Minnesota Noxious Weed Risk Assessment

Developed by the Minnesota Noxious Weed Advisory Committee

Assessment Information

Common Name: Winged burning bush; other common names include burning bush, burning-bush, burningbush, winged Euonymus, winged spindle, winged spindle-tree, corky spindletree/spindle-tree, winged wahoo.

Scientific name: *Euonymus alatus* (Thumb.) Sieb. (Synonyms – *Euonymus striata*, *Celastrus alata*, *Celastrus striata*).

Family name: Celastraceae (Bittersweet or Staff-Vine Family)

Current Reviewer: James Calkins, Minnesota Nursery and Landscape Association (MNLA)
Date of Current Review: August 27, 2025.

Previous Reviewer: Emilie Justen, Minnesota Department of Agriculture (MDA)
Date of Previous Review: August 13, 2019.

Species Description

Photographs

Photo caption: Winged burning bush (*Euonymus alatus*) expanding new growth and corky bark extensions (wings); note the opposite branching habit that results from the opposite bud arrangement along the stems; depending on the genetics of the individual plant or horticultural cultivar (cultivated variety), the bark extensions may simply be represented by corky ridges or by wing-like extensions that are variable in height. Photo credit: North Carolina Extension Photo Library.

Photo caption: Winged burning bush (*Euonymus alatus*) unopened flower buds and open flowers; note the four, fused stamens that surround the distinct nectar disk and less obvious pistil in the center of each flower. Photo credit: James Calkins, Minnesota Nursery and Landscape Association.

Photo caption: Winged burning bush (*Euonymus alatus*) summer foliage on current season's growth showing the opposite leaf arrangement (actually subopposite, slightly offset, for this individual) and leaf shape. Photo credit: James Calkins, Minnesota Nursery and Landscape Association.

Photo caption: Winged burning bush (*Euonymus alatus*) immature fruits. Photo Credit: James Calkins, Minnesota Nursery and Landscape Association.

Photo caption: Form and fall color of a young, winged burning bush (*Euonymus alatus*) plant in a foundation planting. Photo credit: James Calkins, Minnesota Nursery and Landscape Association.

Photo caption: A relatively large, winged burning bush (*Euonymus alatus*) exhibiting form and fall color in a foundation planting. Photo credit: James Calkins, Minnesota Nursery and Landscape Association.

Photo caption: Winged burning bush (*Euonymus alatus*) fall color and mature fruits (capsules) with the four purple valves spit open and reflexed to expose the orange arils which surround the seeds; although the flowers have four carpels and the potential to produce four seeds (Simkovic 2024), but the tendency is that most fruits only produce one or two seeds (Missouriplants.com 2025) as seen here. Photo credit: James Calkins, Minnesota Nursery and Landscape Association.

Photo caption: Winged burning bush (*Euonymus alatus*) 1-year old stem in winter showing buds and developing wing-like bark extensions. Photo credit: James Calkins, Minnesota Nursery and Landscape Association.

Photo caption: Winged burning bush (*Euonymus alatus*) infestation (the understory plants with developing pink fall color) in a Connecticut woodland setting. Photo credit: Leslie J. Mehrhoff, University of Connecticut, Bugwood.org.

Why the Plant is Being Assessed

- Based on a risk assessment using the *Plant Risk Assessment & Management Protocol for Minnesota* that was completed in 2019, winged burning bush (*Euonymus alatus*; including all cultivars) was initially listed as a Specially Regulated Plant in Minnesota in 2020 to allow for a 3-year phase-out period for the nursery and landscape industry and has subsequently been listed as a Restricted Noxious Weed in Minnesota since January 1, 2023 (Minnesota Department of Agriculture 2025a) and may not be imported, sold, or transported in the state (Minnesota Department of Agriculture 2025b, Minnesota

Legislature – Office of the Revisor of Statutes 2024). It should be noted that regulation as a Restricted Noxious Weed does not require efforts to manage plants that have escaped cultivation and become established in natural areas or the removal of existing plants from designed landscapes so the removal of existing winged burning bush plants from residential, commercial, and public landscapes is not required.

- In response to the popularity of winged burning bush as a landscape plant and its historical value to the nursery and landscape industry, plant breeders have been working on the development of sterile or low-fecundity cultivars which will need to be reviewed as possible exceptions to the listing of the species as a Restricted Noxious Weed in Minnesota as they become available. At the time this updated risk assessment was prepared, at least two such cultivars have recently been released, and several others are in the pipeline. As a result, the risk assessment for *Euonymus alatus* is being updated to include additional information about the species and to include information that can be used to assess the invasive potential and possible exemption from regulation of the newly-released cultivar – 'NCEA1' / Fire Ball Seedless™ which became available for sale in 2024 and is currently being promoted as "the only seedless, sterile, non-invasive" selection of burning bush available in the nursery trade, and 'ZeroSeed' / ZeroSeed Blaze™ which has been released for production and should become available for sale in one to two years.

  Fire Ball Seedless™ was developed by Dr. Thomas Ranney at North Carolina State University (Department of Horticultural Science, Mountain Horticultural Crops Research & Extension Center) (Spring Meadow 2024 and personal communication – Ranney 2024) and should not be confused with the cultivar 'Select' / Fire Ball® which is an older selection that is not sterile and is still available in the nursery trade but is being phased out (Proven Winners 2024). Like the original Fire Ball®, Fire Ball zero to Seedless™ is part of the well-known Proven Winners brand of landscape plants and more specifically the Proven Winners® ColorChoice Flowering Shrubs category of plants (Proven Winners 2024). According to Dr. Ranney via personal communications (Ranney 2024 & 2025), the reproductive capacity (fecundity) of 'NCEA1' (Fire Ball Seedless™) based on seed set (number of seeds produced per plant) has been limited to 0 to 60 seeds/plant, between 0% and 1.4% of the seed set observed for control 'Compactus' plants (a reduction of more than 98%, the level of reduced fecundity that has been accepted by a number of regulatory authorities as sufficient to allow the sale of selections of potentially invasive plants that meet this standard.

  ZeroSeed Blaze™ was developed by Dr. Yi Li at the University of Connecticut (Department of Plant Science and Landscape Architecture). According to Dr. Li via personal communications (Li 2024 & 2025). 'ZeroSeed' (ZeroSeed Blaze™) is truly sterile with no fruit production for more than 10 years. A plant patent has been applied for this selection and pre-research publication information about this sterile selection of winged burning bush has been shared with the author for inclusion in this updated risk assessment.

  See Box 7, Question 7J within the Risk Assessment below for more detailed information about these cultivars.

Identification, Biology, and Life Cycle

- *Euonymus alatus* is a deciduous, woody shrub, that typically grows 5-10 feet tall but can grow to heights of 15-20 feet with a spread of up to 12 feet; the species is sometimes pruned as a small tree.

- Plants have a rounded to spreading form, typically equal to or broader than high, and can be single- or multiple-stemmed with primary branching occurring close to the ground; the stems of new growth are initially bright green before developing distinctive, rusty-brown, corky ridges or wing-like extensions that become grayish-tan with age (the specific epithet *alatus* is the Latin term for winged or having wings).
- Leaves are dark green, opposite to subopposite (two leaves and buds on opposite sides of the stem or slightly offset at each node), simple, 1-3 inches long and 0.5-1.5 inches wide, elliptic to obovate, sharply and finely serrate with short petioles. The leaves turn brilliant red in the fall in full sun and various shades of pink in shade (depending on the degree of shade) before abscising.
- Flowers are radial, perfect, 4-merous (four or multiples of four of each of the floral parts; in this case, 4-petals, sepals, stamens, and pistils) with rounded petals, small, inconspicuous, greenish-yellow, and produced in clusters of three (cymes) in the axils of the leaves in May-June.
- Fruits are oblong, dehiscent, 4-celled capsules about 0.2-0.3 inches long with a red to purple pericarp when mature (September-October); the pericarp is sutured with four valves that open to reveal up to four, fleshy, bright orange to orange-red arils (fleshy seedcoats) that surround the seeds; it has been reported that mature *Euonymus alatus* plants can produce as many 4,230 fruits per plant which would be equivalent to 4,230 to 8,460 seeds per plant based on 1-2 seeds per fruit based on typical seed set for the species (missouriplants.com 2025). Although relatively small, the fruits can be quite showy when present in large numbers, especially after the leaves have abscised, and often persist into the winter; fruits are attractive to and eaten by birds.
- Depending on their size, the corky wings on the stems can be quite distinct and showy during the winter, especially after a snowfall when the snow collects on the corky wings. The species is cold hardy to U.S.D.A. Hardiness Zone 3 (-30 to -40 degrees Fahrenheit) to 5 (-10 to -20 degrees Fahrenheit) depending on individual plant genetics (Dirr 1990, Fryer 2009, Snyder 2000).
- *Euonymus alatus* is a member of the Celastraceae, the Bittersweet or Staff-Vine Family.

Winged burning bush (*Euonymus alatus*) was introduced in North America as a landscape plant from Asia in about 1860 (Dirr 1990, Snyder 2000) and has been described by Michael Dirr as “Truly one of the great aesthetic and functional shrubs available for American gardens” (Dirr 2011). The bright red fall foliage makes it an attractive and, historically, very popular landscape plant, and it has been commonly planted along highways, as hedges, and in foundation and other landscape plantings (specimen plants, borders, screens, and masses). Shade tolerance, soil adaptability (soil texture and pH, including heavy clay soils but excluding wet or poorly drained soils), and good form with little to no pruning required are also characteristics that have made winged burning bush a valuable and popular landscape plant, which it remains today even though it has been shown to have invasive tendencies. Because the species can get quite large (up to 20 feet in height) and can become leggy, and because the fall color is variable, multiple cultivars have been selected based on growth habit (compactness – smaller, denser plants), superior fall color, fruitfulness, and cold hardiness (Dirr 1990, Snyder 2000) with compactness and fall color tending to be most important. More recently, sterility/low fecundity have become important selection criteria for *Euonymus alatus* and other invasive landscape species in response to the invasive tendencies of the species (Contreras 2022, Ranney et al. 2007, Thammina et al. 2011, University of Connecticut 2011). Some examples of named cultivars include ‘Compactus’ (more compact than the species in general, wings reduced to corky ridges, scarlet fall color, one of the earlier selections), ‘Fire Ball’ (compact with reliable cold hardiness and bright red fall color), ‘Hayman’ (Unforgettable Fire® - naturally full and compact with smaller leaves and reliable fall color), ‘Nordine’ (compact, fruitful), ‘Odom’ (Little Moses® - dwarf, fiery red fall

color), ‘Rudy Haag’ (dwarf, fiery red fall color), and others. Winged burning bush has few significant pests but can suffer considerable damage caused by rabbits during the winter (based on author James Calkins’ experience). From a nursery production standpoint, winged burning bush is also easy to propagate (typically from semi-hardwood cuttings, although it is generally easy to root whenever plants are in leaf) and transplants easily (Dirr 1990).

