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| MN NWAC Risk Assessment Worksheet (04-2011) | Common Name | Latin Name |
| | Japanese barberry | <i>Berberis thunbergii</i> DC. |
| Reviewer | Affiliation/Organization | Date (mm/dd/yyyy) |
| Laura Van Riper | Minnesota Department of Natural Resources | 8/15/2013 |
| Tim Power | MN Nursery and Landscape Association | |

| Box | Question | Answer | Outcome |
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| 1 | Is the plant species or genotype non-native? | <p>Yes, it is non-native.</p> <p>USDA PLANTS database (http://plants.usda.gov/java/profile?symbol=BETH)</p> <p>Native to Japan (http://www.na.fs.fed.us/fhp/invasive_plants/weeds/japanese-barberry.pdf)</p> <p>Native to central and southern Japan (Ohwi 1965)</p> | Go to box 3 |
| 3 | Is the plant species, or a related species, documented as being a problem elsewhere? | <p>Yes.</p> <p>Japanese barberry considered invasive by:</p> <p>US Forest Service, Eastern Region categorizes as a Category 1 Plant - highly invasive, defined as: These plants are all non-native, highly invasive plants which invade natural habitats and replace native species. http://www.fs.fed.us/r9/wildlife/range/weed/Sec3B.htm</p> <p>Massachusetts: Prohibited plant in MA (The importation, sale, and trade of the prohibited plants is banned. This ban also covers the purchase and distribution of these plants and related activities.) http://www.mass.gov/agr/farmproducts/prohibitedplantlist.htm</p> <p>New Hampshire: Prohibited invasive plant in NH http://www.nh.gov/agric/divisions/plant_industry/documents/list.pdf</p> <p>Connecticut: Invasive, but not banned. http://www.hort.uconn.edu/cipwg/pdfs/invplantsCT2010commonname.pdf</p> <p>Voluntary phase out of 25 cultivars by the Connecticut Nursery and Landscape Association http://www.flowersplantsinct.com/invasive_index.htm</p> | Go to box 6 |

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| | | <p>Indiana Invasive Plant Species Assessment Work Group recommendation – do not buy, sell, or plant Japanese barberry in Indiana. http://www.in.gov/dnr/files/Official_Japanese_Barberry_Assessment.pdf</p> <p>Wisconsin Department of Natural Resources http://dnr.wi.gov/invasives/fact/barberry.htm</p> <p>Naturalized in more than 30 states and 2 Canadian provinces (http://plants.usda.gov/java/profile?symbol=BETH)</p> <p>Maine http://www.maine.gov/doc/mfs/pubs/pdf/fpminfo/7_invasives.pdf http://www.umext.maine.edu/onlinepubs/pdfpubs/2504.pdf</p> | |
| 6 | Does the plant species have the capacity to establish and survive in Minnesota? | Yes from 6A. | Go to box 7 |
| | A. Is the plant, or a close relative, currently established in Minnesota? | <p>Yes. Japanese barberry is known to establish and survive in Minnesota. It is widely planted in landscapes. It is also known to escape and naturalize. Examples of naturalized sites in MN include mapped sites on USDA Plants: http://plants.usda.gov/java/county?state_name=Minnesota&statefips=27&symbol=BETH and EDDMaps (includes sites mapped on MN DNR lands): http://www.eddmaps.org/google/index.cfm?sub=3010 and the US Forest Service records Japanese barberry on their lands in MN http://www.nrs.fs.fed.us/pubs/jrnl/2009/nrs_2009_moser_002.pdf Japanese barberry does well in hardiness zones 4 through 9 (Lehrer et al. 2006a), this covers much of Minnesota with the exception of the northern portion of the state.</p> | Go to box 7 |
| 7 | Does the plant species have the potential to reproduce and spread in Minnesota? | Yes. | Go to Box 8 |

