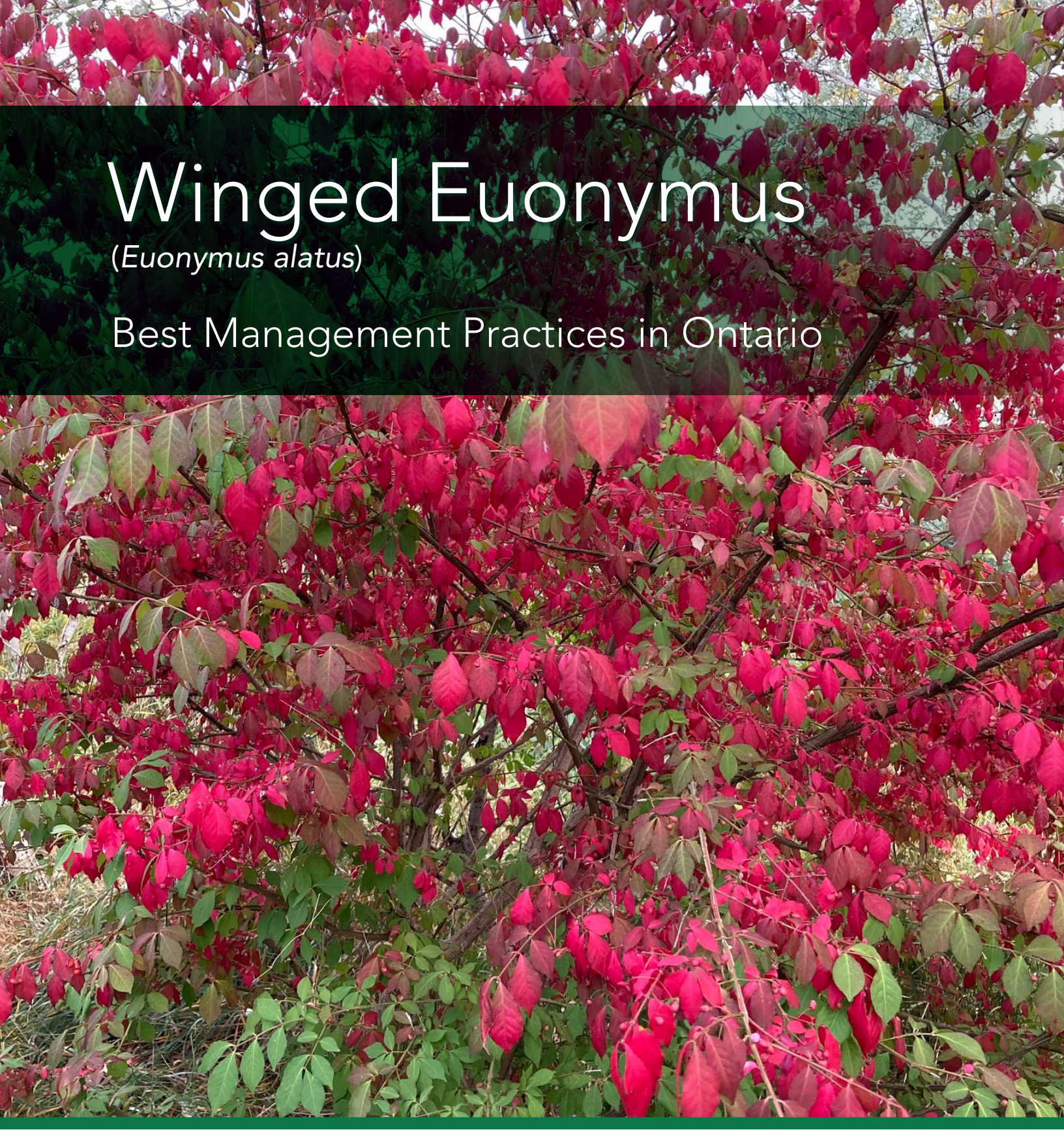
Winged Euonymus

(*Euonymus alatus*)

Best Management Practices in Ontario



TORONTO

ONTARIO INVASIVE PLANT COUNCIL

Foreword

These Best Management Practices (BMPs) provide guidance for managing invasive winged euonymus or fusain ailé (*Euonymus alatus*) in Ontario. Funding and leadership to produce this document was provided by the City of Toronto. These BMPs were developed by the Ontario Invasive Plant Council (OIPC) and its partners to facilitate invasive plant control initiatives by individuals and organizations concerned with the protection of biodiversity, agricultural lands, infrastructure, crops and species at risk in Ontario. This document also supports and advances the management of invasive species identified as a priority by the City of Toronto's Ravine Strategy and Biodiversity Strategy.

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 control practices known from research, experience and literature available at this time. It 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. The information provided in this BMP is not to be considered legal advice. The timing windows 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 OIPC (www.ontarioinvasiveplants.ca) for updates.

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Inquiries regarding this document can be directed to the **Ontario Invasive Plant Council (OIPC)**
Email: info@oninvasives.ca

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

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Winged euonymus.

Photo courtesy of: Freyja Whitten, Credit Valley Conservation.

The bright fall foliage of winged euonymus has made it a popular ornamental shrub in landscape plantings.

Introduction

Winged euonymus (*Euonymus alatus*) is a woody, multi-stemmed deciduous shrub in the staff-vine family (Celastraceae), frequently planted as an ornamental shrub. There are many common names associated with this species, including winged burning bush, oriental spindle-tree, winged spindle-tree, and winged wahoo. The name 'winged' derives from the unique shape of its twigs, which are lined with cork-like ridges or wings. It is also named 'burning bush' after the flaming bush that appeared to Moses in the book of Exodus due to its brilliant pink-red fall colour.

Its stunning fall foliage and attractive berries are some of the main reasons it has become popular in ornamental landscaping since its initial introduction into the United States from Asia in the 1860s. It has been planted in urban gardens, along roadsides, hedges, and foundation plantings. Winged euonymus is also prized for its low maintenance, shade tolerance, rapid growth, and ability to adapt to many growing conditions. However, these traits have helped it escape into natural areas and become a problematic invasive in several regions, including Ontario and throughout the northeastern United States. In Ontario it has escaped from local urban centers into natural ravines and forests, where it alters habitat, forming dense thickets and out-competing native shrubs and herbaceous plants. Winged euonymus is a successful invader due to its ability to cast dense shade, produce seeds prolifically, and spread vegetatively through its root system. It is also spread by seed when birds and wildlife consume the fruit and deposit the seeds long distances in their droppings. Each shrub can have hundreds of small seedlings growing underneath it.

Winged euonymus is not the only invasive Euonymus species to watch out for in Ontario. There are several other Euonymus species native to Asia and Europe planted as ornamentals in Ontario with invasive characteristics, such as European euonymus (*Euonymus europeaus*) and winter creeper (*Euonymus fortunei*). The best way to prevent the spread is to stop buying these non-native ornamental species and substitute non-invasive or native species that provide comparable fall colours, attractive fruit and growth habits.

This document will suggest suitable native alternatives to plant instead of winged euonymus, its cultivars and other non-native euonymus species. It will also increase awareness of this invasive species in Ontario and provide guidance on the effective and consistent management of winged euonymus.

Description

Size and Shape:

Winged euonymus is a rounded, deciduous shrub. It can form multiple stems or a single stem that normally branches close to the ground. It typically ranges from 1.5 – 4 m tall, but may reach up to 6 m.

Rounded, deciduous shrub.

Photo courtesy of: Stephen Smith, Urban Forest Associates.

Stem and Bark:

Younger twigs or branches are lime-green and square with two to four corky brown wings along the stems. Wings are less prominent in some cultivated varieties. Older twigs or branches are grey or brownish grey with small fissures. The buds are green-brown-red in colour and diverge from the stem.

Winged euonymus has distinctive corky wings along the stems.

Photo courtesy of: Stephen Smith, Urban Forest Associates.

Buds are green-brown-red and diverge from the stem.