Current Distribution

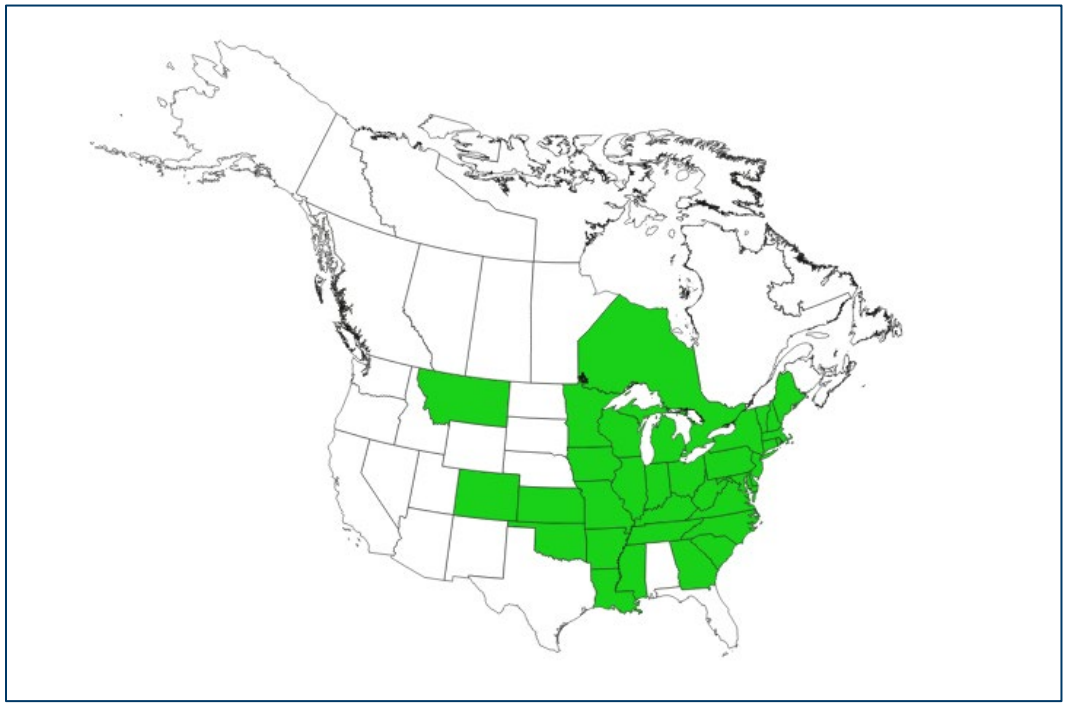

Image caption: Reported distribution of winged burning bush (*Euonymus alatus*) in the United States and Canada at the state and province level (EDDMapS 2025a); at the time of this updated assessment, winged burning bush had been reported in every state in the eastern U.S.A. from Minnesota south to Louisiana and east except for Alabama and Florida, plus Montana, Colorado, Kansas, and Oklahoma to the west, and in the Canadian province of Ontario (EDDMapS 2025a). In contrast with the reporting on the EDDMapS Database, Arkansas, Colorado, Kansas, Louisiana, Maine, Minnesota, Mississippi, Oklahoma, and Tennessee are not included as states where winged burning bush has been reported on the USDA NRCS PLANTS Database (USDA Plants Database 2024; see Appendix for the PLANTS Database distribution map).

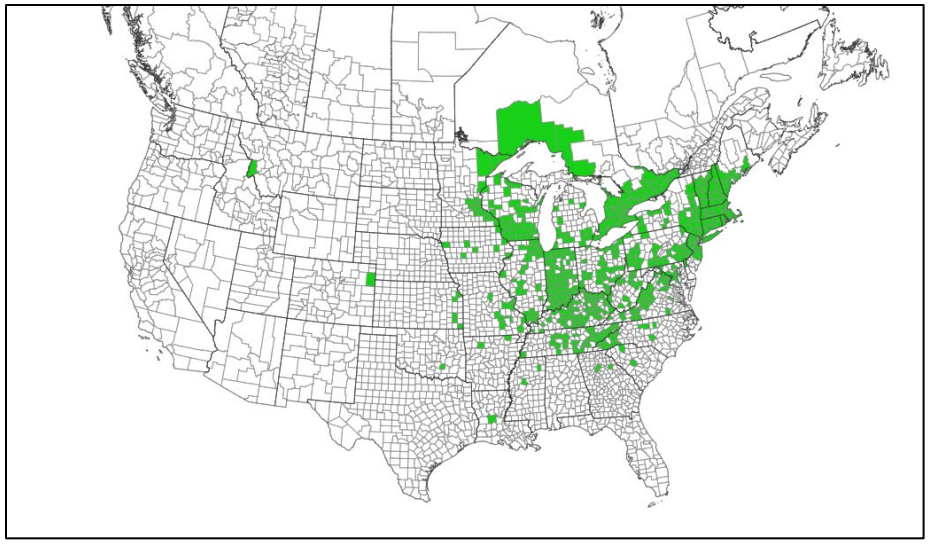

Image caption: Reported distribution of winged burning bush (*Euonymus alatus*) in the United States and Canada at the county level (EDDMapS 2025a).

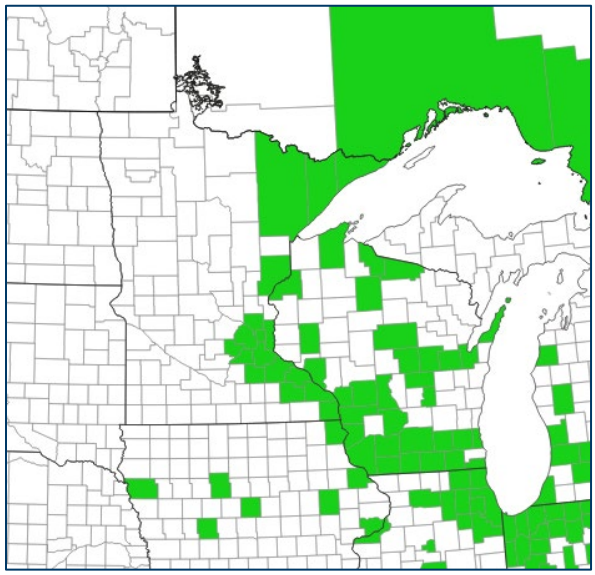

Image caption: Reported distribution of winged burning bush (*Euonymus alatus*) in Minnesota and Wisconsin (and portions of neighboring states and Canadian provinces) at the county and district (Canada) level (EDDMapS 2025a); at the time of this assessment, winged burning bush had been reported in 16 counties in Minnesota (131 reports statewide; eight of these reports are in managed landscapes) with most reports in the Twin Cities metropolitan area and in southeastern Minnesota (Washington County – 23 reports, Hennepin County – 22 reports, Winona County – 18 reports, Ramsey County – 14 reports, Olmsted County – 11 reports, and Dakota County – 10 reports), and 32 counties in Wisconsin (184 reports statewide) with most reports in Dane County (29 reports), Waukesha County (48 reports), La Crosse County (9 reports), and Portage County (9 reports). Winged burning bush has also been reported in the neighboring state of Iowa (reported in 8 widely distributed counties; 15 reports statewide) but has not been reported in North Dakota or South Dakota. In neighboring Ontario, Canada, most of the reports are far removed from Minnesota in the eastern portion of the province; the closest reports are in the city of Thunder Bay in Thunder Bay District which is located north of northeastern Minnesota and Lake Superior (2 reports; both in managed landscapes).

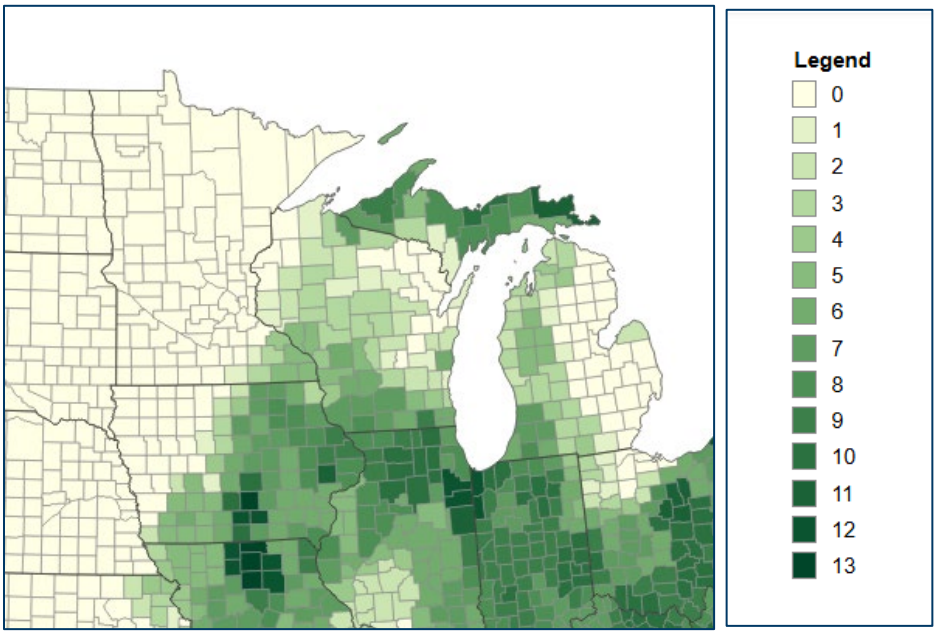

Image caption: A map showing the predicted distribution county-level distribution of winged burning bush (*Euonymus alatus*) in Minnesota and Wisconsin (and portions of neighboring states) by 2041-2060 based on the agreement among 13 climate models (EDDMapS 2025b, the darker the pigmentation, the higher agreement among the 13 climate models); note that it is predicted that the distribution of winged burning bush is predicted to be limited to the southeastern corner of Minnesota.

