

Minnesota Noxious Weed Risk Assessment

Developed by the Minnesota Noxious Weed Advisory Committee

Assessment Information

Common Names: Red Hailstone, Goldencreeper, Golden Creeper, Manchu Tubergourd/Tuber Gourd, Wild Potato)

Scientific Name: *Thladiantha dubia* Bunge (Synonyms - *Gymnopetalum horsfieldii* Miq., *Gymnopetalum piperifolium* Miq., *Thladiantha sparsiflora* E.H.L.Krause)

Family name: Cucurbitaceae

Current reviewer name and organizational affiliation: James Calkins, Minnesota Nursery and Landscape Association

Date of current review: September 29, 2020

Species Description

Photographs



Photo Caption: *Thladiantha dubia* (red hailstone) flowers; Stillwater, MN infestation (Photo Credit: Peter Dziuk; acquired from the [Minnesota Wildflowers website](#); Accessed January 17, 2020).



Photo Caption: *Thladiantha dubia* (red hailstone) leaves; Stillwater, MN infestation (Photo Credit: Katy Chayka; acquired from the [Minnesota Wildflowers website](#); Accessed January 17, 2020).



Photo Caption: *Thladiantha dubia* (red hailstone) tubers; Stillwater, MN infestation (Photo Credit: Katy Chayka; acquired from the [Minnesota Wildflowers website](#); Accessed January 17, 2020).



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Photo Caption: *Thladiantha dubia* (goldencreeper) infestation in Stillwater, MN (Photo Credit: Katy Chayka; acquired from the [Minnesota Wildflowers website](#); Accessed January 17, 2020).



Photo Caption: *Thladiantha dubia* (red hailstone) fruit (Photo Credit: Image acquired from the [Scirpidiella's Plants website](#) [Manchu tubergourd](#) webpage; Accessed March 22, 2020).

Why the Plant is Being Assessed

- Red hailstone (*Thladiantha dubia* Bunge) has been documented with a limited distribution in Minnesota and has been reported in Anoka, Carver, Otter Tail, Sherburne, and Washington County (Stillwater) in Minnesota; the Stillwater population appears to be the largest infestation in the state.
- The primary concern is that the vines are very vigorous and can quickly cover and shade out native vegetation; if male and female plants and suitable pollinators are present, the species can spread by seed and plants can also spread vegetatively via tubers and can form large monocultures that outcompete other species.

Identification, Biology, and Life Cycle

- Red hailstone (*Thladiantha dubia* Bunge) is a member of the Cucurbitaceae (Gourd Family) and is native to eastern Asia. The species is dioecious (male and female flowers produced on separate plants; individual plants male or female); all plants are capable of reproducing vegetatively through tuber production (Burnham 2008-2014).
- A fast growing, herbaceous, perennial, climbing vine, 2-6 meters (6.5-20 feet) in length/height (Burnham 2008-2014).
- Plants pubescent (hooked hairs) with alternate, simple, toothed, broadly cordate (heart-shaped) leaves with a deep, rounded, U-shaped base (sinus) and a slender, stretched-out tip; climb by axillary, unbranched tendrils (Burnham 2008-2014, Ontario Weed Committee 2020).
- Flowers axillary, solitary (staminate flowers solitary or in groups), yellow, actinomorphic (radially symmetrical), campanulate (bell shaped), unisexual, and pubescent with five recurved lobes: July through September in Canada (Burnham 2008-2014).
- Fruits oblong green, yellow-orange, or red, pubescent with many seeds (ovate, black or gray, flat, smooth); 4-5 cm (1.5-2 inches) long and 2.5-5 cm (1-2 inches) wide; botanically classified as berries (Burnham 2008-2014).
- Small, potato-like, perennial tubers produced regularly on underground stems (rhizomes) and function in vegetative reproduction; reportedly the primary method of reproduction in North America because only male plants may be present (Burnham 2008-2014, Ontario Ministry of Agriculture, Food and Rural Affairs 2020, Ontario Weed Committee 2020).
- Plants are reportedly hardy to USDA Cold Hardiness Zone 5/6 (-10 to -20 °F/0 to -10 °F; Dave's Garden 2020, Plants For a Future 2020, Szymański 2017), but are present and persisting in east central Minnesota (Stillwater; Zone 4b, -20 to -25 °F; [Minnesota Wildflowers website](#), Anthony Randazzo-Washington Conservation District/personal communication, and personal observation by James Calkins) and north central Minnesota (Fergus Falls; Zone 4a, -25 to -30 °F; [Early Detection & Distribution Mapping System/EDDMapS](#) and [USDA Plant Hardiness Zone Map 2012](#)) and also reported from St. Lawrence County in northern New York (Zones 4b to 3b, -20 to -35°F; Welby et al. 2020 and [USDA Plant Hardiness Zone Map 2012](#)) and Moscow, Russia (Zone 5a, -15 to -20 °F; Alegro et al. 2010). Most recently, the species has been reported as cold hardy to -40 °C (-40 °F; USDA Cold Hardiness Zone 3a/-35 to -40 °F; Kuluev et al. 2019).
- Grows in full sun to partial shade ([Minnesota Wildflowers website](#)).

