climatique Canada

Foreword

These Best Management Practices (BMPs) provide guidance for managing invasive black locust (*Robinia pseudoacacia* L.) in Ontario. Funding and leadership for the production of this document was provided by Environment and Climate Change Canada, Canadian Wildlife Service - Ontario (CWS - ON). The BMPs were developed by the Ontario Invasive Plant Council (OIPC) and its partners to facilitate the invasive plant control initiatives of individuals and organizations concerned with the protection of biodiversity, agricultural lands, infrastructure, crops and natural lands.

These BMPs are based on the most effective and environmentally safe control practices known from recent research and experience. They reflect current provincial and federal legislation regarding pesticide usage, habitat disturbance and species at risk protection. These BMPs are subject to change as legislation is updated or new research findings emerge. They are not intended to provide legal advice and interested parties are advised to refer to the applicable legislation to address specific circumstances. Check the website of the Ontario Invasive Plant Council (www.ontarioinvasiveplants.ca) for updates.

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For more information on invasive plants in Ontario, please visit the following websites:
www.ontario.ca/invasivespecies, www.ontarioinvasiveplants.ca, www.invadingspecies.com or www.invasivespeciescentre.ca

Front and back cover photo courtesy of Ken Towle.

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Black locust.

Photo courtesy of Jon L. Peter.

Black locust can survive in many ecosystem and soil types including nutrient poor soils, readily colonizing disturbed or damaged ecosystems.

Photo courtesy of Ken Allison.

Introduction

Black locust (*Robinia pseudoacacia* L.), also known as false acacia, post locust and yellow, white or green locust, is a tree belonging to the pea (Fabaceae) family. It is native to the Appalachian Mountains and Ozark Plateau, with its native range reaching from central Pennsylvania to Alabama and Georgia. Because of its durability, adaptability to highly disturbed sites and because it burns well for firewood, it became a popular tree to plant in the early 1900s throughout North America. Its fast-growing nature makes it popular for mine reclamation, reforestation and erosion control, and it is still one of the most widely planted trees in North America. Black locust is commonly used for fence posts, mine timbers, poles, railroad ties, insulator pins, ship timber, nails for wooden ship construction, pulp, boxes, crates, etc. It is also a popular choice for woodworking projects, as the wood is naturally resistant to most rots.

Although its native range starts just a few hundred kilometres south of Ontario, black locust invasions can have a wide range of negative impacts on Ontario's native ecosystems and species, including Species at Risk. For this reason, it is important that control measures be taken on a site-by-site, priority basis. As a pioneer species, black locust can survive in many ecosystem and soil types, including nutrient poor soils, readily colonizing disturbed or damaged ecosystems. It is cold hardy and can withstand weather extremes, such as prolonged droughts, giving it an advantage over many native species. It aggressively invades ecosystems such as oak (*Quercus* spp.), beech-maple (*Fagus* sp. – *Acer* spp.) and aspen (*Populus* spp.) forests, and already fragmented native prairie and savanna ecosystems, where it forms dense colonies and shades out native plants, causing floristic homogenization (the increasing similarity of species composition over time). The roots of the black locust have nitrogen fixing nodules that can increase the nitrogen content in the soil, altering ecosystem structure and dynamics and causing a decrease in species richness. It is insect pollinated and may divert pollinators away from native plants. Many parts of the plant, including the leaves, inner bark, young shoots, pods and seeds, are toxic to humans and many animals, with horses being particularly susceptible. It reproduces through seeds but is extremely inclined to colonization through suckering (producing a number of new root sprouts), making physical control methods difficult and often impractical.

This document was developed to help guide the effective and consistent management of this invasive tree across Ontario.

Black locust leaf.

Photo courtesy of Central Lake Ontario Conservation Authority.

Description

Black locust (*Robinia pseudoacacia* L.) is a legume belonging to the pea (Fabaceae) family.

Morphology

Size and shape:

It is a medium-sized tree, averaging 12 to 30 m in height and 30 to 60 cm (up to 150 cm) in diameter. Its crown is narrow with an open, irregular form and contorted branches.

There are a variety of black locust cultivars available.

Photo courtesy of Jon L. Peter.

Stems:

Stems tend to be straight in forests but with spreading, curvy branches in open areas. The bark of young trees is brown or greenish, smooth and with conspicuous lenticels (pores) and spines. It becomes deeply tan or gray-brown and deeply furrowed with flat-topped ridges in older trees (key identification feature). The inner bark is orange.

The bark of young trees is smooth with conspicuous lenticels and spines.

Photo courtesy of Jon L. Peter.

The bark of older black locust trees are deeply furrowed with flat-topped ridges.

Photo courtesy of Bill McIlveen.

Leaves:

Leaves are deciduous, alternate, pinnately (odd) compound with 7 to 21 oval, smooth-edged leaflets (terminal leaflet present). These leaflets, each 30 to 50 mm long, are on a stalk that is 20 to 30 cm long, giving it a fern-like appearance. Dull bluish-green leaves turn yellowish-brown before falling off in autumn.

Seedlings and young sprouts have paired, 1.3 cm long stipular spines (resembling stubby thorns) at the base of their leaves. These modified stipules can persist for years and vary in size.

The leaflets are arranged on a 20 to 30 cm stalk, giving the leaves of black locust a fern-like appearance.

Photo courtesy of Central Lake Ontario Conservation Authority.

The paired stipular spines of young black locusts can persist for years and vary in size.

Photo courtesy of Central Lake Ontario Conservation Authority.

Roots:

The extensive network of fibrous, lateral roots produce suckers. Radial roots typically extend 1 to 1.5 times the tree height, though lengths of 50 m have been documented. Taproots are rare but have been documented at lengths of up to 7.6 m with deep lateral roots.

Flowers:

Fragrant clusters of 10 to 25 pea-like, white flowers hang from branches in late spring. Flowers have 5 irregular petals and the upper petal has a yellow blotch. Black locust trees typically flower for 10-20 days in May or June, approximately one month after the leaves emerge.

Fragrant clusters of 10 to 25 pea-like, white flowers hang from branches in late spring.

Photo courtesy of Bill McIlveen.

Seeds:

Smooth, flat, dark red-brown seed pods (key identification feature) are 7 to 12.7 cm long, and contain 4 to 8 flat, brown, bean-like toxic seeds each about 3 to 5 mm long. Seed pods form in fall and many persist on the tree through winter.

Each seed pod can contain up to one hundred seeds.

Photo courtesy of Ken Towle.

Lookalikes

Table 1: The main identification features of black locust in comparison to five species that may appear similar (lookalikes).