Photo courtesy of: Cassi Saari. Available: https://www.inaturalist.org/observations/5039711, licensed under CC-by-NC.

Leaves:

The paired opposite leaves are elliptic or obovate, widest at or above the middle and narrowed at both the base and tips of the leaf with finely toothed edges and 2 - 7 cm long, and 1 - 4 cm wide. Leaves have a very small leaf stalk (petiole) that is just 1.5 – 3.5 mm long. The upper- surfaces of the leaves are medium to dark green, while the under-surfaces are a lighter shade of green. During fall the leaves turn pink-red to a darker red-purple (crimson) in full sun, or a lighter pink in heavy shade. Where it has escaped into natural areas, the leaves often turn yellow in fall instead of red.

First year growth. Note the opposite, elliptical leaves with wings visible on stem.

Photo courtesy of: Katherine Baird, Toronto Botanical Garden.

Opposite leaves and corky wings on stems.

Photo courtesy of: Freyja Whitten, Credit Valley Conservation.

Flowers:

The flowers are yellow-green with four petals, loosely arranged in clusters of one to three emerging in the leaf axils (where the leaf attaches to the stem). Flowers are 0.6 - 0.8 cm wide, inconspicuous and lie flat against the leaves. The flowers are seen throughout the spring.

Yellow-green flowers with four petals.

Photo courtesy of: John F Foster, Ontario Invasive Plant Council.

Flowers are inconspicuous and lie flat against the leaves.

Photo courtesy of: Nathan Martineau. Available: https://www.inaturalist.org/observations/25880816, licensed under CC-by-NC.

Fruit and Seeds:

The abundant fruit capsules are about 1 cm long, dark red to purple and open in the fall to reveal a fleshy bright orange to orange-red aril. Arils are fleshy coatings covering a seed and are often brightly coloured. Each aril contains up to four seeds.

Unopened fruit capsules are dark red to purple.

Photo courtesy of: Megan R King. Available: https://www.inaturalist.org/observations/2330981, licensed under CC-by-NC.

In the fall, fruit capsules open to reveal a fleshy orange to orange-red aril.

Photo courtesy of: Andrew Keaveney. Available: https://www.inaturalist.org/observations/66641352, licensed under CC-by-NC.

Cultivars of Winged Euonymus

There are a variety of cultivars of winged euonymus, including several dwarf varieties that are very popular in ornamental landscaping. These include 'Little Moses' and 'Rudy Haag' that reach a height of up to 1.5 m, and 'Compactus', which is not truly a dwarf species but often advertised as such, reaching a height of 3 m. 'Compactus' is prized for its compact form and rounded shape and has less prominent or absent corky wings. These cultivars and others have been promoted as sterile varieties and safe alternatives to the original species, due to a reduction in seed production and seed viability. However, since cultivars are usually clonal selections (from a single genetic individual) and not produced from seed, they still have the potential to produce offspring with high seed production if they are able to cross-pollinate with other cultivars (Brand *et al.*, 2012; Knight *et al.*, 2011). Further, demographic models by Knight *et al.* (2011) found that for long-lived woody plant species such as winged euonymus, large reductions in fecundity (seed production and viability) were not enough to reduce population growth, as they were still able to produce fertile offspring. To date, there has been research into developing cultivars that are truly seed-sterile triploid varieties, although none are currently available (Ranney *et al.*, 2004).

Winged euonymus.

Photo courtesy of: Lindsey K Wise. Available: https://www.inaturalist.org/observations/8530333, licensed under CC-by-NC.

Lookalikes: The *Euonymus* genus

The *Euonymus* genus comprises about 170 species of trees, shrubs and woody vines, mostly found in Asia. Four shrubs and small trees are native to Canada, and several introduced species are used for ornamental purposes. *Euonymus* species share several characteristics:

- Deciduous, simple leaves that are, in general, oppositely arranged along the stem.
- Flowers are small and inconspicuous.
- Seeds are often covered in a brightly coloured fleshy aril, which serves to attract animals that disperse the seeds once consumed in their droppings. The arils are covered by a fruit capsule, which splits open to reveal the arils in the fall. Arils are divided into two, three, or four segments.

Winged euonymus can be distinguished from the other *Euonymus* species by the presence of prominent broad corky wings on the stems, although the cultivar 'Compactus' has reduced or absent wings. Other Euonymus species can have wings, but they are not as broad as winged euonymus and are not found on first year growth. Winged euonymus may be confused with two native Euonymus species, eastern burning bush (*Euonymus atropurpureus*) and running strawberry-bush (*Euonymus obovatus*).

There are two additional non-native ornamental *Euonymus* species with invasive tendencies that could be confused with winged euonymus:

European spindle tree (*Euonymus europaeus*):

- This is very similar to winged euonymus but does not have prominent "wings"; rather wings are absent or narrow, and the narrow wings if present are not found on first year growth. European spindle tree also has long leaf stalks (petioles) of 4 – 22 mm long compared to 1.5 – 3.5 mm long in winged euonymus. European spindle tree can be distinguished from the rare native eastern burning-bush or eastern wahoo (*Euonymus atropurpureus*) by the flowers; European spindle tree has white flowers in late May while eastern burning-bush has maroon flowers in June. The European spindle tree also retains its leaves much later into the fall, and the twigs tend to be thicker and more rigid.

Leaves and branching pattern.

Photo courtesy of: Katherine Baird, Toronto Botanical Gardens.

Pink fruit capsules.

Photo courtesy of: Stephen Smith, Urban Forest Associates.

Winter creeper (*Euonymus fortunei*):

- It creates a dense monoculture groundcover and can also climb trees in forests, preventing native herbaceous plants and tree seedlings from growing, thus reducing understory species richness. The leaves have a glossy sheen and are dark green with lightened main veins.

Winter creeper.

Photo courtesy of: Stephen Smith, Urban Forest Associates.

Table 1: The main identification features of winged euonymus in comparison to non-native invasive or native Euonymus look-alike species also found in Ontario. Key identification features which differentiate the species are in **bold**.

	Winged Euonymus *(Euonymus alatus)*	**European spindle tree** *(Euonymus europaeus)*	**Winter creeper** *(Euonymus fortunei)*	**Eastern wahoo** *(Euonymus atropurpureus)*	**Running strawberry-bush** *(Euonymus obovatus)*
	 INVASIVE **Photo courtesy of: Megan R King. Available: https://www.inaturalist.org/observations/2330981, licensed under CC-by-NC.**	 INVASIVE **Photo courtesy of: Thomas Koffell. Available: https://www.inaturalist.org/observations/34666098, licensed under CC-by-NC.**	 INVASIVE **Photo courtesy of: Stephen Smith, Urban Forest Associates.**	 NATIVE **Photo courtesy of: Christopher David Benda. Available: https://www.inaturalist.org/observations/189284636, licensed under CC-by-NC.**	 NATIVE **Photo Courtesy of: Chris McAnlis. Available: https://www.inaturalist.org/observations/15861451, licensed under CC-by-NC.**
Native range and habitat	• **Native range:** Northeastern Asia, Japan, central China • **Native habitat:** Forests, woodlands, scrublands • **Introduced range:** Semi natural habitat; in ravines, woodlots, open areas and neighboring urban areas	• **Native range:** Europe • **Native habitat:** Forest edges, gentle slopes • **Introduced range:** Aggressive colonizer of open forests and meadows; prevents forest regeneration	• **Native range:** China, Japan, Korea • **Native habitat:** Woodlands, scrublands, forests • **Introduced range:** Forest openings, disturbed sites	• **Native range:** North America. Rare native in southwestern Ontario. Naturalized in southwestern Quebec • **Native habitat:** Along streams, on floodplains, moist woodlands, occasionally in rocky woods	• **Native range:** Eastern North America • **Native habitat:** Rich moist woods and hillsides. Deciduous and mixed forests
Typical size and form	• Multi-stemmed shrub • 1.5 – 4 m, up to 6 m	• Small tree to large shrub • Up to 6 m	• Perennial climbing vine, sprawling shrub, ground cover • Variable growth habit and appearance; often puts out aerial roots • 10 – 30 cm, up to 70 m as a climbing vine	• Erect or spreading shrub, or small tree, sparsely branched • Up to 6 m	• Ground-hugging vine or trailing shrub. Short erect or leafy branches low to the ground, does not form dense mats • 1 – 3 cm, up to 1.5 m
Stem, Twigs and Bark	• Young bark prominent raised ridges on square lime-green stem • **Broad corky winged stems,** including developing on 1st year growth • Buds cone-shaped and pointed, green-brown-red in colour and diverge from the stem	• Young bark smooth, green square stem • **Wings absent or narrow,** never on first year growth • Buds plump, not pressed against the stem, scales diverging	• Twigs square, stout, and green • Wings absent • Buds plump, green, sharp-pointed, with three or four pairs of scales	• Bark greenish-grey, streaked with reddish-brown. Branches are smooth, greenish, somewhat four-sided • Wings absent or narrow, never on first year growth • Terminal bud ovoid, pointed, green tinged with red, with 6 narrow scales. Lateral buds pressed against the twig	• Bark grey-green to brownish. Branches are smooth, greenish, often four-sided or conspicuously angled • Wings absent