Current Distribution

Red hailstone (*Thladiantha dubia*) is native to eastern Asia; southeastern Russia, northeastern China, and the Korean peninsula ([Wikipedia](#) and Kuluev et al. 2019). The reported North American distribution is variable depending on reporting source. Burnham (2008-2014) reported that it had been documented in six states in the United States (Illinois, Massachusetts, Michigan, Minnesota, New Hampshire, New York, and Wisconsin) and

three Canadian provinces (New Brunswick, Ontario, and Quebec). The USDA Natural Resources Conservation Service Plants Database (accessed 3-22-20) indicates the same distribution with the addition of the Canadian province of Manitoba and excluding Michigan and Wisconsin while the Early Detection & Distribution Mapping System (EDDMapS, University of Georgia; accessed 3-22-20) only includes reports from Minnesota, Massachusetts, and Wisconsin. Specific to Ontario, Canada, red hailstone has been reported in scattered locations in southern Ontario by the Ministry of Agriculture, Food and Rural Affairs (2020) and has been described as “spreading through lawns, gardens, along roadsides, in waste places and into cultivated fields.”

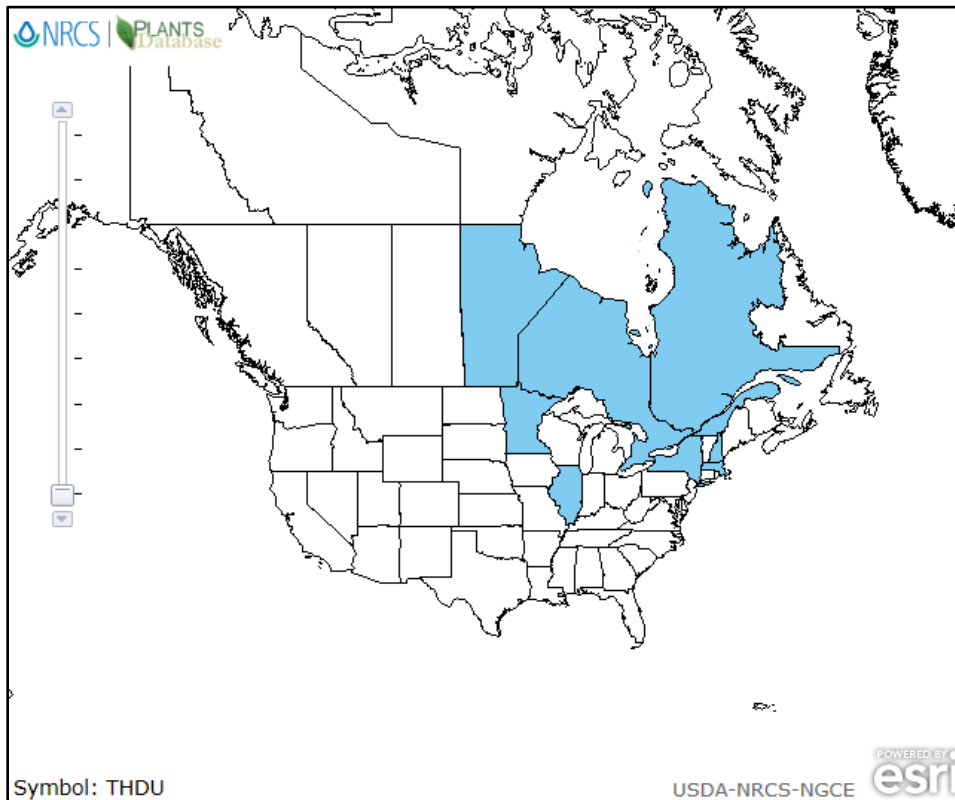


Image Caption: North American distribution of *Thladiantha dubia* (red hailstone) from the [USDA Natural Resources Conservation Service Plants Database](#) based on literature reports showing that red hailstone has been reported in Illinois, Massachusetts, Minnesota, New Hampshire, and New York in the United States and in Manitoba, New Brunswick, Ontario, and Quebec in Canada. Map accessed on March 22, 2020.

More specifically, Red hailstone has been reported in Minnesota (six reports; Anoka County/2 reports, Carver County/1 report, Otter Tail County/1 report, Sherburne County/1 report, and Washington County/1 report), Wisconsin (15 reports; Grant County/14 reports and neighboring Richland County/1 report in the far southwestern corner of the state), and Massachusetts (1 report) on the [Early Detection & Distribution Mapping System \(EDDMapS\) database](#). Reportedly, the red hailstone infestation in Washington County Minnesota (an all-male population) was first reported in 2013 and was thought to be eradicated, but was still present and spreading five years later ([Minnesota Wildflowers website](#)). The Washington County infestation has subsequently been treated with herbicide (triclopyr) in 2018, 2019, and 2020 with good results (Cameron Blake, Washington Conservation District, personal communication via email July 21, 2020; cblake@mnwcd.org).

In addition to these reports, golden creeper was reported as growing “semi-wild” in Cass County in north-central Minnesota by Richard Pohl (Department of Botany and Plant Pathology, Iowa State University) in 1963. This is

the first report of red hailstone in Minnesota and may be the unconfirmed Cass County report that is mentioned on the [Minnesota Wildflowers website](#).