| Box | Question | Answer | Outcome |
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| | A. Does the plant reproduce by asexual/vegetative means? | Yes. Can spread by creeping roots. Branches root when they touch the ground. (Czarapata 2005) | Go to 7B. |
| | B. Are the asexual propagules effectively dispersed to new areas? | No. Vegetative spread is local and is not part of dispersing to new areas (Czarapata 2005). | Go to 7C. |
| | C. Does the plant produce large amounts of viable, cold-hardy seeds? | Yes. Seeds are a primary form of recruitment (Ehrenfeld 1999). Seed production can vary by cultivar (Lehrer et al. 2006a and b). | Go to 7F |
| | D. If this species produces low numbers of viable seeds, does it have a high level of seed/seedling vigor or do the seeds remain viable for an extended period? | | |
| | E. Is this species self-fertile? | | |
| | F. Are sexual propagules – viable seeds – effectively dispersed to new areas? | Yes. Seeds are in small berries which are eaten by birds and rabbits that disperse seeds. (Czarapata 2005, Silander and Klepeis 1999). Mule deer, white-tail deer, turkeys, and grouse can be agents of long-distance seed dispersal (Ehrenfeld 1997). | Go to Box 7I |
| | G. Can the species hybridize with native species (or other introduced species) and produce viable seed and fertile offspring in the absence of human intervention? | Yes. Can hybridize with non-native common barberry (<i>Berberis vulgaris</i>) (Silander and Klepeis 1999). Common barberry has been widely eradicated as it is a host to wheat rust. A new study indicates that this hybrid is relatively widespread in the wild in Connecticut and Massachusetts and that those hybrid plants are capable of producing some viable seed and pollen (Connolly et al. 2013). | |

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| | H. If the species is a woody (trees, shrubs, and woody vines) is the juvenile period less than or equal to 5 years for tree species or 3 years for shrubs and vines? | Yes. Three years after field planting of 2-year-old container-grown nursery plants in a Connecticut study, fruit counts varied by cultivar from zero to nearly 10,000 per plant (Brand, Lehrer and Lubell 2012). | |
| | I. Do natural controls exist, species native to Minnesota, that are documented to effectively prevent the spread of the plant in question? | No. Found no literature documenting natural controls. Not palatable to deer, so does well in areas of high deer density (Silander and Klepeis 1999). The North American native lepidopteran <i>Coryphista meadii</i> (barberry geometer) has been observed to defoliate new shoots of Japanese barberry (not leaves on older stems), but it unclear if it impacts barberry on a population level (Ehrenfeld 2009). | Go to Box 8 |
| 8 | Does the plant species pose significant human or livestock concerns or has the potential to significantly harm agricultural production, native ecosystems, or managed landscapes? | Yes. | Go to Box 9 |
| | A. Does the plant have toxic qualities, or other detrimental qualities, that pose a significant risk to livestock, wildlife, or people? | No. No information found that documents this. | Go to 8B |
| | B. Does, or could, the plant cause significant financial losses associated with decreased yields, reduced crop quality, or increased production costs? | No. No information found that documents this. | Go to 8C |