	Winged Euonymus *(Euonymus alatus)*	European spindle tree *(Euonymus europaeus)*	Winter creeper *(Euonymus fortunei)*	Eastern wahoo *(Euonymus atropurpureus)*	Running strawberry-bush *(Euonymus obovatus)*
	 INVASIVE Photo courtesy of: Megan R King.	 INVASIVE Photo courtesy of: Thomas Koffell.	 INVASIVE Photo courtesy of: Stephen Smith.	 NATIVE Photo courtesy of: Christopher David Benda.	 NATIVE Photo Courtesy of: Chris McAnlis.
Leaves	• Deciduous • Elliptic or obovate • Widest at or above middle • Narrowed at the base and tip • Dark green upper-surface, light green under-surface • Underside of leaf hairless • 2 - 7 cm long, 1 - 4 cm wide • Finely toothed • In autumn: Pink-red to red-purple (full sun). Yellow or pink (forests, full shade)	• Deciduous • Elliptical • Widest at middle • Narrowed at the base and tip • Dark green • Underside of leaf hairless • 3 - 8 cm long, 1 - 3 cm wide • Finely toothed • In autumn: Yellow-green to red-purple • Holds leaves longer in fall than Eastern burning-bush	• Evergreen • Oval • Widest at or below middle • Glossy, dark green with lightened main veins. Leaf colour variable: dark green with silver-toned veins, green-white and green-yellow variegation • Underside of leaf hairless • 2.5 – 6.4 cm long • Slightly toothed; sharp to bluntly toothed • In autumn: Leaves remain green all year	• Deciduous, opposite • Elliptic to oval, rounder • Widest at middle • Narrowed at the base and tip, tip is longer pointed, base is more rounded • Lime green • Underside finely hairy • Up to 13 cm long, 5 cm wide • Finely toothed • In autumn: Red or pale yellow	• Deciduous, opposite • Elliptical to oblong or obovate • Wider at the tip not the middle • Rounded or slightly pointed at the tip and tapered at the base to a short grooved petiole • Medium green upper-surface, paler lower-surface with raised veins • Underside hairless, except for sometimes on main veins • Up to 7 cm long and 3.5 cm wide • Very finely toothed • In autumn: Purple, maroon, pink
Flowers	• Yellow-green • Four petals • Flowers in small clusters emerging at leaf axils and tend to lay flat against the leaves • **May to June**	• Green or yellow-green to white • Four petals • Flowers in small clusters emerging at leaf axils • **Late May to June**	• White to yellow-green • Four petals • Flowers in small clusters emerging at leaf axils • **May to July**	• **Dark purple, brown purple, purple maroon** • Four petals • On slender stalks in few-flowered clusters from the lower leaf axils • **Late June - early July**	• Greenish-purple • **Five round overlapping petals** • One to several flowers • on long stalks from the leaf axils • **May – June**
Fruit	• Two to four parted fruit capsule • Fruit capsules dark red to purple • Capsules open to expose orange to orange-red arils in fall	• Four-parted fruit capsule • Fruit capsules pink to red • Capsules open to expose yellow to orange arils in fall	• Four-parted fruit capsule • Fruit capsules white to pale pink • Capsules open to expose orange arils in fall	• Four-parted fruit capsule • Fruit capsules are pink when ripe in fall • Capsules open to expose bright orange-red or scarlet aril in fall	• Three-parted fruit capsule • Fruit capsule pink-purple or crimson, warty (textured) when ripe, look somewhat like a strawberry. • Capsules open to expose orange to scarlet aril in fall. Seeds hang suspended on slender threads from the pendent capsule

Winged euonymus reproduces primarily by seed, which are produced in abundance.

Photo courtesy of: iNaturalist. Available: https://www.inaturalist.org/observations/8959287, licensed under CC-by-NC.

Biology and Life Cycle

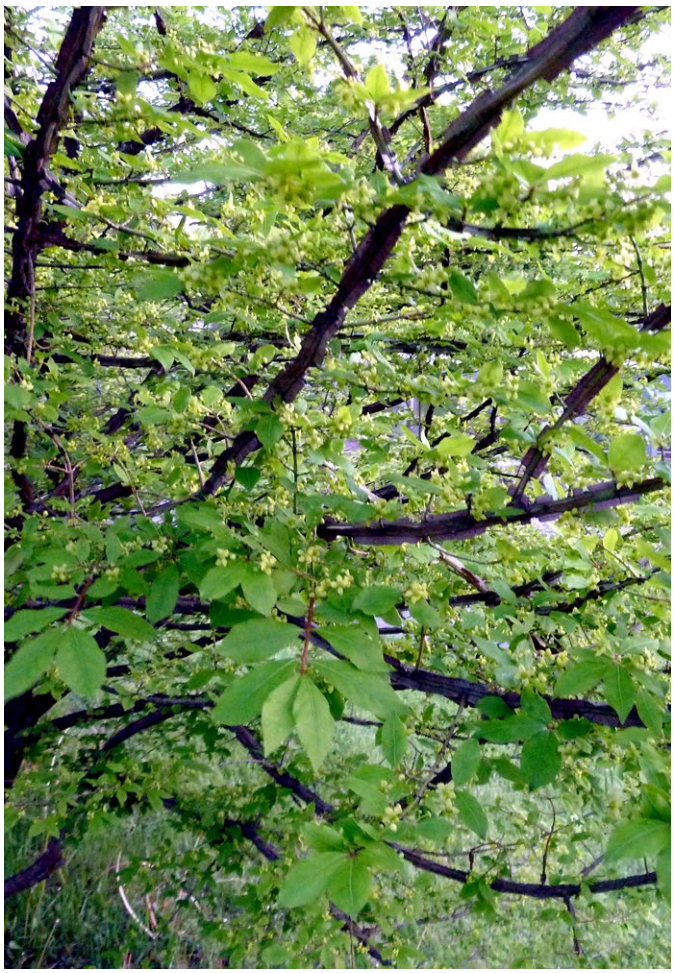
Winged euonymus reproduces primarily by seed, but it can also spread vegetatively by root suckering. The small inconspicuous flowers appear at the end of May and last until early June. The fruits begin to appear in mid-September as closed four-lobed capsules, which split open in October to reveal the fleshy orange-red arils. The fruit remains on the shrub after the leaves are dropped in November and stay on the branches until February. The bright red-orange fruit attracts birds and wildlife, who consume the seeds throughout the fall and winter and spread the seeds to new locations. Seed germination rates may be increased with passage through an animal's digestive system, although this has not yet been studied. The seeds require one to three months of cold moist stratification (October – February). Mature shrubs are prolific seed produces and can produce thousands of seeds per plant. Seeds germinate readily in both shady and sunny conditions, and many fall close to the parent plant, creating a dense bed of seedlings.

