

White Mulberry

(*Morus alba*)

Best Management Practices in Ontario



Foreword

These Best Management Practices (BMPs) provide guidance for managing invasive white mulberry (*Morus alba*) in Ontario. Funding and leadership for the production of this document was provided by the Ministry of the Environment, Conservation and Parks - Ontario (MECP). 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.

The intent of this document is to relay specific information relating to invasive plant control practices that have been recommended by leading professionals across Ontario. This document contains the most up-to-date, effective and environmentally safe research and knowledge available at the time of publication and complies with current provincial and federal legislation regarding pesticide usage, habitat disturbance and species at risk protection. It is subject to change as legislation is updated or new research findings emerge and is not intended to provide legal advice. The timing suggested will differ throughout Ontario and should be tailored to your region. 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.

Warne, Amanda. 2020. White Mulberry (*Morus alba*) Best Management Practices in Ontario.

Ontario Invasive Plant Council, Peterborough, ON.

This document was prepared for the Ministry of the Environment, Conservation and Parks - Ontario by the Ontario Invasive Plant Council.

Support for the production and publication of this document was provided by: Ministry of the Environment, Conservation and Parks - Ontario.

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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

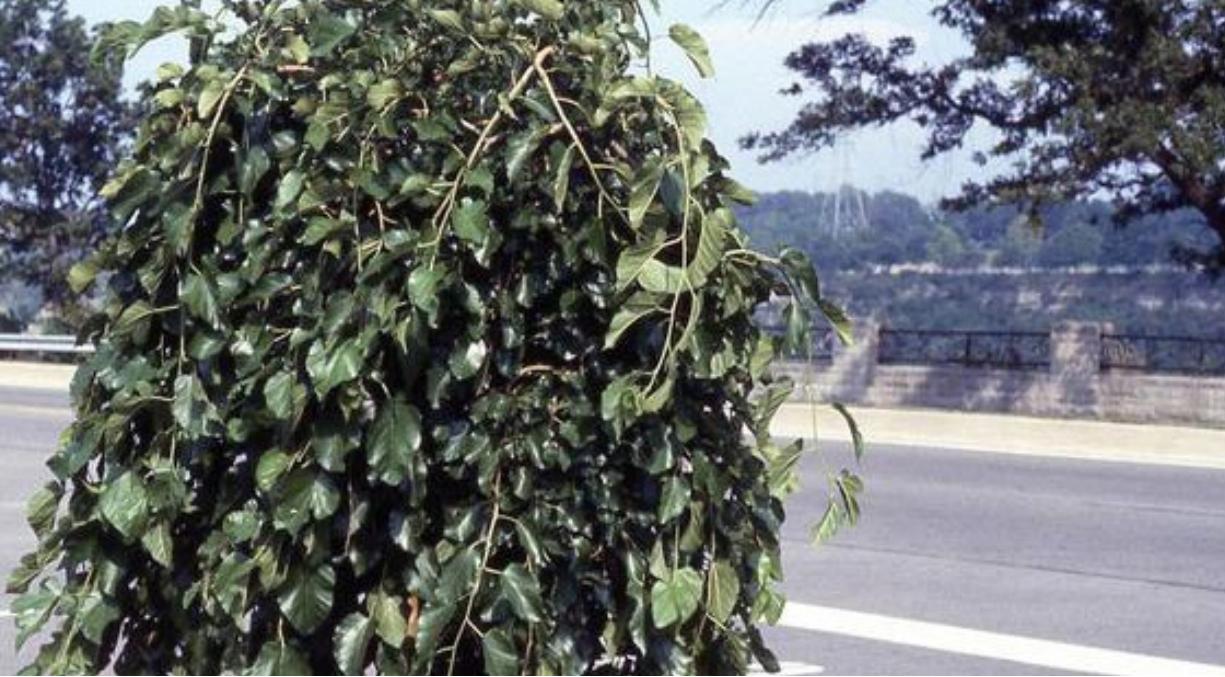
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White mulberry.

Photo courtesy of John Foster.



The willow-like cultivars are popular as ornamentals.

Photo courtesy of T. Davis Sydnor, The Ohio State University, Bugwood.org.

Introduction

White mulberry (*Morus alba* L.), also known as Chinese white mulberry, mûrier blanc, common mulberry, Russian mulberry, silkworm mulberry, chi sang, chin sang and moral blanco, is a small to medium sized deciduous tree belonging to the Moraceae family. It is native to China where it has been used for thousands of years as food for silkworms and is now naturalized in many countries throughout the globe where silkworm production was established.

White mulberry was introduced to the United States from East Asia in the 1600s in an effort to establish the silkworm industry and later as an ornamental and fruit tree. Numerous cultivars of white mulberry have been identified in North America but two botanical varieties are recognized (var. *multicaulis* and var. *alba*). White mulberry trees (and mulberry hybrids) are widely sold, particularly in urban areas, as they are fairly hardy, salt-resistant and adapt to a wide range of soil and environmental conditions. They are popular as an ornamental and for their edible fruit, which are also used in traditional herbal medicine to treat a wide variety of health-related issues. The smaller, willow-like "Pendula" (fruit-bearing female) and "Chaparral" (fruitless male) cultivars are especially popular as ornamentals.

White mulberry is an aggressive colonizer of disturbed areas, forest edges, roadsides and old fields. It readily grows and even thrives in inhospitable locations. White mulberry is of particular concern in Ontario due to the fact that it outcompetes, and readily hybridizes with, red mulberry (*Morus rubra* L.). Red mulberry is native to the Carolinian forests of southern Ontario and is listed as endangered both federally and provincially. There are reportedly only 217 known individuals left in Ontario, spread across 18 sites. Both white mulberry and mulberry hybrids are more abundant, live in a broader range of habitats, often display superior fitness, and produce more pollen, fruit and seeds than red mulberry, giving white mulberry a competitive advantage.

This document was developed to aid in the effective and consistent management of white mulberry, and hybrids of red (*Morus rubra*) and white (*Morus alba*) mulberry, across Ontario.

Description

Size and Shape:

White mulberry is a small to medium sized deciduous tree, typically measuring 9 to 15 m (can reach up to 20 m) tall, though weeping cultivars are typically smaller, rarely growing more than 3 m tall. The trunk is often relatively short with a rounded crown and a dense canopy of spreading branches. Trees may also display witches' broom clusters of twigs from frequent winter dieback.



A rounded crown and a dense canopy of spreading branches are typical for white mulberry.

Photo courtesy of T. Davis Sydnor, The Ohio State University, Bugwood.org.

Fruit and Seeds:

Fruit are plentiful and range in colour from white, nearly black, pink to purple when ripe. The fruit are ovoid or cylindrical in shape and 1 to 2 cm long. Though they resemble blackberries, the fruit are really drupes consisting of a cluster of tiny fruits, each with a hard-coated seed. Fruit are abundant from June to July and are edible when ripe.



Seeds have a hard coat.

Photo courtesy of Steve Hurst, USDA NRCS PLANTS Database, Bugwood.org.

Stem and Bark:

The irregularly branching trunk typically measures less than 90 cm in diameter (can reach 1.5 m) and has a broad, rounded crown. In older trees, bark is gray and rough with tight, narrow, irregular furrows. Bark along the roots and the inner bark of the main stem are typically bright orange (a key diagnostic feature). Lenticels are also typical. Branches may have a smooth (glabrous) or hairy (pubescent) surface, but no thorns. A milky white sap is visible from broken lead stems.



An orange tint can be seen between bark ridges.

Photo courtesy of John Foster.

Leaves:

Leaves are alternate, simple and can vary in shape (polymorphic) from ovate to broadly ovate on the same tree. They range from un-lobed to many-lobed and sometimes appear mitten- or glove-like, though this is usually a trait of the native red mulberry. The leaves are typically 3 to 6 cm wide and 5 to 15 cm long but may be 20 cm or longer on young shoots. The top side is a glossy dark green while underneath the leaves are paler, smooth and slightly hairy along the 3 prominent veins that radiate from an uneven, heart-shaped base. The plump buds of white mulberry are small and domed in the middle, with a short, very sharp tip. They usually sit along the center of the twig and each bud scale has a brown band. The margins are coarsely toothed (serrate or dentate).



The top side is a glossy dark green while underneath the leaves are paler.

Photos courtesy of David J. Moorhead, University of Georgia, Bugwood.org.

Flowers:

White mulberry trees can be dioecious (male and female flowers on separate trees) or monoecious (male and female flowers on the same tree) and the pendulous, stiff, green catkins bloom in early spring. Male flowers are small with 4 stamens, forming 2.5 to 5 cm long catkins. Female flowers are crowded in short, inconspicuous spikes, with the catkins being typically 1 to 2 cm long. Flowers are borne in the leaf axils. Winter buds can be 3 to 4 mm long.



