INDIANA

NON-NATIVE PLANT INVASIVENESS RANKING FORM

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

Scientific name:	Cynanchum rossicum (C. medium, Vincetoxicum medium, V.rossicum) USDA Plants Code: CYRO8
Common names:	European Swallow-wort, pale swallow-wort, dog strangling vine
Native distribution:	Central Eurasia
Date assessed:	7 April 2009
Assessors:	Ellen Jacquart
Reviewers:	Brenda Howard
Date Approved:	September 21, 2012

Indiana Invasiveness Rank: Very High (Relative Maximum Score >80.00)

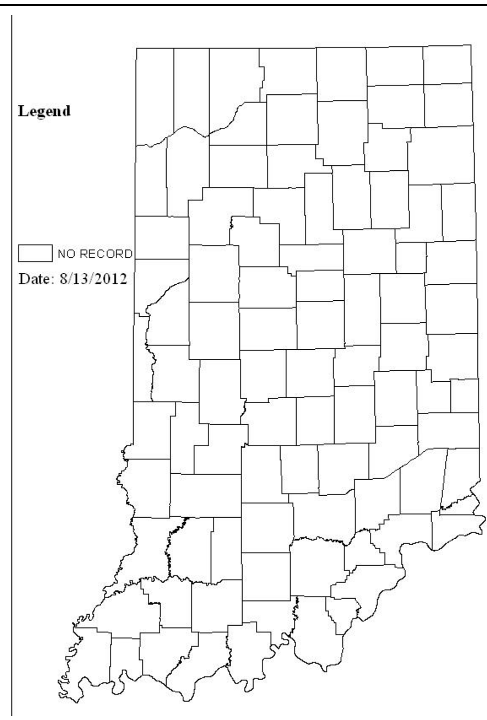
Invasiveness Ranking Summary (see details under appropriate sub-section)		Total (Total Answered*) Possible	Total
1	Ecological impact	40 (40)	34
2	Biological characteristic and dispersal ability	25 (25)	24
3	Ecological amplitude and distribution	25 (25)	15
4	Difficulty of control	10 (7)	6
	Outcome score	100 (97)[b]	79[a]
	Relative maximum score †		81.44
	Indiana Invasiveness Rank §	Very High (Relative Maximum Score >80.00)	

* 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):

A1.1. Has this species been documented to persist without cultivation in IN? (reliable source; voucher not required)	
☒	**Yes – continue to A2.2**
☐	No – continue to A2.1

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)	
x	Likely – continue to A2.2
☐	Not likely



Documentation:
Sources of information:
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Indiana CAPS database, http://extension.entm.purdue.edu/CAPS/index.html; Indiana IPSAWG reports (unpublished); and EDDMapS reports, http://eddmaps.org/.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>	**<u>Cultivated*</u>**
	Beaches/dunes	**<u>Old Fields*</u>**
	Ditches*	**<u>Roadsides*</u>**

Other potential or known suitable habitats within Indiana:
Urban pavement cracks, vacant lots, edge of salt marsh, railway and utility corridors

Documentation:
Sources of information:
Lawlor, 2001; Fellows, 2004; DiTommaso et al., 2005; Brooklyn Botanic Garden, 2009.

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 7

Documentation:

Identify ecosystem processes impacted (or if applicable, justify choosing answer A in the absence of impact information)
Ecosystem scale modification appears obvious but full impacts have not yet known as studies are lacking. Large stands clearly cause a significant decrease in light availability. Latex of plant probably impacts soil chemistry but specific studies on this not known.

Sources of information:
Lawlor, 2001; Fellows, 2004; DiTommaso et al., 2005.

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: 7

Documentation:

Identify type of impact or alteration:
Large, monospecific stands can form in open, fully-exposed areas. In brushy areas, these vines can over-top and smother shrubs, forming the dominant cover. Under forested canopies, plants of shorter stature can comprise the dominant cover in the herbaceous understory layer.
Sources of information:
Lawlor, 2001; Fellows, 2004; DiTommaso et al., 2005.