The leaf buds start to form in April, and leaves remain green throughout the summer until the middle to end of September when they change to brilliant pink-red to red-purple foliage (in full sun), although many populations in natural areas turn yellow. The leaves remain in full colour throughout October and begin to drop in November.

Shrubs reach reproductive maturity in three to five years and can live up to 250 years in its native range (NH Department of Agriculture Factsheet). The growth rate varies seasonally, tending to be rapid in spring ('growth spurt') and slow during the rest of the growing season. The shrubs are dioecious (each shrub bears either a male or female flower).

Seasonality:

- **Flowers:** Late May – June
- **Leaves:** Late April – November
- **Fruit/Seeds:** September – January



Winged euonymus in flower.

Photo courtesy of: John Foster, Ontario Invasive Plant Council.

In shaded forest habitat, winged euonymus leaves turn a lighter pink colour in fall.

Photo courtesy of: Bryon Shafer. Available: https://www.inaturalist.org/observations/65070619, licensed under CC-by-NC.

Habitat

Winged euonymus adapts to many environmental conditions. It grows well in a variety of soil types and pH levels including moist to dry-mesic conditions but it does not thrive in very dry or very wet (waterlogged) soils. A study in New England found that in comparison to two other invasive species (winged euonymus and Japanese barberry), winged euonymus was more of a generalist without a distinct preferred habitat, although it slightly favored edge habitats, deciduous forests, and closed canopy wetlands (Ibanez *et al*. 2009). This versatility is what has contributed to its popularity as an ornamental, as this shrub can perform well in difficult growing conditions associated with urban sites. Winged euonymus is typically planted in residential gardens, foundation plantings, along roads and highways, parking lot islands, commercial strips, hedges, and fencerows.

In Ontario, where it has spread from urban areas into natural areas it is typically found along ravines and throughout deciduous forests, where as an understory shrub it forms dense thickets similar to other invasive shrub species like buckthorns (*Rhamnus* spp.) and honeysuckles (*Lonicera* spp.).

In the northeastern United States, Wisconsin and Illinois, winged euonymus has been documented invading forest understories and grasslands, including oak upland forests, lowland forests, pastures, shady hillsides, and glacial drift prairies. It has also been found in open disturbed areas such as abandoned fields and pastures, forest edges, roadsides, and urban parks.

Pathways of Spread and Distribution

The native range of winged euonymus extends throughout northeastern Asia, including central China, Korea, and Japan, where it occurs in forests, woodlands, and scrublands.

Winged euonymus has naturalized in at least 21 states throughout the central, northeastern, and mid-Atlantic United States. It has extensively invaded Washington DC, New Jersey, Connecticut, Massachusetts, New Hampshire, and Vermont. Its extent is south to Georgia and west to Kansas. The sale of winged euonymus is prohibited in Massachusetts and Wisconsin, and it is a regulated invasive plant in New York.

In Canada, naturalized populations are largely scattered around urban centers in southern Ontario, although winged euonymus has also been found in British Columbia, Quebec, and the maritime provinces. In Ontario it is found throughout the Greater Toronto Area including Mississauga, Brampton, and Toronto. Winged euonymus is also found in southwestern Ontario including London, Norfolk County, Leamington, Hamilton, Niagara Falls, to the east in Peterborough and Ottawa, and in northern Ontario in North Bay, Huntsville, Sault Ste. Marie and Thunder Bay. In Quebec, it is currently found only in urban areas surrounding Montreal and Sherbrooke.

The ongoing nursery availability and popularity of winged euonymus as a landscape ornamental means that it will more likely continue to escape from cultivated areas in the future and its range is expected to continue increasing. This species can expand locally through vegetative reproduction and to new areas when birds consume the seeds and disperse them into new areas. Other non-native euonymus species, such as winter creeper and European spindle tree, are also expected to continue expanding their range for these reasons.

For up-to-date distribution information:
http://www.EDDMapS.org or http://inaturalist.ca.

Winged euonymus planted in a garden bed.

Photo courtesy of: Leslie J. Mehrhoff, University of Connecticut, Bugwood.org, licensed under CC-by-NC.

Winged euonymus seedlings cover the forest understory and blend in with other vegetation at certain times of year.
Photo courtesy of: Bryon Shafer. Available: https://www.inaturalist.org/observations/65070619, licensed under CC-by-NC.

Impacts

Ecological:

Although winged euonymus is a popular ornamental shrub of choice for its attractive fall display, colourful fruit, interesting winged stems and general hardiness, it also has many traits that make it a highly successful invader. Its adaptability to a variety of environmental conditions, high seed germination rates, and ability to establish in both full sun and dense shade allows it to colonize many habitats including deciduous closed-canopy forests, open forests, forest edges, meadows, old fields, and prairies. It forms dense thickets that crowd out and displace native species, although it grows at a slower rate than some other invasive shrub counterparts [e.g., buckthorns (*Rhamnus* spp.), and honeysuckles (*Lonicera* spp.)]. Mature shrubs are not only prolific seed producers creating a large volume of seeds every year, they can also spread vegetatively. Most of the seeds germinate beneath the parent plant, creating a dense bed of seedlings, sometimes called a 'seed shadow'. Once established, winged euonymus can become the dominant species in the forest understory, preventing forest regeneration and altering forest community structures. A study by Roberson and Cipollini (2015) compared spider assemblages in areas invaded by winged euonymus compared to intact stands of native shrubs and found lower abundance and diversity of spiders in invaded stands, highlighting the impacts of winged euonymus invasions on community richness and structure.

Winged euonymus also has few enemies in its non-native range, remaining free of pests or diseases, and is not favored for browsing by wildlife such as white-tailed deer. Birds and wildlife are attracted to the berries when food sources are limited in fall and winter, contributing to its dispersal and spread.

Economic or Societal:

Winged euonymus is a minor host of the box tree moth (*Cydalima perspectalis*), vine weevil (*Otiorhynchus sulcatus*), and the banana root nematode (*Pratylenchus coffeae*) (CABI Invasive Species Compendium, 2019).

All parts of winged euonymus are toxic by ingestion, causing symptoms of severe discomfort. The corky winged stems are used in traditional Chinese and Korean medicine to treat conditions such as cancer, hyperglycemia, and diabetes complications (Zhai *et al.* 2016).

Applicable Legislation

(Last Updated – June 2024)

Regulatory Tools – Winged euonymus:

Winged euonymus is not a federally or provincially regulated species. **See Table 2 for details.**

Depending on the location, timing of work, and the type of management activities (e.g., mechanical/manual or chemical), permits, approvals or authorizations may be required from municipal, provincial or federal agencies before winged euonymus control can be initiated. Individuals undertaking control activities for winged euonymus are responsible for ensuring that these are obtained and complying with any applicable legislation. Please note that this is only for general guidance and is not intended as legal advice.

Additionally, if protected species or habitats are present, an assessment of the potential effects of the control project and authorization could be required. Depending on the species and its location, applications should be directed to the appropriate authorities.

While not an exhaustive list of permits or rules that may apply to winged euonymus management, the following examples are provided for consideration.

Table 2: Legislation pertaining to winged euonymus management.

