

INDIANA

NON-NATIVE PLANT INVASIVENESS RANKING FORM

ASSESSMENT FOR INVASIVE PLANTS NOT IN TRADE
Form version date: March 3, 2009

Scientific name:	Cardamine impatiens L.	USDA Plants Code: CAIM
Common names:	Narrowleaf bittercress	
Native distribution:	Eurasia	
Date assessed:	July 15, 2012	
Assessors:	Ellen Jacquart, Alison Clements	
Reviewers:	Jason Larson,	
Date Approved:	September 21, 2012	

Indiana Invasiveness Rank: Moderate (Relative Maximum Score 50.00-69.99)

Invasiveness Ranking Summary (see details under appropriate sub-section)		Total (Total Answered*) Possible	Total
1	Ecological impact	40 (20)	10
2	Biological characteristic and dispersal ability	25 (25)	20
3	Ecological amplitude and distribution	25 (25)	18
4	Difficulty of control	10 (6)	3
	Outcome score	100 (76) ^b	51
	Relative maximum score [†]		67.11
	Indiana Invasiveness Rank [§]	Moderate (Relative Maximum Score 50.00-69.99)	

* For questions answered "unknown" do not include point value in "Total Answered Points Possible." If "Total Answered Points Possible" is less than 70.00 points, then the overall invasive rank should be listed as "Unknown."

[†]Calculated as 100(a/b) to two decimal places.

[§]Very High >80.00; High 70.00–80.00; Moderate 50.00–69.99; Low 40.00–49.99; Insignificant <40.00

A. DISTRIBUTION (KNOWN/POTENTIAL):

<p>A1.1. Has this species been documented to persist without cultivation in IN? (reliable source; voucher not required)</p> <p><input checked="" type="checkbox"/> Yes – continue to A2.2</p> <p><input type="checkbox"/> No – continue to A2.1</p>	
<p>A2.1. What is the likelihood that this species will occur and persist outside of cultivation given the climate in Indiana? (obtain from occurrence data in other states with similar climates)</p> <p><input type="checkbox"/> Likely – continue to A2.2</p> <p><input type="checkbox"/> Not likely</p>	

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Documentation:

Sources of information: Range maps compiled from PLANTS database, <http://plants.usda.gov/java/>; Indiana CAPS database, <http://extension.entm.purdue.edu/CAPS/index.html>; Indiana IPSAWG reports (unpublished); and EDDMapS reports, <http://eddmaps.org/>

If the species does not occur and is not likely to occur in Indiana, then stop here as there is no need to assess the species.

A2.2. Describe the potential or known suitable habitats within Indiana (underlined). Natural habitats include all habitats not under active human management. Managed habitats are indicated with an asterisk.

Aquatic Habitats	Wetland Habitats	Upland Habitats
Rivers/streams	Marshes	<u>Forest</u>
Natural lakes and ponds	Fens	Savannas
Reservoirs/impoundments*	Bogs	Barrens
	Shrub swamps	Prairies
	<u>Forested wetlands/riparian</u>	Cultivated*
	Beaches/dunes	Old Fields*
	Ditches*	Roadsides*

Other potential or known suitable habitats within Indiana:
Footbaths, pond shores.

Documentation:

Sources of information:
Habitat description by J. Larson and M. Everidge; Invasive.org habitat description.

B. INVASIVENESS RANKING

Questions apply to areas similar in climate and habitats to Indiana unless specified otherwise.

