ELEMENT STEWARDSHIP ABSTRACT

for

Vincetoxicum nigrum (L.) Moench.
&
Vincetoxicum rossicum (Kleopov) Barbarich

Swallow-wort

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SCIENTIFIC NAME

Vincetoxicum nigrum (L.) Moench.
Vincetoxicum rossicum (Kleopov) Barbarich

SYNONYMS

V. nigrum =Cynanchum nigrum (L) Pers., *C. louiseae* Kartesz and Gandhi.,
V. rossicum =C. medium R. Br., *C. rossicum* Kleo., *V. medium* (R. Br.) Decne., *C. rossicum* Kleo., *Antitoxicum rossicum* (Kleo.) Pobed., *C. rossicum* (Kleo.) Borhidi. (Sheeley and Raynal 1996).

These species are assigned to the genus *Cynanchum* by the USDA (2000), the New York State Museum (Mitchell and Tucker 1997) and some other taxonomists in the United States. Gleason and Cronquist (1991), Canadian and European workers assign these species to the genus *Vincetoxicum.* Generic and specific taxonomic considerations are addressed by Sheeley and Raynal (1996), who have used *Vincetoxicum* .

COMMON NAME

V. nigrum is commonly known as black swallow-wort.
V. rossicum is variably named. This species is often not included in popular field guides and readers are directed to the black swallow-wort identification. Otherwise *V. rossicum* has been called: swallow-wort, swallowwort, dog-strangling vine, pale swallow-wort, and European swallow-wort.

DESCRIPTION AND DIAGNOSTIC CHARACTERISTICS

General Description

V. rossicum and *V. nigrum* are members of the milkweed family (Asclepiadaceae), and are both herbaceous perennial twining vines that can grow to one to two meters in height depending on habitat and available support. In open areas without brush for support, the plants tend to twine around each other, forming 'ropy' tops. They have opposite leaves that are 5-10 cm long, hairless and smooth, oblong to ovate in shape, narrowing to a point at the tip. Their twining habit and opposite, smooth leaves with their somewhat shiny or reflective quality, distinguish these two *Vincetoxicum* species from other native and introduced species in the northeastern quarter of the US and adjacent Canada.

Flowers of both species are small, 5-9 mm wide and borne in small clusters in the leaf axils. *V. nigrum* flowers are purple-black and those of *V. rossicum* are pale to dark maroon, purple or pinkish. Both species produce slender, 4-7 cm long pods that split open lengthwise along one side to release many tufted, windborne seeds. The fruits are often borne in pairs, somewhat reminiscent of the forked tail of a swallow. Senescing plants turn a golden yellow in late summer. The dehisced pods persist on the dried vines, especially in brushy areas.

Detailed description and characteristics

The leaves of both species are opposite, oblong to ovate, acuminate rounded to sub-cordate at the base with short petioles, 5-10 cm long, glabrous, and shiny-smooth with entire to wavy margins. Subterranean buds on the root crown may produce one to several shoots. *V. nigrum* is reported to have rhizomes (Lumer and Yost 1995), but investigators have been unable to verify such connections among *V. rossicum* plants (Sheeley and Raynal 1996, Christensen 1998, Lawlor 2000). The fibrous roots of both species can hold tenaciously to the soil substrate.

Flowers of *Vincetoxicum* species have 5 fleshy, deltoid corolla lobes, a fleshy 5-lobed cup-like corona. Like other members of the Asclepiadaceae, *Vincetoxicum* flowers have 2 free, superior ovaries, each with its own stigma. The stigmas are fused only at their tips to form a common stigma. The filaments, anthers and styles are fused to form a gynostegium and a corona. The 2 separate ovaries and styles have a single, common stigma. Each bicarpellate ovary develops into a linear dry fruit (follicle) which splits open when ripe along a single lengthwise suture to release its many numerous coma-bearing (hairy) seeds (Sheeley and Raynal 1996, Gleason and Cronquist 1991, Watson and Dallwitz 1992). The inflorescences of these two *Vincetoxicum* species are solitary cymes arising from the leaf axils, with few-10 flowers per cluster.