Legislation & Regulating Body	Purpose	Application to Winged Euonymus Management
PROVINCIAL		
***Invasive Species Act*, Ontario Regulation 354/16** Ministry of Natural Resources (MNR) Applicable to Terrestrial and Aquatic Environments	Prevent the Introduction and Spread of Invasive Species	Winged euonymus is not regulated under the *Invasive Species Act*, 2015. For more information, visit: https://www.ontario.ca/page/managing-invasive-species-ontario
Weed Control Act Ontario Ministry of Agriculture, Food and Agribusiness (OMAFA)	Regulation of Noxious Weeds in Ontario	Winged euonymus is not listed in the Schedule of Noxious Weeds under the *Weed Control Act* (WCA), 1990. The WCA is administered by the Ontario Ministry of Agriculture, Food and Agribusiness (OMAFA). The objective of the WCA is to minimize the impact of noxious weeds and weed seeds on agriculture or horticultural land. Landowners whose property contains noxious weeds and weed seeds that negatively affect agriculture or horticultural lands are responsible for weed control and associated costs. For more information on noxious weeds and what to do if you find them on your property visit: https://www.ontario.ca/page/noxious-weeds-ontario

Legislation & Regulating Body	Purpose	Application to Winged Euonymus Management
Endangered Species Act Ministry of Environment Conservation and Parks (MECP) Applicable to Terrestrial and Aquatic Environments	Protection of Endangered and Threatened Species and their Habitat	The *Endangered Species Act* (ESA) prohibits the killing, harming, and harassing of species at risk (SAR) classified as extirpated, endangered or threatened, as well as damage and destruction of the habitat of endangered and threatened SAR. Management activities that may adversely impact protected SAR or habitat may proceed in accordance with an ESA authorization (permit or agreement) or regulatory exemption. For the full list of species at risk in Ontario and for information on permit requirements consult: http://ontario.ca/page/how-get-endangered-species-act-permit-or-authorization
***Pesticides Act* & Regulation 63/09** Ministry of Environment Conservation and Parks (MECP) Applicable to Terrestrial and Aquatic Environments	Regulation of Pesticide Use in Ontario	The *Pesticides Act* and Ontario Regulation 63/09 govern the sale, use, transportation, storage and disposal of pesticides in Ontario including license and permit requirements. Most invasive species control projects will require a licensed exterminator. Only pesticides registered under the federal *Pest Control Products Act* by the PMRA can be used in Ontario. **The pesticide label is a legal document that must be followed exactly.** Exterminations on land are subject to the cosmetic pesticide ban. Other than certain biopesticides and low-risk pesticides on Ontario's "Allowable List", pesticides can only be used in accordance with an exception (e.g., agriculture, forestry, public health and safety, natural resources and other legislation) to the cosmetic pesticide ban. The licensed exterminator in charge can provide guidance regarding how the exceptions to the cosmetic pesticide ban apply to the specific extermination and any requirements that must be met to perform work under the exception. For more information on these exceptions and the rules with respect to pesticide use visit: https://www.ontario.ca/laws/regulation/090063
FEDERAL		
***Species at Risk Act* (SARA)** Environment and Climate Change Canada (ECCC) Applicable to Terrestrial Environments	Protection and Recovery of Species at Risk and their Habitats	For most extirpated, endangered and threatened species, the *Species at Risk Act* (SARA) applies automatically only on federal lands. This includes national parks, national marine conservation areas, national historic sites and other protected heritage areas administered by Parks Canada. For control activities on federal lands that may affect non-aquatic species listed on Schedule 1 of SARA, or which contravene SARA's general or critical habitat prohibitions, permits may be required. For more information, consult: https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/permits-agreements-exceptions/permits-agreements-information.html

Legislation & Regulating Body	Purpose	Application to Winged Euonymus Management
***Migratory Birds Convention Act* & Regulations** Environment and Climate Change Canada (ECCC) – Canadian Wildlife Service (CWS) Applicable to Terrestrial and Aquatic Environments	Protection of Migratory Birds, and their Nests and Eggs	When undertaking your project, you should take precautions to avoid harming migratory birds, nests and eggs. This includes: • Understanding how migratory birds and their nests are legally protected • Consider species activity timelines (i.e. active nesting season) • Planning your activity ahead of time, evaluate if the activity may cause harm to migratory birds, and determine what measures can be taken to avoid causing this harm • Develop and implement preventative and mitigation measures, such as beneficial management practices. For more information please visit: https://www.canada.ca/en/environment-climate-change/services/migratory-birds-legal-protection/convention-act-regulations.html
Pest Control Products Act Pest Management Regulatory Agency (PMRA), Health Canada Applicable to Terrestrial and Aquatic Environments	Regulation of Pest Control Products in Canada	Before a pesticide can be sold or used in Ontario, it must be registered under the federal *Pest Control Products Act* (PCPA) by the Pest Management Regulatory Agency (PMRA) of Canada. The pesticide label is a legal document. **Follow all label directions – and ensure you have the most current label and are aware of any re-evaluation decisions.** Visit the PMRA's product label search site at https://pr-rp.hc-sc.gc.ca/ls-re/index-eng.php

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 responsible for enforcing the *Weed Control Act of* (1990) to reduce the infestation of noxious weeds that negatively impact 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 winged euonymus in your community.

Invasive Management Planning

Management Considerations

Avoiding planting winged euonymus and preventing its spread 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 invasive plant (i.e., its biology and life cycle), and its surrounding environment. This often requires more than one type of control measure to be successful.

Once winged euonymus has been confirmed at a location, a control plan should be developed based on infestation size, site accessibility, potential for spread, and the risk of environmental, economic, or social impacts. Consider site-specific conditions such as native plant richness and diversity and wildlife usage including bird migration routes and species at risk. 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 on wildlife and native plant species.

Mapping

If you are planning a restoration project on your property, conducting an ecological survey is a beneficial way to document current and future distributions of invasive plants that might be present, such as winged euonymus. Conservation authorities or municipalities which manage large land areas may use internal staff or contractors, or have qualified volunteers conduct ecological surveys. However, private landowners with smaller properties may be able to conduct their own surveys or hire a contractor. If you know you have winged euonymus in one area, survey the rest of the property to identify other infestations. Map the extent of the invasion, as well as any small satellite populations.

For detailed information on mapping techniques consult the Landowners Guide for Managing and Controlling Invasive Plants in Ontario. To determine potential infestations in your areas, consult EDDMapS: https://www.eddmaps.org/

Landscape Level Management

If winged euonymus has become widely established, a more detailed management strategy should be undertaken. A strategic, landscape-level approach to management should be undertaken that aids in bringing together partners, landowners, and land managers. This approach is designed to work towards common and shared goals that consider both site-level needs in conjunction with wider landscape considerations. It makes it easier to use resources efficiently, coordinate management activities and accomplish strategic goals. Failure to consider a broader landscape context, by only focusing on individual or local challenges, may increase management costs, be more labour intensive, and may not produce desired results across larger areas. Effective management of winged euonymus requires repeat treatments and a combination of control methods (i.e., hand pulling or digging, cutting and herbicide use). It is important to determine the land use objective and desired plant community because it is not always realistic, especially for larger populations, to eliminate the entire infestation at once. From here, develop an appropriate IPM strategy which takes into consideration the biology and life cycle of the plant in addition to using a combination of management techniques.

Setting Priorities

Establishing your highest priority locations for control prior to management will help to determine the best course of action. Therefore, when developing a management strategy, it is important to consider the following considerations to help inform control decisions:

1. **Protect** federally, provincially, and regionally rare species and communities by removing invasive plants and ensuring rare species are not negatively impacted by control efforts. You are responsible for ensuring that your project follows provincial, federal, and municipal laws, including the provincial *Endangered Species Act*, and federal *Species at Risk Act*. For species-specific information consult: https://www.ontario.ca/page/species-risk-ontario

2. **Ensure** all landowners have been identified and consulted before control takes place.

3. **Contain:** If you have limited resources, try to remove the outlying populations winged euonymus first (isolated plants or satellite populations), to prevent further spread. Protect areas where winged euonymus is absent or just appearing. When action is taken early it can significantly reduce the cost of control. Targeting new populations while they are still in seedlings can help to reduce seed source and spread. In these areas, the native habitat is likely also most intact, and will be fastest to recover from the infestation.

4. **Work inward:** If you have more resources, working from the outlying or satellite populations inward into larger, "core" populations of winged euonymus and reducing the quantity of seeds can prevent spread into uninfested areas. In many cases, resource limitations may prohibit the immediate removal of entire core populations. Under these circumstances, core areas should be prioritized and addressed strategically.

5. **Consider sensitive ecological areas:** Concentrate on preventive strategies in high-priority ecological 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, or a favourite natural area. Pay special attention to disturbed sites which can be quickly colonized by winged euonymus and other invasive plants. Reduce the spread of winged euonymus by following the Clean Equipment Protocol and removing invasive plant material from boots, clothing, and animal fur.