1. ECOLOGICAL IMPACT

1.1. Impact on Natural Ecosystem Processes and System-Wide Parameters (e.g. fire regime, geomorphological changes (erosion, sedimentation rates), hydrologic regime, nutrient and mineral dynamics, light availability, salinity, pH)

- A. No perceivable impact on ecosystem processes based on research studies, or the absence of impact information if a species is widespread (>10 occurrences in minimally managed areas), has been well-studied (>10 reports/publications), and has been present in the northeast for >100 years. 0
- B. Influences ecosystem processes to a minor degree (e.g., has a perceivable but mild influence on soil nutrient availability) 3
- C. Significant alteration of ecosystem processes (e.g., increases sedimentation rates along streams or coastlines, reduces open water that are important to waterfowl) 7
- D. Major, possibly irreversible, alteration or disruption of ecosystem processes (e.g., the species alters geomorphology and/or hydrology, affects fire frequency, alters soil pH, or fixes substantial levels of nitrogen in the soil making soil unlikely to support certain native plants or more likely to favor non-native species) 10
- U. Unknown

Score

U

Documentation:

Identify ecosystem processes impacted (or if applicable, justify choosing answer A in the

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absence of impact information)
No studies on the impact on natural ecosystem processes located.
Sources of information:
Lu, 2004.

1.2. Impact on Natural Community Structure

- | | | |
|----|--|----|
| A. | No perceived impact; establishes in an existing layer without influencing its structure | 0 |
| B. | Influences structure in one layer (e.g., changes the density of one layer) | 3 |
| C. | Significant impact in at least one layer (e.g., creation of a new layer or elimination of an existing layer) | 7 |
| D. | Major alteration of structure (e.g., covers canopy, eradicating most or all layers below) | 10 |
| U. | Unknown | |

Score 3

Documentation:
Identify type of impact or alteration:
Reported to form dense patches at the ground-level herbaceous layer. (Lu, 2004). Reports from J. Larson and M. Everidge indicate the species can form dense colonies in floodplain forests that exclude other species. European studies (Margules et al., 1994; Willaims, 2000) suggest *C. impatiens* is intolerant of competition with high rates of extinction. There are conflicting reports from North American investigators regarding invasive nature (Lu, 2004; Poindexter, 2006).
Sources of information:
Margules et al., 1994; Williams, 2000; Lu, 2004; Poindexter, 2006; J. Larson and M. Everidge personal observations..

1.3. Impact on Natural Community Composition

- | | | |
|----|---|----|
| A. | No perceived impact; causes no apparent change in native populations | 0 |
| B. | Influences community composition (e.g., reduces the number of individuals in one or more native species in the community) | 3 |
| C. | Significantly alters community composition (e.g., produces a significant reduction in the population size of one or more native species in the community) | 7 |
| D. | Causes major alteration in community composition (e.g., results in the extirpation of one or several native species, reducing biodiversity or change the community composition towards species exotic to the natural community) | 10 |
| U. | Unknown | |

Score 7

Documentation:
Identify type of impact or alteration:
Reported to form dense patches and to outcompete native species (Lu, 2004).
Sources of information:
Margules et al., 1994; Williams, 2000; Lu, 2004; Poindexter, 2006.

1.4. Impact on other species or species groups (cumulative impact of this species on the animals, fungi, microbes, and other organisms in the community it invades. Examples include reduction in nesting/foraging sites; reduction in habitat connectivity; injurious components such as spines, thorns, burrs, toxins; suppresses soil/sediment microflora; interferes with native pollinators and/or pollination of a native species; hybridizes with a native species; hosts a non-native disease which impacts a native species)

- | | | |
|----|-----------------------------|---|
| A. | Negligible perceived impact | 0 |
| B. | Minor impact | 3 |
| C. | Moderate impact | 7 |

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- D. Severe impact on other species or species groups 10
 U. Unknown

Score

U

Documentation:

Identify type of impact or alteration:
 No studies on the impact on other species located.
 Sources of information:
 Lu, 2004.