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| | C. Can the plant aggressively displace native species through competition (including allelopathic effects)? | Yes. Forms dense thickets, according to studies on the Eastern seaboard (Silander and Klepis 1999, Harrington et. al. 2006) and MN DNR observations in MN. No mention found of allelopathy. | Go to Box 9 |
| | D. Can the plant hybridize with native species resulting in a modified gene pool and potentially negative impacts on native populations? | No. No information found that documents this. | |
| | E. Does the plant have the potential to change native ecosystems (adds a vegetative layer, affects ground or surface water levels, etc.)? | Yes. Soil under Japanese barberry has higher pH and higher nitrogen (higher nitrification and mineralization rates) than soils under a common native shrub (Ehrenfeld et al. 2001). Greenhouse studies showed that Japanese barberry leaf litter was higher in nitrogen than native species and decomposed more rapidly (Ehrenfeld et al. 2001). Soils under Japanese barberry also differ in microbial community structure and function from that under a native shrub (Kourtev et al. 2002). Altering soil functions in an ecosystem could have ecosystem level effects (Ehrenfeld et al. 2001). Additionally, the timing of nutrient uptake and deposition differs from native species, also contributing to ecosystem level changes (Ehrenfeld et al. 2001, Ehrenfeld 2004). Ehrenfeld et al. (2001) note that while densities of Japanese barberry start out low, over time they alter the soil to be higher in nutrients, which then makes the site more favorable for additional Japanese barberry plants, leading to dense populations and altered soil over time. Cassidy et al. (2004) found that Japanese barberry does better in sites with higher nitrogen. | If Yes, go to box 9. If No, go to 8F. |
| | F. Does the plant have the potential to introduce or harbor another pest or serve as an alternate host? | This has not been documented, but there is some concern. Common barberry (<i>Berberis vulgaris</i>) has been widely eradicated as it serves as a host to wheat rust. Japanese barberry is not a host of wheat rust. However, Connolly et al. (2013) note that <i>Berberis</i> × <i>ottawensis</i> (<i>B. thunbergii</i> × <i>B. vulgaris</i>) is relatively common in the wild in Connecticut and Massachusetts and that those hybrid plants are capable of producing some viable seed and pollen. There is an emerging wheat rust (first documented in Uganda in 1999) called Ug99. There is great concern that if this rust strain reaches North America it would cause | If Yes, go to box 9. If No, then this species is not currently believed to be a risk. |

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| | | <p>extensive damage to US crops and cause millions/billions in crop losses. At this time there is no evidence that Japanese barberry can serve as a host to the stem rust fungus Ug99. Because other barberries are hosts and Japanese barberry and all its cultivars haven't been tested, Canada is not allowing additional Japanese cultivars into Canada except for the ones that are already on its approved list.</p> <p>Additionally, research is underway at the University of Minnesota examining potential hosts of rusts of rye grasses (<i>Lolium</i>) and it may include Japanese barberry.</p> | |
| 9 | Does the plant species have clearly defined benefits that outweigh associated negative impacts? | See discussion in sub-boxes below. After weighing information available, it is recommended that regulation as a Specially Regulated Plant is more appropriate than regulation as a Prohibited or Restricted Noxious Weed. | Go to Box 11 |
| | A. Is the plant currently being used or produced and/or sold in Minnesota or native to Minnesota? | Yes. Japanese barberry is produced and sold in the horticulture industry in Minnesota. It is considered a staple in the industry because of its unique colors, forms, toughness and deer resistance. A single Minnesota wholesale grower produces and sells 100,000+ Japanese barberry plants nationwide. A 2011 poll by the Minnesota Nursery and Landscape Association (MNLA) showed the most popular cultivars in Minnesota to be 'Crimson Pygmy', 'Rose Glow', 'Concorde' (may be a selection of <i>B. × ottawensis</i> ; <i>B. thunbergii</i> × <i>B. vulgaris</i>), 'Bailtwo' (Burgundy Carousel®), 'Helmond Pillar', 'Tara' (a selection of <i>B. thunbergii</i> × <i>B. koreana</i> ; Emerald Carousel®), 'Baisel' (Golden Carousel®), 'Bailone' (Ruby Carousel®), 'Gentry' (Royal Burgundy®), 'Kobold', 'Monlers' (a selection of <i>B. thunbergii</i> × <i>B. koreana</i> ; Golden Nugget™) and 'Moreti Select' (Cabernet®), in that order. | Go to 9B. |