Globally, red hailstone was reportedly introduced in eastern Europe when it was collected, named, and brought to Moscow, Russia, by the Russian botanist Alexander von Bunge and in 1833 where it became a popular garden plant “due to its winter hardiness” (Alegro et al. 2010). Red hailstone was then documented as a botanical specimen in Berlin, Germany, in 1868 and was first reported as an escape in near Berlin and Potsdam in 1884. The species has subsequently been variously reported as a “casual alien species” and an “invasive species” across much of Europe (Alegro et al. 2010, Culita 2007, Kuluev et al. 2019) and in Japan (Mito and Uesugi 2004). It has been specifically reported in floodplain forests in Croatia (Alegro et al 2010).

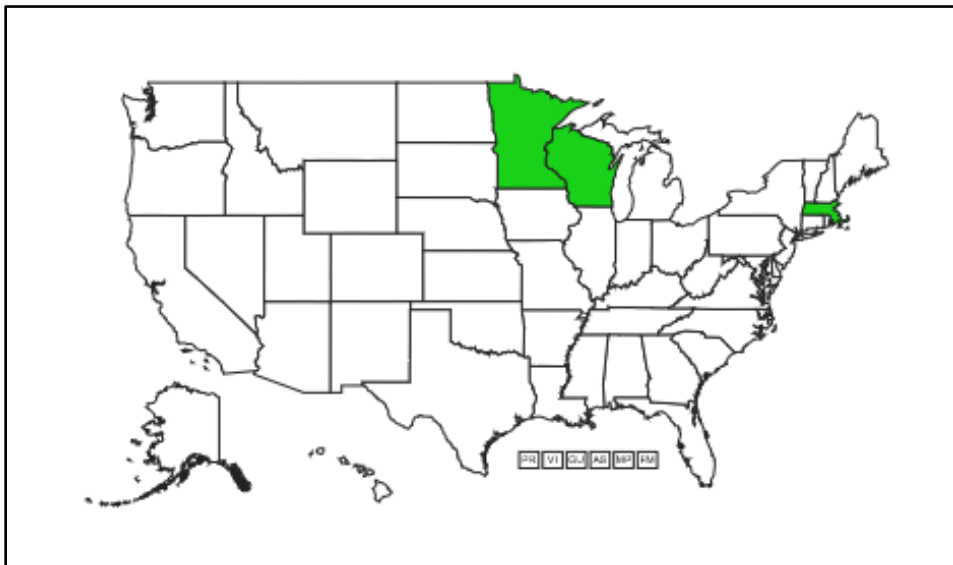


Image Caption: Map showing the distribution of *Thladiantha dubia* (red hailstone) in the United States on a state basis where red hailstone has been reported in Massachusetts, Minnesota, and Wisconsin ([Early Detection & Distribution Mapping System/EDDMapS](#)). Map accessed on March 22, 2020.

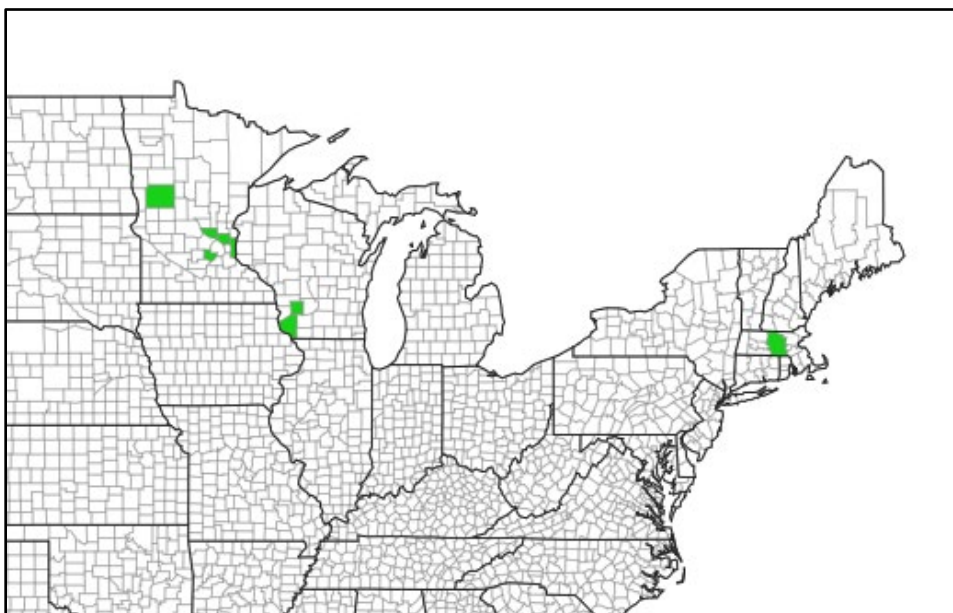


Image Caption: Map showing the distribution of *Thladiantha dubia* (red hailstone) in the United States on a county basis where red hailstone has been reported six times in five counties in central Minnesota, 15 times in two counties in southwestern Wisconsin, and one report in one county in Massachusetts ([Early Detection & Distribution Mapping System/EDDMapS](#)). Map accessed on March 22, 2020.