6. **Logistics and costs:** Review the different control options and costs with consideration to surrounding water, habitat, time of year, and type of land use (i.e., high-traffic recreational areas, agriculture, etc.).

7. Consider dedicating a certain time each year to control efforts and make it a joint effort with neighbouring landowners and/or 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 new plants or address resprouts that may emerge after initial control efforts. Control for winged euonymus is most successful using a combination of techniques (mechanical removal, chemical control) applied more than once per year, as well as repeat monitoring and control over multiple years.

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. Reverse the invasion, expand the cleared area outward and ensure that un-invaded areas are kept free of invasive plants (with regular monitoring).

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

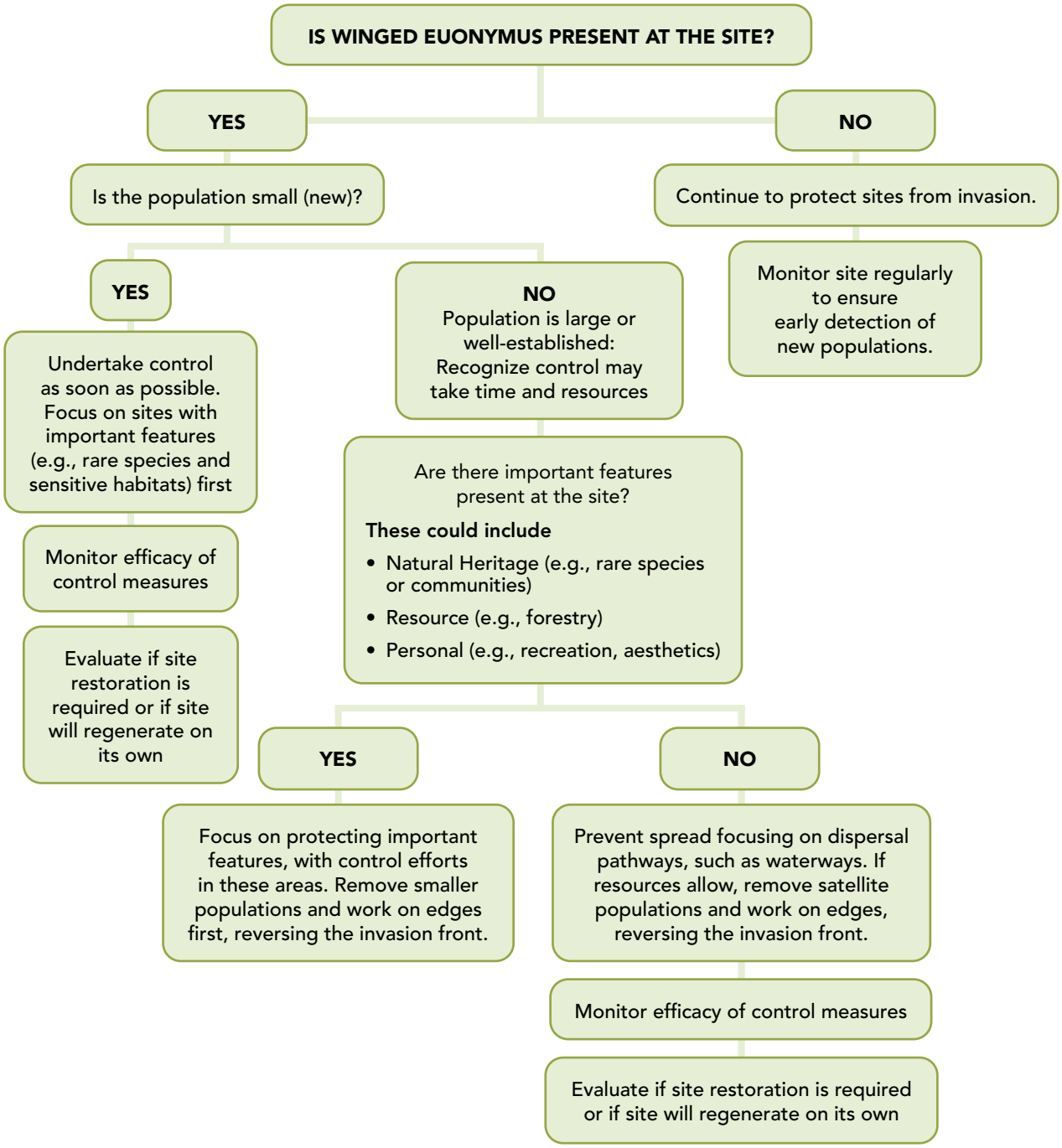


Figure 1: How to prioritize winged euonymus sites for effective control.

Long-term Management and Monitoring

To prevent the establishment of winged euonymus, a long-term management and monitoring plan should be created prior to the implementation of control efforts. Monitoring will enable assessment of the initial control measures, including their effectiveness, as well as the types of follow-up treatments that are necessary. Ongoing management is critical to the success of a project; after removal, a site remains at risk of reinvasion by nearby populations or another invasive species.

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 spot treatment will help to ensure the invasive population remains under control and allows for the regeneration of native plant species.

For detailed information on monitoring consult the Landowners Guide for Managing and Controlling Invasive Plants in Ontario.

After Management: Assessing Regeneration vs. Restoration

Consider the following factors:

1. **Level of disturbance at the site:**
    - Was this a heavily invaded site (e.g., was much disturbance caused during control measures)?
    - Will it continue to be disturbed (e.g., through land-use activities such as logging)?
2. **Biology of the invasive species removed:**
    - Is there a seed bank to consider?
    - Are there seed banks from other invasive plants in the area?
3. **Re-invasion risk:**
    - Are there any winged euonymus populations nearby which could re-invade the site through various pathways of spread (i.e. bird dispersal, nearby trails, or roads)?
4. **Existing native vegetation:**
    - Will any native vegetation that still exists on the site regenerate quickly?
    - Does it need help? Species with specific habitat requirements or reproductive strategies resulting in low fecundity, including 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 under 1 to 3, it is most likely that (a) the site will be re-invaded before it has a chance to regenerate on its own or (b) that winged euonymus will continue to invade and be present among the native species so that annual control of winged euonymus may be required. Restoration will need to reduce the risk of re-invasion.

If you answered **Yes** to the questions under 4, your site may have a lower risk of invasion but could still require some restoration measures to help re-establish native vegetation.

An understory of pink, created by a winged euonymus infestation in Rothrock State Forest, Pennsylvania.

Control Measures

Practice Prevention:

The best method to control and prevent the spread of winged euonymus and other non-native euonymus species is to stop planting them. There are a variety of native alternatives to consider in residential gardens, that provide attractive fall colours and distinctive fruit. They provide the added benefit of attracting birds, butterflies, and other pollinators:

- Eastern buttonbush (*Cephalanthus occidentalis*)
- Fragrant sumac (*Rhus aromatica*)
- Grey dogwood (*Cornus racemosa*) turns red in fall
- Maple-leaved viburnum (*Viburnum acerifolium*)
- Nannyberry (*Viburnum lentago*)
- Northern spicebush (*Lindera benzoin*)
- Red chokeberry (*Aronia arbutifolia*)
- Red-osier dogwood (*Cornus sericea*)

Control strategies:

Winged euonymus is easier to control than other more aggressive invasive shrubs. While its prolific seed production and formation of dense thickets can be a challenge for control, it is not known to have a persistent seed bank in the soil and has a slower growth rate than some other notable invasive shrub species. Its cultivars also have low germination rates (<40%) (Brand *et al.*, 2012).

Be sure to carefully monitor the site and identify all winged euonymus shrubs in the area. Individual shrubs can sometimes be overlooked in deciduous forests, as in the summer their non-descript appearance can make them hidden amongst other vegetation. The leaf color varies in the fall, from turning yellow to pale pink or red-pink in forest understories.