White mulberry flower.

Photo courtesy of John Foster.

Roots:

White mulberry have a wide, spreading root system with both tap and lateral roots. The lateral roots are often wide close to the root crown, becoming more fibrous just a few feet away. One study characterized the roots as being up to 4 m deep and spreading as wide as 13 m, with the majority of the lateral roots occurring in the top 30 to 60 cm of soil. Roots are bright orange.

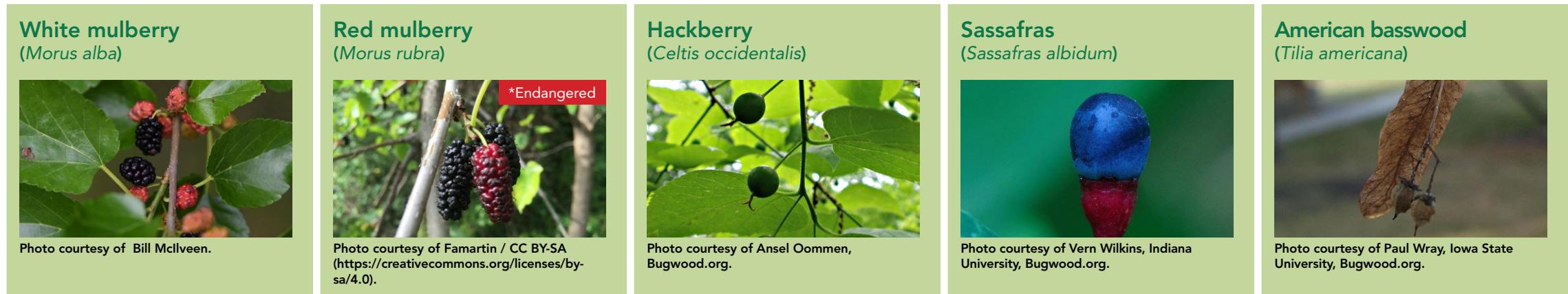


The roots of white mulberry trees are a distinct orange colour.

Photo courtesy of Bill McIlveen.

Lookalikes

Table 1: The main identification features of white mulberry in comparison to four species that may appear similar (lookalikes). Key I.D. features that separate the lookalikes from white mulberry are in bold.

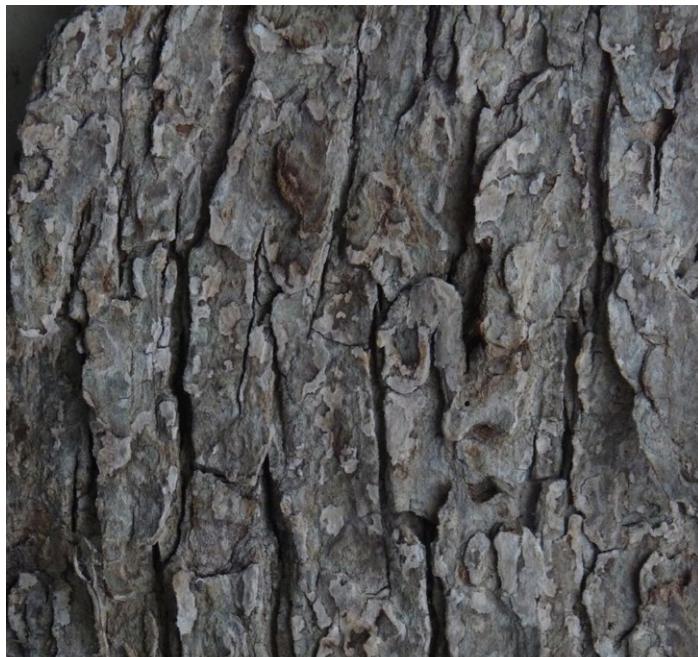


Native Range and Habitat	<ul style="list-style-type: none"> Introduced to Ontario from China Tolerates a variety of soil, salinity, shade and moisture conditions Old fields, urban lots, roadsides, forest edges, and other disturbed areas 	<ul style="list-style-type: none"> Native to Carolinian forests of southern Ontario Tolerates sandy to loamy soils; moderately shade tolerant Moist forest, ravines, woodlands, moist talus slopes and floodplains 	<ul style="list-style-type: none"> Native to Ontario Tolerates a wide range of pH, moisture and soil conditions; full sun to moderate shade Moist woodlands, uplands, bottomlands and urban areas 	<ul style="list-style-type: none"> Native to Carolinian forests of southern Ontario Tolerates a variety of moisture conditions and soil types; moderate to full sun Wood edges and dry, open, sandy areas 	<ul style="list-style-type: none"> Native to Ontario Prefers moist, rich, well-drained soils; full shade to full sun Woodlands, stabilized sand dunes, riverbanks, slopes of wooded ravines and talus slopes
Typical Size and Form	<ul style="list-style-type: none"> 9-15 m tall, up to 20 m Irregularly branching trunk with broad, rounded crown; weeping cultivar have drooping branches Trunk 20-90 cm in diameter, up to 1.5 m 	<ul style="list-style-type: none"> 6-20 m tall Broad, rounded crown; often with spreading branches Trunk 10-90+ cm in diameter 	<ul style="list-style-type: none"> 12-25 m tall Broad, upright crown Trunk 50 cm in diameter (can be larger) Often with witches' broom clusters of twigs 	<ul style="list-style-type: none"> 5-15 m tall, up to 20 m Tiered, irregular shape; twisting branches; umbrella-like crown Often form thickets via suckers Trunk up to 60 cm in diameter 	<ul style="list-style-type: none"> 20-40 m tall Conical form; rounded crown Trunk 40-80 cm in diameter
Bark and Wood	<ul style="list-style-type: none"> Mature bark: gray, rough with tight, narrow, irregular furrows Orange tint between bark ridges on young to mid-age trees and roots Twigs slender, light orange-brown Milky sap 	<ul style="list-style-type: none"> Mature bark: reddish-brown to greyish-tan with loose vertical plates Inner bark tan Orange tint on roots only Twigs green to grey- or reddish brown Milky sap 	<ul style="list-style-type: none"> Mature bark: dark brown covered with distinctive warty projections Young bark: gray and smooth Twigs slender, shiny, light brown to gray; zigzag; no terminal bud Clear sap 	<ul style="list-style-type: none"> Mature bark: deep furrows with corky ridges Orange-brown, fragrant wood and bark, especially when crushed Twigs glossy purplish Clear sap 	<ul style="list-style-type: none"> Mature bark: long, medium ridges and furrows Young bark: smooth long, narrow ridges Light to silvery gray bark Twigs yellowish-brown Clear sap