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| | B. 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? | <p>The spread of Japanese barberry cannot be easily prevented or controlled once it is introduced. Offspring of cultivars (such as purple- or yellow-leaved forms) can be green, making it difficult to tell phenologically which cultivar was a parent to a naturalized barberry plant (Lehrer et al. 2006c). Use of genetic markers through tools such as amplified fragment length polymorphism (AFLP) can identify feral barberry parents (Lubbell et al. 2008). Though cultivar influence in invasive populations of Japanese barberry was shown via AFLP to be small, it was present and therefore important (Lubbell and Brand 2008).</p> <p>Japanese barberry cultivars with low or no seed production are likely to be less invasive (Brand 2013), though Knight et al. (2011) note that large changes in fecundity result in relatively small changes to the population growth rates of long-lived species like Japanese barberry. This question comes down to whether a plant needs to be “safer” or “safe” in order to have its “negative impacts minimized....”</p> <p>It is difficult to control the spread of woody species once they are widely distributed. Methods for Japanese barberry control are similar to those for buckthorn or other woody invasives – very time and labor intensive. Management includes applying glyphosate to Japanese barberry during early spring leafout (Silander and Klepeis 1999). Silander and Klepeis (1999) recommend control of small, newly expanding populations as the most effective landscape-level control.</p> | <p>If Yes, go to Box 11.</p> <p>If No, go to Box 9C.</p> |
| | C. Is the plant native to Minnesota? | No. Plant is native to Asia. | Go to 9D |
| | D. Is a non-invasive, alternative plant material commercially available that could serve the same purpose as the plant of concern? | <p>Brand (2013) reports that long-term observation is necessary to ensure sterility or extremely low seed counts in new Japanese barberry crosses, and that his sterility trials now reflect ten years of research. See box 9B for further discussion.</p> <p>Alternatives suggested on various websites (these may not all be appropriate for MN): MN Department of Natural Resources http://www.dnr.state.mn.us/invasives/terrestrialplants/woody/japanesebarberry.html <i>Dirca palustris</i> (Leatherwood), <i>Viburnum rafinesquianum</i> (Downy Arrowwood), <i>Corylus americana</i> (American Hazel), and <i>Corylus cornuta</i> (Beaked Hazel).</p> | <p>If Yes, go to Box 10.</p> <p>If No, go to 9E.</p> |

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| | | <p>Midwest Invasive Plant Network http://www.mipn.org/MIPN%20redraft2.pdf <i>Tilia cordata</i> (Littleleaf Linden), <i>Buxus</i> spp. (Boxwood ‘Glencoe’/Chicagoland Green® or ‘Green Velvet’), <i>Ribes alpinum</i> ‘Green Mound’ (Alpine Currant), <i>Fothergilla major</i> (Large Fothergilla), <i>Cotoneaster divaricatus</i> (Spreading Cotoneaster), <i>Ilex verticillata</i> (Winterberry), <i>Rosa rubrifolia</i> (Redleaf Rose), <i>Rosa</i> ‘Radrazz’ and others (Knock Out® Roses), <i>Cotinus coggygria</i> (Common Smokebush), <i>Physocarpus opulifolius</i> ‘Monlo’, ‘Seward’, ‘Mindia’, and ‘Center Glow’ (Diablo®, Summer Wine®, Coppertina™, and ‘Center Glow’ Common Ninebark), and <i>Weigela florida</i> ‘Alexandra’ (Wine & Roses® Weigela).</p> <p>National Park Service http://www.nps.gov/plants/alien/fact/beth1.htm <i>Myrica pensylvanica</i> (Northern Bayberry), <i>Ilex glabra</i> (Inkberry), <i>Ilex verticillata</i> (Winterberry), <i>Viburnum dentatum</i> (Arrowwood Viburnum), <i>Kalmia latifolia</i> (Mountain Laurel), <i>Physocarpus opulifolius</i> (Common Ninebark), and <i>Euonymus americanus</i> (Strawberry Bush).</p> <p>City of Chicago http://www.cityofchicago.org/city/en/depts/oc/supp_info/invasive_species.html <i>Physocarpus opulifolius</i> (Common Ninebark), <i>Ribes odoratum</i> (Clove Currant), and <i>Buxus</i> spp. (Boxwood).</p> <p>Connecticut Agricultural Experiment Station http://www.ct.gov/caes/lib/caes/documents/special_features/nativealternatives.pdf <i>Myrica pensylvanica</i> (Northern Bayberry), <i>Vaccinium corymbosum</i> (Highbush Blueberry), <i>Aronia arbutifolia</i> (Red Chokeberry), and <i>Ilex verticillata</i> (Winterberry).</p> | |