Small infestations of young shrubs (seedlings and shrubs up to 90 cm tall) can be effectively hand pulled, as they are shallowly rooted and can be pulled out entirely with relative ease in moist soil. Larger shrubs can be dug or pulled using a hand tool such as an Extractigator™. Ensure that the entire root is removed, as any leftover roots can vigorously re-sprout. The roots are fibrous and white, making them easy to see. Methods that involve only top killing of the shrub (i.e., mowing, prescribed fire), or where roots are left intact in the soil, are unlikely to be effective as the plant will respond with vigorous regrowth.

For early infestations manual control alone can suffice. However, where manual control is impractical, such as dense infestations or for mature shrubs that develop deep and fibrous root systems, chemical control is an effective approach. Young shrubs can be treated with a basal bark application of herbicide, and older mature shrubs with extensive root systems can be effectively treated by basal bark application or cutting followed by a systemic herbicide. Foliar spray is more suitable for large, dense thickets, dense populations of seedlings, or as a follow-up on resprouts that emerge after cutting. Note that large, multi-stemmed mature shrubs may take 1-2 years to completely die after basal bark or foliar spray treatments. Continue to return to the site after control to monitor for any missed plants.

Manual

Pulling and Digging:

Since winged euonymus has a shallow root system, seedlings and small shrubs (up to 90 cm tall) can be easily hand-pulled from moist soils. To limit soil disturbance, pull steadily and slowly, and pat disturbed soil down after removal. Larger shrubs can be dug out with a spade, mattock or pulled using equipment (i.e., Extractigator™, weed wrench). Wear thick gloves and a long-sleeved shirt to protect your hands and arms from sharp branches. It is important to remove the entire root system to prevent re-sprouting, which can be difficult with larger shrubs due to a deep and fibrous root system. Large, mature shrubs will need herbicide follow-up treatment for full eradication. Hand pulling or digging is most ideal in early spring or summer and best before the plant produces fruit (before July), in order to prevent seed spread. Continue monitoring the site for any missed plants and repeat pulling or digging as required. The pulled shrubs can be overturned, roots left to dry on site and kept aboveground. Any plants that re-root can be pulled in subsequent seasons. If no fruit is present, they can be left on site, otherwise shrubs with fruit should be bagged and disposed off-site.

Cutting or Mowing (stand-alone):

NOT RECOMMENDED. Cutting or mowing aboveground growth is not recommended as a stand-alone method because the roots remain intact, and the shrub will re-sprout shortly after cutting. Mechanical control works best when applied as an initial treatment and then followed-up with another treatment such as herbicide application, or manual control (e.g., cutting top growth and then removing the root crown).

Clipping Flowers:

Trimming off flowers in spring can help to eliminate seed production of individual shrubs in residential gardens. However, this process is very labor intensive and unlikely to get all flowers, therefore the plant will still produce some seed and spread.

Prescribed Fire:

Prescribed fire may be a potential option for controlling dense populations of small seedlings regenerating under mature plants. Larger shrubs generally re-sprout after fires, so follow-up herbicide application on re-sprouts may be needed. This method is intended for groups with appropriately qualified personnel who are able to conduct prescribed burns.

Chemical

The management of pesticides is a joint responsibility of the federal and provincial governments. The federal government, through the Pest Management Regulatory Agency (PMRA), is responsible for approving the registration of pesticides across Canada under the *Pest Control Products Act*. Ontario regulates the sale, use, storage, transportation and disposal of pesticides including issuing licenses and permits under the *Pesticides Act* and Ontario Regulation 63/09. Federally registered pesticide products are assigned one of four product class designations (i.e., Manufacturing, Restricted, Commercial and Domestic). The class of pesticides determines who can sell or use the pesticides products as well as what restrictions are placed on its use (e.g., requires a license and/or permit). Most invasive species control programs using a pesticide will require an appropriately licensed exterminator.

The use of pesticides on land is subject to the cosmetic pesticide ban. Other than certain biopesticides and low-risk pesticides on Ontario's "Allowable List", pesticides can only be used if the use is permitted under an exception to the ban. Depending on the specifics of the extermination, invasive plant control may be permitted in accordance with exceptions for forestry, agriculture, public health and safety (e.g., plants poisonous to humans by touch and plants that affect public works and other buildings and structures) and compliance with other legislation (e.g., control of noxious weeds where required by the *Weed Control Act*). There is also an exception for the management, protection, establishment or restoration of a natural resource that may be considered if other exceptions do not apply. The requirements that must be met for pesticide use under each exception are set out in Ontario Regulation 63/09 and may include conditions such as certification in integrated pest management, a letter from the relevant Ministry (MNR or MECP) and/or others. The appropriately licensed exterminator in charge can provide guidance on requirements that apply to the specific extermination under consideration.

Herbicide Selection and Application

Pesticide applications can be an effective method for winged euonymus management when used as part of an integrated pest management program and in consideration of the species biology and site-specific information. Pesticides must be applied in accordance with the federal *Pest Control Products Act*, the *Ontario Pesticides Act*, Ontario Regulation 63/09 and all label directions. Most invasive species control programs using a pesticide will require an appropriately licensed exterminator. The availability of pesticides to control winged euonymus may change over time, as may the label directions on how to use the pesticide so that it does not endanger human health or the environment.

Before using any pesticide, ensure you have the most current label. Pesticide labels can be accessed using the PMRA's label search tool, which can be found by searching "PMRA label search" in any major search engine. Always read and follow all directions on the label. The label is a legal document that must be followed exactly, including any applicable buffer zones. Using a pesticide to treat a species not listed on the label, or in a manner other than specified on the label violates the *Pest Control Products Act* and may incur penalties.

Herbicides and Winged Euonymus

Table 3: Herbicides effective at controlling winged euonymus.

Herbicide	Application/Timing	Herbicide Class	Benefits	Cautions
Glyphosate	• Apply as a foliar spray to seedlings or dense infestations. • Apply with a backpack or canister sprayer	• Commercial • *Only licensed professionals may apply this herbicide.*	• *Low rate of persistence in the environment, low toxicity.*	• Observe required buffer zones. Non-selective, avoid contact with non-target plants. • Avoid application if heavy rain is forecasted.
Triclopyr	• Apply to bark or cut stump from mid-summer onwards. Avoid using during heavy sap flow in spring. • Apply with a backpack or canister sprayer.	• Commercial • *Only licensed professionals may apply this herbicide.*	• Fast acting (3-5 days). Can be used for both basal bark and cut stump treatments.	• Observe required buffer zones. Non-selective herbicide, avoid contact with non-target broadleaf weeds and woody plants. • Avoid application if heavy rain is forecasted.

Basal Bark:	
Infestation Size:	• Any infestation size for small to medium stems.
Goal:	• Eradication.
Timing (season):	• Any time of year except during heavy sap flow in spring. Less effective if snow prevents spraying at the desired height above ground level. Most effective in late summer and early fall when the sap of the shrub flows towards the roots.
Treatment Frequency:	• Repeat if re-growth is observed.
Best Practices:	• A triclopyr-based herbicide is recommended as these products can penetrate bark. • Use a low-pressure, low-volume backpack sprayer. • Apply herbicide to the bark around the entire stem in a band 5-10 cm wide, in the lower parts of individual stems and the root collar. Wet bark thoroughly but not to the point of run-off. • Do not apply if snow or other vegetation obscures the target area.
Advantages:	• Does not require cutting top of plant. Treated shrubs can be left dead-standing on site.
Disadvantages:	• Labour-intensive for large, dense infestations.
Ideal for:	• Small to medium stems (less than 2.5 cm diameter). • Shrubs that are too difficult to pull or dig out using mechanical methods.

Foliar Spray:

Foliar application involves coating the leaves of target plants with herbicide. The leaves absorb the herbicide; it then translocates to other parts of the plant. A backpack sprayer is the most common equipment for targeted foliar application.