V. nigrum flowers are purple-black, with the corolla lobes ('petals') about as wide as long (1.5-3 mm) with straight white hairs on the dorsal surface. Peduncle (flowerstem) lengths can be 0.5 to 3 cm (Gleason and Cronquist 1991; Sheeley and Raynal 1996). The corona is weakly 5-lobed, minutely toothed with the segments joined by a connective membrane 2/3 their length. The fruits of *V. nigrum* are often borne in pairs and are 5-7 cm long by 0.8 cm wide (Sheeley and Raynal 1996).

V. rossicum flowers are pale to dark maroon, purple or pinkish, glabrous, and longer than wide. Peduncles are 2-5 mm. *V. rossicum* follicles are 4-6 cm long by 0.5 cm wide (Sheeley and Raynal 1996).

The fruits (follicles) of both *Vincetoxicum* species contain numerous, polyembryonic coma-bearing seeds. Upon ripening, the fruits split open lengthwise along a single suture to release the seeds (Sheeley 1992). Releases of seed are copious on windy, dry, late-summer/fall days.

STEWARDSHIP SUMMARY

These two Eurasian *Vincetoxicum* species are invasive in both disturbed and undisturbed upland natural areas. *V. nigrum* is invasive in coastal areas of New England, the Connecticut River valley, and the lower Hudson River region. *V. rossicum* is invasive in the lower Great Lakes basin, particularly in regions around Lake Ontario in New York and Ontario, as well as in areas further south and west (e.g. in Pennsylvania and Michigan). Both species occupy similar ecological niches. Light and moisture tolerances are wide, and both species can occupy sites from full sun and dry soils over exposed bedrock, to wooded and shady riparian streamsides.

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. Seed production is prodigious and seed is wind-dispersed. The impact of *Vincetoxicum* spp. on the Monarch butterfly (*Danaus plexippus*), whose reproduction is obligate on the genus *Asclepias*, also of the Asclepiadaceae or milkweed family, is a concern. In North America, neither of these two *Vincetoxicum* species have natural controls and they are not readily used by other species, although some insects do collect nectar from their flowers.

Like many invasive herbaceous perennial plants, successful management and control can be difficult. Mechanical cutting is inadequate, as mature plants readily re-sprout. Herbicide choice will depend on site conditions, and repeated herbicide applications followed by careful monitoring are usually required. The best control of *V. nigrum* and *V. rossicum* will most likely occur with an integrated management approach.

RANGE

V. nigrum is native to western European Mediterranean regions. The earliest North American herbarium specimen of *V. nigrum* was collected in Ipswich, Essex County, Massachusetts in 1854. Collections have also been made in New York, Michigan, Ohio, Rhode Island, Vermont, Pennsylvania, Illinois, Missouri, Connecticut, Maine, Maryland, New Jersey, New Hampshire, Indiana and Wisconsin (Sheeley and Raynal 1996). Additional states listed in the USDA plants profile database (USDA 2000) include Kansas, Kentucky, Nebraska and California. Pringle (1973) notes *V. nigrum* in four counties of Ontario.

V. rossicum is native to the Ukraine and southwestern European Russia, and is apparently endemic to regions north of the Black Sea. The "Flora of the USSR" published in 1952 locates the species in the south of the European part of Russia, and Caucasus (correspondence between Andre Gassman and Sergey Y. Reznik). The first collections of *V. rossicum* were in Monroe and Nassau counties, New York State, in 1897. Massachusetts, Pennsylvania, New Jersey, Indiana, Connecticut, New Hampshire and Michigan have recorded collections (Sheeley and Raynal 1996). The species has also been reported from Wisconsin (personal communication, Kelly Kearnes, TNC). Pringle (1973) documents its presence in eight counties in southern Ontario. Very large populations are known from central New York and the Toronto, Ontario region.