	Black Locust (*Robinia pseudoacacia*)	**Honey Locust** (*Gleditsia triacanthos*)	**Bristly Locust** (*Robinia hispida*)	**False Indigo** (*Amorpha fruiticosa*)	**Prickly-Ash** (*Zanthoxylum americanum*)	**Kentucky Coffee-Tree** (*Gymnocladus dioicus*)
	 Photo courtesy of Bill McIlveen.	 Photo courtesy of Jon L. Peter.	 Photo courtesy of Bill McIlveen.	 Photo courtesy of Bill McIlveen.	 Photo courtesy of Wasyl Bakowsky.	 Photo courtesy of Sally and Andy Wasowski, Wildflower.org.
Habitat	• Introduced to Ontario • Poor, dry, sunny locations, savannas, prairie, fencerows, roadsides, forest edges, valley slopes, limestone etc.	• Native to Southwestern Ontario, but rare outside of ornamental plantings • Moist, rich bottomland	• Introduced to Ontario (very rare) • Good to moderate drainage	• Native to Ontario • Alluvial soils, riverbanks, moist thickets etc.	• Native to Ontario • Fencerows and forest edges	• Native to Ontario • Moist, rich soils (floodplains) are typical but tolerates shallow, sandy or rocky soils
Height	• Up to 30 m	• Up to 30 m	• Up to 3.7 m	• Up to 5.1 m	• Up to 3 m	• 15 to 20 m
Stems	• Smooth bark; brown to green in young trees, tan to gray-brown, deeply furrowed ridges in older trees • Orange inner bark • Often form colonies with many suckers at margins	• Smooth, brownish/ dark grey bark with horizontal lenticels • Older trees deeply furrowed with scaly ridges • Orange inner bark • Wild plants have 3+ thorns (3-10 cm long) on branches and trunk; cultivars lack thorn but suckers may have them	• Brown straggly, woody bark • Branches are bristle • Covered	• Whitish bark with horizontal lenticels • Twigs more or less pubescent to almost glabrous	• Smooth bark, becoming furrowed, gray or brown with lighter blotches • Thicket-forming • Spread via suckers	• Thick, dark bark • Gray to grayish-brown • Often marked with deep, irregular furrows and plates that curl at their sides

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Leaves	• Pinnately compound (single) • 7-21 leaflets 30-50 mm long • Terminal leaflet present • Rachis 20-30 cm long • Bluish-green (yellowish-brown in autumn) • Paired stipular spines	• Pinnate to bi-pinnate leaves • 14-30 leaflets, 25-40 mm long • No terminal leaflet • Rachis 15-20 cm long • Glabrous • Dark green (some cultivars have yellow leaves in spring)	• Compound • 13 or fewer leaflets	• Pinnately compound • 13-25 rounded leaflets • Dull green marked with resinous dots • 10-30 cm long	• Pinnately compound • 5-11 toothed leaflets on prickly rachis, 10-20 cm long	• Pinnately compound • Leaves are the biggest of any Canadian tree, growing as big as 60 by 90 cm • Bluish-green
Flowers	• Fragrant white clusters of 10-25 pea-like flowers • Upper petal has a yellow blotch	• Green-white clustered • Not obvious or showy	• Rose-coloured • Pea-like • Brush-like hairs	• Purple • 6-8 mm long • Pea-like	• Greenish • Small • Small clusters appear before leaves	• Greenish-white inconspicuous flowers
Seeds	• Smooth, flat, dark red-brown pods are 7-12.7 cm long • 4-8 flat, brown, bean-like seeds 3-5 mm long	• Long, flat, curved, twisted, brownish Pods 15-40 cm • Bean-like seeds	• Bristle covered pods, 5-13 cm in length • Seeds 0.5 cm long, dark brown, very hard	• Oblong, compressed, rough pods	• Bright red capsule • Rounded, 4-5 mm wide • Spicy odour	• Hard, dark, leathery bean-like, 15-20 cm long pods • 4-7 seeds per pod

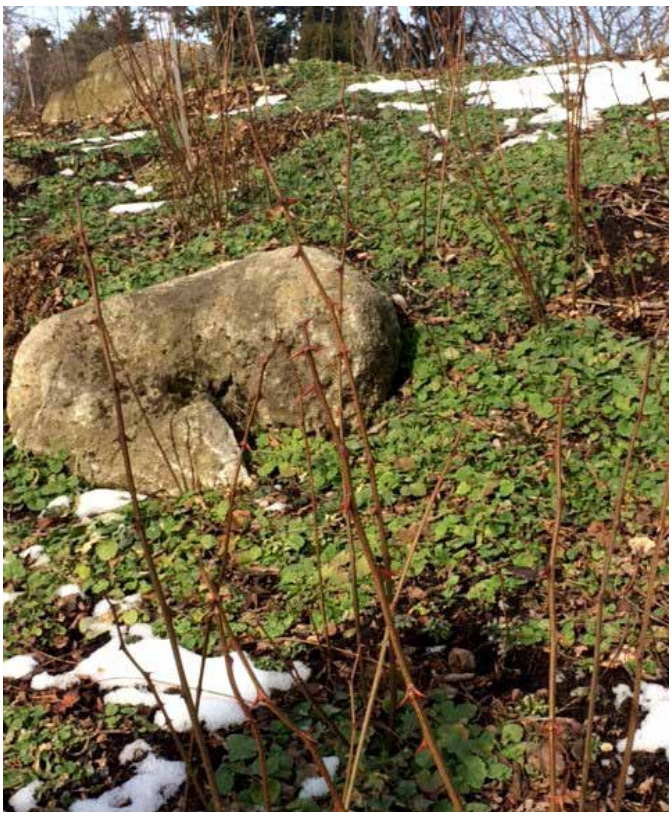
*General status according to *Species at Risk Act*

Biology and Life Cycle

Black locust is a fast growing but medium-lived deciduous tree with an average lifespan of about 80 to 90 years (rarely over 100). It reaches sexual maturity early, producing seeds after approximately 6 years and beginning to sucker after just 4 years. Although black locust can produce large quantities of viable seed, it primarily spreads by vegetative reproduction, suckering easily from roots and stumps, especially after being cut or damaged.

Fragrant, white flowers appear in showy, drooping (pendulous) racemes (an inflorescence having stalked flowers arranged singly along an elongated unbranched axis, with the flowers at the bottom opening first) after leaf emergence in May or June and are insect pollinated, though hummingbirds favour the tree as well.

Seed ripening takes place in late summer and early autumn (September to October), with seed pods persisting on the branches through the winter into early spring. Pods dry, crack open and seeds are dispersed from hanging pods between September and April. Black locust is a prolific seed-producer, with reports of seed densities of up to ~74 000 seeds/hectare in second-growth mixed forests, though lower numbers have been reported in mature forests. Heavy seed crops occur at 1 to 2 year (some report 2 to 3 year) intervals and trees produce seeds until about 60 years, with greatest productivity being between 15 to 40 years. Seeds are heavy and tend to fall close to the tree, though they can be dispersed by strong winds, birds and animals.



Black locusts spread primarily through suckering.
Photo courtesy of Jon L. Peter.

