

Minnesota Noxious Weed Risk Assessment

Developed by the Minnesota Noxious Weed Advisory Committee

Assessment information

Common name: Callery pear

Scientific name: *Pyrus calleryana* Decne.

Family name: Rosaceae

Current reviewer name and organizational affiliation: David Stevenson, Minnesota Landscape Arboretum and Laura Van Riper, Minnesota Department of Natural Resources

Date of current review: June 22, 2022

Species description

A compact, upright, medium-sized flowering tree with white flowers.

Photos



Photo caption: Callery pear tree in flower. Photo credit: Dan Tenaglia, Missouriplants.com, Bugwood.org.



Photo caption: Callery pear flower cluster. Photo credit: Alpsdake/Wikimedia Commons/CC BY-SA 3.0.



Photo caption: Callery Pear fruit and foliage. Photo credit: Rlevse/Wikimedia Commons/public domain.

Why the plant is being assessed

- The species has been identified as introduced or invasive in several eastern, southeastern and Midwestern states.
- Although callery pear is listed as being cold hardy to USDA Cold Hardiness Zone 5, some cultivars and hybrids have survived for a period of years in Minnesota.

Identification, biology, and life cycle

- A conical crown becoming rounded with age; 30-50 feet in height and 20-30 feet in spread.
- The bark is lustrous brown when young becoming grayish-brown and ridged and furrowed with age.
- Leaves are alternate, simple, and crenate; 1.5 – 3 inches long and about as wide as long; an acuminate tip with a variable base from rounded to truncate; leathery and lustrous green.
- The monocious flowers are white up to 0.75 inches across; five petaled and typical of *Pyrus*; born in corymbs before or with the expanding leaves.
- Fruit is a small, rounded pome; less than 0.5 inches diameter; large quantities may be present.
- Not self-fertile but will readily cross with other cultivars of callery pear, other pear species and rootstocks of grafted pear cultivars.
- Very prominent fall color from scarlet to purple.
- Tolerant of a range of soil types, some drought and pollution; not shade tolerant.
- Birds readily eat the fruit and spread the seeds.
- Can look similar in some characteristics to crabapple: bark, fruit size, can be somewhat thorny

Current distribution

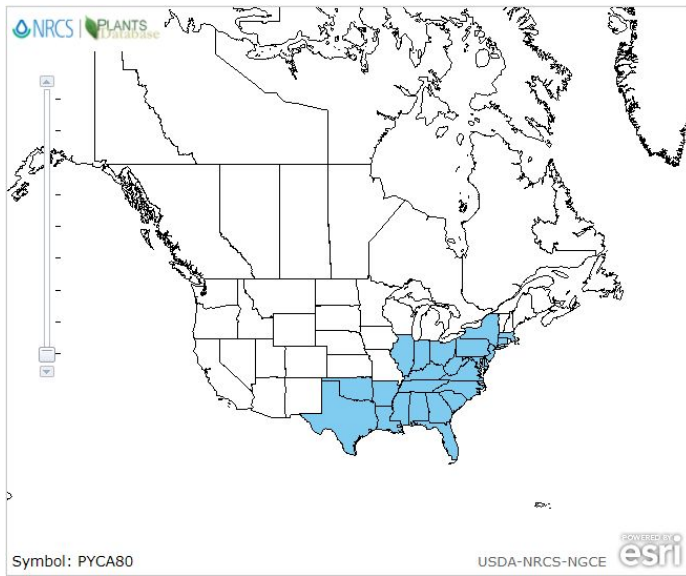


Photo caption: National level map for callery pear from USDA Plants, Feb. 2021.