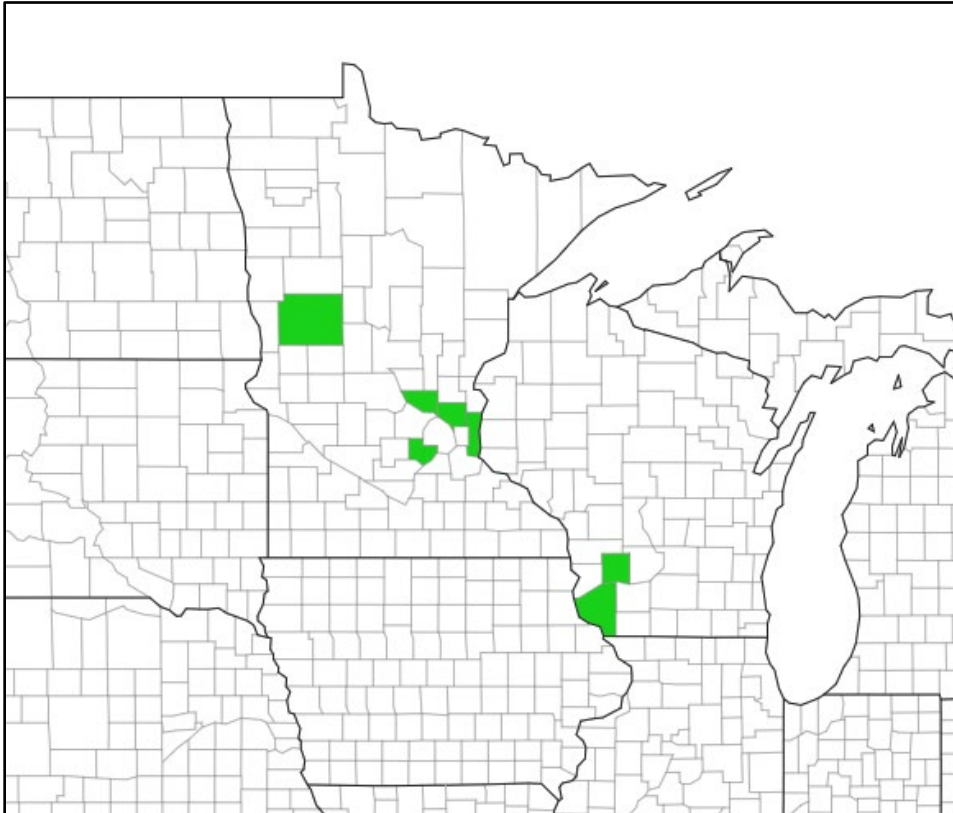


Image Caption: Close-up map showing the distribution of *Thladiantha dubia* (red hailstone) at the county level in Minnesota and Wisconsin; six reports in five counties in central Minnesota and 15 reports in two counties in southwestern Wisconsin ([Early Detection & Distribution Mapping System/EDDMapS](#)). Map accessed on March 22, 2020.

Current Regulation

Red hailstone (*Thladiantha dubia* Bunge) is not currently regulated in Minnesota. No references have been found that indicate the species is regulated in North America, but the species is described on the [Minnesota Wildflowers website](#) as invasive in Stillwater, Washington County, Minnesota.

Risk Assessment

Box 1:

Is the plant species or genotype non-native?

Answer: Yes.

Red hailstone is native to Asia; southeastern Russia, northeastern China, and the Korean peninsula ([Wikipedia](#), Kuluev et al. 2019).

Outcome: Go to Box 3

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?

Answer: Possibly; although red hailstone does not pose a threat to humans or livestock, it has been documented as a problem in agricultural fields in eastern Europe and in southwestern Wisconsin (Kuluev et al. 2019, Leo Roth/Associate Research Specialist, Department of Agronomy, University of Wisconsin – Madison/ personal communication via email on July 21, 2020/nlroth@wisc.edu, and Kelly Kearns/Wisconsin Department of Natural Resources/personal communication via email October 26, 2020/Kely.Kearns@wisconsin.gov). ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.***

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.

Specific information is limited and no records of red hailstone being regulated have been found, but it has been variously reported as an escape in seven states in the United States (Illinois, Massachusetts, Michigan, Minnesota, New Hampshire, New York, and Wisconsin and four Canadian provinces (Manitoba, New Brunswick, Ontario, and Quebec). It has been documented and described as invasive in the city of Stillwater in Washington County, MN ([Minnesota Wildflowers website](#)). The species has also been variously reported as an escape and an invasive species in central and southeastern Europe (Alegro et al. 2010, Culita 2007, Kuluev et al. 2019) and Japan (Mito and Uesugi 2004).

Outcome: Go to Box 6

Box 4:

Are the species' life history & growth requirements sufficiently understood?

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

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.