Seeds have a highly impermeable seed coat and can remain viable for decades. Although eaten by some small birds and mammals, they are generally less desirable to seed predators as a food source, resulting in a higher accumulation in the seed bank compared to native species. The impermeable seed coat requires scarification (cutting or breaking of the seed coat via abrasion, thermal stress or chemicals) as well as bare, mineral soil and light for successful germination. In nature, frost, rain and soil microbes carry out natural scarification. Temperature has been found to significantly affect germination rates, with a decrease in temperature resulting in a decreased germination rate. The ideal temperature range for germination is 18 to 21°C, but even at a range of 9 to 12°C germination rates (after scarrification) are relatively high. Though some sources cite

germination rates as high as 68% in its native range, most sources suggest that seed germination is much lower due to high seed coat impermeability and shade intolerance.

Seedlings have high survivorship compared to other native and non-native species. Growth rate is limited by plant density, insect infestation and disease. Pests of black locust include locust borer (*Megcallene robiniae*), some macrofungi (*Phellinus rimosus* and *Polyporus robiniophilus*), locust leafminer (*Odontota dorsalis*), locust twig borer (*Ecdytolopha insiticiana*), witches' broom (caused by *Chlorogenus robiniae* virus), Texas root rot (*Phymatotrichum omnivorum*) and coral rot (*Nectria cinnabarina*). Growth rate is positively affected by light, moisture and fertilization. The root system is typically shallow and wide spreading, but vertical roots may also develop, allowing it to expand its range outside of its humid to super-humid native habitat into much drier landscapes.

Black locust is extremely hardy and can survive in many extremes.

Photo courtesy of Central Lake Ontario Conservation Authority.

Habitat

Black locust is native to the southern Appalachians and the Ozarks, where it grows primarily on slopes and forest edges. It favours humid and super-humid climates, but because it can produce both lateral and vertical roots, it can tolerate a wide range of moisture gradients including very poor, dry soils, but not those with a high water table. Black locust also tolerates a wide range of pH levels including extremely acidic soils, making it ideal for strip-mine reclamation.

Black locust is generally intolerant of shade and competition, tending to thrive in open vegetation types such as prairies, meadows and savannahs, as well as in disturbed habitats such as pastures, degraded woodlands, thickets, old fields, forest edges and roadsides. Black locust is particularly problematic in pine barren, sand prairie and black oak savannah plant communities. It establishes well in early-successional communities where it often grows in dense thickets or clonal colonies (black locust trees that have originated vegetatively (asexually) from one single tree). Generally, the oldest trees are located in the center and youngest trees on the edges of stands. In its native range black locust is generally an uncommon species in late successional communities, occurring only at low densities.

Although black locust is moderately frost hardy in the Southern and Central Plains, cold weather damage has occurred in the colder parts of its range and it is highly susceptible to frost in the Appalachian region.

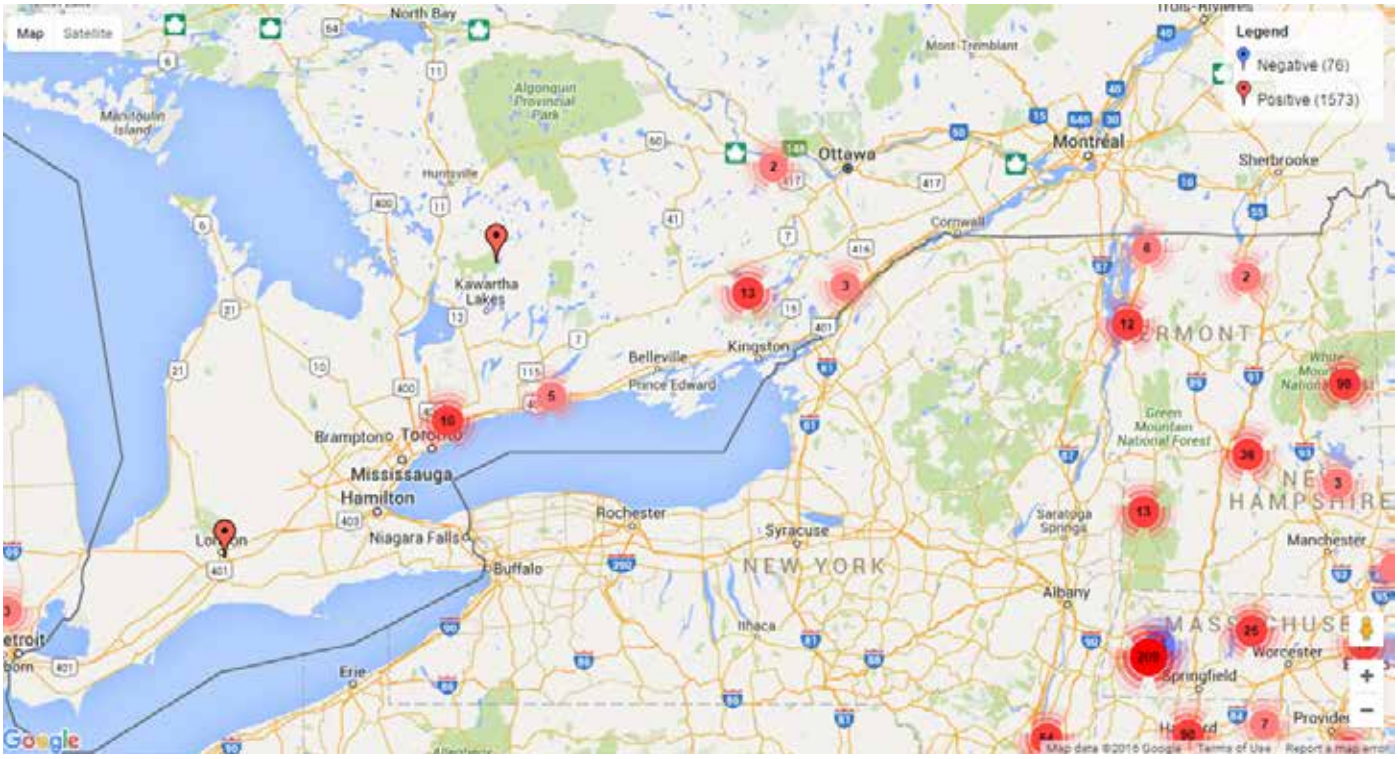
Black locust grows primarily on slopes and forest edges but can tolerate a wide range of moisture gradients and soil types.

Photo courtesy of Jon L. Peter.

Pathways of Spread and Distribution in Ontario

Black locust can spread naturally (via wildlife, birds, strong winds), or through human activity (via contaminated equipment or deliberate planting). It also frequently escapes cultivation.

Although it has not often been formally reported, black locust has been identified in the provinces of British Columbia, Nova Scotia and Ontario. It is most abundant in southern Ontario, but can be found as far north as Ottawa to the east and the County of Haliburton to the west.



Distribution map showing the locations of formally reported black locust trees. Single red dots represent one record. Red dots with numbers indicates the number of records reported in the area.

Black locust distribution map courtesy of EDDMapS (www.eddmaps.org/ontario). The map point data is based on records contained in the Invasive Species Database, compiled as of December 2015 from various sources on a voluntary basis. This map is illustrative only. Please do not rely on this map as a definitive distribution as it is subject to change based on additional confirmed invasive species sites. This map may contain cartographic errors or omissions.