Infestation Size:	• Large sized, well established or dense infestations; mature shrubs or dense seedling populations.
Goal:	• Eradication.
Timing (season):	• Late spring to early fall (mid May – September); after leaves have fully leafed out and shrub actively growing.
Treatment Frequency:	• Repeat annually or when regrowth is observed.
Best Practices:	• Apply using a backpack sprayer under low pressure. • Spray until the leaves are just covered and the herbicide is not dripping off the leaves. • Foliar spray is most frequently applied using a glyphosate-based herbicide. Add a vegetable (or tracker) dye to the herbicide mix to increase spray precision and minimize spray drift. • Spraying in mid-season is ideal when leaves are green and fully leafed out. • Weather may impact treatment effectiveness therefore is an important consideration for foliar spray. Avoid spraying during drought, hot, dry weather, and shortly before rainfall. Higher wind speeds may also increase the risk for drift. • Monitor for effectiveness and treat any resprouts or seedlings in subsequent years (follow up with chemical or non-chemical method). Check the pesticide label for restrictions regarding treatment frequency. • Mature, multi-stemmed shrubs may take 1-2 years to completely die after one foliar application, due to the extensive root system. • Since seedlings are often found under mature winged euonymus shrubs and intermixed with other vegetation, it may be best to first control large, mature shrubs and return to the site after 1-3 years to foliar spray seedlings.
Advantages:	• Effective after a single application, less labour-intensive and costly than other methods.
Disadvantages:	• Potential for spray drift and harm to non-target plants.
Ideal for:	• Since manual methods (i.e., pulling or digging) can effectively remove winged euonymus from a site, foliar spray is reserved for dense infestations where manual control would be impractical. • Effective as a follow-up on resprouts that emerge after cutting or on dense seedling populations.

Cut Stump:

Infestation Size:	• Any infestation size for shrubs with medium to large stems.
Goal:	• Eradication.
Timing (season):	• Any season except during heavy sap flow in spring. Application in mid to late fall when native plants are dormant can minimize effects on non-target plants.

Treatment Frequency:	• Single treatment or may need follow-up to address any resprouts.
Best Practices:	• Follow up stump cutting with herbicide applied to the entire cambium layer of the cut stump surface using a backpack sprayer. A triclopyr-based herbicide is recommended. An advantage of triclopyr products is that the cut does not have to be fresh allowing for flexibility in herbicide application, and herbicide can be applied even in freezing conditions, as long as it is above –10°C. It is however recommended to apply triclopyr to a cut stump as soon as possible, ideally within 48-72 hours after cutting. • Continue to monitor cut stumps and treat any resprouts using herbicide application.
Advantages:	• Selective and cost effective. Effective at killing the whole shrub. • Prevents seed production the following year, so that only resprouts need to be treated.
Disadvantages:	• Labour intensive for large, dense infestations.
Ideal for:	• Mature, multi-stemmed shrubs where manual removal is impractical.

Bark of winged euonymus.

Photo courtesy of: Leslie J. Mehrhoff, University of Connecticut, Bugwood.org, licensed under CC-by-NC.

Winged euonymus.

Photo courtesy of: Glenn Berry. Available: https://www.inaturalist.org/observations/63426062, licensed under CC-by-NC..

Winged euonymus.

Photo courtesy of: Rod Krick, Credit Valley Conservation.

Disposal

In natural areas

In terms of cost effectiveness and time, it is generally better to leave biomass on site. The cut aerial portions will dry out and decompose on their own. Cut stems can be left to rot on site and become a refuge and food source for wildlife. Limbs or small branches without fruit/seeds can be piled and used as wildlife habitat, burned on site (check with your municipality for burn permits), or chipped and mulched. Following hand pulling or digging, the pulled plants should be removed from the site to prevent re-rooting, particularly if the fruit is still present. Place all viable material (roots, fruits/seeds) in thick, garbage bags and leave in the sun for 2-3 weeks. Following this, material can be disposed of in a landfill.

Do not backyard compost if fruit/seeds present:

Backyard composters do not reach the temperatures necessary to kill seeds. Do not compost any viable plant material (i.e., rhizomes, fruits and seeds).

Municipal compost

Large-scale municipal composting facilities where the compost pile reaches temperatures high enough to kill living plant material can be used to dispose of viable plant material. Ontario composting facilities are required to routinely monitor the composting process and meet strict, provincially regulated time-temperature parameters for pathogen kill. Consult your local municipality to determine if this is an appropriate course of action.

Solarize

Place all viable plant material into thick plastic garbage bags. Seal the bags tightly and leave them in direct sunlight for 2-3 weeks. This will "cook" or kill viable plant material. The rotten material can then be composted or disposed of in a landfill.

Restoration

Following control measures, consider restoring the site to encourage the re-establishment of native plant species. Consider the following restoration practices:

Mulching:

Mulch can be created from the chipped material of winged euonymus shrubs. Avoid heavy mulching in natural areas. Covering a forest floor with a thick layer of mulch (> 5 cm) in a natural area can do more harm by changing nutrient composition of the soil and smothering desirable ground vegetation, such as spring ephemerals and native tree or shrub seedlings. Urban sites (i.e., urban parks or gardens) may be more appropriate. Mulch can be used to cover an area immediately after invasive species control (e.g., manual or chemical control), which may help to prevent re-colonization by other invaders and helps to reduce soil compaction by people and pets.

Seeding:

Broadcasting seeds of native plant species immediately after management activities may be most suitable to less urbanized sites where wildlife species have more food sources available. Otherwise, seeds may be quickly eaten by wildlife. Seeding may be useful to prevent the establishment of new invasive plants. This can give desirable native species the chance to establish themselves. Seeding should only be done after management activities are completed to prevent new native plants from being damaged or killed. Collecting local seeds should be done ethically and sustainably.

Planting:

Once winged euonymus has been successfully removed from a site, planting site-appropriate native species can help them out-compete invasive seedlings. This is especially important if there are nearby invasive plants that can colonize the sites. If management activities will be conducted in subsequent years, wait until all management is completed prior to planting to avoid damaging or killing newly planted stock. Consider site characteristics such as light availability and amount of space when choosing plant species for restoration as this will affect growth and soil conditions. A diverse mix of plants should be tailored to the region based on the site's growing conditions. Consider transplanting mature individuals from surrounding good quality habitat. Ensure that any plants brought into the habitat come from an appropriate ecoregional source.

Preventing the Spread

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

☑ Report it.

If you think you see winged euonymus, 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 or www.inaturalist.org. 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 to recognize what winged euonymus looks like and then monitor property boundaries, forested 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.

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.

☑ 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. Do not plant winged euonymus 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 guide lists 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 winged euonymus 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, 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.org). If you suspect you have encountered Winged Euonymus or another invasive species, please take a photograph, mark your location, and call the **Invading Species Hotline at 1-800-563-7711**.

Additional Resources

Woody Invasives of the Great Lakes (WIGL) Collaborative.
https://woodyinvasives.org/woody-invasive-species/winged-burning-bush/

Best Management Practices Document Series

Autumn Olive
Black Locust
Buckthorn
Burdock
Dog-strangling Vine
Erect Hedge-parsley
Eurasian Water-milfoil
European Black Alder
European Frog-bit
Flowering Rush
Garlic Mustard
Giant Hogweed
Goutweed
Invasive Honeysuckles
Invasive Phragmites
Japanese Barberry
Japanese Knotweed
Manitoba Maple
Multiflora Rose
Norway Maple
Oriental Bittersweet
Purple Loosestrife
Reed Canary Grass
Scots Pine
Spotted Knapweed
White Mulberry
White Sweet Clover
Wild Parsnip
Yellow Iris

Technical Bulletin Series from the OIPC

Black Locust
Dog-strangling Vine
European Black Alder
European Buckthorn
Garlic Mustard
Giant Hogweed
Himalayan Balsam
Invasive Honeysuckles
Invasive Phragmites
Japanese Knotweed
Purple Loosestrife
Reed Canary Grass
White Mulberry
White Sweet Clover
Wild Parsnip

Additional Publications from the Ontario Invasive Plant Council

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, Edition 3, 2020 (EN)

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

Invasive Aquatic Plant Species: A Quick Reference Guide

Invasive Terrestrial Plant Species: A Quick Reference Guide

The Landowners Guide to Controlling Invasive Woodland Plants

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