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: 10

Documentation:

Identify type of impact or alteration:
Can form dense populations which displace and eliminate native plant spp., including rare plant species, such as those in Alvar grasslands in northern New York. Occurrence of stands of this species may threaten the survival of rare and threatened native species, such as Jessop's milkvetch (Astragalus robbinsii), Hart's tongue fern (Phyllitis scolopendrium), and green comet milkweed (Asclepias viridiflora).
Sources of information:
Lawlor, 2001;Fellows, 2004; DiTommaso et al., 2005.

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

Score: 10

Documentation:
Identify type of impact or alteration:
May adversely affect butterfly populations; Monarch's ovipost on swallow-worts (instead of milkweeds) but suffer higher mortality; also displacing native milkweeds and affecting food plant supply fr butterfly species that are dependent on these. Can act as an alternate host for rusts attacking Pinus species. Chemicals in latex probably affect compostition of the soil microbial community. Studies suggests a decline in arthropod, lichens, and grassland bird diversity. Toxic to grazing mammals.
Sources of information:
Lawlor, 2001;Fellows, 2004; DiTommaso et al., 2005b; Ernst & Cappuccino, 2005.

Total Possible: 40
Section One Total: 34

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):
Single vine can produce thousands of seeds. Seeds are adventitiously polyembryonic, the additional embryos being formed from other diploid cells beyond the zygote.
Sources of information:
Fellows, 2004; Smith et al., 2006; Hotchkiss et al., 2008.

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	4

plant)
U. Unknown

Score 4

Documentation:
Identify dispersal mechanisms:
A large proportion of seeds remains close to the parent plant, but many small, satellite populations are often found far downwind of large seed source populations through wind dispersal (anemochory).
Sources of information:
Lawlor, 2001; Fellows, 2004; Ladd & Cappuccino, 2005.

2.3. Potential to be spread by human activities (both directly and indirectly – possible 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 2

Documentation:
Identify dispersal mechanisms:
Currently not widely available for sale. Inadvertent introduction through transport in hay. Human land management activities may also contribute to dispersal.
Sources of information:
Lawlor, 2001;DiTommaso et al., 2005

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 6

Documentation:
Evidence of competitive ability:
Perennial, allelopathic, tolerant to a wide range of light intensities, and can tolerate a variety of soil conditions. Can self-pollinate and long-lived flowers enhance fruit set. Polyembryonic seeds can produce multiple seedlings (DiTommaso et al., 2005b), although recent studies (Cappuccino, et al., 2002; DiTommaso et al, 2005a; Smith et al., 2006; Hotchkiss et al., 2008) suggests that any fitness advantage provided by polyembryony may be habitat (light), seed weight, and competition dependent. High rates (71-100%) of seedling survivorship were reported from one study (Ladd & Cappuccino, 2005). Plants in shaded locations have been observed to produce flowering axillary shoots in late summer when plants are ripening seed, extending the potential seed production period.

Plant extracts were found to contain potent inhibitors of plant pathogenic fungi, diverse bacteria, and herbivorous insects (Mogg et al., 2008).

V. rossicum appears to suppress background vegetation more effectively when growing in larger patches (Cappuccino, 2004).

Sources of information:
Lawlor, 2001; Cappuccino, et al., 2002; Cappuccino, 2004; St. Denis & Cappuccino, 2004; DiTommaso et al., 2005b; Ladd & Cappuccino, 2005; Hotchkiss et al., 2008; Mogg et al., 2008

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: 2

Documentation:
Describe growth form:
This species can form dense stands that can smother the herbaceous layer and shrubs.
Sources of information:
Lawlor, 2001;Fellows, 2004; DiTommaso et al., 2005.

2.6. Germination/Regeneration

A.	Requires open soil or water and disturbance for seed germination, or regeneration from vegetative propagules.	0
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 do not require stratification. Germination rates as high as 72% have been reported. Specific site conditions can have a significant effect on seed weight and germination percentage.
Sources of information:
DiTommaso et al., 2005a; Ladd & Cappuccino, 2005.

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

A.	No	0
B.	Yes	3
U.	Unknown	

Score: 3

Documentation:
Species:
Cynanchum louiseae. Weldy & Werier, 2009.