Red hailstone has been documented outside of cultivation in Minnesota; the species has been reported in five counties in Minnesota, two counties in Wisconsin, and one county in Massachusetts on the [Early Detection & Distribution Mapping System \(EDDMapS\) database](#) (Accessed 3-22-20). There have been six reports in Minnesota where it has been found in Anoka County (2 reports near Linwood and Martin Lake), Carver County (1 report near Watertown), Otter Tail County (1 report near Fergus Falls), Sherburne County (1 report near Zimmerman), and Washington County (1 report in Stillwater; known to be a persistent population since at least 2013). There have been 15 reports in Wisconsin where it has been found in two neighboring counties in the southwestern corner of the state – Richland County (1 report near Gotham along the Pine River just upstream from its confluence with the Wisconsin River) and Grant County (14 reports along the Big Green River between its confluence with the Wisconsin River and the town of Werley. There has also been one report in Polk County in northwestern Wisconsin and several reports in Waukesha County in southeastern Wisconsin, but these reports have not yet been reported to EDDMapS (Ward and Green 2019). More recently, red hailstone has also been documented on two urban/residential sites in Dane County, WI (Madison), where it is spreading from one yard to another, but these plants are in managed landscapes and are not escaped populations (Kelly Kearns; Wisconsin Department of Natural Resources, Kelly.Kearns@wisconsin.gov – personal communication via email on October 26, 2020). Massachusetts has had 1 report. No information regarding the origins of these plants/infestations has been found. The area along the Big Green River in southwestern Wisconsin was surveyed again in August 2020 with the following observations: red hailstone has spread into farm fields adjacent to the infested areas along the river corridor where it appears it is being spread by farm machinery, red hailstone appears to be controlled in areas grazed by cattle, and only male plants were found (male flowers only; no female flowers or fruits were observed) (Kelly Kearns; Wisconsin Department of Natural Resources, Kelly.Kearns@wisconsin.gov – personal communication via email on October 26, 2020).

Outcome: Go to Box 7

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.***

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.

Although the species has apparently been planted in designed landscapes in Europe, Asia, and North America (limited), and other locations for its yellow flowers and showy edible fruits, no documentation that named cultivars exist has been found.

Outcome: Go to Question 7B; also answer Question 7J

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

Answer: Yes.

The species is dioecious (individual plants male or female) and only female plants produce fruits and seeds, but both male and female plants reproduce and spread vegetatively through the production of tubers along spreading rhizomes (Burnham 2008-2014). Tubers float and can move along waterways (Minnesota Wildflowers website).

Outcome: Go to Question 7C

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

Answer: Yes (suspected, but only limited information found).

Asexual propagules (tubers) are produced, but limited information was found regarding dispersal to new areas; assume movement with soil (erosion and human mediated); tubers float and can move along waterways (Minnesota Wildflowers website); it is interesting that reported plants are dispersed along a stream in Wisconsin (Big Green River) which may be a consequence of the movement and the dispersal of vegetative propagules (tubers and rhizome pieces) via erosion along stream corridors is suspected as a potential pathway for spread (Leo Roth, Associate Research Specialist, Mark Renz Weed Lab/ <https://renzweeds.cals.wisc.edu/>, Department of Agronomy, University of Wisconsin – Madison; personal communication via email on July 21, 2020; nlroth@wisc.edu); infestations have been found along a fence line and in corn/soybean fields in southwestern Wisconsin and it is suspected that plants have been spread by cultivation in these areas and local farmers have reported that cultivation and registered agricultural herbicides have not been effective in controlling red hailstone (Leo Roth; personal communication via email on July 21, 2020); red hailstone has been described as having the “ability to rapidly reproduce by underground tubers,” including “small pieces of tubers,” and as a “weed with high invasive potential” in one reference (Kuluev et al. 2019).

Outcome: Go to Question 7I (Given that the “Yes” answer to this question is based on limited information, if the question was answered “No” instead of “Yes” the risk assessment would direct to Questions 7D-7H and based on the answers to those questions, the assessment would still direct to Question 7I. Answers to Questions 7D-7H are provided in the risk assessment.)

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

Answer: No; probably not in Minnesota, but not known for sure

Thus far only male plants have been documented in Minnesota and seed production has not been documented in Minnesota or Wisconsin. Peak flowering has been reported to typically occur in southwestern Wisconsin (specifically along the Big Green River) from about the middle of August to the middle of September (Eddie Shea/Eddie.Shea@wisconsin.gov, Wisconsin Department of Natural Resources; personal communication via email on July 3, 2020). Red hailstone is pollinated by insects, specifically wild bees (*Ctenoplectra* spp.) that are believed to have co-evolved with *Thladiantha* spp.) where native. Supposedly insect pollination does not occur in Europe and North America where these bees are not present, and the native insects do not visit the flowers because the female flowers produce an oil instead of nectar (Alegro et al. 2010). Female plants can form small, seedless fruits without pollination. In the non-native range, fruits with seeds are not produced unless pollinated by hand. When pollinated, 40-100 small, black seeds are typically produced in each fruit (Szymański 2017). ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.***

Outcome: Decision tree does not direct to this question.

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)?

Answer: No; seeds probably not produced in Minnesota.

Reportedly, few fruits and no seeds are produced in North America in response to a lack of suitable pollinators (see answer to Question 7D; Szymański 2017). ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.***

Outcome: Decision tree does not direct to this question.

Question 7F: Is the plant self-fertile?

Answer: No.

The species is dioecious (individual plants male or female) and plants are, therefore, not self-fertile (Burnham 2008-2014). ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.***

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: No; seeds probably not produced in Minnesota

Reportedly, few fruits and no seeds are produced in North America in response to a lack of suitable pollinators (see answer to Question 7D; Szymański 2017). ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.***

Outcome: Decision tree does not direct to this question.