HABITAT

Both *V. nigrum* and *V. rossicum* are associated with disturbances, particularly with anthropogenic disturbances such as highway, rail, utility and other transportation corridors, limestone quarries, abandoned pastures and old fields, Christmas tree plantations, nursery crops and other perennial crops. *Vincetoxicum* species can successfully invade natural areas with some type of disturbance regime. Rivers and streams that experience spring flood scouring or areas subject to hydrologic extremes such as in the alvar communities of the eastern Lake Ontario region or New England coastal areas, are vulnerable to invasion. *V. nigrum* and *V. rossicum* are ecologically similar, flourishing in sunny open areas, shrub habitats and hedges, as well as under fully shaded forest canopies.

V. nigrum is found in a wide range of upland habitats and is primarily a species of woods and moist sunny places (Gleason and Cronquist 1991). Coastal and roadside infestations are common, indicating a probable tolerance of alkaline soils and a possible preference for calcareous soils.

In central New York State, *V. rossicum* habitats range from dry and sunny to shaded and moist, from shallow soils on limestone bedrock to deep well-drained silt-loam soils, from wooded ravines and talus slopes to alluvial woods, pastures and grasslands. *V. rossicum* is associated with calcareous soils.

V. nigrum habitat in its native western Mediterranean region is slopes, copses and stoney, dry areas from sea level to 500 meters (Fournier 1977). *V. rossicum* native habitat is steppe, sandy hills and ravines (correspondence between Andre Gassman and Sergey Y. Reznik).

IMPACTS

V. nigrum and *V. rossicum* can both form dense stands that displace desirable native species. Community dynamics studies have not been carried out, but large, mono-specific stands of these two *Vincetoxicum* species suggest they can suppress other plant species via competition for soil moisture and nutrients, light, other environmental factors, or via alleopathy. Large-scale ecosystem modification appears obvious, but has not been studied.

Populations of *Vincetoxicum* are frequently established in disturbed areas such as limestone quarries, old agricultural fields, utility rights-of-way or transportation corridors. *V. nigrum* can be persistent on ice-scoured banks (e.g. along the Connecticut River near Windsor, Vermont), streamsides exposed to forceful spring snowmelts (e.g. Great Gully Preserve, Cayuga County, NY), and alvar sysems exposed to severe flood/drought hydrologic cycles (e.g. Jefferson County, NY). At these sites, *V. nigrum* may threaten the survival of rare and threatened native species, such as Jessop's milkvetch (*Astragalus robbinsii*) in Vermont (personal communication, Robert Popp, Vermont Nongame and Natural Heritage Program). *V. rossicum* has apparently increased from occasional patches to dominant stands covering 5 hectares (Montezuma National Wildlife Refuge, Seneca Falls, NY), to a 30 hectare mono-specific stand (Grenadier Island, Jefferson County, NY) within 50 to 100 years.

Vincetoxicum species may also adversely affect butterfly populations. Laboratory trials testing Monarch (*Danaus plexippus* L.) butterfly oviposition indicated that these butterflies will oviposit on *V. nigrum* rather than on native *Asclepias* species commonly known as milkweeds. The eggs and larvae oviposited on *Vincetoxicum* experience high levels of mortality while those on native *Asclepias* species do far better (personal communication with Richard Cassegrande). This intrusion into the obligate relationship of Monarch reproduction on *Asclepias* species is of concern, especially as *Vincetoxicum* increases its range, because it may lead to declines in numbers of Monarchs. The survival and persistence of *Asclepias* spp. in *Vincetoxicum* infestations need to be studied.

BIOLOGY AND ECOLOGY

Light, temperature and mositure

V. nigrum and *V. rossicum* are both tolerant to a wide range of light intensities. Populations of both species can be dominant in either densely shaded sites or sites in full sun. Their density, cover and reproductive effort are strongly correlated with light availability, however. Cover and density both decrease with decreasing irradiance (Lawlor 2000). Lawlor (2000) found mean densities of stems greater than 25 cm tall in fully shaded, partially shaded, and open sites to average 58, 102, and 178 m^{-2}, respectively. Sheeley (1992) found mean densities of flowering ramets to be 15.5 m^{-2} in shaded sites and 84.8 m^{-2} in open sites. In densely shaded sites, *Vincetoxicum* can be the dominant understory (herbaceous layer) species, but flowering and seed production tend to be low.