Total Possible

20

 Section One Total

10

2. BIOLOGICAL CHARACTERISTICS AND DISPERSAL ABILITY

- 2.1. Mode and rate of reproduction (provisional thresholds, more investigation needed)
- A. No reproduction by seeds or vegetative propagules (i.e. plant sterile with no sexual or asexual reproduction). 0
 B. Limited reproduction (fewer than 10 viable seeds per plant AND no vegetative reproduction; if viability is not known, then maximum seed production is less than 100 seeds per plant and no vegetative reproduction) 1
 C. Moderate reproduction (fewer than 100 viable seeds per plant - if viability is not known, then maximum seed production is less than 1000 seeds per plant - OR limited successful vegetative spread documented) 2
 D. Abundant reproduction with vegetative asexual spread documented as one of the plants prime reproductive means OR more than 100 viable seeds per plant (if viability is not known, then maximum seed production reported to be greater than 1000 seeds per plant.) 4
 U. Unknown

Score

4

Documentation:

Describe key reproductive characteristics (including seeds per plant):
 Individual plants have been reported to produce over 5,500 seeds.
 Sources of information:
 Kimata, 1983.

- 2.2. Innate potential for long-distance dispersal (e.g. bird dispersal, sticks to animal hair, buoyant fruits, pappus for wind-dispersal)
- A. Does not occur (no long-distance dispersal mechanisms) 0
 B. Infrequent or inefficient long-distance dispersal (occurs occasionally despite lack of adaptations) 1
 C. Moderate opportunities for long-distance dispersal (adaptations exist for long-distance dispersal, but studies report that 95% of seeds land within 100 meters of the parent plant) 2
 D. Numerous opportunities for long-distance dispersal (adaptations exist for long-distance dispersal and evidence that many seeds disperse greater than 100 meters from the parent plant) 4
 U. Unknown

Score

4

Documentation:

Identify dispersal mechanisms:
 Hydrochory (water) and epizoochory (animals, but without ingestion) have been hypothesized.
 Sources of information:
 Glenn & Barringer, 2004.

- 2.3. Potential to be spread by human activities (both directly and indirectly – possible

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mechanisms include: commercial sales, use as forage/revegetation, spread along highways, transport on boats, contaminated compost, land and vegetation management equipment such as mowers and excavators, etc.)

- A. Does not occur 0
- B. Low (human dispersal to new areas occurs almost exclusively by direct means and is infrequent or inefficient) 1
- C. Moderate (human dispersal to new areas occurs by direct and indirect means to a moderate extent) 2
- D. High (opportunities for human dispersal to new areas by direct and indirect means are numerous, frequent, and successful) 3
- U. Unknown

Score

Documentation:

Identify dispersal mechanisms:

Often observed along roadside and footpaths probably spread by motorized vehicles and foot traffic. Possibly also spread via contaminated soil from nurse plantings (Lamont & Young, 2004) and through mowing.

Sources of information:

Glenn & Barringer, 2004; Lamont & Young, 2004.

2.4. Characteristics that increase competitive advantage, such as shade tolerance, ability to grow on infertile soils, perennial habit, fast growth, nitrogen fixation, allelopathy, etc.

- A. Possesses no characteristics that increase competitive advantage 0
- B. Possesses one characteristic that increases competitive advantage 3
- C. Possesses two or more characteristics that increase competitive advantage 6
- U. Unknown

Score

Documentation:

Evidence of competitive ability:

Shade tolerant, fast growth. Annual or biennial with selfing rates as high as 99% (Kimata, 1983). Basal rosettes formed in autumn, providing an advantage over spring-germinating species (authors' personal observations).

Sources of information:

Kimata, 1983; Glenn & Barringer, 2004..

2.5. Growth vigor

- A. Does not form thickets or have a climbing or smothering growth habit 0
- B. Has climbing or smothering growth habit, forms a dense layer above shorter vegetation, forms dense thickets, or forms a dense floating mat in aquatic systems where it smothers other vegetation or organisms 2
- U. Unknown

Score

Documentation:

Describe growth form:

Reported to form dense patches at the ground-level herbaceous layer. (Lu, 2004). .

Sources of information:

Lu, 2004.