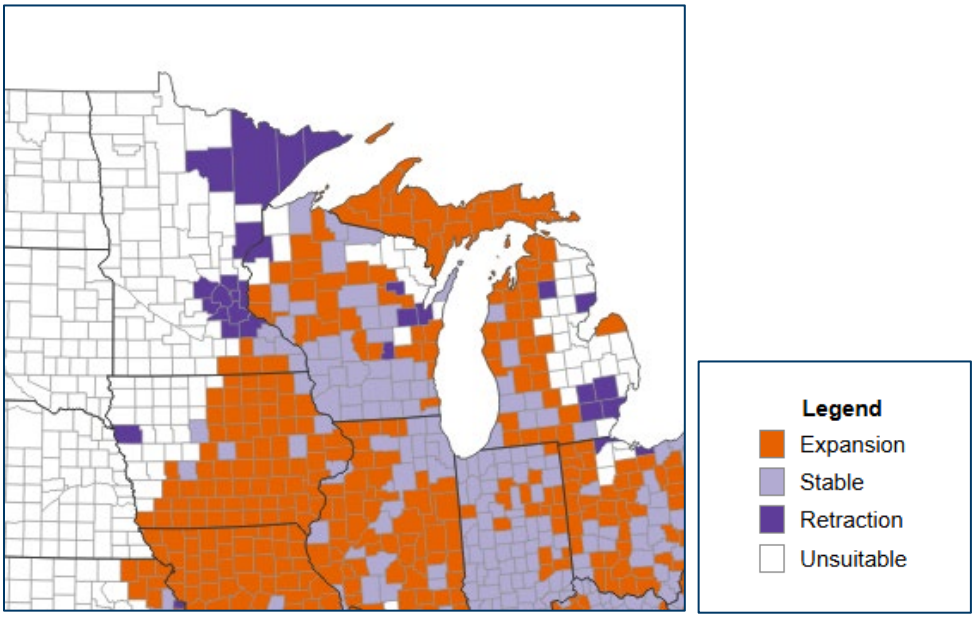

Image caption: A map showing the predicted distribution trends for winged burning bush (*Euonymus alatus*) in Minnesota and Wisconsin (and portions of neighboring states at the county level by 2041-2060 based on climate modeling (EDDMapS 2025c); note that it is predicted that winged burning bush populations will remain stable or decrease in Minnesota except in the southeastern corner of the state.

Current Regulation

- Beginning on January 17, 2020, winged burning bush was regulated as a Specially Regulated Plant in Minnesota to allow for a 3-year phase out period which ended on December 31, 2022. Since then, winged burning bush has been regulated as a Restricted Noxious Weed in Minnesota and may not be imported, sold, or transported in the state (Minnesota Department of Agriculture 2025). Winged burning bush is also regulated in Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Vermont, and Wisconsin (see Box 3 within the Risk Assessment section below). In New York, winged burning bush is a Regulated invasive species which are species that cannot be knowingly introduced into a free-living state, or introduced by a means that one should have known would lead to such an introduction, although such species shall be legal to possess, sell, buy, propagate and transport (New York State Department of Environmental Conservation 2014). Winged burning bush is not on the Federal Noxious Weed List [USDA Animal and Plant Health Inspection Service (APHIS) 2010].

Risk Assessment

Box 1:

Is the plant species or genotype non-native?

Answer: Yes.
Outcome: Go to Box 3.
Euonymus alatus is native to Asia including central and eastern China, the Korean peninsula, the Sakhalin Islands of eastern Russia, and Japan (Dirr 1990, Fryer 2009, Invasive Plant Atlas 2017).

Box 2:

Does the species pose significant human or livestock concerns or have the potential to significantly harm agricultural production?

Question 2A: Does the plant have toxic qualities that pose a significant risk to livestock, wildlife, or people?

Outcome: Decision tree does not direct to this question. Go to Box 9 (Yes) or Go to Question 2B (No).

Question 2B: Does the plant cause significant financial losses associated with decreased yields, reduced quality, or increased production costs?

Outcome: Decision tree does not direct to this question.

Box 3:

Is the species, or a related species, documented as being a problem elsewhere?

Answer: Yes.
Outcome: Go to Box 6.
Winged burning bush (*Euonymus alatus*) has been documented as a problem and an invader of forests throughout the eastern United States (Invasive Plant Atlas 2017) and is currently regulated in nine states including Delaware (Delaware General Assembly 2022), Maine (Maine Department of Agriculture, Conservation and Forestry 2018), Maryland (University of Maryland Extension 2023), Massachusetts (Massachusetts Department of Agriculture Resources 2018), Minnesota (), New Hampshire (New Hampshire Department of Agriculture, Markets and Food 2018), New York (New York State Department of Environmental Conservation

2014), Vermont (Vermont Agency of Agriculture, Food and Markets 2012), and Wisconsin (Wisconsin Department of Natural Resources 2018). Although not yet regulated, legislation that would halt the sale of *Euonymus alatus* 'Compactus' beginning on January 1, 2029, was passed by the Missouri Legislature on May 15, 2025, and awaits the governor's signature; the governor has until July 14, 2025, to sign the bill.

Although not formally regulated, a number of other states and national parks have reported it to be invasive in natural areas. For example, winged burning bush has been recognized as invasive and is considered a "significant threat" by the Pennsylvania Department of Conservation and Natural Resources (DCNR) (PennState 2020). Other states where winged burning bush is considered an invasive species but not regulated include Georgia, Indiana, Kentucky, Michigan, New Jersey, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Virginia, and West Virginia. Once again, winged burning bush is variously regulated in nine states including Delaware, Maine, Maryland, Massachusetts, Minnesota, New Hampshire, New York, Vermont, and Wisconsin. In Delaware, it is illegal to import, export, buy, sell, transport, distribute, or propagate any viable portion, including seeds, of a plant on the Invasive Plant List which includes winged burning bush (Delaware General Assembly 2022). In Massachusetts, the importation, sale, trade, purchase, distribution, and related activities of winged burning bush, including all cultivars, varieties and hybrids, is prohibited. In Maine, it is illegal to import, export, buy, sell or intentionally propagate winged burning bush for sale or distribution and all cultivars, varieties and hybrids are included (Maine Department of Agriculture, Conservation and Forestry 2018). In Maryland regulation only includes a labeling requirement indicating the plant is invasive (University of Maryland Extension 2023). In Minnesota, winged burning bush is regulated as a Restricted Noxious Weed and the species and its propagating parts, including for all hybrids, cultivars, and varieties unless specifically exempted, may not be imported, sold, or transported in the state (Minnesota Department of Agriculture 2025). In New Hampshire, the collection, transportation, importation, exportation, movement, purchase, sale, distribution, propagation or transplantation of any living and viable portion of winged burning bush, including all cultivars and varieties, is prohibited (New Hampshire Department of Agriculture, Markets and Food 2018). In New York, with the exception of Nassau County and Suffolk County/eastern Long Island where sale is prohibited (Nassau and Suffolk Counties 2009), the regulation of winged burning bush only includes a requirement that the species cannot be knowingly introduced into a free-living state, or introduced by a means that one should have known would lead to such an introduction, and plants offered for sale must have a label indicating the plant is considered invasive and harmful to the environment; so long as these requirements are followed, it is legal to possess, sell, buy, propagate and transport winged burning bush in the state (New York State Department of Environmental Conservation 2014). In Vermont. winged burning bush is classified as a Class B Noxious Weed and meaning the sale, movement, and/or distribution winged burning bush is prohibited (Vermont Agency of Agriculture, Food and Markets 2012). And finally, in Wisconsin, the species and the cultivar 'Nordine' (very fruitful) are currently restricted (Rule NR 40) with all other cultivars exempt (Wisconsin Department of Natural Resources 2018); however, although a decision had not been made at the time this updated risk assessment was developed, the Wisconsin Invasive Species Council had recommended that winged burning bush remain a restricted species but with no exclusions (Wisconsin Invasive Species Council 2024). In Wisconsin, winged burning bush has been documented as invading open disturbed areas such as abandoned fields, pastures, forest edges, roadsides and yards (Matson 2011). In northeastern states and Illinois, winged burning bush has invaded forest understories and grasslands, and known populations occur in oak upland forest, second growth lowland forest, pastures, shady hillsides, and glacial drift prairies (Ebinger 1983, The Nature Conservancy 2006).

Euonymus alatus has been documented as naturalizing in urban parks. One study of 10 mid-Atlantic urban parks recorded *Euonymus alatus* in all 10 of the parks surveyed (Loeb in Kohli et al. 2008). Research in Indianapolis ranked *Euonymus alatus* as one of the top 5 invasive species that pose the biggest current and emerging threats based on a survey of local experts (Dolan 2016).

Box 4:

Are the species' life history and growth requirements understood?

Answer: Yes. ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.***

Winged burning bush has been grown and used in designed landscapes in North America since the mid-1800s and is adaptable to many growing conditions. It is cold hardy to USDA Hardiness Zones 3-8 and prefers mesic woodlands (Dirr 1990, Fryer 2009, Farrar 2001, Snyder 2000). The species also transplants easily, grows well in full sun and dense shade, is adaptable to different soil types and pH levels, and has no serious pest problems, though browsing by deer and rabbits can girdle plants (Fryer 2009). Winged burning bush has also been shown to sprout from the crown following top-kill by herbicides and it is likely that it will resprout following other types of top-killing events such as fire (Fryer 2009). *Euonymus alatus* reproduces prolifically by seed, but a study in Kentucky involving the cultivar 'Compactus' showed that seed may have limited persistence in the soil and concluded that seed viability was estimated to be 2% after one year (Finneseth 2009, Matson 2011).