In shaded sites, non-reproductive populations of *Vincetoxicum* may persist for years. When a disturbance event finally takes place that can release plants from light competition (forest gap situation), these plants can rapidly respond by producing seed (Sheeley 1992). Under garden cultivation, the time from seed germination to its first seed crop was two growing seasons (Lawlor, unpublished data).

V. nigrum and *V. rossicum* can tolerate a variety of soil conditions, ranging from thin droughty soils over shallow bedrock to streamside alluvial soils. Sheeley (1992) found that in thin soils, ramets of *Vincetoxicum* were able to maintain low water tension in stem xylem, which enables it to survive in these harsh sites. At his shaded site, midday and pre-dawn water potentials were -0.43 and -0.23 Mpa and at sunny sites, -0.06 and -0.08 Mpa, respectively.

Reproduction

The reproductive behavior of *V. nigrum* and *V. rossicum* is similar. *V. nigrum* blooms June through September (Gleason and Cronquist 1991). In central New York State, *V. rossicum* flowers bloom in late May through early July in sunny locations. In more shaded locations, both species bloom a week or two later and for a longer period, often into August. *V. rossicum* 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 (Lawlor, personal observation). Lumer and Yost (1995) used insect exclusion techniques to confirm that *V. nigrum* is capable of self-pollination but is also pollinated by insects. Using similar techniques, Lawlor (2000) observed bees, wasps, flies, ants and beetles visiting and presumably pollinating *V. rossicum* flowers. Individual visitors bearing pollinia were observed from these insect families—flies: Anthomyiidae, Trixoscedididae, Sarcophagidae; ants: Formicidae; and beetles: Curcurlionidae. Christensen (1998) collected floral visitors to *C. rossicum*, including these families—flies: Anthomyiidae, Sacrophagidae, Calliphoridae; bees and wasps: Syrphidae, Vespidae and Halictidae; ants: Myrmicinae and Formicidae; beetles: Carabidae.

Sheeley (1992) found the fruit to flower ratio to be 1:5 in fully-exposed situations and 1:14 in shaded areas. Fruit ripens late July in sunny locations and throughout August in shadier locations. Seed production is highest in locations receiving full sun exposure. Seed production decreases as shading increases. Sheeley (1992) found mean seed production per flowering ramet to be 15.5 in shaded sites and 84.8 in open sites, translating to 1330 and 2090 seeds m^{-2}, respectively. Observations of both species growing in complete shade found little reproductive effort--flowers were few and fruits rare (Lawlor, personal observation). The ability of both *V. nigrum* and *V. rossicum* to produce polyembryonic seeds (more than 1 embryo per seed) may increase their reproductive potential (Sheeley 1992).

Seed germination is bimodal with germination of some seeds in the fall and others in the following spring. Sheeley's (1992) germination study found 22.5% germination in the greenhouse and 46% in a growth chamber. Germination of seeds kept in the dark in the growth chamber was just 36% while 46% of those exposed to light germinated. Seed longevity of these species is unknown.

The seed bank dynamics of *V. nigrum* and *V. rossicum* are unknown. Plant life span of these two species is also unknown, but populations have persisted for at least 70 years at Great Gully, Cayuga County, New York (personal communication, Central-Western New York Chapter of The Nature Conservancy).

Vegetative reproduction

The confirmation of rhizomes in *V. nigrum* suggests vegetative reproductive capacity in that species. Both species readily resprout after destruction of the aboveground shoot. Dormant buds on the root crowns of *V. rossicum* can readily re-sprout when cut.

Seed Dispersal

Seeds of *Vincetoxicum* are wind-dispersed, bearing the tuft of hairs, or coma, typical of the milkweed family. Observations indicate a large proportion of seeds remains close to the parent plant. Many small, satellite populations are often found downwind of large seed source populations (Lawlor, personal observations). Dispersal distances have not been studied.