Impacts

Ecological Impacts: Ecosystem Function, Biodiversity and Wildlife

Black locust aggressively invades dry and nutrient-poor sites and lowlands, outcompeting native plants and forming dense colonies which shade-out native flora. Plant communities of native forests are more diverse when compared to pure black locust stands, and wetland and riparian areas can also be affected. The replacement of native communities by homogenous and low-diversity communities of pure black locust stands causes both plant richness loss and shifts in species composition. This is especially concerning for the species designated under the *Species at Risk Act* (SARA) as being extirpated, endangered or of special concern in Canada. Many of these may be impacted by this reduction in biodiversity. The following is a list of Species at Risk for which black locust is named as a specific threat to the species in Ontario in either the federal Recovery Strategy (for species listed as Threatened or Endangered) or in the federal Management Plan (for species listed as Special Concern). More information can be found at the Species at Risk Act (SARA) Registry (www.sararegistry.gc.ca/default.asp?lang=en&n=24F7211B-1).

Table 2: Species at Risk for which black locust is named as a specific threat in Ontario.

Species at Risk	SARA Status	Habitat / Details	Primary Threat(s) from Black Locust
Pink milkwort (*Polygala incarnata*)	• Endangered	• Found in open, mesic to dry mesic sand prairie	• Habitat loss due to invasion/competition
White prairie gentian (*Gentiana alba*)	• Endangered	• Found in oak-hickory savannahs and areas frequently disturbed by fire • Prefers well drained, calcareous soils or limestone • Does not like shade	• Habitat loss due to invasion/competition • Shading
Skinners agalinis (*Agalinis skinneriana*)	• Endangered	• Grows in dry prairies, open woods, rocky open glades, bluffs or pockets among sand dunes, where the soil is shallow	• Habitat loss due to invasion/competition • Shading
Showy goldenrod (*Solidago speciosa*)	• Endangered in the Great Lakes Plains • Threatened in Boreal forest	• Found on flat, prairie-like areas, under oak canopy in partial shade, along sandy road embankments and rolling hills	• Habitat loss due to invasion/competition

Being a legume, black locusts have nitrogen-fixing nodules which increase the nitrogen content in soils, altering the growing conditions for other species. Phosphorus and calcium levels are also elevated under black locusts. In low nutrient habitats, introducing high amounts of these nutrients provides ideal habitat for non-native, nitrogen-loving weeds, resulting in an altered succession pattern.

Black locust leaves, stems, bark and seeds contain gastrointestinal neurotoxins. These can be fatal to humans and some animals (horses in particular). It is, however, a food item for many wildlife species, including white-tailed deer, ruffed grouse, squirrels, pheasants and other game birds. In fact, the flowers of the black locust are favoured by pollinators and there is concern that black locust's abundant nectar may attract pollinators away from native species that flower at the same time.

The black locust's abundant nectar may attract pollinators away from native species.
Photo courtesy of Ken Allison.

Black locusts can also alter fire-adapted communities, as fuels do not accumulate beneath it.

Applicable Legislation

Many plant species and control methods are regulated under federal and/or provincial legislation. Regulations regarding black locust, pesticide use and the biological control of black locust at the time of writing are summarized in this document. Please note that this is for clarity only and **is not legal advice.** Please refer to the applicable legislation and government website(s) to determine the applicable legislative requirements.

Federal

Plant Protection Act and Plant Protection Regulations

Under the *Plant Protection Act* and Plant Protection Regulations, the Canadian Food Inspection Agency (CFIA) is responsible for protecting plant resources in Canada by preventing the importation of new plant pests and limiting the movement and spread of pests within Canada. Invasive plants that are regulated under the *Plant Protection Act* are included in the list of Pests Regulated by Canada.

Weed Seeds Order

The Weed Seeds Order (WSO), 2005 is a ministerial order made under the *Seeds Act* which lists invasive plants regulated under the *Seeds Act*. Under this order the CFIA restricts the presence of weed species in commercially sold seeds in an effort to prevent the introduction and spread of new weeds.

Black locust is not listed in the Weed Seeds Order or as a pest registered in Canada.

Pest Control Products Act

The management of pesticides is the joint responsibility of the federal and provincial governments. Under the *Pest Control Products Act*, (PCPA) Health Canada's Pest Management Regulatory Agency (PMRA) registers pesticides for use in Canada with an approved label after conducting a stringent, science-based evaluation that ensures any risks are acceptable. The pesticide label is a legal document that prescribes how the pesticide can be used; pesticides must be applied in accordance with all label directions. Ensure you have the most current label and are aware of any re-evaluation decision if using herbicides to control black locust. Visit the Pest Management Regulatory Agency's product label search site at http://pr-rp.hc-sc.gc.ca/ls-re/index-eng.php for more information.

Fisheries Act

The Fisheries Act, administered by Fisheries and Oceans Canada (DFO) and Environment and Climate Change Canada (ECCC), applies to both plant and pesticide use as it specifies that it is an offence to (for example):

- harmfully alter, disrupt, or destroy fish habitat, including streamside vegetation;
- move or introduce aquatic organisms (including plants) to new habitats;
- damage fish habitat or put harmful substances such as pesticides into water frequented by fish, including pesticide drift.

For more information to ensure your project does not violate the Act, visit: http://www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html.

Species at Risk Act

ECCC also enforces the *Species at Risk Act* (SARA), whose purpose is "to prevent wildlife species in Canada from disappearing, to provide for the recovery of wildlife species that are extirpated (no longer exist in the wild in Canada), endangered, or threatened as a result of human activity, and to manage species of special concern to prevent them from becoming endangered or threatened." Permits are required by those persons conducting activities that may affect Species at Risk, such as invasive plant management. To find out which species are at risk, for more information about critical habitat, or information on obtaining a permit, consult the SARA Public Registry (http://www.sararegistry.gc.ca/default.asp?lang=en&n=24F7211B-1).

Migratory Birds Convention Act

The Migratory Birds Convention Act (MBCA), administered by ECCC, provides for the protection of migratory birds through the Migratory Birds Regulations and the Migratory Birds Sanctuary Regulations. For birds protected under the MBCA (http://www.ec.gc.ca/nature/default.asp?lang=En&n=496E2702-1), it is not permitted to kill a bird and/or disturb or destroy its nest or eggs anywhere they are found in Canada except under the authority of a permit issued under the Migratory Birds Regulations. Information on general nesting periods is available to minimize the risk to breeding birds (https://www.ec.gc.ca/paom-itmb/default.asp?lang=En&n=4F39A78F-1). However, operating outside nesting periods is not a guarantee that birds will not be killed or disturbed; therefore, it is the individual's responsibility to ensure they do not contravene the *Act*. More information can be found at https://www.ec.gc.ca/nature/default.asp?lang=En&n=2D16D723-1.