Box 5:

Gather and evaluate further information

Outcome: Decision tree does not direct to this question.

Box 6:

Does the species have the capacity to establish and survive in Minnesota?

Question 6A: Is the plant, or a close relative, currently established in Minnesota?

Answer: Yes.

Outcome: Go to Box 7.

Winged burning bush has been planted and survived in Minnesota landscapes for decades (based on author Jim Calkins' knowledge and experience) and reporting via EDDMapS indicates the species can naturalize in Minnesota (EDDMapS 2025a).

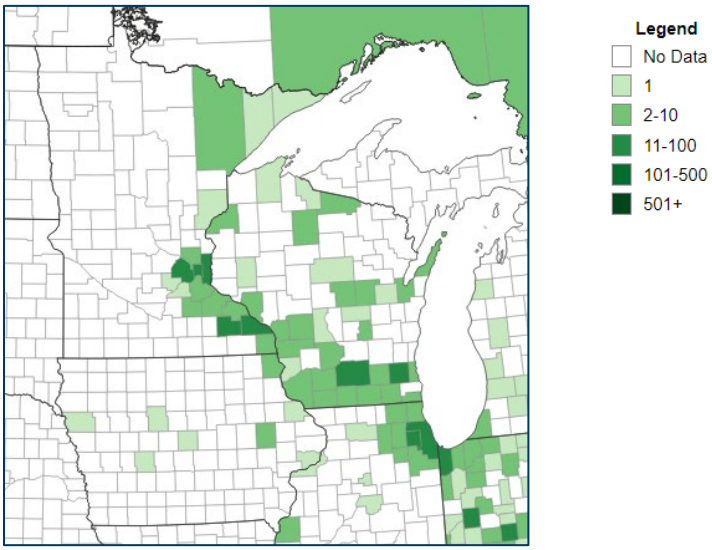

Image caption: *Euonymus alatus* record density map showing the number of reports of *Euonymus alatus* on a county basis (EDDMapS 2025a).

While most winged burning bush infestations are single plants or small groups of plants in Minnesota, a densely infested 4-acre area with another 15 acres of scattered plants has been reported in southeastern Minnesota (Fritcher 2018). Although *Euonymus alatus* is cold hardy to USDA Cold Hardiness Zone 4, the cultivar 'Compactus' is borderline hardy in Zone 4 and has suffered winter injury at the Minnesota Landscape Arboretum during normal winters (Dirr 2009, Snyder 2000).

Question 6B: Has the plant become established in areas having a climate and growing conditions similar to those found in Minnesota?

Answer: Yes. ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.***

Winged burning bush has been documented as naturalizing beginning in 1984 in Illinois and 2001 in Iowa (Ebinger et al. 1984, Farrar 2001) and it has been reported that specimens were collected as "spontaneous" in the Chicago region in 1940 (Wilhelm 2018). It has been reported as naturalized in 32 counties in Wisconsin (EDDMapS 2024; up from 6 counties as reported in the 2019 risk assessment) and has been observed escaping cultivation in the Northeast and Midwest (Matson 2011). Currently reported naturalizing in 17 counties in Minnesota (EDDMapS 2024; up from 11 counties as reported in the 2019 risk assessment).

Question 6C: Has the plant become established in areas having a climate and growing conditions similar to those projected to be present in Minnesota under future climate projections?

Outcome: Decision tree does not direct to this question.

Box 7:

Does the species have the potential to reproduce and spread in Minnesota?

Question 7A: Are there cultivars of the plant that are known to differ in reproductive properties from the species?

Answer: Yes.

Outcome: Answer Questions 7B-I and then Go to Question 7J and explain which cultivars differ from the species in reproductive potential and how.

As a consequence of the popularity of winged burning bush and other species of landscape plants that have been classified as invasive species in recent years, and in recognition of and response to concerns about these species becoming regulated as noxious weeds and/or invasive species in a number of states, developing sterile selections (cultivars) of invasive species including winged burning bush has been an increasing focus of plant breeders for several years (Chetty et al. 2024, Contreras et al. In Press, Ranney et al. 2007a, Ranney et al. 2007b). ploidy manipulation (e.g., triploids vs. diploids), mutation breeding via exposure to gamma radiation, X-rays, and mutagenic chemicals, and biotechnical genetic modification techniques like transformation and gene editing (Contreras 2022). As a result of these efforts, multiple selections of winged burning bush have been developed that exhibit reduced fecundity and at least two of these selections have been given cultivar names and released for production. The cultivar 'NCEA1' (Fire Ball Seedless™) developed by Dr. Thomas Ranney at the Mountain Horticultural Crops Research and Extension Center Mountain Crop Improvement Lab at North Carolina State University is the first sterile/low fecundity cultivar to become available on the market. Several other sterile/low fecundity selections of winged burning bush have also been developed at the University of Connecticut by Dr. Yi Li (Department of Plant Science and Landscape Architecture, College of Agriculture, Health, and Natural Resources) and one of these cultivars – 'ZeroSeed' (ZeroSeed Blaze™) – has been released and should be available for purchase in a year or two. See Question 7I below for additional information.

Question 7B: Does the plant reproduce by asexual/vegetative means?

Answer: No.

Outcome: Go to Question 7D.

Clonal/asexual/vegetative propagation via stem cuttings is the standard method of propagation for both the species and named cultivars of *Euonymus alatus* in nursery production, but winged burning bush does not naturally reproduce vegetatively including via root suckers (Dirr 2009). Plants can resprout after cutting and after fire but there is no evidence that plants are more vigorous in response to these impacts (Fryer 2009).

Question 7C: Are the asexual propagules - vegetative parts having the capacity to develop into new plants - effectively dispersed to new areas?

Outcome: Decision tree does not direct to this question.

Question 7D: Does the plant produce large amounts of viable, cold hardy seeds? For woody species, document the average age the species produces viable seed.

Answer: Yes.

Outcome: Go to Question 7G.

Euonymus alatus is a prolific seed producer and has the ability to produce thousands of seeds per plant (Brand et al. 2012, Dirr 2009, Fryer 2009). Seeds germinate readily and are disbursed by birds and humans. A study in Connecticut concluded that of the nine cultivars that were field tested, all had the potential to produce large amounts of seed if allowed to mature and were exposed to cross pollination with different genotypes (Brand et al. 2012). Herbarium specimens show that winged burning bush is reproducing in Ramsey, Scott, and Anoka County and in Duluth (St. Louis County) in Minnesota (Cholewa 2018). The juvenile period is greater than three years (Calkins 2018).

Question 7E: For species that produce low numbers of viable seeds, do they have a high level of seed/seedling vigor or remain viable for an extended period (seed bank)?

Outcome: Decision tree does not direct to this question.

Question 7F: Is the plant self-fertile?

Answer: Possibly. ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.***

Winged burning bush has perfect flowers – both male and female flower parts (stamens and pistils, respectively) are present in the same flower (Dirr 2011), but specific information regarding self-compatibility has not been found. It has been suggested (without documentation) that *Euonymus alatus* 'Odom' (Little Moses®) is self-fertile and can produce fruit without cross-pollination with another plant (in this case, another cultivar), but cross-pollination with other *Euonymus alatus* plants can increase fruit production (Brand et al. 2012, Shrub Hub Garden Marketplace 2024).

Question 7G: Are sexual propagules – viable seeds – effectively dispersed to new areas? List and consider all vectors.

Answer: Yes.

Outcome: Go to Question 7I.

The fruits are attractive to birds which then spread the seeds to new areas (Dirr 2009, Fryer 2009, Global Invasive Species Database 2005).

Question 7H: Can the species hybridize with native species (or other introduced species) and produce viable seed and fertile offspring in the absence of human intervention?

Answer: Unknown. ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.***

Euonymus atropurpureus (American/eastern wahoo) is the only other species of *Euonymus* that is native to Minnesota. Other introduced species include *Euonymus fortunei* (wintercreeper euonymus; many cultivars), *Euonymus europaeus* (European/common spindle/spindletree; several cultivars with 'Red Cascade' being the most common), and *Euonymus hamiltonianus* (Hamilton's spindletree), however none of these species are widely planted in Minnesota.

Question 7I: Do natural controls, species native to Minnesota, which have been documented to effectively prevent the spread of the species in question?

Answer: No.
Outcome: Go to Box 8.
No natural controls that are native to Minnesota exist.

Question 7J: Was the answer to Question 7A (Are there cultivars that differ in reproductive properties from the original species) "Yes"?

Answer: Yes.
Outcome: Document cultivars and differences here.
Several cultivars of winged burning bush that are reportedly sterile or have low fecundity have been developed by plant breeders and two cultivars – 'NCEA1' (Fire Ball Seedless™) and 'ZeroSeed' (ZeroSeed Blaze™) – have been released for commercial production.

Euonymus alatus 'NCEA1' / Fire Ball Seedless™

Euonymus alatus 'NCEA1' (Fire Ball Seedless™), a new cultivar of winged burning bush developed by Dr. Thomas Ranney (North Carolina State University) and is currently being promoted as "the only seedless, sterile, non-invasive" selection of burning bush available in the nursery trade by Proven Winners (2024) and personal phone and email communications with Dr. Ranney; Ranney 2024 & 2025), is included in this risk assessment for review as a potential exemption to the listing of *Euonymus alatus* as a Restricted Noxious Weed in Minnesota. Dr. Thomas Ranney is a JC Raulston Distinguished Professor at the North Carolina State University, Mountain Horticultural Crops Research and Extension Center in Mills River, NC .