	White mulberry (<i>Morus alba</i>)	Red mulberry (<i>Morus rubra</i>)	Hackberry (<i>Celtis occidentalis</i>)	Sassafras (<i>Sassafras albidum</i>)	American basswood (<i>Tilia americana</i>)
	 Photo courtesy of Bill McIlveen.	 Photo courtesy of Famartin / CC BY-SA (https://creativecommons.org/licenses/by-sa/4.0/).	 Photo courtesy of Ansel Oommen, Bugwood.org.	 Photo courtesy of Vern Wilkins, Indiana University, Bugwood.org.	 Photo courtesy of Paul Wray, Iowa State University, Bugwood.org.
Leaves	<ul style="list-style-type: none"> Alternate, simple Ovate to variously lobed; uneven, heart-shaped base Upper side glossy, smooth, dark green; underside paler and slightly hairy along the 3 prominent veins Broad, blunt, wedge-shaped tip 5-20+ cm long; 3-6 cm wide Margins coarsely toothed (serrate or dentate) Small, domed buds with sharp tips and brown band Milky sap 	<ul style="list-style-type: none"> Alternate, simple Ovate to variously lobed, often mitten- or glove-shaped; even, heart-shaped base Upper side dull, rough, pale yellowish-green; underside hairy/fuzzy Long, tapered tip 7-25+ cm long and nearly as wide Margins sharply toothed (serrate or dentate) Larger, flattened bud with black band Leaf out very late in spring Milky sap 	<ul style="list-style-type: none"> Alternate, simple Ovate with 1 side longer or wider than the other Deep green; rough; underneath somewhat hairy; 3 prominent veins Long, tapered tip 3-17 cm long and nearly twice as long as wide Margins sharply toothed (serrate) Brown, oval to triangular bud, 3-4 scales 	<ul style="list-style-type: none"> Alternate, simple Ovate or broad 2- or 3- lobed; oval-, mitten- or glove-shaped Pale green and smooth on top; whitish underneath 10-25 cm long; 5-10 cm wide Entire, smooth margins Fragrant citrus-type odour when crushed Greenish, plump, scaled buds 	<ul style="list-style-type: none"> Alternate, simple Unlobed; heart-shaped Upper side glossy to dull green; underneath slightly paler with tiny tufts of hairs in prominent vein axils Abruptly slender-pointed 7-20 cm long; 18 cm wide (up to 38 x 30 cm on seedlings, sprouts and young trees) Margins coarsely toothed Buds plump, 2-3 scales Clear sap
Flowers	<ul style="list-style-type: none"> Bloom in early spring Male flowers small, green, forming long (2.5-5 cm) catkins Female flowers in short, inconspicuous spikes, 1-2 cm long catkins Borne in the leaf axils 	<ul style="list-style-type: none"> Bloom late May to mid-June (before or with leaves) Small yellow to reddish- or yellowish-green catkins Male clusters loose and elongated Female clusters short and dense Borne in leaf axils 	<ul style="list-style-type: none"> Bloom April-May Small, inconspicuous green flowers Male flowers in clusters toward base of new branches Female flowers toward tip, small, single or paired 	<ul style="list-style-type: none"> Bloom in late May Small, greenish-yellow, loose, stalked clusters at tip of twigs Individual male flowers 5-8 mm across, 6 greenish-yellow petaloid sepals Individual female flowers 8 mm across, 6 greenish-yellow petaloid sepals 	<ul style="list-style-type: none"> Bloom in midsummer Yellow flowers Flowers on leaf-like bracts Fragrant Apple green buds
Fruit	<ul style="list-style-type: none"> Resemble blackberry Plentiful; white, nearly black, pink, purple Ripen June-July 1-2 cm long 	<ul style="list-style-type: none"> Resemble blackberry Less abundant; deep red to dark purple Ripen June-July 2-3+ cm long 	<ul style="list-style-type: none"> Small, single, round drupe; fleshy with single hard seed Dark reddish-purple when ripe Ripen in September 0.8-1.1 cm in diameter 	<ul style="list-style-type: none"> Resemble an elongated blueberry Dark blue drupes on a long red stalk Ripen July-August Single large brown stone seed 1-1.5 cm diameter 	<ul style="list-style-type: none"> Small round Grayish-brown open cluster of hard nutlets borne on a stem coming from a narrow, elliptical "wing"

*Status according to the federal Species at Risk Act (2002) and provincial Endangered Species Act (2007)

Many of the identification features of both red and white mulberry range greatly and overlap, leaving identification sometimes difficult. In general, red mulberry leaves are larger, rougher and thinner than white mulberry leaves with an upper surface that is dull instead of shiny and a long, tapering tip. The lower surface of red mulberry leaves is fuzzy whereas white mulberry leaves are smooth on both sides. The mitten- or glove-shaped lobed leaves tend to be characteristic of red mulberry leaves, though not exclusively. Red mulberry fruit and flowers tend to be pendulous and long. The white mulberry flowers are stiff and shorter. White mulberry displays a distinctive orange tint between the bark ridges of young to mid-age trees that red mulberry lacks.



Bark of a mature red (left) and white (right) mulberry tree.

Photo courtesy of John Ambrose.



Photo courtesy of T. Davis Sydnor, The Ohio State University, Bugwood.org.



Red (left) and white (right) mulberry leaves.

Photo courtesy of D. Wallace, University of Georgia, Bugwood.org



Photo courtesy of Carlene Perkin

Mulberry Hybrids

Hybrids are often difficult to identify without genetic analysis. In Ontario, the majority of mulberry hybrids are genetically more similar to white mulberry than red. Both white-red hybrids (mother was a white mulberry) and red-white hybrids (mother was a red mulberry) show varying degrees of characteristics of both parents, though both of those hybrid combinations have some smaller dissected, shinier leaves. Hybrids may intermingle and backcross with other red, white or hybrid individuals. In-field visual identification of white mulberry trees is achievable, and some hybrids that more obviously exhibit characteristics of both parent species can be easily identified. However, in the field it can be difficult to visually differentiate between some hybrid mulberries and pure red mulberries with 100% accuracy without genetic analysis. For more information about genetic testing of mulberry trees, contact Aron Fazekas, PhD at the University of Guelph (afazekas@uoguelph.ca).



Hybrid trees display characteristics of both red and white mulberry.

Photos courtesy of Julia Marko.

Biology and Life Cycle

White mulberry is a medium-sized deciduous tree. On average, its lifespan is less than 90 years but specimens have been known to live up to 250 years. It can reproduce from seed as well as vegetatively through adventitious buds and root crown sprouting. The tree is relatively fast growing and reaches reproductive maturity at about 10 years of age. White mulberry trees are generally dioecious, meaning each tree contains either male or female flowers, but monoecious trees also occur.

Flowers bloom in early spring (April to June) and produce a great deal of pollen. Both white and red mulberry are known for the rapid release of their pollen. This occurs when their anthers explosively dehisce (split open), releasing a puff of pollen into the air at up to half the speed of sound. The large amount of white mulberry pollen covers surfaces in the vicinity of the tree, including nearby red mulberry trees, resulting in hybridization. Flowers are wind-pollinated, though some cultivars reportedly set fruit without any pollination.

Fruit ripens by mid-summer and is abundant. Each fruit reportedly produces an average of 22 seeds, each covered in a hard, bony coat; a pound of fruit (~450 g) is estimated to contain 235 000 seeds, equaling as many as twenty million seeds per tree. Seeds are generally spread by birds and other wildlife which eat the fruit and pass the seeds undamaged.

Seed viability has been reported as being at least 720 days. Seeds may germinate readily but often display some dormancy characteristics; germination is often improved by exposure to cold temperatures (0 to 5°C) for a period of 1 to 3 months. Some seeds excreted by birds have also been shown to germinate more completely and more rapidly than seeds of the same tree that do not pass through the digestive systems of birds, but this is dependent upon the type of dormancy the seed displays. Viability has been found to be

as high as 92%. Seedlings have high vigor, growing rapidly and developing a deep and spreading root system.



White mulberry sprout.

Photo courtesy of Sarah Richer.



White mulberry grow in a wide variety of habitats, including pastures and fields.

Photo courtesy of Ohio State Weed Lab, The Ohio State University, Bugwood.org.

Habitat

White mulberry is native to northern China where it has been used for over four thousand years to feed silkworms. It is widely cultivated and naturalized all over Eurasia and can be found across the globe, including in South Africa, North and South America and is considered invasive in many of those countries. The most cold-hardy of mulberry species, white mulberry grows in hardiness Zone 4b in Ontario, Quebec and British Columbia. It is found in the understory of floodplains, wooded areas, dry to moist thickets, low stream banks, prairie hills, along rail tracks, hedgerows and pastures and readily invades old fields, urban lots, roadsides, forest edges and other disturbed areas.

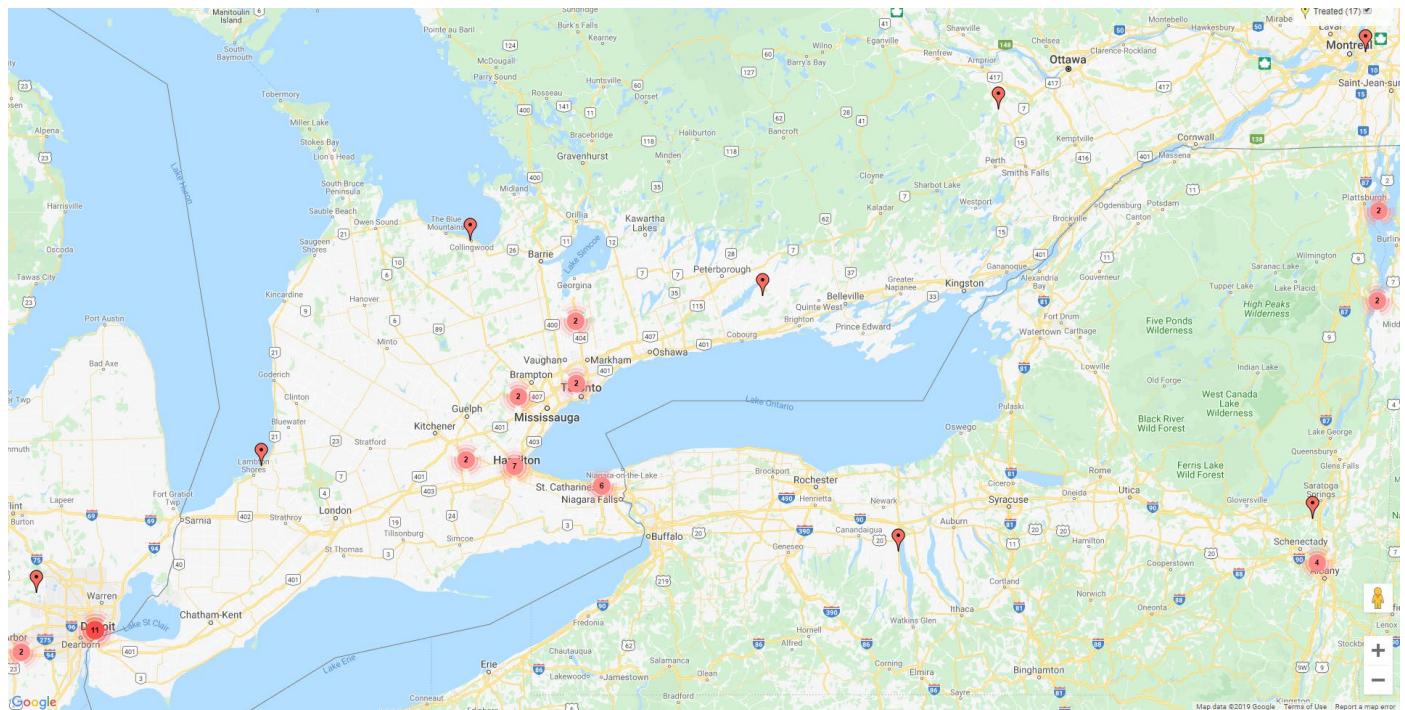
White mulberry tolerates a variety of soils from coarse to fine textures, pH 5.0 to 7.0 and has medium drought, salinity and shade tolerance. It prefers warm, moist, well-drained loamy soils in sunny locations and does not tolerate full shade and rarely growing in heavily forested sites. This tree tolerates a wide range of precipitation and is not restricted to any successional stage.

