

Invasive Plant List



Planting for a *livable* Delaware

Widespread and Invasive

			<u>Growth Habit</u>
1.	Multiflora rose	<i>Rosa multiflora</i>	S
2.	Oriental bittersweet	<i>Celastrus orbiculata</i>	V
3.	Japanese stilt grass	<i>Microstegium vimineum</i>	H
4.	Japanese knotweed	<i>Polygonum cuspidatum</i>	H
5.	Russian olive	<i>Elaeagnus umbellata</i>	S
6.	Norway maple	<i>Acer platanoides</i>	T
7.	Common reed	<i>Phragmites australis</i>	H
8.	Hydrilla	<i>Hydrilla verticillata</i>	A
9.	Mile-a-minute	<i>Polygonum perfoliatum</i>	V
10.	Clematis	<i>Clematis terniflora</i>	S
11.	Privet	Several species	S
12.	European sweetflag	<i>Acorus calamus</i>	H
13.	Wineberry	<i>Rubus phoenicolasius</i>	S
14.	Bamboo	Several species	H

Restricted and Invasive

15.	Japanese barberry	<i>Berberis thunbergii</i>	S
16.	Periwinkle	<i>Vinca minor</i>	V
17.	Garlic mustard	<i>Alliaria petiolata</i>	H
18.	Winged euonymus	<i>Euonymus alata</i>	S
19.	Porcelainberry	<i>Ampelopsis brevipedunculata</i>	V
20.	Bradford pear	<i>Pyrus calleryana</i>	T
21.	Marsh dewflower	<i>Murdannia keisak</i>	H
22.	Lesser celandine	<i>Ranunculus ficaria</i>	H
23.	Purple loosestrife	<i>Lythrum salicaria</i>	H
24.	Reed canarygrass	<i>Phalaris arundinacea</i>	H
25.	Honeysuckle	<i>Lonicera</i> species	S
26.	Tree of heaven	<i>Ailanthus altissima</i>	T
27.	Spotted knapweed	<i>Centaruea biebersteinii</i>	H

Restricted and Potentially-Invasive

28.	Butterfly bush	<i>Buddleia davidii</i>	S
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Growth Habit: S=shrub, V=vine, H=herbaceous, T=tree, A=aquatic

THE LIST

- Plants on The List are non-native to Delaware, have the potential for widespread dispersal and establishment, can out-compete other species in the same area, and have the potential for rapid growth, high seed or propagule production, and establishment in natural areas.
- Plants on Delaware's Invasive Plant List were chosen by a committee of experts in environmental science and botany, as well as representatives of State agencies and the Nursery and Landscape Industry.
- An environmental assessment was conducted on each of the plants listed, and placement on the list results from review of the scientific literature, as well as a consensus of expert opinion. Plants on the list are ordered from highest invasiveness.
- Plants on the list should not be planted, under any circumstances, and should be removed from properties as feasible.
- Listed plants that are currently in the nursery trade should be phased out of inventory and production.
- Homeowners are encouraged to ask nurseries, garden centers, and landscapers for non-invasive plants, preferably natives.
- Widespread and Invasive plants are currently invasive, cause serious management concerns or pose a serious threat to the biological diversity of Delaware.
- Restricted and Invasive plants are equally problematic. However, they have a more localized distribution in Delaware.
- This list will be widely distributed to nurseries, garden centers, landscapers, homeowners, gardeners, and land managers.

**A more complete list can be viewed at:
www.dnrec.state.de.us/fw/wildrehe.htm**

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Fact Sheet #1

Multiflora Rose (*Rosa multiflora*)



Photo: James H. Miller, USDA Forest Service

Description & Identification

Native to Eastern Asia, Multiflora Rose was introduced to the United States in the late 1800's as rootstock for ornamental rose species, and was later recommended by the Soil Conservation Society (NPS PCA) for planting as hedgerows (Uva et al, 1997). State conservation departments soon discovered value in Multiflora rose as wildlife cover for pheasant, bobwhite quail, and cottontail rabbit and as food for songbirds and encouraged its use by distributing rooted cuttings to landowners free of charge. More recently, Multiflora rose has been planted in highway median strips to serve as crash barriers and to reduce automobile headlight glare. Its tenacious and unstoppable growth habit was eventually recognized as a problem on pastures and unplowed lands, where it disrupted cattle grazing. For these reasons, Multiflora rose is classified as a noxious weed in several states, including Iowa, Ohio, West Virginia, and New Jersey (NPS PCA). This species has since become naturalized and is now found throughout the eastern half of the US as far west as the Rocky Mountains and in the western US is seen in California, Washington, and Oregon (USDA PLANTS, 2006).