Euonymus alatus 'NCEA1' (Fire Ball Seedless™) is a recently developed and released (2024) selection of winged burning bush that is being marketed as being sterile and a member of the Proven Winners® Color Choice® Flowering Shrub brand (Proven Winners 2024, Spring Meadow Nursery 2024). *Euonymus alatus* 'NCEA1'was developed through a breeding program conducted at the Mountain Horticultural Crops Research and Extension Center in Mills River, North Carolina and was selected from a population of plants derived from gamma irradiated seed of *Euonymus alatus* in 2013 (Google Patents 2024 – USPP 36198P2). Dr. Ranney has reported that 0 to 60 seeds/plant were produced by Fire Ball Seedless™ plants which represents a 100-98.6% reduction in seed set compared to control plants of a similar size and grown next to each other in the same location (see Table 1 below), and believes this reduction is sufficient to reduce the risk of invasiveness. It should be noted that when evaluating the fecundity of plants with the goal of finding individuals with reduced fecundity, it is important to grow the plants together with other cultivars as was done in this research to allow for cross pollination to get a more realistic assessment of potential seed set (Brand et al 2012). It should also be noted

that seed viability and seedling survival in competition with other plants in a wild environment will also play a role in the invasive capacity of low fecundity cultivars and would likely reduce seedling survival and the risk of invasiveness even further. As a result of this introduction of the low fecundity cultivar 'NCEA1' developed by Dr. Ranney, and considering the supporting information provided by Dr. Ranney, the possibility of exempting *Euonymus alatus* 'NCEA1' (Fire Ball Seedless™) from regulation is recommended for discussion and a vote by the full Noxious Weed Advisory Committee (NWAC).

Photo caption: Fall color and form of *Euonymus alatus* 'NCEA1' (Fire Ball Seedless™), a new, "sterile" (actually low fecundity) selection of winged burning bush developed by Dr. Thomas Ranney, Mountain Horticultural Crops Research and Extension Center, Mountain Crop Improvement Lab, North Carolina State University. Photo credit: Spring Meadow Nursery, Proven Winners® Color Choice® Flowering Shrub brand.

Per Dr. Thomas Ranney, the developer of *Euonymus alatus* 'NCEA1' (Fire Ball Seedless™), via email communication on 5/21/2024:

Hi Jim,

Sorry for the slow response.

As you indicated, Fire Ball Seedless™ burning bush (Euonymus alatus 'NCEA1') was intentionally developed as a highly infertile (seedless) form of burning bush to minimize or prevent reseeding. We have evaluated the plant in a field trial with dozens of different burning bush and found seed set (number of seeds produced per plant) to vary from 0 to 60 seeds/plant that represented 0 to 1.4% that of the fertile, similar sized, control 'Compactus'. Other states, including Oregon accept cultivars of potentially weedy plants that have a 98% reduction in fertility to be allowed for sale.

Let me know if you have other questions.

Thanks.

Tom

Table 1. *In-field assessment of seed set (number of seeds produced per plant) of Euonymus alatus Fire Ball Seedless compared to 'Compactus'.*

Accession	*Seed Set 2017*	*Seed Set 2018*	*Seed Set 2019*	*Seed Set 2020*	*Seed Set 2021*
Fireball Seedless	***0***	***0***	***23***	***24***	***60***
'Compactus'			***3169***	***3530***	***4230***
% of Control			***0.7***	***0.7***	***1.4***

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Note: Dr. Ranney has also reported via personal communication that there was no seed set for Fire Ball Seedless™ in 2022, 2023, and 2024 (Ranney 2024 & 2025).

Note: The reference to Oregon allowing cultivars of potentially weedy plants that have a 98% reduction in fertility to be sold in the state in Dr. Ranney's email is based on Oregon Administrative Rules, Chapter 603, Division 52, Rule 1200 – Oregon Department of Agriculture Noxious Weed Quarantine (603-052-1200 – Oregon Secretary of State Administrative Rules 2025), whereby listed noxious weeds – "A" Weeds (weeds that "occur in the state in small enough infestations to make exclusion, eradication, or containment possible; or which are not known to occur, but their presence in neighboring states makes future occurrence in Oregon seem imminent") and "B" Weeds (weeds that "are regionally abundant, but which may not occur or have limited distribution in some counties" that will be "managed on a priority basis as resources allow") are quarantined (propagation, transport, and sale prohibited). The rule was initially approved in 2004 and was subsequently revised in 2009 to exempt sterile selections of butterfly bush (*Buddleia davidii*; originally quarantined in 2004 as a "B" Weed) that are approved by the Oregon Department of Agriculture with the requirement that they "produce less than 2% viable seed and inter-specific hybrids that are not regulated, and may be propagated and sold if labeled with the approved variety name." The list of approved butterfly bush cultivars is available at the Oregon Department of Agriculture (2025) butterfly bush approved cultivars webpage. The Oregon exemption of sterile cultivars based on the requirement that they "produce less than 2% viable seed" has also been referenced in subsequent articles that recommend or reference the 98% fertility reduction threshold (2% viable seed) as an option for exempting cultivars of species that are regulated as invasive species from regulation (Contreras 2022, Contreras

and McAninch 2013, Still and Contreras 2024). Most recently, the Wisconsin Invasive Species Council has included the "less than 2% seed viability" standard in its recommendations to the Wisconsin Department of Natural Resources for changes to the NR 40 Rule (Wisconsin Invasive Species Rule, Chapter NR 40, Wisconsin Administrative Code, Wisconsin Legislature 2025) which were submitted on August 8, 2024. More specifically, the "less than 2% seed viability" recommendation relates to the council's broader recommendation that the NR 40 Rule be changed to remove all cultivars from regulatory exemption and require reviews to determine if specific cultivars meet criteria for being exempt from regulation including the "less than 2% seed viability" standard (Wisconsin Invasive Species Council 2024).

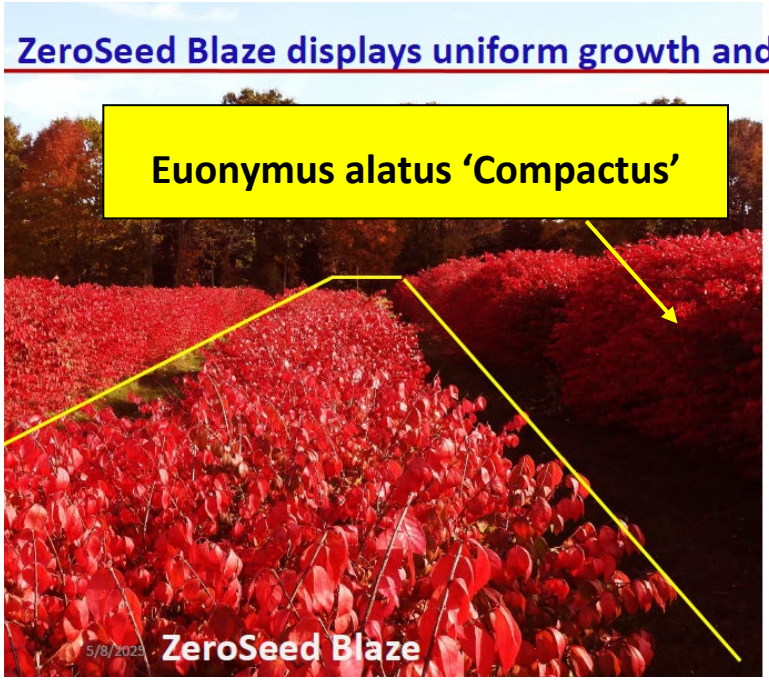
Euonymus alatus 'ZeroSeed' / ZeroSeed Blaze™

Euonymus alatus 'ZeroSeed' (ZeroSeed Blaze™), a new cultivar of winged burning bush developed by Dr. Yi Li (University of Connecticut) and described as a sterile cultivar of winged burning bush that is expected to become available to consumers in a year or two (personal phone and email communications with Dr. Li; Li 2024 & 2025), is included in this risk assessment for review as a potential exemption to the listing of Euonymus alatus as a Restricted Noxious Weed in Minnesota. Dr. Yi Li is a Professor of Horticultural Plant Biotechnology in the College of Agriculture, Department of Plant Science and Landscape Architecture, University of Connecticut.

Euonymus alatus 'ZeroSeed' (ZeroSeed Blaze™), is a new cultivar of winged burning bush that was generated using X-ray-treated pollen. The performance characteristics of 'ZeroSeed' winged burning bush as a potential landscape plant and an assessment of its fertility and apparent sterility has been ongoing for fourteen years. During this time, 'ZeroSeed' plants have never produced fruits, including when grafted onto *fertile Euonymus alatus* rootstocks. As a result of this introduction of the sterile cultivar 'ZeroSeed' developed by Dr. Li, and considering the supporting information provided by Dr. Li, the possibility of exempting *Euonymus alatus* 'ZeroSeed' (ZeroSeed Blaze™) from regulation is recommended for discussion and a vote by the full Noxious Weed Advisory Committee (NWAC).

The following information has been provided by Dr. Li for inclusion in this risk assessment (and should not be used for other purposes). The following data and images have been provided by Dr. Li as evidence of the sterile nature of ZeroSeed Blaze™ winged burning bush.

ZeroSeed Blaze displays uniform growth and striking, vibrant red color



ZeroSeed Blaze is more compact than E. alatus: 10 years old, plants reached 90% of the size of E. alatus.

No significant differences were observed between ZeroSeed Blaze and E. alatus Compactus.

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Photo caption: ZeroSeed Blaze displays uniform growth and striking, vibrant red color. ZeroSeed Blaze is more compact than *E. alatus*: at 10 years old, the plants reached 90% of the size of E. alatus. No significant differences were observed between ZeroSeed Blaze and *E. alatus* 'Compactus'. Photo credit: Dr. Yi Li.

Seed production from UConn sterile lines of *E. alatus*

	2016	2017	2018	2019	2020	2021	2022	2023	2024
E. alatus 'Compactus'	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Sterile-2	4.67%	1.54%	0.74%	0.86%	0.62%	0.17%	0.80%	1.25%	0.25%
Sterile-9	8.82%	0.39%	0.09%	1.00%	1.68%	0.31%	1.25%	1.48%	2.06%
Sterile-13	0.97%	0.32%	0.00%	0.09%	0.49%	1.99%	2.58%	1.38%	1.67%
Sterile-21	0.00%	0.16%	0.01%	0.18%	0.86%	1.67%	1.83%	1.29%	1.87%
Sterile-26	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

– E. alatus 'Compactus' and derived sterile lines were propagated in 2011 and planted in the field in 2013.

– Seed production from non-sterile E alatus averaged 1,156 seeds per plant in 2016 and gradually increased to 19,388 seeds per plant by 2024.