Pathways of Spread and Distribution in Ontario

White mulberry was introduced to North America in the 1600s, as per records of the Virginia legislature, which document the requirement of white mulberry trees to be planted in an effort to establish the silk industry. White mulberry became a popular ornamental tree and its many uses is one of the reasons it has become so well established all over the world. Both foliage and fruit of white mulberry are edible to livestock and wildlife. It provides cover for wildlife and nesting habitat. The fruit is commonly used in baking, jam and wine making. Its bark can be ground up into meal or used to make dye and fibers for weaving. Its flexible wood is durable and ideal for tennis and badminton rackets, hockey sticks, furniture, house and boating materials, agricultural implements and paper. It is used in traditional medicine for a wide variety of ailments, from sore throats to constipation, and is also cultivated as a biofuel. White mulberry has also been used for windbreaks and erosion control, and is relatively tolerant of salt, drought, pollution and poor soil quality, making it ideal for urban landscaping. The weeping cultivars of white mulberry are widely used in landscaping.

White mulberry has long since escaped cultivation and the seeds are spread by birds and animals who consume the fruit. Birds are the main vector of spread, as white mulberry seeds are still viable after being eaten and excreted. Most of the fruit falls close to the parent tree. The plant also spreads asexually, sprouting from adventitious buds and the root crown.

In North America, white mulberry is widely distributed, occurring across all of the United States with the exceptions of Nevada and Alaska, and has been reported to grow in the provinces of British Columbia, Ontario and Quebec.



Distribution map showing the locations of formally reported white mulberry. Single red dots represent one record. Red dots with numbers indicate the number of records reported in the area.

For up-to-date distribution maps, please visit EDDMapS (www.EDDMapS.org/Ontario). The map point data is based on records contained in the Invasive Species Database, compiled as of December 2019 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

White mulberry is invasive in North America and is considered a noxious weed in some US states. Because of its relative hardiness, ability to adapt to a wide variety of environmental conditions, high growth rate, its abundant fruit, seed and pollen production, it outcompetes and displaces native plants. White mulberry may also demonstrate allelopathic properties, inhibiting germination of other species.

In Ontario, white mulberry is the primary threat to the closely related native red mulberry, with which it freely hybridizes and potentially displaces. Red mulberry is a small to medium sized tree, native to eastern North America. It was designated by COSEWIC (Committee on the Status of Endangered Wildlife in Canada) as threatened in 1987 and then as endangered in 1999. It is listed as endangered on Schedule 1 of Canada's Species at Risk Act (2002). It is also listed as endangered under Ontario's *Endangered Species Act* (2007).

Red mulberry is an understory tree, native to damp or moist, forested habitats in southern Ontario's Carolinian Life Zone, which is at its northern most range. As of 2014 there were only 217 known individual trees left in Canada, only 105 of which were of reproductive age. All of these were located in fragmented populations over 18 sites in Essex County, the Municipality of Chatham-Kent and Niagara, Hamilton and Burlington. Only six of these sites contained five or more mature trees.

In the presence of white mulberry, red mulberry produces very few pure red offspring, and almost all red mulberry populations in Canada occur in communities mixed with white mulberry trees. Red mulberry hybridizes with the more abundant white mulberry and the resulting plants are genetically more similar to white mulberry than red, further endangering the red mulberry populations. Both white mulberry and white-red hybrids outcompete and display superior fitness to red mulberry.

In addition to white mulberry and mulberry hybrids, red mulberry is negatively impacted by diseases that cause twig cankers, blight and dieback, habitat fragmentation and loss, as well as other invasive plants. The excrement of Double-crested Cormorants also affects Erie Island populations.



Red mulberry (*Morus rubra*) is endangered in Canada.

Photo courtesy of Julia Marko.

Applicable Legislation

Many plant species and control methods are regulated under federal and/or provincial legislation. Regulations regarding chemical, mechanical and biological control of white mulberry at the time of writing are summarized in this document. **Please note that this is only for general guidance and is not legal advice.**

Land/vegetation managers are responsible for ensuring that the management or control project complies with all relevant legislation. If protected species or habitats are present, an assessment of the potential effects of the control project could be required. For activities that may affect species listed in the *Endangered Species Act* (2007), species listed on Schedule 1 of the *Species at Risk Act* (2002) (SARA) and for activities which contravene SARA's general or critical habitat prohibitions, permits may be required. Depending on the species and its location, applications should be directed to the appropriate authorities. See details below. Consult with your local Ministry of Natural Resources and Forestry (MNRF) district office early in your control plans for advice (<https://www.ontario.ca/page/ministry-natural-resources-and-forestry-regional-and-district-offices>).

Not all of the legislation below currently applies to any one project but legislation is always changing and may become relevant after publication of this document. Always refer to the most current legislation.

Federal

Plant Protection Act and Plant Protection Regulations

Under the *Plant Protection Act* (1990) 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* (1990) are included in the list of [Pests Regulated by Canada](#).

At the time of publication, white mulberry is not listed under the Pests Regulated by Canada.

Weed Seeds Order

The Weed Seeds Order (WSO), 2016 is a ministerial order made under the *Seeds Act* (1985) which lists invasive plants regulated under the *Seeds Act* (1985). 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.

At the time of publication, white mulberry is not currently listed under the WSO.

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: visit the Pest Management Regulatory Agency's product label search site at <http://pr-rp.hc-sc.gc.ca/lr-re/index-eng.php>.

Fisheries Act

The *Fisheries Act*, administered by both Fisheries and Oceans Canada (DFO) and Environment and Climate Change Canada (ECCC), applies to both the 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 via pesticide drift

To find out if you need a permit under the *Fisheries Act*, consult <http://www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html>.

Species at Risk Act

ECCC also enforces the *Species at Risk Act* (2002) (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* (1994) (MBCA) administered by ECCC, provides for the protection of some migratory birds through the Migratory Birds Regulations and the Migratory Birds Sanctuary Regulations. For birds protected under the MBCA (<https://www.canada.ca/en/environment-climate-change/services/migratory-birds-legal-protection/convention-act.html>), it is an offence to kill, capture, injure, take or disturb a protected migratory bird or damage, destroy, remove or disturb its nest without authorization from a permit issued under the Migratory Birds Regulations. Information on general nesting periods is available to minimize the risk to breeding birds (<https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/general-nesting-periods/nesting-periods.html>). 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. For more information or to find out if you require a permit under the MBCA, visit: <https://www.canada.ca/en/environment-climate-change/services/migratory-bird-permits.html>.



Photo courtesy of John Ruter, University of Georgia, Bugwood.org.

Provincial

Weed Control Act

The *Weed Control Act* (1990) is administered by the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) and enforced provincially. The intent of the *Weed Control Act* (1990) is to reduce negative impacts of noxious weeds on agriculture and horticulture; to reduce plant diseases by eliminating plant disease host plants; and to reduce health hazards to livestock caused by poisonous plants.