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: No.

No specific information on the potential for hybridization with other species has been found, but red hailstone is insect pollinated and is not believed to be pollinated by Minnesota insects (see answer to Question 7D; Szymański 2017). Members of the Cucurbitaceae that are native to Minnesota include *Echinocystis lobata* (wild cucumber) and *Sicyos angulatus* (bur cucumber). ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.***

Outcome: Decision tree does not direct to this question.

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

Answer: No (no information/documentation found).

No specific information found, but other cold hardy cucurbits, including native species, survive and spread and there have been no reports of negative impacts or control by native (or non-native) species.

Outcome: Go to Box 8

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; in this case, Go to Box 8 (Outcome for Question 71)
There are no cultivars that differ in reproductive capacity compared to the species; no documentation that named cultivars exist has been found.

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.

No information about toxicity to wildlife or livestock found. Young shoots (cooked), ripe fruits (raw, cooked), and tubers are edible (Burnham 2008-2014, Szymański 2017).

Outcome: Go Question 8B

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

Answer: Yes.

Red hailstone has been reported as a serious weed in vegetable gardens as a result of reproduction from tubers and tuber pieces (Kuluev et al. 2019) and it has been advised that “all necessary measures should be taken to exclude” it from “agroecosystems” in the Republic of Bashkortosan in east European Russia for the same reason and because it is difficult to eradicate (Kuluev et al. 2019). It has also been reported to significantly reduce corn yields in Austria (Kuluev et al. 2019). A single plant can cover an area of about 10-12 m² (108-129 ft²) within a few years (Kuluev et al. 2019). Infestations in agricultural fields that have proven to be difficult to control have also been reported in southwestern Wisconsin (Leo Roth, Associate Research Specialist, Mark Renz Weed Lab/ <https://renzweedsience.cals.wisc.edu/>, Department of Agronomy, University of Wisconsin – Madison; personal communication via email on July 21, 2020; nlroth@wisc.edu).

Outcome: Go to Box 9

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

Answer: Yes.

Displacement of native species has been documented (Kuluev et al. 2019, Minnesota Wildflowers website, Eddie Shea/Wisconsin Department of Natural Resources/personal communication via email on July 16, 2020/eddie.shea@wisconsin.gov, Kelly Kearns/Wisconsin Department of Natural Resources//personal communication via email October 26, 2020/Kelly.Kearns@wisconsin.gov, personal observations of the Stillwater infestation) and red hailstone infestations in woodlands have been described as “kudzu-like, covering much of the ground and climbing 20 feet or more into the trees” (Southeastern Wisconsin Invasive Species Consortium 2018); no information found regarding allelopathic effects. ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.***

Outcome: Decision tree does not direct to this question.

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

Answer: Unknown, but probably No.

No specific information on the potential for hybridization with other species found, but insect pollinated and not believed to be pollinated by Minnesota insects (see answer to Question 7D; Szymański 2017). Members of the Cucurbitaceae that are native to Minnesota include *Echinocystis lobata* (wild cucumber) and *Sicyos angulatus* (bur cucumber). ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.***

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.)?

Answer: Yes.

Based on images included with infestation reports and reports from the Wisconsin Department of Natural Resources (WI DNR), the vines climb trees and completely cover shorter vegetation ([Minnesota Wildflowers website](#), Alegro et al. 2010, Eddie Shea/Wisconsin Department of Natural Resources/personal communication via email on July 16, 2020/eddie.shea@wisconsin.gov). ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.***

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?

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

Outcome: Decision tree does not direct to this question.

Box 9: (Regardless of pathway, the decision tree directs to 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.

Thladiantha dubia is not native to Minnesota (see Box 1) and based on independent research by the author and the results of a MDA/MNLA nursery and landscape industry survey conducted in September and October 2020 is not being produced or sold in Minnesota. Seed can be purchased online which could result in outcrossing and seed production if a mixed population of male and female plants becomes established (so far, only male populations have been documented in North America) and if suitable pollinators were present, but compatible pollinators are not believed to be present outside the native range (suitable pollinators are not believed to be present in Europe or North America).

Outcome: Go to Box 10

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: Possibly, but probably not.

Thladiantha dubia is difficult to control as a consequence of reproduction from tubers (Kuluev et al. 2019). Control via cultivation and registered agricultural herbicides has not been effective in agricultural fields in

southwestern Wisconsin (Leo Roth/nlroth2@wisc.edu, Associate Research Specialist, Mark Renz Weed Lab/<https://renzweedsience.cals.wisc.edu/>, Department of Agronomy, University of Wisconsin – Madison; personal communication via email on July 21, 2020), but a preliminary greenhouse study (2019) has indicated that imazapyr (Arsenal Powerline, 32 ounces/acre; 16 ounces/acre did not provide good control) and metsulfuron (Escort XP, 3 ounces/acre) provided complete control (Leo Roth, personal communication via email on July 21, 2020; Roth and Renz 2019). In a field study initiated in 2019, summer (August 20) and fall (October 7) applications of glyphosate (Roundup PowerMax), metsulfuron (Escort XP), triclopyr (Garlon 4), and aminocyclopyrachlor (Method 240SL) provided 85-100% control of aboveground growth; follow-up data on resprouting in 2020 has not been completed (Leo Roth, Mark Renz Weed Lab/<https://renzweedsience.cals.wisc.edu/>; personal communication via email on July 21, 2020). ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.***
Outcome: Decision tree does not direct to this question.