2.6. Germination/Regeneration

- A. Requires open soil or water and disturbance for seed germination, or regeneration from vegetative propagules. 0

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- B. Can germinate/regenerate in vegetated areas but in a narrow range or in special conditions 2
- C. Can germinate/regenerate in existing vegetation in a wide range of conditions 3
- U. Unknown (No studies have been completed)

Score

3

Documentation:

Describe germination requirements:

Seeds extremely adaptable and durable, studies found germination rates as high as 80% even after deep freezing (-196 degrees C for 50 days) (Voronkova, 2007); and germination rates over 56% in standing water (Kimata, 1983). While no definitive studies on germination vis a vis existing vegetation have been located, the authors' personal observations in the field suggest the ability to readily germinate in existing vegetation.

Sources of information:

Author's (Glenn's) personal observations; Kimata, 1983; Voronkova, 2007.

2.7. Other species in the genus invasive in Indiana or elsewhere

- A. No 0
- B. Yes 3
- U. Unknown

Score

0

Documentation:

Species:

Cardamine flexuosa and C. hirsuta reported from NY, but not tracked as invasive. Weldy & Werier, 2009.

Total Possible

25

Section Two Total

20

3. ECOLOGICAL AMPLITUDE AND DISTRIBUTION

3.1. Density of stands in natural areas in the northeastern USA and eastern Canada (use same definition as Gleason & Cronquist which is: "The part of the United States covered extends from the Atlantic Ocean west to the western boundaries of Minnesota, Iowa, northern Missouri, and southern Illinois, south to the southern boundaries of Virginia, Kentucky, and Illinois, and south to the Missouri River in Missouri. In Canada the area covered includes Nova Scotia, Prince Edward Island, New Brunswick, and parts of Quebec and Ontario lying south of the 47th parallel of latitude")

- A. No large stands (no areas greater than 1/4 acre or 1000 square meters) 0
- B. Large dense stands present in areas with numerous invasive species already present or disturbed landscapes 2
- C. Large dense stands present in areas with few other invasive species present (i.e. ability to invade relatively pristine natural areas) 4
- U. Unknown

Score

4

Documentation:

Identify reason for selection, or evidence of weedy history:

Large stands noted in floodplains with few or no other invasives present.

Sources of information:

Lu, 2004; Glenn & Barringer, 2004..

3.2. Number of habitats the species may invade

- A. Not known to invade any natural habitats given at A2.2 0

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- B. Known to occur in two or more of the habitats given at A2.2, with at least one a natural habitat. 1
- C. Known to occur in three or more of the habitats given at A2.2, with at least two a natural habitat. 2
- D. Known to occur in four or more of the habitats given at A2.2, with at least three a natural habitat. 4
- E. Known to occur in more than four of the habitats given at A2.2, with at least four a natural habitat. 6
- U. Unknown

Score

Documentation:

Identify type of habitats where it occurs and degree/type of impacts:
See A2.2.

Sources of information:

Glenn & Barringer, 2004; Lu, 2004; Brooklyn Botanic Garden, 2009.

3.3. Role of disturbance in establishment

- A. Requires anthropogenic disturbances to establish. 0
- B. May occasionally establish in undisturbed areas but can readily establish in areas with natural or anthropogenic disturbances. 2
- C. Can establish independent of any known natural or anthropogenic disturbances. 4
- U. Unknown

Score

Documentation:

Identify type of disturbance:
Disturbance reported to enhance occurrence and increase in populations. Establishment in relatively undisturbed habitats (authors' personal observations).

Sources of information:

Margules et al., 1994; Williams, 2000; Lu, 2004; authors pers. obs..

3.4. Climate in native range

- A. Native range does not include climates similar to Indiana 0
- B. Native range possibly includes climates similar to at least part of Indiana 1
- C. Native range includes climates similar to those in Indiana 3
- U. Unknown

Score

Documentation:

Describe what part of the native range is similar in climate to Indiana:
Eurasia, as far north as Finland.

Sources of information:

Von Numers, 1991; Lu, 2004; Brooklyn Botanic Garden, 2009.