Provincial

Weed Control Act

The *Weed Control Act*, administered by Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) and enforced locally by municipalities, is in place to reduce the infestation of prescribed plants (noxious weeds) that negatively impact agricultural or horticultural operations.

A noxious weed includes a plant that has been listed in the Schedule of Noxious Weeds found in Regulation 1096 made under the *Act*. This list is commonly referred to as the "Noxious Weed List".

In general, a species designated as a noxious weed under the *Weed Control Act* is one that:

- Is difficult to manage on agricultural land once established and will reduce the yield and quality of the crop being grown;
- Negatively affects the health and well-being of livestock; or
- Poses a risk to the health and well-being of agricultural workers.

In Ontario, 25 weeds are designated as noxious under the Weed Control Act, however, black locust is not designated.

Pesticides Act

A federally registered pesticide must also be classified by MOECC under the *Pesticides Act* before it can be sold, stored or used in Ontario. The provincial classification of federally registered pesticides can be found at www.lrcsde.lrc.gov.on.ca/PCDWeb/home.action. Pesticides must also only be used for purposes allowed under Ontario's Cosmetic Pesticides Ban. The Ontario's Cosmetic Pesticides Ban specifies exceptions for the use of certain pesticides (Class 9), including the use of pesticides related to protecting public works including roads, buildings and structures, and provided certain conditions are met. For example, an exemption for a Class 9 active ingredient may apply if a plant interferes with the essential maintenance of a public works.

Endangered Species Act

The Ministry of Natural Resources and Forestry (MNRF) enforces the *Endangered Species Act*, whose purpose is to provide protection for species classified by the province as endangered or threatened, as well as to provide habitat protection for species classified by the province as endangered or threatened. Permits are required by those persons conducting activities that may affect Species at Risk, such as invasive plant management. To find out which species are at risk in Ontario or for information on obtaining a permit, consult www.ontario.ca/environment-and-energy/species-risk-ontario-list.

Municipal

Property standards and bylaws are the responsibility of individual municipalities. Municipalities are also responsible for enforcing the *Weed Control Act* and can produce bylaws to designate additional plants not listed on the Ontario Noxious Weed list as noxious within their own jurisdiction. In the City of London, for example, black locust is included in the Tree Conservation Bylaw as an invasive or potentially invasive species.

Municipal bylaws regarding the use of animals for targeted grazing may also be in place.

Best Management Practices

Black locust grows and spreads rapidly, resulting in populations that can establish very quickly. It is very difficult to control and no single technique has been identified as being entirely effective. It is therefore very important to control the infestation before it becomes locally established. This will reduce its impacts on biodiversity, the economy and society.

Physical control such as cutting, girdling and burning will stimulate suckering and expedite colonization.
Photo courtesy of Jon L. Peter.

Once black locust is established, any attempt at physical control will encourage suckering/colonization, making it extremely difficult and costly to eradicate fully. If this species is confirmed at a location, it is important to create an integrated pest management (IPM) plan that is specific to your goals and resources, the infestation size and site conditions, as well as the sensitivity of the local flora and fauna which may be impacted by the weed and/or control measure themselves. IPM uses existing knowledge about the plant species (biology, life cycle, predators etc.) and its surrounding environment to choose the most efficient and effective control measure(s) and timing to best prevent and fight infestations. This could mean treating a plant when it is in its most vulnerable stage or perhaps before seed production, or it could mean choosing a treatment or time frame that least affects non-target species. An IPM plan usually relies on more than one type of control measure to be successful. A planned, well thought out management plan is the key to success.

A detailed species inventory of each site is strongly recommended before starting control efforts. Black locust is most readily identified in May and June while in flower but its bark is distinctive year-round. The infestation size and density information gathered in the inventory will aid in selecting control strategies and prioritizing areas. Keep in mind that some options may not be practical or legal for the habitat, budget or time of the year.

With large infestations and limited time and resources, control work can seem daunting. It is important to develop a feasible, long-term strategy with the following considerations:

1. After an infestation of black locust is confirmed, land managers should first focus their efforts on **preventing spread** by removing isolated plants and small populations (satellite infestations) outside of the main infested area. When action is taken early it can significantly reduce the cost of control.
2. Concentrate on **high-priority areas** such as the most productive or sensitive habitats, a favourite natural area or the side of a trail where people may come into contact with the plants.
3. Consider dedicating a certain time each year to control efforts and make it a **joint effort** with neighbouring landowners/land managers.
4. Consider **replanting** native plant species once the black locust population is eradicated or under control. This will help jump-start natural succession and increase biodiversity in the area.
5. Follow-up **monitoring** is crucial to remove seedlings that may sprout after initial control efforts. It is also important in understanding the impact of management efforts on native flora and fauna and adjusting management techniques as required.

Natural Resource Considerations

You are responsible for ensuring that your project follows all relevant laws, including the *Endangered Species Act*, *Migratory Birds Convention Act* and the *Species at Risk Act*. If protected species or habitats are present, an assessment of the potential effects of the control project could be required. Consult your local Ministry of Natural Resources and Forestry (MNRF) district office (www.ontario.ca/page/ministry-natural-resources-and-forestry-regional-and-district-offices) early in your control plans for advice.

If controlling black locust in riparian areas, impacts to shoreline health must also be considered. Factors to consider before removing or treating riparian areas include impacts to forage quality and quantity for wildlife, bank stability and erosion potential, and the likelihood of downstream impacts such as the spread of the plant with water flow.

Setting Priorities

When creating management plans, it is important to make the most of resources by prioritizing invasive species control. The following will help you to prioritize sites and areas within sites for control of black locust.

Site Prioritization

(This section is modified from "The Landowners Guide to Managing and Controlling Invasive Plants", published by Credit Valley Conservation).

1. Protect areas where black locust is absent or just appearing.
2. Protect rare species and communities. These include federally, provincially and regionally listed rare species. See www.ontario.ca/environment-and-energy/species-risk-ontario-list and www.plantsofcanada.info.gc.ca/ for species-specific information.
3. Protect important habitats and land values (i.e. agriculture, wildlife appreciation, forestry).
4. Cost and effort: Will the black locust invasion area require restoration or can it be left to regenerate naturally? (Note: It is usually recommended to restore control areas to make them more resilient to future invasions and prevent other invasive plants from invading.).