– Sterile-2 and Sterile-9 were developed via gamma ray mutagenesis; Sterile-13 and Sterile-21 are triploids, and Sterile-26 (currently named 'ZeroSeed Blaze') was generated using X-ray treated pollen.

– None of the 35 vegetatively propagated 'ZeroSeed Blaze', produced seeds through 2024. We have released "ZeroSeed Blaze" to several nurseries nationwide.

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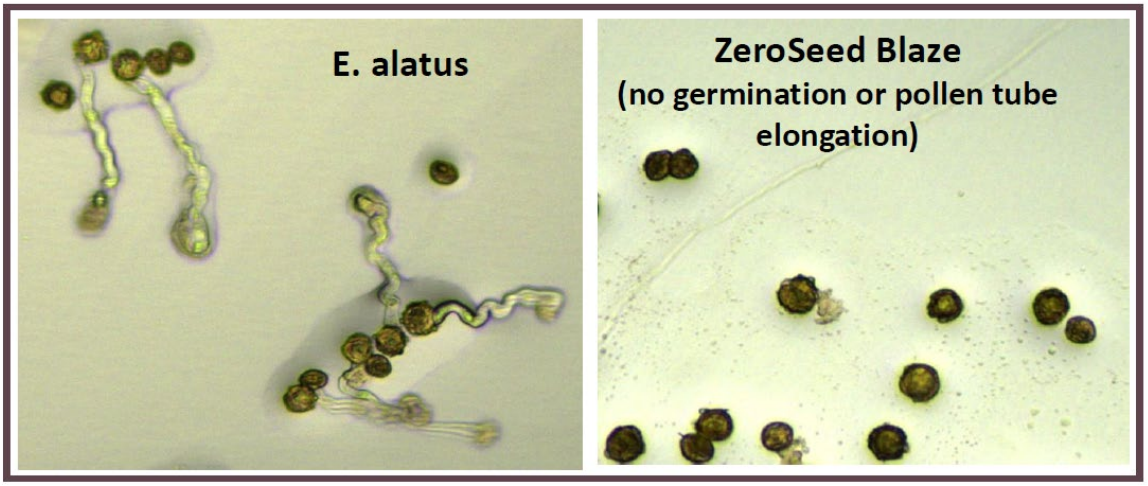
Image caption: Table of seed production as a percentage compared to 100% seed production of *E. alatus* 'Compactus' over nine growing seasons. The five lower fecundity cultivars ranged from 4.67% to 0.00%. Cultivar "Sterile-26" is now named 'ZeroSeed Blaze' and was 0 seeds in each growing season. It was generated using X-ray treated pollen. Image credit: Dr. Li Yi.

Pollen Sterility in ZeroSeed Blaze



Approximately 1,000 pollen grains for each were examined for germination

Image caption: Pictures comparing pollen germination for *Euonymus alatus* and the selection ZeroSeed Blaze (trademarked name) a sterile selection. There is no germination or pollen tube elongation in the ZeroSeed Blaze image. Image credit: Dr. Yi Li.

ZeroSeed Blaze is both male- and female-sterile*

Pollen donor / Pollen recipient	E. alatus	ZeroSeed Blaze
E. alatus	176	0
ZeroSeed Blaze	0	0

***Two hundred flowers were used as pollen recipients (female) for every cross-pollination experiment.**

Image caption: A cross-pollination experiment showed that ZeroSeed Blaze is both male- and female-sterile. Image credit: Dr. Yi Li.

Image caption: Side-by side pictures of *Euonymus alatus* and the sterile selection ZeroSeed Blaze (comparing fruit production); the species is full of fruit while ZeroSeed Blaze has no fruit. Image credit: Dr. Yi Li.

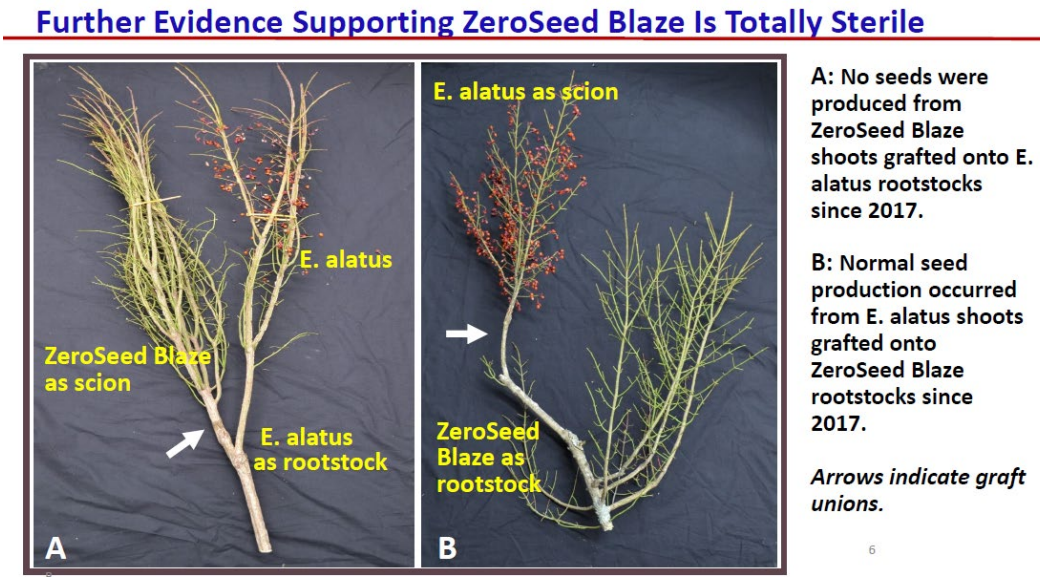


Image caption: Pictures of *Euonymus alatus* plants created by grafting the sterile selection ZeroSeed Blaze onto the species and vice versa showing ZeroSeed Blaze remains fruitless when grafted on to the species while the species produces fruit when grated onto ZeroSeed Blaze. Image credit: Dr. Yi Li.

It should be noted that Dr. Li has developed multiple selections of winged burning bush with significantly reduced fecundity including a number of selections that have exhibited fecundity levels below the 2% fertility level of control plants (alternatively, a 98% fertility reduction) that has been suggested as a potential threshold for allowing reduced-fecundity selections to be exempted from invasive species regulations. He has, however, made the decision to only release one selection for landscape use – ZeroSeed Blaze™ – the only selection that

has proven to be completely sterile based on rigorous testing based on multiple factors as demonstrated by the supporting information provided by Dr. Li and presented as part of this risk assessment.

Box 8:

Does the species pose significant human or livestock concerns or have the potential to significantly harm agricultural production, native ecosystems, or managed landscapes?

Question 8A: Does the plant have toxic qualities, or other detrimental qualities, that pose a significant risk to livestock, wildlife, or people?

Answer: No.
Outcome: Go to Question 8B.
Winged burning bush can be toxic if eaten, but only if large quantities are ingested. All parts of *Euonymus alatus* are reportedly toxic if ingested by humans and can cause vomiting, diarrhea, weakness, chills, and convulsions but the poison severity is rated as low (North Carolina State Extension 2024, The Royal Horticultural Society 2018). Winged burning bush is reported to be mildly toxic to dogs (Pet Poison Helpline 2024).

Question 8B: Does, or could, the plant cause significant financial losses associated with decreased yields, reduced crop quality, or increased production costs?

Answer: No.
Outcome: Go to Question 8C.
Winged burning bush is not an agricultural weed.

Question 8C: Can the plant aggressively displace native species through competition (including allelopathic effects)?

Answer: Yes.
Outcome: Go to Box 9.
Euonymus alatus forms dense thickets where "hundreds of seedlings are often found below the parent plant in what is termed a 'seed shadow'" (Swearingen et al. 2010). The species adapts to a wide range of habitats, including prairies, grasslands, and forests (Clements et al. 2012, Robertson et al. 1995).

Winged burning bush can create a dense shrub layer that shades out species in lower layers, outcompeting native plant species by altering community structure (Fryer 2009, The Nature Conservancy 2006, NatureServe 2017, Swearingen et al. 2010). The species forms a mat-like root system, has a dense branching structure, and can create a dense stand of seedlings immediately below the parent plant (NatureServe 2017).

No evidence of allelopathy has been found.

Question 8D: Can the plant hybridize with native species resulting in a modified gene pool and potentially negative impacts on native populations?

Answer: Unknown. ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.***
The only species of *Euonymus* that is native to Minnesota is *Euonymus atropurpureus* (American/eastern wahoo), but no information regarding potential hybridization between *Euonymus atropurpureus* and *Euonymus alatus* has been found. Cultivars of *Euonymus alatus* are known to cross-pollinate with each other and have high fruit production (Knight et al. 2011).

Question 8E: Does the plant have the potential to change native ecosystems (adds a vegetative layer, affects ground or surface water levels, etc.)?

Answer: Yes. ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.***

Euonymus alatus can form dense thickets, can be a prolific seed producer, and can produce hundreds of seedlings and a dense stand of seedlings below the parent plant (Swearingen et al. 2010). *Euonymus alatus* also forms a broad, closed crown which can shade and crowd out native herbs and shrubs, and changes prairie vegetation to shrubland (Fryer 2009, NatureServe 2017, Swearingen et al. 2010). It has also been documented invading forest understories, pastures, and coastal shrublands (Miller et al. 2010).

Infestations of winged burning bush have been documented since the late 1980s in glacial drift hill prairies in Illinois (Ebinger 1983, Ebinger et al. 1984, Robertson et al. 1995) and a 15-acre infestation of winged burning bush that exhibits a high density of seedlings and very few other species of plants has been documented in southeastern Minnesota (Fritcher 2018).

Euonymus alatus is shade tolerant and has the potential to dominate the understory of mature forests by outcompeting native shrubs and herbs (Matson 2011).

At the University of Minnesota Landscape Arboretum, the species has been naturalizing in forested understories (McNamara 2017).

Question 8F: Does the plant have the potential to introduce or harbor another pest or serve as an alternate host?

Outcome: Decision tree does not direct to this question.

Box 9:

Does the species have clearly defined benefits that outweigh associated negative impacts?

Question 9A: Is the plant currently being used or produced and/or sold in Minnesota or native to Minnesota?

Answer: No.