3.5. Current introduced distribution in the northeastern USA and eastern Canada (see question 3.1 for definition of geographic scope)

- A. Not known from the northeastern US and adjacent Canada 0
- B. Present as a non-native in one northeastern USA state and/or eastern Canadian province. 1
- C. Present as a non-native in 2 or 3 northeastern USA states and/or eastern Canadian provinces. 2
- D. Present as a non-native in 4–8 northeastern USA states and/or eastern Canadian provinces, and/or categorized as a problem weed (e.g., “Noxious” or “Invasive”) in 1 northeastern state or eastern Canadian province. 3
- E. Present as a non-native in >8 northeastern USA states and/or eastern Canadian provinces, and/or categorized as a problem weed (e.g., “Noxious” or “Invasive”) in 2 northeastern 4

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- states or eastern Canadian provinces.
U. Unknown

Score

Documentation:

Identify states and provinces invaded:

CT, DE, IN, KY, MA, ME, MI, NH, NJ, NY, OH, PA, VT, WV; New Brunswick, Ontario.

Sources of information: See known introduced range in plants.usda.gov, and update with information from states and Canadian provinces.

U.S.D.A., 2009.

3.6. Current distribution of the species outside of cultivation in Indiana

- A. Present in no Indiana counties 0
- B. Present in 1-10 Indiana counties 1
- C. Present in 11-20 Indiana counties 2
- D. Present in 21-50 Indiana counties 3
- E. Present in more than 50 Indiana counties or on Federal noxious weed list 4
- U. Unknown

Score

Documentation:

Describe distribution:

See A1.1.

Sources of information:

Total Possible
Section Three Total

4. DIFFICULTY OF CONTROL

4.1. Seed banks

- A. Seeds (or vegetative propagules) remain viable in soil for less than 1 year, or does not make viable seeds or persistent propagules. 0
- B. Seeds (or vegetative propagules) remain viable in soil for at least 1 to 10 years 2
- C. Seeds (or vegetative propagules) remain viable in soil for more than 10 years 3
- U. Unknown

Score

Documentation:

Identify longevity of seed bank:

Can apparently seed bank for several years, although no quantitative studies located. Seeds extremely durable, one study found germination rates as high as 80% even after deep freezing (-196 degrees C) for 50 days (Voronkova, 2007). No evidence for viability for longer than 10 years.

Sources of information:

Williams, 2000; Voronkova, 2007.

4.2. Vegetative regeneration

- A. No regrowth following removal of aboveground growth 0
- B. Regrowth from ground-level meristems 1
- C. Regrowth from extensive underground system 2

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- D. Any plant part is a viable propagule 3
U. Unknown

Score

1

Documentation:

Describe vegetative response:

Annual or biennial, plants die after fruiting; will regrow if cut.

Sources of information:

Glenn & Barringer, 2004; Lu, 2004.

4.3. Level of effort required

- A. Management is not required: e.g., species does not persist without repeated anthropogenic disturbance. 0
B. Management is relatively easy and inexpensive: e.g. 10 or fewer person-hours of manual effort (pulling, cutting and/or digging) can eradicate a 1 acre infestation in 1 year (infestation averages 50% cover or 1 plant/100 ft²). 2
C. Management requires a major short-term investment: e.g. 100 or fewer person-hours/year of manual effort, or up to 10 person-hours/year using mechanical equipment (chain saws, mowers, etc.) for 2-5 years to suppress a 1 acre infestation. Eradication is difficult, but possible (infestation as above). 3
D. Management requires a major investment: e.g. more than 100 person-hours/year of manual effort, or more than 10 person hours/year using mechanical equipment, or the use of herbicide, grazing animals, fire, etc. for more than 5 years to suppress a 1 acre infestation. Eradication may be impossible (infestation as above). 4
U. Unknown

Score

U

Documentation:

Identify types of control methods and time-term required:

Mechanical- It is relatively easy to pull up (author's personal observations; Lamont & Young, 2004; Lu, 2004). No other management studies located. Populations frequently in wetlands.

Sources of information:

Lamont & Young, 2004; Lu, 2004; authors' pers. obs..

Total Possible

6

Section Four Total

3

Total for 4 sections Possible

76

Total for 4 sections

51

References for species assessment:

Brooklyn Botanic Garden. 2009. AILANTHUS database. [Accessed on 22 April 2009].