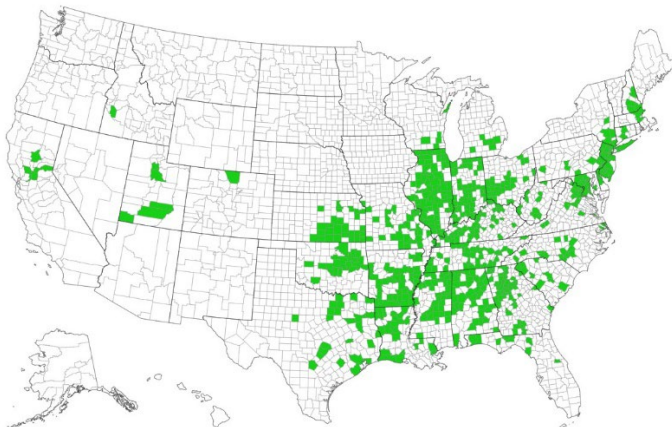


Photo caption: County level map for callery pear from EDDMaps, Feb. 2021.

USDA Plants identifies *Pyrus calleryana* as introduced in states from Massachusetts west to Illinois and south to Texas. In addition to the area listed above, EDDMaps shows the species to be present in Wisconsin, Michigan, Missouri, Oklahoma, Kansas, Colorado, Utah, Idaho, and California

No escaped populations of callery pear have been reported in Minnesota. The cities of Saint Paul and Minneapolis have planted trees in their city inventories. The assessment author has also observed plantings of callery pear in the Twin Cities western suburbs.

Current regulation

Pyrus calleryana will become an Ohio prohibited invasive plant in 2023 and has been listed as a Class B Noxious Weed in Pennsylvania and sale will no longer be allowed beginning in February 2024 following a 2-year phase out period. The species has been prohibited from sale in the state of Maryland since 2018.

Pyrus calleryana is not regulated at the federal level.

Risk assessment

Box 1:

Is the plant species or genotype non-native?

Answer: yes

Outcome: Go to Box 3

Callery pear is native to slopes, plains, mixed valley forests and thickets in southeastern China, Taiwan, Korea, Japan, and Vietnam (eFloras 2021).

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.

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

The species appears on various invasive species lists from organizations in at least 15 states (invasiveplantatlas.org 2021).

Box 4:

Are the species' life history and growth requirements understood?

Outcome: Decision tree does not direct to this question.

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

Pyrus calleryana is most typically listed as being cold hardy to USDA Zone 5 by nurseries but at least two cultivars that can be found listed by some nurseries as zone 4: Autumn Blaze and Jaczam (Jack®). The 2021 Minnesota Dept. of Agriculture Cold Hardiness lists the cold hardiness of ‘Autumn Blaze’ Callery pear as USDA Zone 4 and ‘Aristocrat’, ‘Chanticleer’, ‘Red spire’, and ‘Trinity’ as USDA Zone 5 (Minnesota Department of Agriculture 2021).

Cold hardiness research done at the University of Minnesota Landscape Arboretum in the early 1990s examined the hardiness of several callery pear cultivars along with some other pear taxa. The callery pear cultivars Whitehouse, Bradford and Capital were all demonstrated to lack sufficient hardiness for minimum winter temperatures in USDA Zone 4a surviving only a single season in the field. ‘Autumn Blaze’ showed the best hardiness of the *Pyrus calleryana* cultivars tested but none of those tested were hardy enough to survive long-term in USDA Zone 4a. ‘Autumn Blaze’ survived in the field from 1986 to 1993 but were killed when temperatures reached -33°F in January 1994 (McNamara and Pellet 1994).

Plantings of callery pear in the Twin Cities in more recent years seem to indicate that the above findings may no longer be applicable. Hardier cultivars such as Jaczam (Jack®) have been introduced since the research was done and plantings in Saint Paul indicate that even the cultivar Bradford can survive to gain significant size.

The “public” tree inventory provided by the City of Minneapolis in February 2021 lists 75 specimens of *Pyrus calleryana* ‘Jaczam’. Inventory dates range from 2015-2020. 36 specimens are listed and “dead/nearly dead” but 38 specimens are listed as “good/healthy and vigorous”. 1 specimen was listed as “fair/generally healthy”. No other taxa of *Pyrus calleryana* are listed in the inventory.