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| | E. Does the plant benefit Minnesota to a greater extent than the negative impacts identified at Box #8? | Japanese barberry's deer resistance, unique colors and forms, suitability for specimen or mass plantings and adaptability to varied planting sites have made it a landscape staple for many years. Seed quantity and color have been significant selling points for Japanese barberry cultivars in the past. Unfortunately, the seediness of many Japanese barberry cultivars and the parent species engender their invasiveness in forested settings, especially those settings previously exposed to agricultural disturbance. This invasiveness is exacerbated by feral Japanese barberry's eventual tendency to form thickets in naturalized populations. Japanese barberry is of high horticultural value and the benefit/negative impact equation would be significantly improved by reduction or elimination of seed in future selections. | If Yes, go to Box 11. If No, go to Box 10. |
| 10 | Should the plant species be enforced as a noxious weed to prevent introduction &/or dispersal; designate as prohibited or restricted? | | |
| | A. Is the plant currently established in Minnesota? | Yes. See maps on USDA Plants http://plants.usda.gov/java/county?state_name=Minnesota&statefips=27&symbol=BETH and EDDMaps http://www.eddmaps.org/google/index.cfm?sub=3010 | Go to 10B |
| | B. Does the plant pose a serious human health threat? | No. However, studies in Maine and Connecticut found that black legged ticks were twice as abundant in Japanese barberry invaded forests than non-invaded forests which could lead to increases in tick-borne diseases such as Lyme disease (Elias et al. 2006, Williams and Ward 2010). | Go to 10C |
| | C. Can the plant be reliably eradicated (entire plant) or controlled (top growth only to prevent pollen dispersal and seed production as appropriate) on a statewide basis using existing practices and available resources? | No. Individual plants can be killed by pulling, digging or cut-stump or basal bark herbicide treatments (Czarapata 2005). Due to the spines, management should be done carefully to avoid injury. On a statewide basis, eradication or control would be difficult. Many existing naturalized populations in Minnesota are on steep, wooded hillsides, inaccessible by machinery and difficult to walk through. Additionally, eradication or control would be extremely unpopular since Japanese barberry cultivars have been planted extensively and remain in residential, commercial and institutional landscapes statewide. | If yes, list as a prohibited noxious weed. If no, list as a restricted noxious weed. |

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| 11 | Should the plant species be allowed in Minnesota via a species-specific management plan; designate as specially regulated? | <p>Yes. The Connecticut Nursery and Landscape Association implemented a voluntary phase-out of 25 heavy-seeding Japanese barberry cultivars in 2010. See http://www.flowersplantsinct.com/invasive_index.htm for cultivar lists. Wisconsin is proposing a three-year phase-out and eventual ban of the same CT cultivars, out for public comment in 2013 and possible implementation in 2014. Minnesota should implement a three-year phase-out of the seediest Japanese barberry cultivars (using the CT cultivar list), followed by a ban of those seediest cultivars. Ongoing sterility and invasiveness research on Japanese barberry should be monitored closely. If and when horticulturally-acceptable seedless cultivars of Japanese barberry are developed and successfully in trade, revisions should be considered in the seediness level of Japanese barberry cultivars considered “acceptable to plant”.</p> <p>Knight et al. (2011) note that large changes in fecundity result in relatively small changes to the population growth rates of long-lived species like Japanese barberry and that only female sterile cultivars that cannot reproduce vegetatively are truly non-invasive. However, the publicity attendant to listing Japanese barberry as a specially-regulated plant will reduce the popularity of the species as a whole and educate consumers to the fact that less-seedy cultivars will present less risk of invasions.</p> | List as a Specially Regulated Plant and phase out the sale of the seediest cultivars using the list from CT and WI. |