Human land management activities may also contribute to dispersal. There is concern that mature plants and seeds may be harvested in hay making operations, then inadvertently introduced to new sites via hay shipments. Infestations are typically found on old limestone mine tailings and along rights-of way including railroads, highways, old canals and utility lines. Traffic and maintenance procedures along these rights-of-way may contribute to seed dispersal into new areas.

ECONOMIC USES

V. nigrum is believed to have arrived to North America as a horticultural plant, but neither *V. nigrum* nor *V. rossicum* are currently favored as such. *V. rossicum* is reported to have been grown at the Ottawa Central Experimental Farm from 1940 to 1942 as part of a war-time study of possible rubber substitutes (McNeill 1981). The closely related *V. hirundinaria* was utilized in post-World War I Lubeck, Germany as a fiber plant where it was processed much like linen (Hegi 1907-31). There are no current economic uses for *Vincetoxicum* species in North America.

The flowers of *V. nigrum* and *V. rossicum* are often visited by nectar gathering insects, some visits resulting in pollen transfer (Lumer and Yost 1995, Christensen 1998, Lawlor 2000), but the number and native status of these insects have not been studied.

MANAGEMENT

Restoration potential

The prevention of new infestations is the best management method for the control of any invasive species, and *Vincetoxicum* is no exception. Prevention may be difficult, however, because the *Vincetoxicum* species are already widely distributed in the northeastern US, upper midwest and adjacent Canada and seeds of both are readily dispersed by the wind. Land managers have reported that once *Vincetoxicum* is established it is difficult to control mechanically or with herbicides. The eradication of isolated plants and small patches is possible with persistence and an early detection system. Large areas infested with *Vincetoxicum,* however, will require persistent effort and follow-up monitoring to control. *Vincetoxicum* will most likely be controlled only by the implementation of a multi-year integrated management approach accompanied by intensive revegetation efforts. Native species that can provide significant competition (for light, nutrients, etc.) early in the growing-season, have the highest likelihood of promoting control of *Vincetoxicum.*

Sensitive areas downwind of large populations will require particular attention for prevention, early detection and control efforts. Cooperation with adjacent landowners, particularly in preventing the release of seeds from large established populations, is important to prevent further spread of *Vincetoxicum*.

Manual and Mechanical Control

Land managers of The Nature Conservancy's Central and Western New York chapter at the Great Gully Preserve report that digging up *V. rossicum* root crowns was more effective than hand pulling alone. The stem tends to break easily above the root crown if pulled while the root crown itself is held tenaciously in place by the fibrous root system and has several perennating buds which can readily resprout if the stems are cut or broken. If the root crown is pulled up, it must be removed from the site and/or destroyed because broken root crowns tossed on the ground have been observed to re-grow. This suggests that disk harrowing may not be a successful control method, and may actually contribute to increases in patch size. Mowing presents the same rapid re-sprouting problem as manual pulling.

Fruits of *Vincetoxicum* can be manually removed and carried off-site to prevent seed dispersal, but this practice is time-consuming and must be continued until no more pods are produced and the plants senesce at the end of the growing season. It is more effective to remove the entire plant by mowing or pulling as it takes the plants a long time to recover and they often cannot do so in time to produce more seeds that season.

Chemical Control

Lawlor (2000) reported that the responses of *Vincetoxicum* spp. to herbicides varied by site and site condition. In one study, the effects of applications of the herbicides glyphosate and triclopyr on the biomass and the density of stems greater than 25 cm tall (those plants not sheltered from foliar herbicide application by other plants in the *Vincetoxicum* canopy), was measured and compared to a no treatment control. RoundupPro (active ingredient glyphosate), 2% formula solution, reduced biomass by 83% and reduced density of stems >25 cm by 61%. RoundupPro, 5% formula solution, (above label recommendation), reduced biomass by 84% and reduced density of stems >25 cm by 84%. Garlon4 (active ingredient triclopyr ester), 1% formula solution, reduced biomass by 83% and reduced density of stems >25 cm by 77%. All foliar spray treatments were superior to cut-stem treatments. RoundupPro, 50% formula solution, cut-stem application, reduced biomass by 55% and reduced density of stems >25 cm by 38%. Garlon 3A (active ingredient triclopyr amine), 25% formula solution, cut-stem application, reduced biomass by 55% and reduced density of stems >5 cm by 8%. The effects of foliar applications were not statistically separable. Lawlor's (2000) results were highly variable depending on light and moisture availability. The foliar sprays had no detectable impact on *Vincetoxicum* seedlings and juveniles that were present below the treated, adult plants.