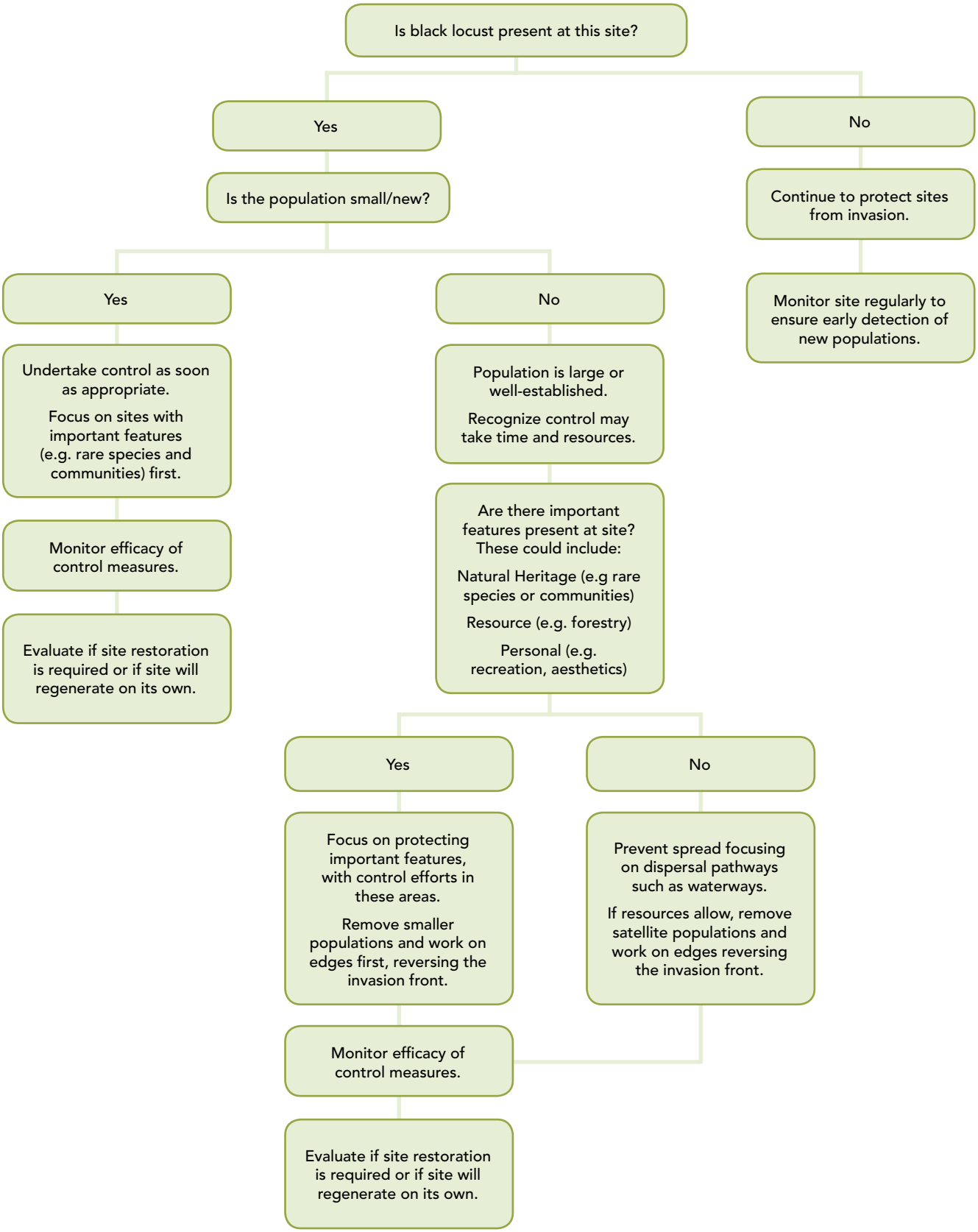
Prioritizing within a Control Area

1. Focus on large blocks of un-invaded areas and keep them free of invaders.
2. Control small, younger, outlier (satellite) populations first.
3. Remove outlying plants.
4. Reverse the invasion, expand the un-invaded area outward.

It is crucial to prioritize control efforts by determining where the satellite populations are, and eradicating those before they join larger populations.

This flow chart can help land managers choose which site to first focus control efforts:

Figure 1: How to prioritize black locust sites for effective control.



Control Measures

Damage to the root will cause suckering! Where clones are present, always treat the entire clone and make sure to treat or remove **the entire root system**. Eradicate smaller satellite populations – a single stem can repopulate the area. Even plants that appear dead may re-sprout several years after treatment. **Annual monitoring is of critical importance in managing this species.**

Where clones are present always treat the entire clone and make sure to treat or remove the entire root system.
Photo courtesy of Jon L. Peter.

Mechanical

Pulling and Digging:

Because plants are connected underground, hand pulling is not effective and will cause root damage, resulting in suckering. If a single sapling is present, dig a large circumference around the plant to ensure that the entire root system is removed.

Cutting:

Cutting without application of herbicide stimulates re-sprouting. For instance, in one study the mean number of basal sprouts from a 6-year-old stump, one year after cutting, was 9 sprouts/stump. The growth rate of the cut stands was nearly twice that of the uncut stands, and cut stands reached a mature stage (defined by the onset of flowering) in half the time required by uncut stands.

If this method is to be used, repeated cutting of stems including new stems must be done every growing season for several years in order to exhaust the root system. Combining this method with herbicide application can be effective.

Mowing:

Not recommended. Mowing areas around mature trees where seed pods have dropped will cause seed scarification and promote seed germination. If this method is used, for instance in a golf-course setting, mowing must be continual.

Bulldozing:

Bulldozing may be a practical consideration on some sites but, because it will remove all species in the area, is therefore not suitable for ecologically sensitive areas. Bulldozing, piling and burning of trees followed by the planting of a cover crop or native species can effectively eliminate root sprouts and seed germination. Sites must be monitored for sprouting from root fragments or seed germination and be followed-up with mechanical or chemical treatment.

Burning:

Not recommended. Burning tends to stimulate re-sprouting and causes seed scarification, encouraging germination. When adequate fuel is present, burning will kill seedlings and help exhaust the seedbank. Burning can be useful as a restoration method in fire-adapted communities once mature black locust has been removed and the native vegetation that provides fuel recovers. Burning can be used to control seedlings and sucker growth after the tree and seed pods have been removed, but it is only recommended in combination with other control methods, such as herbicide treatment (ex. basal bark treatment prior to burning).

Girdling:

Not recommended. Girdling kills the black locust stem but promotes the formation of suckers from the girdled trunk and roots.

Biological

Targeted Grazing:

Grazing over many years can control height but because black locust is toxic to cows and other grazing animals, this method is only recommended when using non-sensitive grazers. Certain goat varieties feed specifically on black locust.

Biological Control:

Black locust pests and diseases mentioned previously can cause considerable damage to the trees, but no biological control program for black locust has been attempted, and there are no approved biocontrol agents for this species.

Chemical

The *Ontario Pesticides Act* and Ontario Regulation 63/09 provide natural resources, forestry and agricultural exceptions which may enable chemical control of invasive plants on your property. Other exceptions under the *Act* include golf courses, and for the promotion of public health and safety.

Natural Resource Exception:

The "natural resources" exception exists for the use of prohibited pesticides to manage, protect, establish or restore a natural resource. In order to qualify for this exception your project must meet the criteria specified in Section 33 of Ontario Regulation 63/09, including the use of pesticides in accordance with Integrated Pest Management (IPM) principles outlined in this BMP guide. You will need to contact the Ontario Ministry of Natural Resources and Forestry (www.ontario.ca/page/ministrynatural-resources-and-forestry-regional-and-district-offices) to obtain a written letter of opinion from the MNRF Regional or Branch Director.