Question 9C: Is the plant native to Minnesota?

Answer: No.

Red hailstone is not native to Minnesota; see Box 1. ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.***

Outcome: Decision tree does not direct to this question.

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.

Potential alternatives:

- Clematis (*Clematis* spp.; native and introduced vines and shrubs)
- Wild Cucumber (*Echinocystis lobata*, native annual vine)
- Bur Cucumber (*Sicyos angulatus*, native annual vine)
- Other species from the Gourd Family (Cucurbitaceae)– *Citrullus* spp. (watermelon and others), *Cucumis* spp. (cucumber, muskmelons, and others), *Cucurbita* spp. (squash, pumpkin, zucchini, some gourds), *Lagenaria* spp. (calabash/bottle gourd and others), and *Momordica* spp. (bitter melon and others).

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

Outcome: Decision tree does not direct to this question.

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

Answer: No.

Rarely planted and the benefits do not benefit Minnesota more than the negative impacts on agriculture and native ecosystems. ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.***

Outcome: Decision tree does not direct to this question.

Box 10:

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

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

Answer: Yes.

An established population is present in Stillwater, Minnesota ([Minnesota Wildflowers website](#), EDDMaps).

Outcome: Go to Question 10D

Question 10B: Would prohibiting this species in trade prevent the likelihood of introduction and/or establishment?

Answer: Yes/Possibly (but maybe not).

Although no documentation that red hailstone is sold by Minnesota nurseries or seed suppliers has been found, it is suspected that the Minnesota infestations have resulted from escapes from ornamental or food plantings, but the origin of these plants are unknown (possibly online sources which are difficult to regulate). ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.***

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?

Answer: Yes.

Thladiantha dubia has the potential to cause harm to agriculture and native ecosystems and the established populations in Minnesota that are known are small (see earlier distribution questions). ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.***

Outcome: Decision tree does not direct to this question.

Question 10D: Does the plant pose a serious human health threat?

Answer: No.

Young shoots (cooked), ripe fruits (raw, cooked), and tubers are edible (Burnham 2008-2014, Szymański 2017).

Outcome: Go to 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?

Answer: No.

Thladiantha dubia does not pose a serious health threat. ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.***

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 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: Yes.

If established, *Thladiantha dubia* can cause significant ecological and economic harm and because its distribution in Minnesota is currently limited (see the reported distribution on the [Early Detection & Distribution Mapping System/\(EDDMapS database\)](#)). Given that red hailstone can propagate from tubers and tuber pieces, cultivation is not recommended as a management practice. Systemic herbicides applied in late summer early fall (likely with repeated applications) would be the likely choice as an eradication tool, but limited research has been done and limited information about controlling red hailstone with herbicides is available at this time. Research and control efforts are, however, ongoing. A preliminary greenhouse study (2019) has indicated that imazapyr (Arsenal Powerline, 32 ounces/acre; 16 ounces/acre did not provide good control) and metsulfuron (Escort XP, 3 ounces/acre) provided complete control (Leo Roth/nlroth@wisc.edu, Mark Renz Weed Lab/<https://renzweeds.cals.wisc.edu/>; personal communication via email on July 21, 2020). A field study initiated in 2019, summer (August 20) and fall (October 7) applications of glyphosate (Roundup PowerMax), metsulfuron (Escort XP), triclopyr (Garlon 4), and aminocyclopyrachlor (Method 240SL) provided 85-100% control of aboveground growth; follow-up data on resprouting in 2020 has not been completed (Leo Roth/nlroth@wisc.edu, Mark Renz Weed Lab/<https://renzweeds.cals.wisc.edu/>; personal communication via email on July 21, 2020). In addition, the red hailstone infestation in Stillwater, MN (Mulberry Ravine) has been treated (2018, 2019, and during the third week of July 2020) with triclopyr (Garlon 3A; 3%; treatment area is near a stream) with promising results, but follow-up treatments will still be needed.

Outcome: **LIST THE PLANT, red hailstone (*Thladiantha dubia*), AS A PROHIBITED / ERADICATE NOXIOUS WEED** and there are no named cultivars that merit exemption from this listing.

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: Unknown; distribution is currently limited). **This information is supplemental and is not part of the flow chart pathway for this risk assessment.**

Outcome: Decision tree does not direct to this question.

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.

Red hailstone is not known to be grown or sold by Minnesota nurseries or garden centers, but populations have become established; in short, the source of the existing populations is unknown. Seed is available through the internet, but planting from seed should result in male and female plants within the resulting populations which has not been reported (only male plants have been observed and reported, but whether only male plants are present in Minnesota is becoming a focus of more recent surveys in an attempt to answer this question.

Whether pollination would occur if both male and female plants were present is also somewhat of an unknown that needs to be confirmed; it has been suggested that suitable pollinators are not present in North America including Minnesota. ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.***

Outcome: Decision tree does not direct to this question.

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?

Answer: Possibly.