An inventory of *Pyrus calleryana* supplied by the City of Saint Paul in 2021 listed 44 specimens of the cultivar Bradford. No assessment of the health or condition of the trees was provided but the trees vary in size from a DBH of 1” up to 19” with 75% being 8” or larger.

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

Outcome: Decision tree does not direct to this question.

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: no

Outcome: Go to Question 7B

Callery pear cultivars are grafted clones and retain the same general reproductive properties as the species. *Pyrus calleryana* is not self-fertile and cannot effectively pollinate other trees of the same cultivar and only occasionally produce very small fruit with few seeds. This limitation is due to gametophytic self-incompatibility. They can pollinate and be pollinated by their own flowering rootstock, trees of a different cultivar or escaped specimens (Culley and Hardiman 2007).

With the dramatic expansion of introduced cultivars it is now apparent that cultivars in isolation produce little or no fruit but where different cultivars are allowed to cross-pollinate the trees produce fruit.

The triploid hybrid pear *Pyrus x triploida* 'NCPX2' (Chastity® Pear) is described as “highly infertile” and has callery pear in its background but is listed as USDA Zone 5 and was specifically bred to prevent weediness by Dr. Tom Ranney of North Carolina State University (J. Frank Schmidt and Son Company 2021).

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

Answer: yes

Outcome: Go to Question 7C

Grafted callery pear cultivars, the cultivar Bradford in particular, do readily sucker from the rootstock which are typically seedlings of *Pyrus calleryana*. Rootstocks may readily sprout when roots are nicked by lawn mowers (Culley and Hardiman 2007).

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

Answer: no

Outcome: Go to Question 7D

Suckers are generally restricted to the area immediately around the “mother” tree. However, the suckers can flower if they are not removed, and if pollinated by the scion or another genotype may produce seed which then can be disseminated to new areas (Culley and Hardiman 2007).

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

No documentation could be found on the age at which *Pyrus calleryana* begins producing viable seed, but they are known to begin flowering as early as three years of age (Culley and Hardiman 2007).

Eleven-year-old seed of callery pear from cold storage showed rates of germination between 45-87% (Serota and Culley 2019).

Hardiman and Cully (2010) published Reproductive Success of Cultivated *Pyrus calleryana* (Rosaceae) and Establishment Ability of invasive Hybrid Progeny that details information about the reproductive potential for cultivated and escaped (interspecific hybrid) callery pear:

“Although both cultivated and invasive parents displayed substantial reproductive output and the resulting progeny exhibited high rates of establishment ability, no single maternal cultivar or progeny type was shown to be more fecund than the others. With the exception of seed viability, progeny of invasive individuals did not have greater reproduction or establishment ability than cultivated progeny. Regardless of the lack of a fitness advantage for any particular subset, all groups still exhibited substantial seed set, germination rates, and low levels of mortality, which may explain why invasive populations continue to form. In addition, the observation that early- and advanced-generation groups were equally able to establish suggests that invasive populations will continue to persist and spread. In other words, the availability of a variety of cultivars may have created the opportunity for increased reproduction, resulting in enough propagule pressure to initiate naturalization of the species.”

“Cultivated parents produced fruits and seeds that were significantly larger than those of invasive parents. These results could reflect, in part, an effect of the high-resource environment of the cultivated parents, which are located in a horticultural setting with little to no competition. This may confer an advantage for the initial creation of wild populations because larger seeds are more likely to survive and persist in a seed bank (Harrison et al., 2007). Invasive parents did produce higher numbers of seeds, which could promote further spread. In the case of self-incompatible *P. calleryana*, higher seed numbers may reflect a larger number of compatible mates in invasive populations. This would increase the likelihood of encountering genetically different pollen and therefore result in more compatible crosses among invasive individuals (Lafuma and Maurice, 2007).”

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?

Outcome: Decision tree does not direct to this question.

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

Answer: yes

Outcome: Go to Question 7I

Seeds of both cultivated and escaped *Pyrus calleryana* is readily disseminated by birds after eating the fruits, primarily European starlings (Culley and Hardiman 2007).