Outcome: Go to Box 10.

Winged burning bush (*Euonymus alatus*), including all cultivars, has been listed as a Restricted Noxious Weed in Minnesota beginning in 2023 and may not be imported, sold, or transported in the state without a permit. Prior to being listed as a Restricted Noxious Weed in Minnesota in 2023, winged burning bush was produced and sold in Minnesota and was a valuable nursery crop and a popular landscape plant.

In 2017, as part of the information-gathering process for the initial risk assessment for winged burning bush, the Minnesota Department of Agriculture, in partnership with the Minnesota Nursery and Landscape Association, sent a survey to 1,402 Minnesota nursery certificate holders seeking information about the value of winged burning bush to the nursery and landscape industry in Minnesota. The survey found that 41 out of 73 respondents sold *Euonymus alatus* and 17 of the 73 respondents indicated that it was a significant source of income. In addition, based on the percentage of the 73 survey respondents that agreed with statements pertaining to winged burning bush is summarized below:

- I/we currently sell this species or one or more named cultivars of this species - 56.16%
- This species provides significant income for my/our business - 23.29%
- I/we consider this species invasive or problematic in native ecosystems and/or agricultural production

systems in Minnesota - 17.81%
- This species should be regulated as a noxious weed to prevent future spread and establishment in new areas in Minnesota - 12.33%
- If this species were regulated as a noxious weed and not allowed to be sold in Minnesota, it would have a significant negative impact on my/our business - 28.77%
- There are good alternative available with desirable traits that are similar to this species - 24.66%
- There are no good alternatives available with desirable characteristics that are similar to this species – 34.25%

The following year (2018), the Minnesota Nursery and Landscape Association reached out to wholesale growers in an attempt to get an estimate of the wholesale value of winged burning bush to the Minnesota nursery and landscape industry. With the caveat that it is important to note that wholesale value does not represent the full value of a particular species because retail value is not accounted for and is a significant component of the value equation, the wholesale value of winged burning bush was estimated to be $270,946/year in 2018 (about 1.8% of total annual sales for these growers (James Calkins, Minnesota Nursery and Landscape Association; personal communication, August 22, 2018). As a wholesale value based on only the biggest wholesalers of *Euonymus alatus*, and although these growers probably accounted for the majority of the wholesale production of *Euonymus alatus* in Minnesota, this estimate of wholesale value was not representative of every grower and was, therefore, a rough and conservative estimate of the wholesale value. The value of *Euonymus alatus* to these wholesale growers would have also been much higher if out-state sales had been considered. Multiplying the wholesale value by a factor of 1.5 to 2.0 was used to provide a rough, but reasonable, estimate of the ultimate retail value of the *Euonymus alatus* plants sold by these wholesalers. Based on this information, the estimated value (wholesale plus value-added retail) of *Euonymus alatus* plants sold in Minnesota was estimated to be in the range of $677,365 to $812,838/year. Once again, this was considered a conservative estimate because the data set was not complete, and the estimated monetary values also did not account for the unique landscape value of *Euonymus alatus* in designed landscapes.

Question 9B: Is the plant an introduced species and can its spread be effectively and easily prevented or controlled, or its negative impacts minimized, through carefully designed and executed management practices?

Answer: No. ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.***

No special regulations were identified that would be a good fit for this species.

NatureServe (2017) ranked its management difficulty as “Medium/Low.” Seedlings can be hand-pulled and larger plants can be dug. If plants are cut, re-sprouts must be controlled by repeated cutting or application of a systemic herbicide. Cut stump treatment with systemic herbicides is generally effective and a foliar treatment in early summer may be employed for large populations (NatureServe 2017).

Cut stump treatments result in little negative impact to non-target species while foliar herbicide treatments may result in non-target impacts and digging out large plants may cause soil disturbance.

Question 9C: Is the plant native to Minnesota?

Answer: No. ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.***

Euonymus alatus is not native to Minnesota (see Box 1 for more detailed information).

Question 9D: Is a non-invasive, alternative plant material or cultivar commercially available that could serve the same purpose as the plant of concern?

Answer: No, not really. ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.***

While some alternatives to winged burning bush have some of the same characteristics, none of them check all of the boxes, especially when it comes to shade tolerance, fall color, and site adaptability. With the goal of continued use as a landscape plant, research on sterility continues with this species and it does not appear that any of the existing cultivars of winged burning bush could be promoted as being sterile or non-invasive. Although research at the University of Wisconsin showed the cultivar 'Rudy Haag' produced little to no fruit (Renz and Jull 2012), further study at the University of Connecticut suggests "all cultivars have the potential to produce large amounts of seed if the plants are allowed to mature and are exposed to cross-pollination with different genotypes" (Renz 2018, Brand et al. 2012). Additionally, it has been reported that 'Rudy Haag' can cross-pollinate and have high fruit production when grown with other cultivars (Knight et al. 2011).

Research conducted in Connecticut (USDA Zone Hardiness 6a) revealed few alternatives to *Euonymus alatus* (Shrestha and Lubell 2015). A similar study needs to be conducted in Minnesota for native and non-invasive alternatives to woody invasive plants for USDA Zone Hardiness 3 and 4. If cultivars are developed that are low fecundity, the NWAC will consider reviewing and issuing an exemption if backed up with data.

The Midwest Invasive Plant Network lists the following non-invasive alternatives to burning bush: *Aronia arbutifolia* (red chokeberry), *Aronia melanocarpa* (black chokeberry), *Fothergilla major* (large fothergilla), *Fothergilla* 'Mt. Airy' and 'Blue Shadow' (*Fothergilla* cultivars), *Itea virginica* (Virginia sweetspire), *Viburnum prunifolium* (blackhaw), *Rhus copallinum* (shining sumac), *Euonymus americanus* (strawberry bush), *Euonymus atropurpureus* (eastern wahoo), and *Acer palmatum* 'Osakazuki' (Japanese maple). While these are all good plants, the 2024 author (James Calkins, MNLA) does not believe they can truly be considered alternatives to *Euonymus alatus*.

Question 9E: Does the plant benefit Minnesota to a greater extent than the negative impacts identified at Box #8?

Answer: No. ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.***

Based on its review of the risk assessment for winged burning bush (*Euonymus alatus*) which was completed in 2018 and included economic value information, and its subsequent vote to list winged burning bush as a Restricted Noxious Weed, the Minnesota Noxious weed Advisory Committee (NWAC) believed the invasive threat posed by *Euonymus alatus* outweighed the economic value and benefits of this species in Minnesota (see "Initial Risk Assessment Summary (8-13-2019)" section below).

Box 10:

Should the species be regulated as Prohibited/Eradicate, Prohibited/Control, or Restricted Noxious Weed?

Question 10A: Is the plant currently established in Minnesota?

Answer: Yes.

Outcome: Go to Question 10D.

See Question 6A for detail.

Question 10B: Would prohibiting this species in trade prevent the likelihood of introduction and/or establishment?
Outcome: Decision tree does not direct to this question.

Question 10C: Does this risk assessment support this species being a top priority for statewide eradication if found in the state?
Outcome: Decision tree does not direct to this question.

Question 10D: Does the plant pose a serious human health threat?
Answer: No.
Outcome: Go to Question 10F.
See Box 8, Question 8A.

Question 10E: Is the health threat posed by the plant serious enough, and is the plant distribution sufficiently small enough to be manageable, and are management tools available and effective enough to justify listing as Prohibited / Eradicate species?
Outcome: Decision tree does not direct to this question.

Question 10F: Is the plant known to cause significant ecological or economic harm and can the plant be reliably <u>eradicated</u> (entire plant) on a statewide basis using existing practices and available resources considering the distribution, reproductive biology and potential for spread?

- *For distribution, note if the distribution is well documented, the number and acreage of known infestations and how widespread they are in the state. Note if there are infestations in border areas.*
- *For reproductive biology, note if there are reproductive biology factors that make the plant easier to control and eradication more likely (for example, long pre-reproductive period, self-incompatible pollination, short-lived seed bank).*
- *For potential for spread and re-invasion of controlled areas, note its potential to spread beyond places where it is being controlled such as deliberate planting by people, wildlife vectors, re-infestation from border states, or other factors that facilitate spread.*
- *For known management tools, note what management tools are available, potential non-target impacts, and the reasonableness of state management or mandating that landowners throughout the state use the management tools to eradicate or control existing plants*.
- *For available resources, consider the capacity of state and local personnel and availability of funding to respond to new and existing infestations*.

Answer: No.
Outcome: Go to Question 10G.
Whether sufficient resources could be made available for the management of exiting infestations is a question for further discussion. Because *Euonymus alatus* is widely planted as a landscape plant, it cannot be reliably controlled (i.e., eradicated) to prevent dispersal without the development of a statewide management plan that addresses existing plants in designed landscapes.

Distribution: Although the exact distribution of *Euonymus alatus* in Minnesota is not known, the distribution of the species in Minnesota and in border states is likely widespread in developed areas given its popularity as a landscape plant. Having a better understanding of the naturalized distribution in Minnesota and bordering states would be useful from a management perspective.

Reproductive biology: There are currently no known factors that might make it easier to control or eradicate *Euonymus alatus* in Minnesota; the development of sterile cultivars may have the greatest potential in this regard.

Spread and reinvasion of controlled areas: Reinfestation resulting from the dispersal of seeds by birds from *Euonymus alatus* plants that remain in residential and commercial landscapes and naturalized populations is likely.

Known management tools: Herbicides are available and can be effective in controlling *Euonymus alatus*, but non-target impacts can be a concern in natural areas.

Available resources: In the absence of requiring (i.e., listing winged burning bush as a Prohibited-Eradicate Noxious Weed), or at least encouraging, the removal of exiting *Euonymus alatus* plants from residential and commercial landscapes in Minnesota and neighboring states, it would be hard to justify the use of state resources to manage winged burning bush in the state. A well-designed plan for encouraging removals from managed landscapes might be an option.

Question 10G: Is the plant known to cause significant ecological or economic harm and can the plant be reliably controlled to limit spread on a statewide basis using existing practices and available resources? Would the economic impacts or other hardships incurred in implementing control measures be reasonable considering any ongoing or potential future increase of ecological or economic harm?