If the sources of known populations could be determined, if only male plants were allowed to be planted, and if management requirements were developed for intentional plantings and those requirements were effectively enforced. Lots of “ifs” and this would not be easy. ***This information is supplemental and is not part of the flow chart pathway for this risk assessment.***

Outcome: Decision tree does not direct to this question.

Box 11:

The plant is being proposed to be designated as a Specially Regulated Plant. What are the specific regulations proposed?

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

Outcome: Decision tree does not direct to this question.

Final Recommendations of Risk Assessment (2020)

NWAC Listing Subcommittee

Outcome: List red hailstone (*Thladiantha dubia*) as a Prohibited Eradicate Noxious Weed.

Comments: The distribution of red hailstone is currently limited in Minnesota, establishment and spread in riparian habitats is a concern and controlling invasive species in such habitats can be difficult, and now is the time to act to prevent further spread. Unlike a restricted listing, listing red hailstone as a prohibited species will also allow for the detection and removal of plants from private land which has been problematic for land managers because it can hamper detection and management activities.

NWAC Full Committee

Outcome: List red hailstone (*Thladiantha dubia*) as a Prohibited Eradicate Noxious Weed.

Comments: Vote was 14-1 on the recommendation to list.

MDA Commissioner

Outcome: List red hailstone (*Thladiantha dubia*) as a Prohibited Eradicate Noxious Weed.

Comments: No comments.

Risk Assessment Summary (04-26-2021)

- *Thladiantha dubia* (red hailstone) is a non-native species that has been introduced to Minnesota and has proven to be cold hardy to at least USDA Cold Hardiness Zone 4 (and possibly Zone 3) in Minnesota and has become established in at least two locations in the state.
- Red hailstone reproduces by seed and vegetatively via tubers produced along rhizomes, but only male plants have been documented in Minnesota and Wisconsin at this time so seed production is not known to occur. The production of underground tubers makes the species difficult to control once established and red hailstone has the potential to become a serious agricultural weed and to damage native ecosystems and impact agricultural production in Minnesota.
- Preliminary research and control efforts indicate that several herbicides may be effective in controlling red hailstone; research is ongoing.
- Given the potential threat posed to agriculture and native ecosystems in Minnesota and the limited distribution of *Thladiantha dubia* in Minnesota, the species should be listed as a Prohibited/Eradicate Noxious Weed with the goal of eradicating the species from the state and preventing the spread of the species to new locations and the establishment of new infestations.
- A commissioner's order to list red hailstone as a Prohibited Eradicate Noxious Weed was signed on 04/26/2021. The species will be added to the Minnesota Noxious Weed List on 01/01/2023.

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Appendix (Additional photos of red hailstone).



Photo Caption: Selected pictures of the Stillwater (Mulberry Ravine), Minnesota, infestation of *Thladiantha dubia* (goldencreeper), July 3, 2020 (Photo Credits: James Calkins; Minnesota Nursery and Landscape Association).

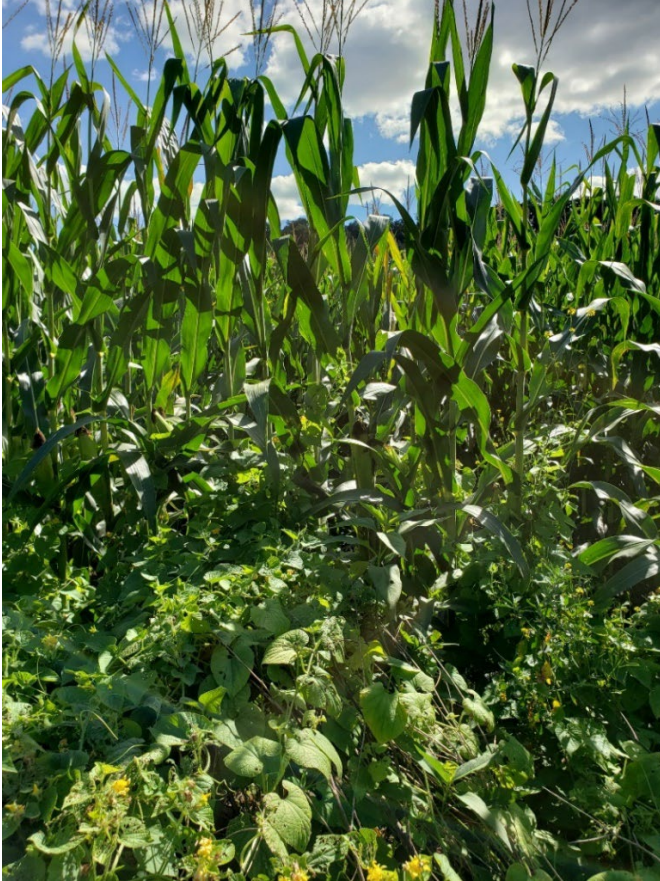


Photo Caption: Red hailstone (*Thladiantha dubia*) growing in a corn field in southwestern Wisconsin (Grant County); August 2020 (Photo Credit: Kelly Kearns; Wisconsin Department of Natural Resources).



Photo Caption: An infestation of red hailstone (*Thladiantha dubia*) in a woodland setting in Waukesha County in southeastern Wisconsin; August 2020 (Photo Credit: Kelly Kearns; Wisconsin Department of Natural Resources).