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?

Outcome: Decision tree does not direct to this question.

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

Browsing by deer could have limited impacts on callery pear:

“The callery pear is susceptible to several herbivores. Damage from white-tailed deer has been observed in cultivated varieties of *P. calleryana* (e.g., ‘Bradford’, ‘Chanticleer’, and ‘Aristocrat’) and in other ornamental *Pyrus* cultivars (Kays et al. 2003). The susceptibility of wild trees to deer damage remains unknown, although herbivory may be deterred in some wild plants by the production of thorns along stems and branches, a condition often seen within *P. calleryana*’s native range in Asia” (Culley and Hardiman 2007).

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

Answer: no

Outcome: continue with 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: Question 8B

“Pear and apple trees are not particularly toxic, nor are the ripe fruit. The seeds contain amygdalin, which is a glycoside that can release cyanide. One would have to eat a lot of seeds to ever get cyanide poisoning by this route.” (Cornell College of Agriculture and Life Sciences 2021)

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

Escaped callery pear is not a problem in agricultural or forestry settings.

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

Answer: yes

Outcome: Go to Box 9

Escaped populations of callery pear have not been reported in Minnesota. In warmer zones (USDA Zone 5 and warmer) extensive escaped populations have developed.

“Because of its rapid growth and preference for high light environments, *P. calleryana* can potentially impede the establishment of late- to middle-stage successional species in disturbed sites. *P. calleryana* can also form dense, thorny thickets, especially from the root sprouts of abandoned trees. These thickets, which are impenetrable to humans, may provide cover for birds and small mammals. *Pyrus calleryana* fruit is also consumed by birds, albeit mostly by introduced European starlings. Wild pears are an unwanted addition in newly restored wetland prairies, where they sprout readily and compete with planted native species. The removal of wild *P. calleryana* is often hampered by the thorny phenotype of some individuals.” (Culley and Hardiman 2007)

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

Outcome: Decision tree does not direct to this question.

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

Outcome: Decision tree does not direct to this question.

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: yes

Outcome: Go to Question 9B

In 2020, the Minnesota Nursery and Landscape Association (MNLA) reached out to wholesale nursery growers in an attempt to get an estimate of the wholesale value, and ultimately the combined monetary value (wholesale plus value-added retail) of callery pear (*Pyrus calleryana*) to the Minnesota economy for inclusion in the risk assessment for this species (Calkins 2021). Although callery pear may be grown on a limited basis in Minnesota, based on the information available, sales did not appear to be a significant contributor to annual nursery and garden center sales and the Minnesota economy at the time this risk assessment was completed. While the number of callery pear for sale at the time of this writing is likely low, woody species have a multiple year production process. A production phase out period is likely needed in order to be respectful of the investments already made and the indications that only a few callery pear cultivars are cold hardy in Minnesota at this time and these cultivars are only hardy to USDA Zone 4.

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

Outcome: Go to Question 9C

Given that spread of callery pear is primarily accomplished through dissemination of seeds by birds (see 7G), prediction of establishment of new invasions is difficult and spread can be indiscriminate.

The most common recommendation for control of callery pear is to not plant it. Once established control methods are resource intensive. Smaller plants can be pulled from moist soil but larger trees require cutting and treatment with herbicide as untreated stumps will readily sprout. Basal bark treatments are also effective. Reinvasions are typical as long as a seed source remains. (Invasive Plant Atlas of the United States 2021, Penn State Extension 2021)

Question 9C: Is the plant native to Minnesota?

Answer: no

Outcome: Go to Question 9D

Callery pear is native to southeastern China, Taiwan, Korea, Japan, and Vietnam.

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: yes

Outcome: Go to Box 10

A good selection of small trees are available as substitutes for callery pear including serviceberries (*Amelanchier* spp.), flowering crabapples (*Malus* spp.), cherries and plums (*Prunus* spp.), and American yellowwood (*Cladrastis kentukea*).