Forestry Exception:

A forest is defined as a treed area of land that is one hectare in size or larger. Class 9 pesticides may be used in a forest for the purposes of harvesting, renewing, maintaining or establishing a forest, protecting forest resources derived from a forest, and accessing a forest for these purposes under the forestry exception. The control of black locust may fall under the forestry exception; a Forestry Class Land Exterminator licence would be required to use commercial pesticides in a forest. Refer also to the Ministry of Environment and Climate Change's factsheet titled "*Pesticides Act* and Ontario Regulation 63/09 Forestry". https://www.ontario.ca/document/technical-guidance-pesticides-act-and-ontario-regulation-6309-forestry.

Agriculture Exception:

The agriculture exception allows a farmer to use Class 9 pesticides for the purposes of the agricultural operation that he or she owns or operates. This exception may apply to the control of black locust if it impacts their agricultural or horticultural operation. Agricultural operations include agriculture, aquaculture and horticulture activities. Examples include:

- growing, producing or raising farm animals;
- production of crops, including greenhouse crops, maple syrup, mushrooms, nursery stock, tobacco, trees and turf grass, and any additional agricultural crops prescribed under the Nutrient Management Act, 2002;
- activities that are part of an agricultural operation such as maintenance of a shelterbelt for the purposes of the agricultural operation, and;
- the production of wood from a farm woodlot, if at least one of the activities described earlier is carried out on the property where the farm woodlot is located.

Some activities are not included in the definition of an "agricultural operation". Please refer also to the Ministry of Environment and Climate Change's factsheet titled "Pesticides Act and Ontario Regulation 63/09 Agriculture May 2011" (www.ontario.ca/document/technical-guidance-pesticides-act-and-ontario-regulation-6309-agriculture).

Herbicide Application:

Herbicides must be applied in accordance with all label directions. For an up-to-date list of herbicides labelled for black locust control, visit the Pest Management Regulatory Agency's web site at http://pr-rp.hc-sc.gc.ca/ls-re/index-eng.php.

The Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA)'s Publication 75, Guide to Weed Control is an excellent reference for all aspects of weed control, and includes a section on invasive plant management. To determine if a federally registered herbicide is also classified for use in Ontario, visit www.lrcsde.lrc.gov.on.ca/PCDWeb/home.action. Anyone using a pesticide is responsible for complying with all federal and provincial legislation. Most non-domestic (i.e. commercial, restricted etc.) herbicides can only be applied by licensed exterminators.

For more information, refer to the Ontario *Pesticides Act* and Ontario Regulation 63/09 (available at www.ontario.ca/laws), or contact the Ontario Ministry of the Environment and Climate Change (www.ontario.ca/ministry-environment-and-climate-change).

Herbicides and Black Locust:

Herbicides, alone or in combination with other control methods, are the most effective method for black locust control but this does depend on the herbicide and concentration used, as well as the timing of the application. Certain herbicides used for cut-surface application may cause vigorous sprouting from roots. Only herbicides which control the tree's root system will kill the tree.

Great care should be exercised to avoid getting any of the mixtures on the ground near the target plant since some non-target species may be harmed. If precipitation is in the forecast for the next 1-4 days, avoid using herbicides that will wash off, as this will cause runoff that will harm non-target species. Any herbicide should be applied while backing away from the treated area to avoid walking through the wet herbicide. By law, herbicides only may be applied according to label directions. As mentioned earlier, follow-up treatments are usually necessary because of black locust's prolific sprouting and rapid growth.

Herbicide Application Methods:

Basal bark treatment:

Basal bark treatment is useful on younger stems with thin bark, typically those stems of less than 15 cm in diameter. It is not effective on larger trees. This method is good for areas of ecological significance, or where non-target effects are of concern. It is best when performed during the growing season (mid-summer to early fall) after the heavy sap flow of spring has slowed. Concentrated herbicide is applied to a band of bark around the stem extending up ~50 cm from the ground. Thoroughly wet all basal bark areas, including crown buds and ground sprouts. A very thorough spraying (spraying until run-off at the ground line) is necessary in order to prevent re-sprouting. This will impact non-target species. Applications in periods of dry weather will aid in root control.

Cut-stump:

Cut-stump treatment (application to cut stumps or cut surfaces) is preferred for larger stems/trees where basal bark treatment may not be effective. This method is good for areas of ecological significance, or where non-target effects are of concern. Treatment is best performed during the growing season. Within 30 minutes of cutting, the stems are painted with concentrated herbicide using a spray bottle or wicking applicator. Small stems can be cut several inches above the ground so that the bark 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. Be sure to read the product label for application method, temperature, concentration and if adjuvants may be used (and at what temperatures) to increase effectiveness of the herbicide. For instance, penetrating oils only work with ester formulations. Similarly, dyes, which are useful in keeping track of which stems have been treated, work with specific herbicide formulations. If using a herbicide that does not kill the root, treated locust stumps will produce suckers that will need to be treated.

Frilling and "hack and squirt":

This technique is 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. Caution should be used using this method, as it will often result in re-sprouting below the cut. It therefore requires multiple applications.

Drill and fill/injection:

This technique is also useful for larger trees and can be done any time except during spring sap flow. Holes are drilled into tree at a downward angle followed by herbicide injection. One hole per 2.5 cm of diameter is ideal.

Foliar Application:

Foliar application should only be considered in low-quality areas where overspray or drift would not be a concern. The vegetation would have to be young/low enough to be able to spray over the canopy. It is not likely a preferred method in high quality natural areas. Foliar sprays are most effective in late summer when the leaves are fully exposed and the movement of nutrients in the plant is toward the root system, allowing the herbicide to be taken into the roots.

Disposal

Parts of the black locust capable of reproducing (seeds and roots) can only be composted if the material is taken to a large-scale municipal composting facility where temperatures in the compost pile reach high enough temperatures to kill the living material. Be sure to check with your local municipality before depositing the material, to ensure their composting programs reach the required temperatures. Small-scale composters (backyard composters) do not reach the required temperatures to kill invasive plant material, therefore do not place the material in small-scale composters.

If your municipality does not have a sufficient composting program, carefully place reproductive material in a black plastic garbage bags. Seal the bags tightly and leave them in direct sunlight for one to three weeks to kill any living plant material. Check the bags to make sure all plant material has died and deposit in your municipal landfill.

The branches and wood of black locust do not reproduce (unless still bound to the soil via roots i.e. stump). Therefore, as long as you carefully remove the seeds and dispose of properly (see above) you can then leave the branches on-site (as long as you have the space) to decompose on their own.

If your municipality does not have a sufficient composting program, place black locust in black plastic garbage bags and leave in sun for one to three weeks.

Photo courtesy of Ontario Federation of Anglers and Hunters.

Restoration

Restoration can be a critical aspect of invasive plant management. Site restoration will result in a healthier ecosystem more resilient to future invasions. Monitor all restoration activities to ensure native species are becoming established, and continue removal of invasive plants that remain on site. Establishment of shade through replanting may inhibit black locust growth.