A noxious weed includes a plant that has been listed in the schedule of noxious weeds found in regulation 1096 made under the *Weed Control Act* (1990). 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* (1990) has one or more of the following characteristics:

- 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
- 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* (1990). Municipalities are responsible for appointing one or more weed inspectors at their discretion. The weed inspector is responsible for responding to calls made to the municipal clerk with regard to a noxious weed that has been reported on someone's property. The weed inspector can order landowner to destroy the weed within seven days.

At the time of publication white mulberry was not regulated under the *Weed Control Act*'s Noxious Weeds List. The noxious weeds list can be found here: http://www.omafra.gov.on.ca/english/crops/facts/noxious_weeds.htm.

Invasive Species Act

Under the *Invasive Species Act* (2015) there are rules to prevent and control the spread of invasive species. At the time of publication white mulberry was not listed under the Act. For more information on which species are listed, visit: <https://www.ontario.ca/page/stop-spread-invasive-species>.

Pesticides Act

A federally registered pesticide must be classified by the Ministry of the Environment, Conservation and Parks (MECP) under the *Pesticides Act* (1990) before it can be sold, stored or used in Ontario. The provincial classification of federally registered pesticides can be found at <https://www.ontario.ca/page/pesticide-classification-guideline-ontario>. 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.

Note: At the time of this document's completion (March 2020), the *Pesticide Act* and *Regulations* are in the process of being amended. Refer to Environmental Registry of Ontario number 019-0601.

Endangered Species Act

The Ministry of Natural Resources and Forestry (MNRF) enforces the *Endangered Species Act*, whose purpose is to provide protection for species and habitat classified by the province of Ontario 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.

Conservation Authorities Act

Ontario's Conservation Authorities were established under the *Conservation Authorities Act (1990)* to ensure conservation, restoration and responsible management of water, land and natural habitat through programs that balance human, environmental and economic needs. They provide approval for projects that are close to or affecting bodies of water, or above the high water mark, but not for projects that are directly in water, or below the high water mark*.

*The high water mark is the level where a body of water reaches its highest point in the season. Sometimes, an impression of the high water mark is left on the landscape, such as a line on rocks.

Consult your local conservation authority here: <http://conservationontario.ca/> to determine if you need a permit to undertake your control project.

Municipal

Under the *Building Code Act (1992)*, municipalities are able to pass bylaws to address the presence of invasive plants. Municipalities can enact bylaws to control plants when there is a risk of negative impact to human health and safety.

Municipalities are also responsible for enforcing the *Weed Control Act (1990)* to reduce the infestation of noxious weeds that negatively impact on agricultural and horticultural land. Subject to the Ministry of Agriculture, Food and Rural Affairs approval, municipalities can designate additional plants not listed on the Ontario Noxious Weed list in their own jurisdiction.

Check with your local municipality to determine if there are further restrictions around white mulberry in your community.



Photo courtesy of John Foster.

Invasive Management Planning

In addition to the management considerations below, a priority of any control strategy should be the removal of any white mulberry or hybrid within at least a 50 m radius around a red mulberry tree. Fifty metres is generally considered the area in which most gene flow is likely to occur, though this will be affected by factors such as topography and tree cover, so increasing the distance to 100 to 200 m is recommended. When working near populations of endangered species, such as the red mulberry, it is important that the land manager or those responsible for managing the endangered population be consulted in advance.

Management Considerations

Preventing the spread of and controlling white mulberry before it becomes locally established will reduce its impacts on biodiversity, the economy and society.

It is important to use a control plan that incorporates integrated pest management (IPM) principles. This means using existing knowledge about the pest species and its surrounding environment to prevent and fight infestations and may require more than one type of control measure to be successful.

Once white mulberry has been confirmed at a location, a control plan can be developed based on infestation size, site accessibility, potential for spread and the risk of environmental, economic or social impacts. Site-specific conditions such as native plant richness and diversity, wildlife usage and water table fluctuations should also be considered when developing control plans. A detailed inventory of each site is strongly recommended before starting control efforts to help ensure proper methods and timing are used to minimize negative impacts of the tree's removal on wildlife and native plant species.

Mapping

If you think there might be white mulberry on your property, you may wish to conduct an ecological survey. While managers of large land areas, such as conservation authorities or municipalities, may hire or recruit appropriately qualified staff or volunteers, private landowners with smaller properties may be able to conduct their own surveys, or contact an expert. If you know you have white mulberry in one area of the property, ensure the rest of the property is surveyed in order to identify other infestations and to document current and future distribution. For detailed information on mapping techniques the Landowners Guide for Managing and Controlling Invasive Plants in Ontario can be found here: <http://www.ontarioinvasiveplants.ca/resources/technical-documents>.

To see what might already be in your area, visit EDDMapS Ontario: <http://www.eddmaps.org/ontario/>

Landscape Level Management

If white mulberry has become widely established, a more detailed management strategy should be undertaken. A strategic and integrated landscape-level approach to management, conservation and planning serves to bring partners, landowners, and land managers together to work toward common and shared goals that consider both site-level needs and wider landscape considerations. Focusing only on individual, local challenges without also examining the site within a broader landscape context may increase management costs, be more labour intensive, and may not result in strategic impacts across larger areas.

Effective management and control of white and hybrid mulberry requires several treatments and a combination of control measures. It's not always realistic, especially for large infestations, to try and eliminate the infestation all at once. Determine the desired plant community and the land use objective, and then develop an appropriate IPM strategy.

Setting Priorities

Determining the highest priority locations for control prior to management will help to determine the best course of action. Therefore, when developing a management strategy, it's important to take into account the following to help inform control decisions:

1. If you have limited resources, first try to remove the outlying populations (isolated plants or satellite populations), to prevent further spread.
2. If you have more resources, addressing larger, "core" populations of white mulberry is an important step toward reducing the quantity of seed dispersing into uninfested areas. In many cases, resource limitations may prohibit immediate removal of entire core populations. Under these circumstances, core areas should be prioritized and addressed strategically.
3. Concentrate on high-priority areas or areas where the plant is going to cause the most problems in terms of spread, such as the most productive or sensitive part of an ecosystem, along a creek, near species at risk, a favourite natural area, or the side of a trail where people may come into contact with the plants.
4. Protect federally, provincially and regionally rare species and communities by removing invasive plants and ensuring rare species are not negatively impacted by control efforts.
5. Review the different control options and costs with considerations to surrounding water, habitat, time of year and type of land use i.e. high-traffic recreational areas, agriculture.
6. Ensure all landowners have been identified and consulted before control takes place.
7. Consider dedicating a certain time each year to control efforts, and make it a joint effort with neighbouring landowners/land managers.
8. Begin to assess whether regeneration or restoration is appropriate, and if seeding or planting of native plants is needed to help jump-start natural succession and increase biodiversity in the area.
9. Follow-up monitoring is crucial to remove seedlings that may sprout after initial control efforts. New seedlings can establish from seedbanks two or more years after control.

Prioritizing within a Control Area

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

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.

This flow chart can help land managers choose where to first focus control efforts if controlling satellite populations due to limited resources::