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

Outcome: Decision tree does not direct to this question.

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

Although there are no reports of escaped callery pear in Minnesota, planted trees are established in the Twin Cities and likely other cities and towns in southern Minnesota (see question 6A).

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: Question 10F

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 eradicated (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 factor 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

Given that there are currently no reported invasions of callery pear in Minnesota and invasion is likely a function of the species' reproductive biology and circumstances/proximity of planted tree cultivars, eradication/removal of limited tree plantings is not presently a reasonable use of resources.

Callery pear is planted in southern Minnesota and seems to survive relatively well at least in the Twin Cities area (see 6A); one likely explanation for escaped populations not yet having been reported is the very limited selection of cultivars planted and their isolation from each other. Due to the self-incompatibility of cultivars, research has indicated that the invasion potential of callery pear is a function of both crossing among different cultivars and crossing between cultivars and escaped populations in areas where the species has been invasive.

“Rather than one cultivar contributing disproportionately to invasive progeny populations, all cultivars appear to be equally and highly capable of reproducing and creating progeny that can successfully establish. Another explanation is one of demography: cultivation and widespread availability through commercial outlets has increased the overall propagule pressure of the species, which also has facilitated release from the lag period and subsequent invasion.” (Hardiman and Culley 2010)

“Therefore, the relatively recent emergence from the lag period in *P. calleryana* is most likely explained by increased propagule pressure due to the introduction of various cultivar types. This could have provided enough genetic variation to overcome the reproductive limitation of self-incompatibility and its associated allele effect, resulting in hybrid populations that are self-sustaining. Additionally, widespread ornamental plantings comprising multiple cultivar types function to increase the inoculum size to the point at which rate of invasion could rapidly increase.” (Hardiman and Culley 2010)

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

Given that there are currently no reported invasions of callery pear in Minnesota, planting of the species has been limited and invasion is likely a function of the species' reproductive biology and proximity of planted tree populations (see question 10G), requiring control of existing planted populations is not reasonable.

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: yes

Outcome: LIST THE PLANT AS A RESTRICTED NOXIOUS WEED

The apparent increase in survivability of callery pear in southern Minnesota since the 1990s (see question 6A) and local nurseries offering cultivars for sale does leave open the potential for increased planting of the species and increased number of callery pear cultivars possibly being introduced to

Minnesota. Given that the likelihood of invasion would increase with the number of trees and diversity of cultivars planted based on evidence from other states (see question 10G) restricting the sale of callery pear in Minnesota would help limit invasions in the future.

Since the sale of callery pear in Minnesota is not a significant financial contribution to the state nursery industry restricting its sale is reasonable and prudent. A three-year production phase out would allow nurseries to recover their current investments while moving toward the full restriction of callery pear sales.

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?

Answer: Decision tree does not direct to this question.

Final recommendations of risk assessment (2022)**NWAC Listing Subcommittee**

Outcome: List as a Restricted Noxious Weed (07/22/2021)

Comments: There was consensus within the subcommittee that restricting the sale of callery pear subsequent to a 3-year phase out period would be prudent due to the increased potential for escapes due to hybridization between cultivars if the diversity of taxa sold was to increase. Although it is possible that birds could facilitate the spread of callery pear into Minnesota from neighboring states in the future, listing callery pear as a Restricted Noxious Weed would reduce the likelihood that callery pear could escape cultivation and become invasive in Minnesota.

NWAC Full Committee

Outcome: List as a Restricted Noxious Weed (12/14/21)

Comments: Callery pear was voted on by NWAC in December 2021. NWAC voted to make it a Restricted Noxious Weed. There was then much discussion about whether or not there should be a phase out period. The assessment was updated in 2022 to explicitly discuss a phase out period for callery pear.

NWAC Full Committee

Outcome: List as a Specially Regulated Plant with a three-year production phase-out period, after which sale of this species will be prohibited and the species will be designated as Restricted in 2026. (12/13/22)

Comments: The vote was 16 in favor and 2 against.