Determining whether or not restoration efforts will be needed will depend upon multiple factors:

1. **Level of disturbance at the site:** What is the level of disturbance at the site? Was it a heavily invaded site (e.g. was a lot of disturbance caused during control measures)? Will it continue to be disturbed (e.g. through recreational use or trail use/management)?
2. **Invasive species biology:** What is the biology of the invasive species removed and is there a seed bank to consider? (Note: there will always be a seed bank to consider when dealing with black locust.).
3. **Re-invasion risk:** Are there invasive species nearby which could re-invade the site from nearby trails, watercourses or other pathways of introduction?
4. **Existing native vegetation:** What native vegetation is left? How long before it regenerates by itself? Does it need help?

Your answers to these questions will help you to determine if the site will be re-invaded before it has a chance to regenerate on its own.

Types of Restoration

During Control

Mulching:

Mulching sites immediately after control (i.e. manual or chemical control) may aid in the recovery of native species and prevent immediate re-colonization by other invaders. Mulching reduces light availability, allowing more shade-tolerant native plant species to germinate and colonize the gaps left by black locust removal. This will also limit the amount of re-growth due to the seed bank.

Seeding:

Seeding an area with an annual cover crop or native plant species immediately after management activities may be useful to prevent the establishment of new invasive species. This can give desirable native species the chance to establish themselves.

After Control

Prescribed burning:

Prescribed burning in fire-adapted communities once the black locust is fully removed may be effective in allowing the native community to recover by increasing the regeneration of desirable species and killing suckers. See the control section for more information.

Planting:

If there are invasive plants nearby or in the seedbank which may colonize the control area, planting larger native species stock (potted etc.) will help it outcompete invasive seedlings. It may, however, be better to monitor and remove black locust over several seasons before investing in restoration planting. Wait until all management is completed before doing a large stock re-planting if you find it difficult to distinguish between newly planted native species and invasive seedlings.

When completing planting at control sites, consider light availability (have any trees recently been removed which have opened up an area?). These environmental changes should be taken into account when choosing plant species for restoration, as they will affect the growing and soil conditions. Also, additional management activities may disturb the newly planted materials, so it is best to postpone planting until all invasive plant control is complete.

Grasses may prevent black locust seedling establishment, though they will not prevent sprouting.

Rubus species have been found to be very effective in limiting black locust growth, but only native, non-invasive plants should be used.

Control Measures Summary

Method	Population Characteristics	Purpose of Control	Notes
Pulling and Digging	• Small	• Removal of all plants	• Roots must be removed
Cutting	• Small to medium	• Depletion of root reserves and reduce seed density	• Cutting promotes suckering • Must be performed annually over many years
Mowing	• **Not recommended**		• Promotes seed germination
Bulldozing	• Small to large	• Removal of all plants	• Non-selective and degrades habitat severely
Burning	• Generally not recommended • Small to large	• Exhausts seedbanks • Kills seedlings • Depletes root reserves • Favours native prairie plants	• Burning may stimulate re-sprouting • Must be repeated • Must have adequate fuel present • Non-selective
Girdling	• **Not recommended**		• Promotes the formation of suckers
Targeted Grazing	• Medium to large	• Removal of top growth, depletion of root reserves	• Toxic to some animals • Non-selective
Chemical	• Small to medium	• Eradication of plants	• May need to re-apply annually, as plants quickly grow from seed bank • Non-selective, unless applying to individual trees • Must use an herbicide that reaches and kills roots

Preventing the Spread

Early detection is the most effective tool for controlling the spread of black locust and everyone can help. Follow these tips:

☑ Report it.

If you think you see black locust take a picture, record the location and report it using the tools listed below.

☑ Watch for it.

Learn what black locust looks like and then monitor hedges, property boundaries, riparian areas, fence lines and trails. Early detection of invasive plants can make it easier and less expensive to remove or control them.

☑ Stay on trails.

Avoid traveling off-trail and in areas known to have black locust or other invasive species.

☑ Stop the spread.

Inspect, clean and remove mud, seeds and plant parts from clothing, pets (and horses), vehicles (including bicycles, trucks, ATVs, etc.), and equipment such as mowers and tools. Clean vehicles and equipment in an area away from natural areas where plant seeds or parts aren't likely to spread (e.g. wash vehicles in a driveway or at a car wash) before travelling to a new area.

☑ Keep it natural.

Try to avoid disturbing soil and never remove native plants from natural areas. This leaves the soil bare and vulnerable to invasive species.

☑ Use native species

Try to use local native species in your garden. Don't plant black locust and if you have removed it, replant with native species. Encourage your local garden centre to sell non-invasive or native plants.
The Grow Me Instead guides list alternatives to plant instead of invasive species.

Tracking the Spread (Outreach, Monitoring, Mapping)

Several reporting tools have been developed to assist the public and resource professionals to report black locust sightings, track the spread, detect it early, and respond to it quickly. These include:

1) EDDMapS Ontario: an online reporting tool where users can view existing sightings of black locust and other invasive species in Ontario, and document their sightings. This tool, at www.eddmaps.org/ontario, is free to use.

2) Toll-free Invading Species Hotline: a telephone number (**1-800-563-7711**) which individuals can use to report sightings verbally.

3) Invading Species Website: an online reporting tool (www.invadingspecies.com).

If you think you have black locust on your property or if you see it in your community, please report it. You will be asked to send in photos of the leaf, stem and trunks and seedpods for identification.

Best Management Practices Documents Series:

Black Locust Best Management Practices for Ontario

Common (European) Buckthorn Best Management Practices for Ontario

Dog-strangling Vine Best Management Practices for Ontario

European Black Alder Best Management Practices for Ontario

Garlic Mustard Best Management Practices for Ontario

Giant Hogweed Best Management Practices for Ontario

Invasive Honeysuckles Best Management Practices for Ontario

Japanese Knotweed Best Management Practices for Ontario

Phragmites (Common Reed) Best Management Practices for Ontario

Phragmites (Common Reed) Best Management Practices for Ontario Roadways

Purple Loosestrife Best Management Practices for Ontario

Reed Canary Grass Best Management Practices for Ontario

White Sweet Clover Best Management Practices for Ontario

Wild Parsnip Best Management Practices for Ontario

Additional Publications from the Ontario Invasive Plant Council:

Creating an Invasive Plant Management Strategy: A Framework for Ontario Municipalities

A Quick Reference Guide to Invasive Plant Species

Clean Equipment Protocol for Industry

Compendium of Invasive Plant Management in Ontario

Grow Me Instead! Beautiful Non-Invasive Plants for Your Garden, a Guide for Southern Ontario

Grow Me Instead! Beautiful Non-Invasive Plants for Your Garden, a Guide for Northern Ontario

A Landowner's Guide to Managing and Controlling Invasive Plants in Ontario

Landowners Guide to Controlling Invasive Woodland Plants

Phragmites Site Prioritization Tool

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