Total Possible	25
Section Two Total	24

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 observed in NY and Northeast, some in relatively pristine areas with few other invasives present.
Sources of information:
Fellows, 2004; authors' personal observations

3.2. Number of habitats the species may invade

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

Documentation:
Identify type of habitats where it occurs and degree/type of impacts:
See A2.2.
Sources of information:
Lawlor, 2001; Fellows, 2004; DiTommaso et al., 2005; 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: 2

Documentation:
Identify type of disturbance:
This species is associated with disturbances; however, once established, the plant will readily move into nearby, less disturbed habitats. Does not require anthropogenic disturbance to establish.
Sources of information:
Lawlor, 2001; Fellows, 2004; DiTommaso et al., 2005.

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: 3

Documentation:
Describe what part of the native range is similar in climate to Indiana:
Ukraine, Russia.
Sources of information:
Tutin & Heywood, 1972; 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 states or eastern Canadian provinces.	4
U.	Unknown	

Score: 4

Documentation:
Identify states and provinces invaded:
CT, IN, MA, MI, NH, NJ, NY, PA, Ontario, Quebec.
Sources of information: See known introduced range in plants.usda.gov, and update with information from states and Canadian provinces.
USDA, 2009.

3.6. Current introduced distribution of the species in natural areas 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: 0

Documentation:
Describe distribution:
See A1.1.
Sources of information:
Brooklyn Botanic Garden, 2009;Weldy & Werier, 2009.

Total Possible: 25

Section Three Total: 15

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: U

Documentation:
Identify longevity of seed bank:
Seed bank dynamics are unknown, most seeds germinate in the fall upon formation or in the subsequent spring. However, longevity of seeds beyond this is not known.
Sources of information:
Lawlor, 2001;DiTommaso et al., 2005.

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

Score: 2

Documentation:
Describe vegetative response:
Plants readily resprout from extensive underground rhizomes.
Sources of information:
Lawlor, 2001;DiTommaso et al., 2005.

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 ft^2).	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: 4

Documentation:
Identify types of control methods and time-term required:
Eradication of isolated plants and small patches is possible with persistence and an early detection system, but large scale infestations will require persistent effort and continuous follow-up monitoring to control.

Biocontrol: There are few to no native pests, diseases or other natural controls in North America, but there are several potential biological control agents associated with the related Vincetoxicum hirundinaria in Europe.

Mechanical: Mowing and hand-pulling are only effective if the extensive and deep root crowns are removed and completely destroyed to prevent resprouting. A study of C. rossicum found that when a single cutting or mowing treatment is to be employed, cutting after the first fruits are produced but before they are fully developed is recommended.

Chemical: Response to herbicides varies by site and site condition. In treating whole plants or tall stems, glyphosate can be used in denegraded patches with little desirable vegetation; triclopyr ester is better in sites with desirable grasses to be conserved. In cut-stem applications, glyphosate was superior to all triclopyr amine concentrations . Dicamba and 2,4-D alone had poor results on C. rossicum. In all cases, repeated follow up herbicide treatments are necessary.

Fire: Fire alone is ineffective but may be useful after herbicide to control seedlings.

Sources of information:
Lawlor, 2001;DiTommaso et al., 2005; McKague & Cappuccino, 2005.

Total Possible	7
Section Four Total	6

Total for 4 sections Possible	97
Total for 4 sections	85

References for species assessment:

Brooklyn Botanic Garden. 2009. AILANTHUS database. [Accessed on 7 April 2009].
Cappuccino, N. 2004. Allee effect in an invasive alien plant, pale swallow-wort Vincetoxicum rossicum (Asclepiadaceae). Oikos. 106(1):3-8.

Cappuccino, N., R. MacKay, & C. Eisner. 2002. Spread of the invasive alien vine Vincetoxicum rossicum: Tradeoffs between seed dispersability and seed quality. American Midland Naturalist. 148(2):263-270.

DiTommaso, A., D. C, Brainard & B. R. Webster. 2005a. Seed characteristics of the invasive alien vine Vincetoxicum rossicum are affected by site, harvest date, and storage duration. Canadian Journal of Botany. 83(1):102-110.