- *Also consider all bullet points listed under 10F when evaluating 10G*

Answer: No.
Outcome: Go to Question 10H.
Although winged burning bush does have the potential to cause significant ecological harm based on this risk assessment, the cost of control on a statewide basis could be significant depending on the naturalized distribution in the state which has not been quantified and reliable control on a statewide basis would not be possible unless the removal of existing plants in residential and commercial landscapes is mandated (i.e., listing *Euonymus alatus* as a Prohibited Eradicate Noxious Weed with judicious enforcement).

Question 10H: Would prohibiting this species in trade have any significant or measurable impact to limit or reduce the existing populations or future spread of the species in Minnesota?

Answer: Possibly (Yes).
Outcome: LIST THE PLANT AS A RESTRICTED NOXIOUS WEED.
Although the spread of *Euonymus alatus* will continue as long as existing plants are allowed to remain in residential and commercial landscapes and given the widespread distribution of the species in designed landscapes in the state, prohibiting the species in trade (the current status) may slow the spread in the shorter term. To this end, maintaining the current status of *Euonymus alatus* as a Restricted Noxious Weed is

recommended with exemptions for the low fecundity and sterile cultivars 'NCEA1' (Fire Ball Seedless™) and 'ZeroSeed' (ZeroSeed Blaze™), respectively.

Question 10I: Are there any other measures that could be put in place as Special Regulations which could mitigate the impact of the species within Minnesota?
Outcome: Decision tree does not direct to this question.

Box 11:

The species is being proposed to be designated as a Specially Regulated Plant. What are the specific regulations proposed?
Outcome: Decision tree does not direct to this question.

Final Outcomes of Risk Assessment (2025)

NWAC Listing Subcommittee

Outcome: A recommendation to the full NWAC that the current regulation of winged burning bush (*Euonymus alatus*) as a Restricted Noxious Weed be retained but to exempt the low fecundity cultivar 'NCEA1' (Fire Ball Seedless®) developed by Dr. Thomas Ranney at the University of North Carolina, and the sterile cultivar 'ZeroSeed' (ZeroSeed Blaze™) developed by Dr. Yi Li at the University of Connecticut, from regulation.

Comments: There are additional sterile/low fecundity cultivars of winged burning bush (*Euonymus alatus*) in the development pipeline. The Noxious Weed Advisory Committee is willing to assess new cultivars for requested exemptions if data on their fecundity is published. The Committee will include requested cultivar assessments in annual work plans and as staff capacity allows. The cultivar exemption information and committee recommendation will be documented. New low fecundity cultivars can be added to the exemption list without updating the entire species risk assessment.

NWAC Full Committee

Outcome: Exempt the following cultivars:

- Proven Winners ® 'NCEA1': Fire Ball Seedless ™
- 'ZeroSeed' (ZeroSeed Blaze ™)

Comments: The vote on 12/16/25 was 16 to 3 in favor of the recommendation.

MDA Commissioner

Outcome: Exempt the following cultivars:

- Proven Winners ® 'NCEA1': Fire Ball Seedless ™
- 'ZeroSeed' (ZeroSeed Blaze ™)

Comments: No comments

Current Risk Assessment Summary (8/27/2025)

Throughout 2025, the NWAC Listing Subcommittee has been discussing how to assess selections of invasive plants that are purported to be sterile or to have a fertility level that has been reduced sufficiently to reduce their invasive potential and allow their exemption from regulation. Without a doubt, this is a very complicated and multifaceted question and a question that applies in the assessment of sterile/low fecundity selections of winged burning bush (and other invasive plants) from a regulatory perspective and was at the center of the

Listing Subcommittee's discussions regarding the possible exemption of the low fecundity cultivar 'NCEA1' (Fire Ball Seedless®) developed by Dr. Ranney at the University of North Carolina and the sterile cultivar 'ZeroSeed' (ZeroSeed Blaze™) developed by Dr. Yi Li at the University of Connecticut. Whether the current regulation of winged burning bush (*Euonymus alatus*) as a Restricted Noxious Weed should be retained or changed was also a topic of discussion.

Based on these discussions, the NWAC Listing Subcommittee recommended that the current regulation of winged burning bush (*Euonymus alatus*) as a Restricted Noxious Weed be retained but to exempt the low fecundity cultivar 'NCEA1' (Fire Ball Seedless®) developed by Dr. Thomas Ranney at the University of North Carolina, and the sterile cultivar 'ZeroSeed' (ZeroSeed Blaze™) developed by Dr. Yi Li at the University of Connecticut, from regulation.

There are additional sterile/low fecundity cultivars of winged burning bush (*Euonymus alatus*) in the development pipeline. The Noxious Weed Advisory Committee is willing to assess new cultivars for requested exemptions if data on their fecundity is published. The Committee will include requested cultivar assessments in annual work plans and as staff capacity allows. The cultivar exemption information and committee recommendation will be documented. New low fecundity cultivars can be added to the exemption list without updating the entire species risk assessment.

Final Outcomes of Risk Assessment (Initial Risk Assessment – 2018)

NWAC Listing Subcommittee

Outcome: On 9/23/2019, the NWAC Listing Subcommittee recommended listing *Euonymus alatus* as a Specially Regulated Plant with a 3-year nursery production phase-out and to move Euonymus alatus to the Restricted Noxious Weed list after the phase-out period to prohibit sale of the species.

Comments: There were many challenges to writing this risk assessment. It is a widely planted landscape plant and grows in many yards and commercial landscapes. The NWAC Listing Subcommittee debated the feasibility of homeowners being able and willing to remove exiting winged burning bush plantings, the impact on the public and how much of a benefit the species is in people's yards. Additional field studies of low fecundity cultivars are needed to determine if cultivars are capable of reverting back to "wild types." Finally, nursery sales data could be incomplete and the NWAC is sensitive to listing *Euonymus alatus* as a Prohibited species without support from the nursery industry.

Comments from 7/18/19: the listing subcommittee discussed the possibility of developing a communication/education plan for homeowners. The MDA does not have the capacity at this time to develop a communication plan. The group also discussed helping municipalities develop a burning bush replacement plan for homeowners. Limitations at this time are funding and staff capacity to develop these plans.

NWAC Full Committee

Outcome: Voted to list *Euonymus alatus* as a Specially Regulated Plant with 3-year production phase out then move to the Restricted Noxious Weed list in 2023. The vote was 14:1 in favor of the NWAC Listing Subcommittee recommendation on 12/03/19.

Comments:

MDA Commissioner

Outcome: The NWAC recommendation to list winged burning bush (*Euonymus alatus*) as a Specially Regulated Plant with 3-year production phase-out and to then move winged burning bush to the Restricted Noxious Weed list in 2023 was approved at its December 2019 meeting and the commissioner's order was signed on 01/15/20 and effective 01/17/20.
Comments:

Initial Risk Assessment Summary (8-13-2019)

After much discussion, the listing subcommittee arrived at a decision to recommend listing *Euonymus alatus* (winged burning bush) as a Specially Regulated Plant in 2020 with a 3-year production phase-out and to then list the species as a Restricted Noxious Weed in 2023. The phase out would help production nurseries diminish their inventory and give the NWAC group time to develop a communication plan for homeowners. Naturalized populations at this time are still limited but potentially underreported. The challenges of both homeowner compliance and sensitivity to the nursery industry's support of listing as Prohibited-Eradicate were acknowledged in NWAC Listing Subcommittee and full NWAC discussions and informed their recommendations.

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Appendix

Euonymus alatus (Thunb.) Siebold

burningbush

burningbush General Information	
Symbol:	EUAL13
Group:	Dicot
Duration:	Perennial
Growth Habit:	Shrub
Native Status:	CAN I L48 I
Other Common Names:	winged burning bush winged euonymus winged spindletree

Download Distribution Data

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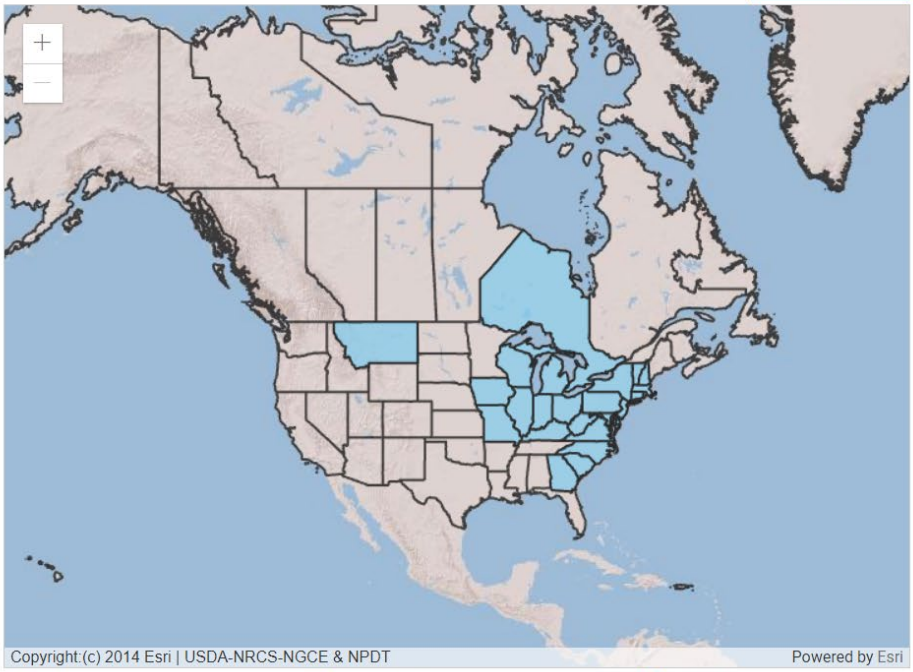

Native
Introduced
Both
Native, No County Data
Introduced, No County Data
Both, No County Data

Native Status:

L48 AK HI PR VI NAV CAN GL SPM NA

Default View

Image caption: Distribution of winged burning bush (*Euonymus alatus*) in the United States and Canada – PLANTS Database; United States Department of Agriculture, Natural Resources Conservation Service. USDA Plants Database (2024), accessed August 11, 2024.