Herbicide choice for foliar spray treatments will depend on site conditions. In degraded patches with little desirable vegetation, glyphosate (RoundupPro,) may be preferred. At sites with desirable grasses that should be conserved, triclopyr ester (Garlon 4, Pathfinder II) would be the herbicide of choice. Follow up treatments will be required.

An additional study (Lawlor in prep) comparing cut-stem applications of increasing concentrations of glyphosate (Roundup Pro: 50%, 100%) and triclopyr amine (Garlon 3A: 25%, 50%, 100%) found all tested concentrations of glyphosate were superior to all triclopyr amine concentrations tested. Cut-stem glyphosate applications gave good control of adult plants. Marked stems > 30 cm high received cut-stem applications of the herbicide treatments. Survival was measured the following growing season. The cut-stem, no herbicide control had 100% survival. The RoundupPro 50% formula solution had 2% survival. The RoundupPro 100% formula solution had no survivors. The Garlon 3A 25% formula solution had 81% survival. The Garlon 3A 50% formula solution had 41% survival. The Garlon 3A 100% formula solution had 26% survival. The results of the 50% and 100% concentrations of RoundupPro were not statistically separable. In situations where spraying is impractical, cut-stem applications with follow up treatments should be effective. Repeated follow-up herbicide treatments are necessary for good control.

Prescribed Burning
Fire alone is not effective in reducing populations of *V. rossicum*. A large area infested with *V. rossicum* was burned at Montezuma National Wildlife Refuge in late spring 1999 to reduce woody debris. The plants recovered and grew and reproduced as usual the following season. The root crown is generally at least a centimeter or more below the soil surface, and is thus protected from the heat of a rapid burn. Burning may be useful after herbicide control of mature growth to control the less-established seedling layer. Seedlings of *Vincetoxicum* lack the well-developed root crown of more mature plants. Flame burners might be used for this purpose. This should be tested before use on a large scale.

Grazing
Grazing is of mixed utility in controlling *V. rossicum.* Cattle will suppress the species but infestations can rebound swiftly when pastures are abandoned. Horses do not eat *Vincetoxicum* and may encourage it by reducing competition from other plants. White-tailed deer appear to shun both *Vincetoxicums*. Grazing impacts require study.

Flooding
Vincetoxicum species are intolerant of prolonged flooding and wetland habitats. Seasonal flooding, however, is tolerated by *Vincetoxicum* and generally does not contribute to its control.

Biological Control
Vincetoxicum nigrum and *V. rossicum* appear to have few pests, diseases or other natural controls in North America. Neither Sheeley (1992) nor Lawlor (2000) observed significant mammal, insect or pathogen damage to *V. rossicum*. A literature survey by Andre Gassman, CABI-Switzerland, (unpublished) indicates several monophageous insects on *Vincetoxicum hirundinaria* in Europe. Gassman notes a complex of Chrysomelidae which are associated with *Vincetoxicum* species in their native range. He further notes that most chrysomelids are successful agents. There are also a few flies, Tephritidae and Cecidomyiidae, that could offer potential control. The taxonomic and chemical isolation (Liede 1996) of *Vincetoxicum* make these invasives within this genus likely candidates for biological control by phytophageous insects in North America. *Vincetoxicum hirundinaria* is known to be a vector for a fungus, *Cronartium flaccidum*, affecting 2 needle pines in Europe (Ragazzi et al 1998), but little is know about pathogens that may be potential controls of *Vincetoxicum*.