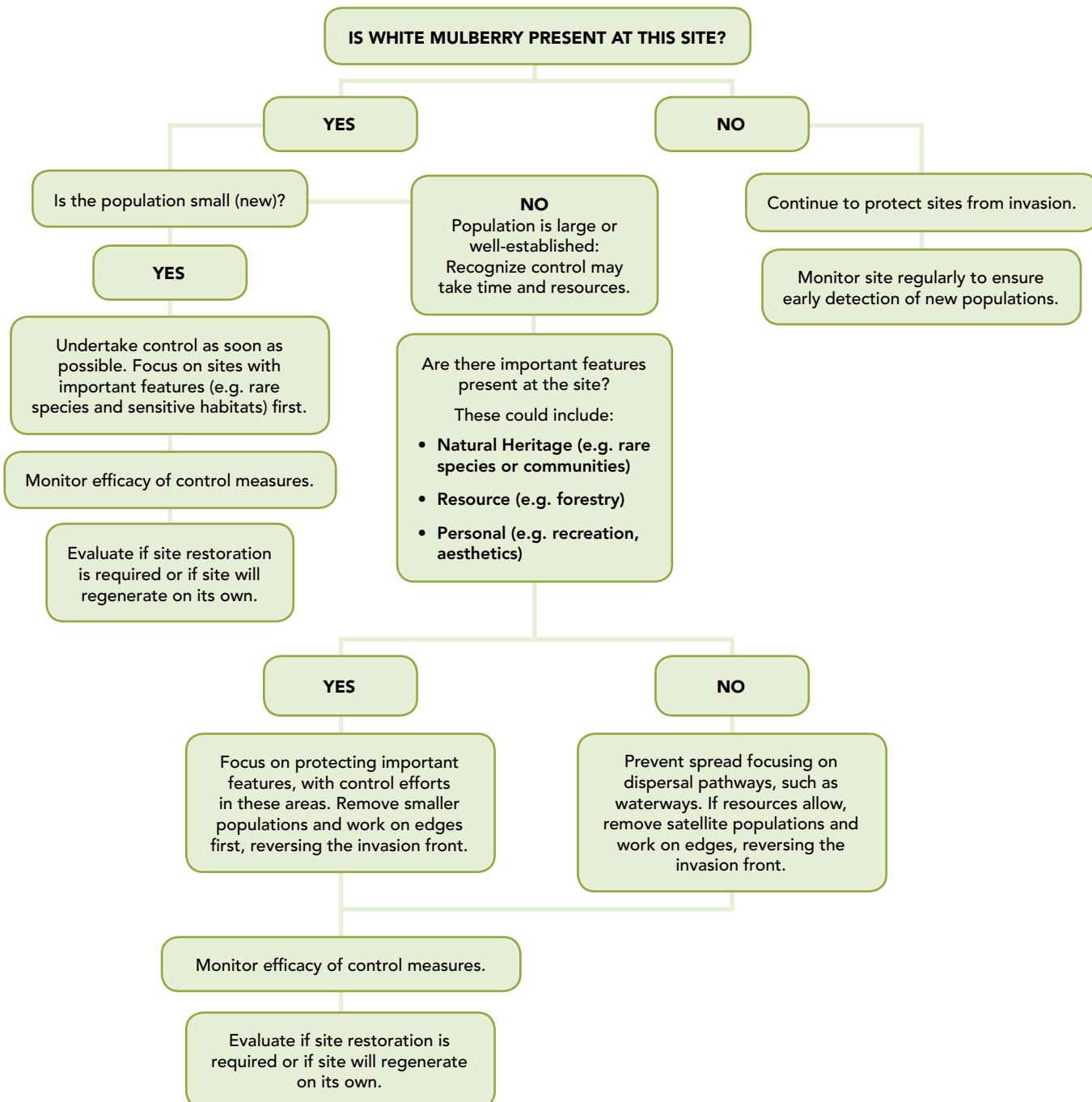


Figure 1: How to prioritize white mulberry sites for effective control.

Long-term Management and Monitoring

Due to the persistent and aggressive nature of white (and hybrid) mulberry, and their ability to regenerate vegetatively, creating an ongoing management and monitoring plan is critical to the success of the control project. Management does not end with the removal of the tree. The seed bank left by the removed white or hybrid mulberry trees must still be managed, as do any other invasive plant populations or seedbanks. There may also be other white or hybrid trees nearby. Monitoring will determine the effectiveness of the initial control treatments as well as the types of follow-up treatments that are necessary.

Monitoring could be as simple as taking photos or performing a visual inspection, or it could be more complex and include extensive surveys. In general, annual treatment is imperative and should focus on selectively removing isolated populations as they appear. Follow-up treatment will ensure the invasive population remains under control and allow for the regeneration of the native plant population. If there is not a native seedbank present to repopulate the area, other restoration techniques may be required. For more information on monitoring see the *Landowners Guide for Managing and Controlling Invasive Plants in Ontario* here: <http://ontarioinvasiveplants.ca/resources/technical-documents>

After Management: Assessing Regeneration vs. Restoration

Consider the following factors:

1. Level of disturbance at the site:

- a. Was this a heavily invaded site (i.e. much disturbance was caused during control measures)?
- b. Will it continue to be disturbed (e.g. through beach use or trail use/management)?

2. Biology of the invasive species removed:

- a. Is there a seed bank to consider?
- b. Are their seedbanks from other invasive plants in the area?

3. Re-invasion risk:

- a. Are there invasive species nearby which could re-invade the site from nearby trails, watercourses or other pathways of introduction?

4. Existing native vegetation:

- a. Will the native vegetation that still exists on the site (if any) regenerate slowly?
- b. Does it need help? Species with specific habitat requirements or reproductive strategies resulting in low fecundity, such as species at risk, may require re-introduction. The majority of plant species should be able to recover naturally, especially if healthy populations exist adjacent to the controlled area.



If you answered yes to most of the questions above, it is likely that the site will be re-invaded before it has a chance to regenerate on its own. It is also likely annual control will be necessary, as the species will continue to invade and be present among the native species. Restoration will likely be needed to reduce the risk of re-invasion. See the section on restoration, below.

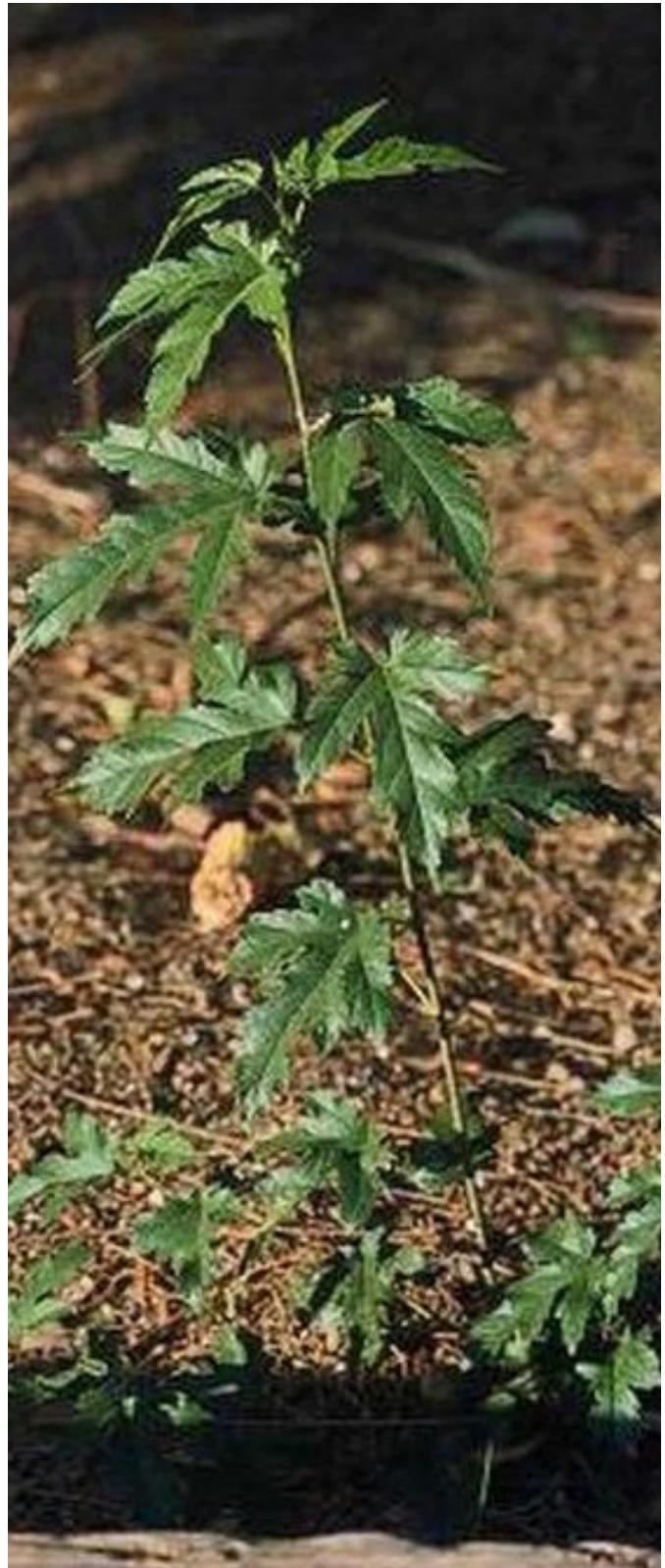
Control Measures

Caution: The milky sap that is contained in all parts of the white mulberry (except fruit) contains latex and is toxic to humans if ingested. It can also cause skin irritation. Caution and protective clothing are recommended when working with this species. Wear waterproof gloves, long sleeve shirts, pants and eye protection.

As mentioned above, this species regenerates with adventitious buds and root crown sprouting (does not regenerate from lateral roots). Sprouting from stumps and root crowns is common if not treated with an herbicide. It is therefore important to remove or treat all clones and the entire root system, or else risk re-sprouting. As both white and mulberry hybrids are considered invasive, it is generally recommended that both white mulberry and hybrid species be controlled.