| Final Results of Risk Assessment | | |
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| Review Entity | Comments | Outcome |
| NWAC Listing Subcommittee | First Review – 5/24/2011; Second Review 10/10/2012; Third Review 8/12/2013- List as a Specially Regulated Plant with a management plan that seeks to phase out the sale of the seediest cultivars using the list from CT and WI. After phase out period, sale of these cultivars would be prohibited. See list of cultivars in Appendix 1. If new cultivars are developed and they have fecundity levels 600 seeds/plant or greater, then the new cultivars should be examined for inclusion in the Specially Regulated Plant category listing of phased out plants in Appendix 1. | Specially Regulated |
| NWAC Full Committee | Reviewed 12/28/2014 Vote 13 -0 to recommend as a specially regulated plant with Listing Subcommittee’s suggested management plan. | Specially Regulated |

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| <p>MDA Commissioner</p> | <p>Reviewed 2/24/2014 Accepted NWAC's recommendation. Commissioner requested that MNLA and MDA Nursery Staff meet to determine an acceptable management plan that will be accepted by the nursery industry. No regulation of Japanese barberry will occur until the commissioner approves a management plan/regulatory phase-out.</p> <p>Commissioner order signed 09/22/14. These plants average greater than 600 seeds per plant and will begin a three-year phase-out period 01/01/15. These cultivars become Restricted 01/01/18. 'Angel Wings', 'Antares', var. atropurpurea. 'Bailtwo' (Burgundy Carousel®), 'Monomb' (Cherry Bomb™), 'Crimson Velvet', 'Erecta', 'Gold Ring', 'Bailsel' (Golden Carousel®; B. koreana xB. thunbergil hybrid), 'Inermis', 'Bailgreen' (Jade Carousel), 'iN Redleaf' (Ruby Jewel™), 'iN Variegated' (Stardust™), 'Kelleris', 'Kobold', 'Anderson' (Lustre Greent™), 'Marshall Upright', 'Painter's Palette', 'Pow Wow', 'Red Rocket', 'Rose Glow', 'Bailone' (Ruby Carousel™), 'Silver Mile', 'Sparkle', 'Tara' (Emerald Carousels; B. koreana xB. thunbergil hybrid), Wild Type (parent species — green barberry)</p> | <p>Specially Regulated</p> |
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Appendix 1. Japanese barberry cultivars to be phased out and then prohibited from sale

These plants average greater than 600 seeds per plant.

Phase out and then prohibit from sale the following 25 *Berberis thunbergii* cultivars and parent species (wild type):

- ‘Angel Wings’
- ‘Antares’
- var. *atropurpurea*
- ‘Bailtwo’ (Burgundy Carousel®)
- ‘Monomb’ (Cherry Bomb™)

- ‘Crimson Velvet’
- ‘Erecta’
- ‘Gold Ring’
- ‘Baisel’ (Golden Carousel®; *B. koreana* × *B. thunbergii* hybrid)
- ‘Inermis’
- ‘Bailgreen’ (Jade Carousel®)
- ‘JN Redleaf’ (Ruby Jewel™)
- ‘JN Variegated’ (Stardust™)
- ‘Kelleris’
- ‘Kobold’
- ‘Anderson’ (Lustre Green™)
- ‘Marshall Upright’
- ‘Painter’s Palette’
- ‘Pow Wow’
- ‘Red Rocket’
- ‘Rose Glow’
- ‘Bailone’ (Ruby Carousel®)
- ‘Silver Mile’
- ‘Sparkle’
- ‘Tara’ (Emerald Carousel®; *B. koreana* × *B. thunbergii* hybrid)
- Wild Type (parent species – green barberry)