Glenn, S. D. & K. Barringer. 2004. Cardamine impatiens L. (Brassicaceae) in New Jersey J. Torrey Bot. Soc. 131: 257-260.

Kimata, M. 1983. Comparative studies on the reproductive systems of Cardamine flexuosa, C. impatiens, C. scutata and C. lyrata, Cruciferae. Botanical-Magazine-Tokyo 96(1044): 299-312.

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Poindexter, D. B. 2006. Eight new plant distributional records to Alleghany County, North Carolina. *J. North Carolina Academy of Science.* 122(3):101-105.

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Von Numers, M. 1991. The status of Cardamine impatiens in Finland in 1990. *Memoranda Societatis pro Fauna et Flora Fennica.* 67(2):71-73.

Voronkova, N. M. 2007. Cryoconservation effect on seeds and fruits viability of some species of the Moneron Island flora (Sakhalin Region). *Rastitel'nye Resursy.* 43(3):34-41.

Weldy, T. & D. Werier. 2009. New York Flora Atlas. [S. M. Landry and K. N. Campbell (original application development), Florida Center for Community Design and Research. University of South Florida]. New York Flora Association, Albany, New York. [Accessed on 22 April 2009].

Williams, L. R. 2000. Annual variations in the size of a population of Cardamine impatiens L. *Watsonia.* 23(1):209-212.

Citation: This IN ranking form may be cited as: Jacquart, E.M., 2012. Invasiveness ranking system for non-native plants of Indiana. Unpublished. Invasive Plant Advisory Committee (IPAC) to the Indiana Invasive Species Council, Indianapolis, IN.

Acknowledgments: The IN form incorporates components and approaches used in several other systems, cited in the references below. The Invasive Plant Advisory Committee was created by the Indiana Invasive Species Council in October 2010, and is made up of the original members of the Indiana Invasive Plant Assessment Working Group (IPSAWG). Original members of IPSAWG included representatives of the The Nature Conservancy; Indiana Native Plant and Wildflower Society; Indiana Nursery and Landscape Association; Indiana Chapter of the American Society of Landscape Architects; Indiana Forage Council; Indiana Wildlife Federation; Indiana State Beekeepers Association; Indiana Beekeeper's Association; Department of Natural Resources; Hoosier National Forest; Indiana Academy of Science; Natural Resources Conservation Service; Indiana Department of Environmental Management; Indiana Department of Transportation; Purdue Cooperative Extension Service; Seed Administrator, Office of the Indiana State Chemist.

References for ranking form:

Carlson, Matthew L., Irina V. Lapina, Michael Shephard, Jeffery S. Conn, Roseann Densmore, Page Spencer, Jeff Heys, Julie Riley, Jamie Nielsen. 2008. Invasiveness ranking system for non-native plants of Alaska. Technical Paper R10-TPXX, USDA Forest Service, Alaska Region, Anchorage, AK XX9. Alaska Weed Ranking Project may be viewed at: http://akweeds.uaa.alaska.edu/akweeds_ranking_page.htm.

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- Heffernan, K.E., P.P. Coulling, J.F. Townsend, and C.J. Hutto. 2001. Ranking Invasive Exotic Plant Species in Virginia. Natural Heritage Technical Report 01-13. Virginia Dept. of Conservation and Recreation, Division of Natural Heritage, Richmond, Virginia. 27 pp. plus appendices (total 149 p.).
- Morse, L.E., J.M. Randall, N. Benton, R. Hiebert, and S. Lu. 2004. An Invasive Species Assessment Protocol: Evaluating Non-Native Plants for Their Impact on Biodiversity. Version 1. NatureServe, Arlington, Virginia. <http://www.natureserve.org/getData/plantData.jsp>
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- Williams, P. A., and M. Newfield. 2002. A weed risk assessment system for new conservation weeds in New Zealand. *Science for Conservation* 209. New Zealand Department of Conservation. 1-23 pp.