Whenever possible, control of mature trees should be done before the female fruits start to drop seed (June-July). Pulling or digging is recommended for removing small trees, while the cut stump method combined with herbicide is recommended for large trees. Annual monitoring for new growth is recommended. Several years of control may be needed since the seeds are unaffected by the above methods and seedlings can recolonize an area.

Because of its impact on the local bird populations, it is generally recommended to avoid the removal of trees during bird nesting season.



White mulberry seedling.

Photo courtesy of Joseph M. DiTomaso, University of California - Davis, Bugwood

Mechanical

Pulling and Digging:

Size:	Seedlings and trees smaller than 5 cm in diameter.
Goal:	Eradication.
Timing (season):	Can be performed any time of the year, preferably after a rain when soil is moist and pliable. Autumn is best for reducing disturbance to ground vegetation and nesting birds.
Treatment Frequency:	Once, if root crown is completely removed.
Best Practices:	Seedlings can be hand-pulled (using gloves) any time of the year. Larger plants can be removed using a weed pulling tool, shovel, fork or winch. The entire root crown must be removed in order to prevent re-sprouting. Disturbed soil will result from these techniques and should be tamped down or covered in a thick layer of mulch to minimize exposing new seeds. Wear gloves, safety glasses and protective clothing. Sprouts are difficult to remove unless the entire root system is removed.
Advantages:	Inexpensive, simple, effective and selective. Can be done in remote locations. Removes the entire plant.
Disadvantages:	Labour intensive. Must remove entire root crown or regeneration can occur. Taproot can be brittle and break when removing. Can cause soil disturbance.
Ideal For:	Landowners with restricted access to chemical control or who have small, recent infestations requiring immediate control. Can be done in remote locations or in environmentally sensitive habitats.

Cutting:

Not recommended unless combined with herbicide treatment. Cutting the tree to the ground and re-cutting at the first appearance of new growth (5-6 times each growing season) will slow the plants growth but will likely encourage sprouting and regrowth. Regular cutting, however, will deplete the plant's energy (carbohydrate) reserves and may eventually kill it. This method requires persistence over many years and is not an effective control option. A cut stump can be covered by a thick black plastic to discourage sprouting, though monitoring will be required, as sprouting may occur through even very heavy plastic. Combining this method with an herbicide can be effective (see below).

Girdling:

Not recommended unless combined with herbicide treatment. Girdling is not recommended for white or hybrid mulberry trees as this technique will likely encourage sprouting. Girdling may slow the growth of the tree but may not inhibit seed, flower and fruit production, nor is it likely to kill the tree. If no herbicide is available, girdling can be performed by cutting a ring into the tree's trunk at ground level and a second cut at least 15 cm above the first cut. The cuts should encircle the tree completely. On mulberry trees less than 10 cm in diameter, this cut should be approximately 1.5 cm deep and 1.5 cm wide. On larger white mulberry trees, the cut should be approximately 4 cm wide and 4 cm deep into the tree. The mulberry bark

should be fully severed to completely interrupt the tree's vascular system. Within a year the bark between the two cuts should fall off. This will confirm that the girdling cuts were done properly. Follow-up will likely be required to cut back new growth.

Burning:

Not recommended. As a result of its thin bark, white mulberry is typically only top-killed by fire. This species regenerates with adventitious buds and root crown sprouting and the seeds typically survive the effects of fire.

Biological

Targeted Grazing:

Grazing is not considered a viable control option.

Biological Control:

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



Untreated white mulberry stumps can re-sprout.

Photo courtesy of Sarah Richer.

Chemical

The management of pesticides is a joint responsibility of the federal and provincial governments. Before a pesticide can be sold or used in Ontario, it must be registered under the federal Pest Control Products Act by Health Canada's Pest Management Regulatory Agency (PMRA) and be classified under the provincial Pesticides Act (2002) by Ministry of the Environment, Conservation and Parks (MECP).

It is important that pesticides be applied in accordance with all label directions. The pesticide label is a **legal document** and prescribes how the pesticide can be legally and safely used. Ensure you have the most current label and are aware of any re-evaluation decisions.

For an up-to-date list of pesticides labelled for white mulberry control and to access the most current label, visit the Pest Management Regulatory Agency's product label search site at <http://pr-rp.hc-sc.gc.ca/lr-re/index-eng.php>. To determine if a federally registered pesticide is also classified for use in Ontario, visit: <https://www.ontario.ca/page/pesticides>.

In addition to being used in accordance with label directions, pesticides must also only be used for purposes allowed under Ontario's Cosmetic Pesticides Ban.

The province's Cosmetic Pesticides Ban contains exceptions for the use of pesticides (class 9), including the use of pesticides related to agriculture, forestry, and the protection of natural resources (provided certain conditions are met) which may allow chemical control of white mulberry on your property (see below).

Furthermore, non-domestic (i.e. commercial, restricted etc.) herbicides can only be purchased, stored and applied by appropriately licensed exterminators.

For more information on pesticides and all aspects of weed control, the Ontario Ministry of Agriculture, Food and Rural Affairs Publication 75, Guide to Weed Control 2014-2015 can be found at: <http://www.omafra.gov.on.ca/english/crops/pub75/pub75toc.htm>.

Exceptions to the Ontario Pesticides Ban

The following are exceptions to the Ontario Pesticides Ban. For details on each exception, refer to the Ontario Governments document "Technical Guidance: Pesticides Act (1990) and Ontario Regulation 63/09 Municipalities". This document provides information to municipalities about Ontario's cosmetic pesticides ban: <https://www.ontario.ca/page/technical-guidance-pesticides-act-and-ontario-regulation-6309-municipalities>.

Are you protecting a Natural Resource?

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 principles outlined in this BMP guide. You will need to contact the Ontario Ministry of Natural Resources and Forestry (<https://www.ontario.ca/page/ministry-natural-resources-and-forestry-regional-and-district-offices>) to obtain a written letter of opinion from the MNRF Regional or Branch Director.

Are you a farmer?

The agriculture exception allows farmers to use Class 9 pesticides for the purposes of the agricultural operation that they own or operate. This exception may apply to the control of white mulberry 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
- 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”

Are you involved in Forestry?

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 white mulberry may fall under the forestry exception; a Forestry Class Land Exterminator licence may be required to use commercial pesticides in a forest.

Herbicides and White Mulberry

Literature and professionals consulted for this document recommend using glyphosate-based or triclopyr-based herbicides for white mulberry control. Glyphosate is a broad-spectrum, systemic herbicide, which is translocated down the plant into the roots where it kills it. As it is not selective, it will also affect non-target plants if they are exposed. Triclopyr is also systemic but more selective. Glyphosate should be applied between 10°C and 30°C and triclopyr under 30°C. Neither should be used in low humidity conditions. The risk of pesticide drift prohibits pesticide use near water. A picloram-based herbicide may also be effective on smaller trees but will not control very large or old trees with large root systems.

Herbicide Application Methods

Note on the EZ-Ject™ Lance:

The EZ-Ject™ Lance is a tool that uses a spring-loaded head which injects an herbicide-filled shell into the cambium of a tree or stump where it is taken up by the tree and allows for targeted treatment that is quick and effective. Small trees can be cut down and the stumps injected with an EZ-Ject™ Lance. Trunks of large trees can be injected with the EZ-Ject Lance™ and left standing (where the tree does not pose a hazard) or subsequently cut down. See the manufacturer’s instructions for details.

Cut Stump:

Size:	Any infestation size of trees with diameter of 5 cm or larger.
Goal:	Eradication.
Timing (season):	After trees begin to leaf out through early winter. Do not attempt to cut and treat the mulberry in spring when the sap is vigorously flowing upwards. Herbicides applied at this time will provide limited control and treatment will need to include multiple applications.
Treatment Frequency:	Once is usually effective if done properly. Follow-up as needed.
Best Practices:	<p>Wearing protective clothing, gloves and safety glasses, cut the tree down or re-cut the stump until live wood is reached. Make the cut surface as flat as possible. Cut larger trees off at the roots (exposing the roots). For large trees, apply the herbicide to at least the cambium layer of the stump. For young trees, apply to the whole cut stump surface. This can be done using a paintbrush, sponge or spray applicator, as the label permits. Thoroughly wet the area but do not apply to the point of runoff. A dye added to the mix will help keep track of treated plants. A cut mulberry will vigorously send up new sprouts if left untreated. Triclopyr-based or glyphosate-based herbicides are recommended.</p> <p>For triclopyr: Dilute the product (with bark oil or canola oil, for example) to a 20-25% solution (based on a product originally containing a concentration of 755 g/L triclopyr). This can be applied immediately or up to week after cutting. Control may be less effective during periods of moisture stress in the late summer. This herbicide is also effective in winter.</p> <p>For glyphosate: Dilute the product (with water) to a 95% solution (based on a product originally containing a concentration of 540 g/L glyphosate). This must be applied immediately after cutting, within 5 minutes, before the plant seals the cut area off.</p>
Advantages:	Selective. Less soil disturbance and quicker than pulling out all the roots. Kills plants whole.
Disadvantages:	Labour intensive and time consuming. May need to be repeated multiple times. May need exemptions from MECP.
Ideal For:	Environmentally sensitive habitats or in restoration sites. Areas where standing dead brush is not desired.