MONITORING
Where large populations of these wind-dispersed seeds are known to be nearby, monitoring is very important. Mid- to late-summer is an optimal time to search for new populations. Senescing leaves of *Vincetoxicum* are a distinctive warm-yellow color and can be differentiated easily from the background vegetation. The often-paired follicles are readily observed. Plants in sunny locations set seed and senesce earlier than do plants in shaded locations. Search efforts should focus on open areas first and then move into shadier locations. Shaded areas will often continue growth into September in central New

York state. Emptied follicles persist on the vines in brushy areas for a season or two, so populations can be located in the winter. Any time after flowering commences is a good time to develop a good search image. Plants can be confused with young oriental bittersweet (*Celastrus orbiculatus*) or small gray-twig dogwood (*Cornus racemosa*).

Yearly monitoring following control will be necessary for assessments of survival and seedling establishment. Until more is known about how long seeds persist in the seed bank it won't be possible to know for sure how long sites where *Vincetoxicum* has been controlled should be monitored for germinating seedlings. Periodic monitoring will be necessary wherever large seed source populations remain nearby. Protocols for monitoring revegetation for desired natives should be established prior to control.

RESEARCH NEEDS

Vincetoxicum species have not been subject to extensive research. Research needs are great, including investigations into mechanisms of establishment and spread, disturbance requirements, seed bank dynamics, long-term ecosystem impacts, alleopathy, effects on herbaceous layer and tree seedling establishment, herbivory, impact on breeding and feeding of native insects, birds and mammals, nutrient dynamics, resistance to invasion, and management.

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REFERENCES

Christensen, T. 1998. Swallowworts, the ecology and control of *Vincetoxicum* spp. Wildflower: 21-25.

Fournier, P. 1977. Les quatres flores de la France. Vol.1. 2nd edition.

P. 866. Editions Lechevalier S.A.R.L., Paris.

Gleason, H. A. and A. Cronquist. 1991. Manual of vascular plants of the northeastern United States and adjacent Canada, Second edition. The New York Botanical Garden, Bronx, New York.

Hegi, G. 1907-31. Illustrierte flora von Mittle-Europa. Vol. 5. J. F. Lehmann, Munich, Germany.

Lawlor, F. M. 2000. Herbicidal treatment of the invasive plant *Cynanchum rossicum* and experimental post control restoration of infested sites. M.S. Thesis, State University of New York College of Environmental Science and Forestry, Lawlor, F. M. and D. J. Raynal. 2001. Response of *Vincetoxicum rossicum* to herbicide application. Weed Science (pending).

Lumer, C. and S. E. Yost. 1995. The reproductive biology of *Vincetoxicum nigrum* (L.) Moench (Asclepiadaceae), a Mediterranean weed in New York State. Bulletin of the Torrey Botanical Club 122:15-23.

McNeill, J. 1981. Taxonomic, nomenclatural and distributional notes on Canadian weeds and aliens. Le Naturaliste Canadien 108:237-244.

Mitchell, R. S. and G. C. Tucker. 1997. Revised checklist of New York State plants. New York State Museum Bulletin No. 490. University of the State of New York, Albany, New York.
Pringle, J. S. 1973. The spread of *Vincetoxicum* species (Asclepiadaceae) in Ontario. The Canadian Field Naturalist 87:27-33.

Sheeley, S. 1992. The distribution and life history characteristics of V. rossicum (*Vincetoxicum rossicum*). M.S. Thesis, State University of New York College of Environmental Science and Forestry,

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

United States Department of Agriculture. 2000. Plant Profile for CYR08. http://plants.usda.gov/plants/cgi_bin/plant_profile.cgi?symbol=CYR08

United States Department of Agriculture. 2000. Plant Profile for CYL011. http://plants.usda.gov/plants/cgi.bin/plant_profile.cgi?symot=CYL011

Watson L. and M. J. Dallwitz. 1992 onwards. The families of flowering plants: Descriptions, illustrations, identification, and information retrieval. Version: 14th December 2000. http://www.keil.ukans.edu/delta/angio/www/asclepia.htm