MDA Commissioner

Outcome: List as a Specially Regulated Plant with a three-year production phase-out period, after which sale of this species will be prohibited and the species will be designated as Restricted in 2026.

Comments: No comments

Risk Assessment Current Summary (06-22-2022)

Pyrus calleryana is a medium-sized white flowering tree native to southeastern Asia. Its seed is spread primarily by birds eating the fruit. It is on invasive lists for organizations in at least 15 states. No escaped callery pear have been reported in EDDMaps for Minnesota to date. As recently as the 1990s research indicated that most callery pear taxa would not be hardy enough to survive Minnesota's most severe winter temperatures but in more recent years the tree inventories for St. Paul and Minneapolis show it has been planted in higher numbers with a significant number of trees surviving to large size. *Pyrus calleryana* taxa are not self-fertile and research has shown that in locations where escaped populations have become established the seed source is the result of different cultivars crossing, or of planted cultivars crossing with established escaped populations. Given that the number of taxa and numbers of trees planted in Minnesota are still quite small relative to areas where the species has become invasive, opportunities for crossing between cultivars is likely very limited or non-existent.

Restricting the sale of and thus the introduction of additional taxa into Minnesota should limit the opportunity for cultivars to produce seed such that the species escapes cultivation in the state. A three-year production phase out would allow nurseries to recover their current investments while moving toward the full restriction of callery pear sales. Minnesota Department of Agriculture may choose to follow their previous process for phase out periods and regulate callery pear as a Specially Regulated Species for three years to highlight that a phase out is in process and that callery pear will be a Restricted Noxious Weed in the year determined by the Minnesota Department of Agriculture. Potential language could be "Three-year production phase-out period, after which sale of this species will be not be allowed and the species will move to the Restricted list in 2026".

References

Calkins, James. 2021. Minnesota Nursery and Landscape Association; personal communication with David Stevenson on 12 April 2021.

Cornell College of Agriculture and Life Sciences. 2021. Department of Animal Science - Plants Poisonous to Livestock. <https://poisonousplants.ansci.cornell.edu/php/plants.php?action=faqs&num=217>. Accessed 25 February 2021.

Culley, T.M. and N.A. Hardiman. 2007. The beginning of a new invasive plant: A history of the ornamental Callery Pear tree in the United States. *BioScience* 57(11):956-964.

eFloras. 2021. *Pyrus calleryana* in Flora of China FOC Vol. 9 page 178. http://www.efloras.org/florataxon.aspx?flora_id=2&taxon_id=200011181. Accessed 25 February 2021.

Hardiman, N.A. and T.M. Culley. 2010. Reproductive success of cultivated *Pyrus calleryana* (Rosaceae) and establishment ability of invasive, hybrid progeny. *American Journal of Botany* 97(10): 1698-1706.

Invasive Plant Atlas of the United States. 2021. Information Page for Callery Pear.
<https://www.invasiveplantatlas.org/subject.html?sub=10957>. Accessed 25 February 2021.

J. Frank Schmidt and Son Company. 2021. JFS Introductions.
<https://www.jfschmidt.com/introductions/chastity/index.html> Accessed 25 June 2021.

McNamara, S. and H. Pellett. 1994. Cold Hardiness of Landscape Pear Taxa. *Journal of Environmental Horticulture*. 12. 227-230. 10.24266/0738-2898-12.4.227.

Minnesota Department of Agriculture. 2021. Cold Hardiness List 2021.
<https://www.mda.state.mn.us/plants-insects/cold-hardiness-list#trees>. Accessed 26 June 2021.

Penn State Extension. 2021. Callery Pear. <https://extension.psu.edu/callery-pear>. Accessed 9 June 2021.

Serota, T. and T.M. Culley. 2019. Seed Germination and Seedling Survival of Invasive Callery Pear (*Pyrus calleryana* Decene.) 11 Years After Fruit Collection. *Castanea* 84(1): 47-52.