Basal Bark:

Size:	Young trees 10-15 cm in diameter.
Goal:	Eradication.
Timing (season):	Can be used when ground is not frozen, but is most effective in late summer and early fall, when the sap of the tree is flowing towards the roots. Dry conditions.
Treatment Frequency:	Often 1 treatment is sufficient.
Best Practices:	If not already added, mix herbicide with bark oil to give it time to penetrate the tree bark. Apply herbicide mixture with a hand sprayer or paint brush, as the label allows, all the way around the stem in a strip. Apply a 5-10 cm high strip on the lower 30 cm of stem. Wet bark thoroughly but not to the point of runoff. Use a triclopyr-based herbicide. Dilute the product (with bark oil) to a 20-25% solution (based on a product originally containing a concentration of 755 g/L triclopyr). Control may be less effective during periods of moisture stress in the late summer. This herbicide is also effective in winter.
Advantages:	Selective. Less soil disturbance and quicker than pulling out all the roots. Kills plants whole. Less labour intensive than pulling.
Disadvantages:	May need to be repeated multiple times. May need exemptions from MECP. Does not always eliminate sprouting.
Ideal For:	Environmentally sensitive habitats or in restoration sites.



Girdle Treatment

Photo courtesy of Kaylyn Crawford

Girdling:

Size:	Trees with diameter > 10 cm.
Goal:	Eradication.
Timing (season):	Can be used when ground is not frozen, but is most effective in late summer and early fall, when the sap of the tree is flowing towards the roots. Dry conditions.
Treatment Frequency:	Often 1 treatment is sufficient.
Best Practices:	Cut 2 parallel rings into the lower 30 cm of the tree's trunk, at least 5 cm apart. The cuts should encircle the tree completely and should be approximately 4 cm wide and 4 cm deep into the tree. Spray or paint the cuts with an herbicide. Within a year the bark between the two cuts should fall off. This will confirm that the girdling cuts were done properly. When the wood is gray and the canopy no longer produces leaves, the tree is dead and is safe to remove if the standing dead tree is in an area that poses a safety hazard. For triclopyr: Dilute the product (with bark oil or canola oil, for example) to a 20-25% solution (based on a product originally containing a concentration of 755 g/L triclopyr). Control may be less effective during periods of moisture stress in the late summer. This herbicide is also effective in winter. For glyphosate: Dilute the product (with water) to a 95% solution (based on a product originally containing a concentration of 540 g/L glyphosate)
Advantages:	Selective. Less soil disturbance and quicker than pulling out all the roots. Kills plants whole. Less labour intensive than pulling.
Disadvantages:	May need to be repeated multiple times. May need exemptions from MECP. Does not always eliminate sprouting.
Ideal For:	Environmentally sensitive habitats or in restoration sites.

Foliar application:

Not effective.

Disposal

Do not backyard compost:

Home composters do not reach the temperature necessary to kill mulberry seeds. Brush and wood can be chipped or composted. Fallen stems may re-root if left in direct contact with the soil.

Municipal disposal:

Although the wood of a white mulberry or hybrid tree can be disposed of without special consideration, the seeds and fruit may not be accepted at municipal disposal sites. Call ahead to your local municipality about disposal availability for invasive plant material. If your local municipality accepts invasive plant material in the local landfill, carefully dispose of the material in a container that will not rip or puncture.

Municipal compost:

Viable plant material (seeds and roots in particular) should only be composted if the material is taken to a large-scale municipal composting facility where the compost pile reaches temperatures high enough to kill the living material. Composting operations that demonstrate strict adherence to pathogen kill processes and maintain optimal moisture conditions may provide sufficient conditions to destroy most seeds of invasive plants. Ontario composting facilities are required to routinely monitor the compost process and meet strict, provincially regulated time-temperature parameters for pathogen kill.

Burn:

Wood from mulberry trees can be burned.

Solarize:

Viable plant material can be treated by placing them in black plastic bags, sealing and leaving them in a sunny place for a 2 to 3 weeks to "cook". The rotten material can then be composted or placed in the trash.

Restoration

During Control

Mulching:

Covering sites with mulch immediately after invasive species 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 and retains moisture, allowing more shade-tolerant native plant species to germinate and colonize the gaps left by white mulberry removal.

Seeding:

Seeding an area with other 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

Planting:

If there are invasive plants nearby or in the seedbank which may colonize the control area, planting larger native species stock (e.g. potted) will help outcompete invasive seedlings. It may, however, be better to monitor and remove invasive species 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 planting at control sites, consider space and 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. Plants should be appropriate for the area being replanted. Other native alternatives include red maple (*Acer rubrum*), hackberry (*Celtis occidentalis*), black gum (*Nyssa sylvatica*) and sassafras (*Sassafras albidum*).

Red Mulberry:

Due to its endangered designation, it is not permitted under the *Species at Risk Act* (2002) to collect seeds or take cuttings from a red mulberry tree without a permit. Although some nurseries sell products listed as red mulberry, most of these products are not pure *Morus rubra*. If your organization is permitted to perform red mulberry restoration, it is critical that cuttings come from DNA verified trees and seeds come from controlled pollination only. For information about seeking a protection or recovery permit, contact the Ministry of the Environment, Conservation and Parks or visit <https://www.ontario.ca/page/how-get-endangered-species-act-permit-or-authorization>.

Preventing the Spread

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

Report it.

If you think you see white mulberry take a picture, record the location and report it using the following tools: contact the Invading Species Hotline at **1-800-563-7711** or report online at www.eddmaps.org/ontario or www.inaturalist.ca. For more information, call the Invading Species Hotline at **1-800-563-7711** or visit www.invadingspecies.com or contact the Ontario Invasive Plant Council at info@oninvasives.ca.

Watch for it.

Learn what white mulberry 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 white mulberry or other invasive species.

Stop the spread.

Inspect, clean and remove mud, seeds and plant parts from clothing, pets (including 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 white mulberry or mulberry hybrids 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 alternative species 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 white mulberry sightings, track the spread, detect it early and respond to it quickly. These include:

- 1) **EDDMapS Ontario:** an online reporting tool and **FREE** mobile application (iPhone and Android) where users can report sightings, review distribution maps and explore educational resources of invasive plants and other invasive species. This tool, at www.eddmaps.org/ontario, is free to use.
- 2) **The Invading Species Hotline:** a toll-free telephone number (**1-800-563-7711**) where individuals can report sightings verbally.
- 3) **iNaturalist:** an online reporting tool (www.iNaturalist.ca). If you suspect you have encountered white mulberry or another invasive species, please take a photograph, mark your location and call the Invading Species Hotline at **1-800-563-7711**.

Best Management Practices Documents Series



Autumn Olive Best Management Practices in Ontario

Black Locust Best Management Practices in Ontario

European Black Alder Best Management Practices in Ontario

Garlic Mustard Best Management Practices in Ontario

Giant Hogweed Best Management Practices in Ontario

Invasive Common (European) Buckthorn Best Management Practices in Ontario

Invasive Dog-strangling Vine Best Management Practices in Ontario

Invasive Honeysuckles Best Management Practices in Ontario

Invasive Reed Canary Grass Best Management Practices in Ontario

Japanese Knotweed Best Management Practices in Ontario

Multiflora Rose Best Management Practices in Ontario

Phragmites (Common Reed) Best Management Practices (EN, FR)



Phragmites (Common Reed) Best Management Practices for Ontario Roadways

Purple Loosestrife Best Management Practices in Ontario

Scots Pine Best Management Practices in Ontario

Spotted Knapweed Best Management Practices in Ontario

White Mulberry Best Management Practices in Ontario

White Sweet Clover Best Management Practices in Ontario

Wild Parsnip Best Management Practices in Ontario

Additional Publications from the Ontario Invasive Plant Council

Invasive Plant Technical Bulletin Series

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

A Quick Reference Guide to Invasive Plant Species

Clean Equipment Protocol for Industry

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

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

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

The Landowners Guide to Controlling Invasive Woodland Plants

Invasive Phragmites Site Prioritization Tool

The Disposal of Invasive Plants in the Greater Toronto Area



The Disposal of Invasive Plants in Northern Ontario Regions

Assessing Invasive Species Seed Viability in Compost

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Design by

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