DiTommaso, A., F.M. Lawlor, & S.J. Darbyshire. 2005b. The biology of invasive alien plants in Canada. 2. Cynanchum rossicum (Kleopow) Borhidi [= Vincetoxium rossicum (Kleopow) Barbar.] and Cynanchum louiseae (L.) Kartesz & Gandhi [= Vincetoxicum nigrum (L.) Moench]. Canadian Journal of Plant Science, 85: 243-263.

Ernst, C. M. & N. Cappuccino. 2005. The effect of an invasive alien vine, Vincetoxicum rossicum (Asclepiadaceae), on arthropod populations in Ontario old fields. Biological Invasions. 7(3):417-425.

Fellows, M. 2004. Cynanchum rossicum. U.S. Invasive Species Impact Rank (I-Rank). NatureServe Explorer. <www.natureserve.org>. [Accessed on 7 April 2009].

Hotchkiss, E. E., A. DiTommaso, D. C. Brainard, & C. L. Mohler. 2008. Survival and performance of the invasive vine Vincetoxicum rossicum (Apocynaceae) from seeds of different embryo number under two light environments. American Journal of Botany. 95(4):447-453.

Ladd, D. & N. Cappuccino. 2005. A field study of seed dispersal and seedling performance in the invasive exotic vine Vincetoxicum rossicum. Canadian Journal of Botany. 83(9):1181-1188.

Lawlor, F. 2001. Element stewardship abstract for Vincetoxicum nigrum (L.) Moench. and Vincetoxicum rossicum (Kleopov) Barbarich. Swallow-wort. The Nature Conservancy, Arlington, Virginia. 13 pp.

McKague, C. I. & N. Cappuccino. 2005. Response of pale swallow-wort, Vincetoxicum rossicum, following aboveground tissue loss: Implications for the timing of mechanical control. Canadian Field-Naturalist. 119(4):525-531.

Mogg, C., P. Petit, N. Cappuccino, T. Durst, C. McKague, M. Foster, J. E. Yack, J. T. Arnason, & M. L. Smith. 2008. Tests of the antibiotic properties of the invasive vine Vincetoxicum rossicum against bacteria, fungi and insects. Biochemical Systematics & Ecology. 36(5-6):383-391.

Sheeley, S.E. and D.J. Raynal. 1996. The distribution and status of species of Vincetoxicum in eastern North America. Buylletin of the Torrey Botanical Club, 123(2):148-156.

Smith, L. L., A. DiTommaso, J. Lehmann, & S. Greipsson. 2006. Growth and reproductive potential of the invasive exotic vine Vincetoxicum rossicum in northern New York State. Canadian Journal of Botany. 84(12):1771-1780.

St. Denis, M. & N. Cappuccino. 2004. Reproductive biology of Vincetoxicum rossicum (Kleo.) Barb. (Asclepiadaceae), an invasive alien in Ontario. Journal of the Torrey Botanical Society. 131(1):8-15.

Tutin, T. G. & V. H. Heywood (eds.). 1972. Flora Europaea. Vol. 3. Cambridge Univ. Press, Cambridge, UK. 370 pp.

United States Department of Agriculture, National Resources Conservation Service. 2009. The PLANTS Database. National Plant Data Center, Baton Rouge, Louisiana [Accessed on 7 April 2009].

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 7 April 2009].

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.

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

Randall, J.M., L.E. Morse, N. Benton, R. Hiebert, S. Lu, and T. Killeffer. 2008. The Invasive Species Assessment Protocol: A Tool for Creating Regional and National Lists of Invasive Nonnative Plants that Negatively Impact Biodiversity. Invasive Plant Science and Management 1:36–49

Warner, Peter J., Carla C. Bossard, Matthew L. Brooks, Joseph M. DiTomaso, John A. Hall, Ann M.Howald, Douglas W. Johnson, John M. Randall, Cynthia L. Roye, Maria M. Ryan, and Alison E. Stanton. 2003. Criteria for Categorizing Invasive Non-Native Plants that Threaten Wildlands. Available online at www.caleppc.org and www.swvma.org. California Exotic Pest Plant Council and Southwest Vegetation Management Association. 24 pp.

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.