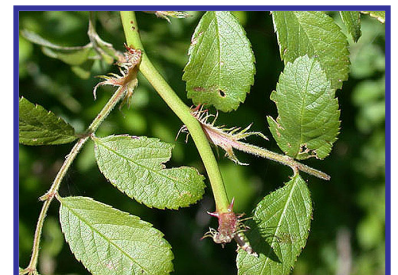
Multiflora Rose resembles ornamental Rose species in that it is typically 1-3 meters tall, has heavily prickled stems, and forms dense, impenetrable thickets when allowed to grow uncontrolled. The canes of Multiflora rose are bright green when new, and may take on a reddish hue at maturity. The leaves are compound, and are composed of 7 to 9 leaflets. Multiflora rose may be differentiated from ornamental Rose species in two ways. First, the leaf stem, or petiole, has brushy hair-like structures, called stipules, where the stem joins the cane. Secondly, the flowers of Multiflora rose are quite small, 2.5cm, and begin to appear in June. The reddish colored fruits are clustered and persist through the winter.

Multiflora Rose establishes new stands primarily by seed dispersal. Birds and other wildlife feed on these seeds quite readily and it is thought that seed germination is enhanced by passing through the digestive system. Once established, Multiflora rose spreads by runners, or adventitious shoots. When the overarching canes of mature plants touch the soil, they form roots and may then form more runners. It has been estimated that an average Multiflora rose plant may produce a million seeds per year, which may remain viable in the soil for up to twenty years.

Multiflora rose is very difficult to control once established and it is for this reason that any small sites found should be controlled immediately. Once established, control may be obtained through mechanical means such as mowing and through the use of systemic herbicides such as glyphosate. Be advised that any of these methods will take more than a year to be effective, and rely upon continued monitoring to be effective. In high quality natural communities, cutting of individual plants is preferred to site mowing to minimize habitat disturbance. Various herbicides have been used successfully in controlling multiflora rose but, because of the long-lived stores of seed in the soil, follow-up treatments are likely to be necessary (NPS PCA). Non-systemic herbicides, such as the growth regulator 2,4-D may be used to prevent seed production but will not kill the plant itself, nor is it likely to prevent the formation of runners. Remember, when applying herbicides to always read the label. The label is the law! For control options in ecologically sensitive areas, contact your local extension agent.

References & Further Information

- Invasive Species Info Government Portal.
<http://www.invasivespeciesinfo.gov/profiles/multiflrose.shtml>
- NPS Plant Conservation Alliance. <http://www.nps.gov/plants/alien/fact/romul.htm>
- Weeds Of The Northeast. Uva, R.H., J.C. Neal, and J.M. DiTomaso. Cornell University Press, 1997.



Close-up showing leaf stipules
Photo: IPANE, 2004

Fact Sheet #2

Oriental Bittersweet (*Celastrus orbiculatus*)

SYN *C. articulatus*, *C. orbiculata*)



Photo: Hugh H. Iltis

Description & Identification

Oriental bittersweet is also known as Asiatic bittersweet and Round-leaved bittersweet. *C. orbiculatus* was introduced to the United States from China as an ornamental around 1860. It is an invasive, deciduous, woody-vine species and may be found across the entire East Coast from Maine to Florida, and is seen on the West Coast as well. Like Porcelain-berry (*Ampelopsis brevipedunculata*), Oriental Bittersweet climbs nearby tree and shrub species, forms dense blankets of foliage which then shade out everything underneath. Another issue related to the spread of *C. orbiculatus* is that it may hybridize with a closely related native species, American Bittersweet (*C. scandens*). The only reliable way in which Oriental Bittersweet may be distinguished from its relative *C. scandens* is by the location of its fruit - *C. orbiculatus* has small clusters of 3-7 fruits in the leaf axils (where the leaf joins the branch) while *C. scandens* has clusters at its branch tips. These fruits are orange to red in Oriental bittersweet while those of American Bittersweet are yellow to orange. The two species may be capable of hybridizing and since the native is relatively rare it is possible that its distinct genetic identity is threatened (Dreyer, TNC). As American bittersweet is a somewhat rare species, it is in danger of becoming extinct through hybridization.

Little research has been conducted on *C. orbiculatus* control but low-growing populations have been successfully treated by cutting and applying triclopyr herbicide to the regrowth about a month later. Larger vines may be cut and the stump treated immediately with triclopyr herbicide. Unfortunately, Asian bittersweet is frequently cultivated and its fruits are gathered for decorative use, which will make preventing further spread and reinfestation all the more difficult. For this reason it is of the utmost importance that land managers, naturalists, botanists, students, horticulturists, gardeners, retailers, etc. learn to distinguish between the native and the introduced bittersweet vine (Dreyer, TNC).



Bittersweet vine, and foliage close up
Photographer: James H. Miller, USDA



Fruit of American Bittersweet
Photographer: Dennis W. Woodland

References & Further Information

- Dreyer, G. D. Element Steward Abstract for *Celastrus orbiculata*. The Nature Conservancy.
- Uva, R.H., J.C. Neal, and J. M. DiTomaso. Weeds of the Northeast. Cornell University Press, 1997.

Fact Sheet #3

Japanese Stilt Grass (*Eulalia viminea*

SYN *Microstegium vimineum*)



Photo: Chuck Barger, University of Georgia

Description & Identification

Japanese stilt grass is currently established in 16 eastern states, from New York to Florida. It occurs on stream banks, river bluffs, floodplains, emergent and forested wetlands, moist woodlands, early successional fields, uplands, thickets, roadside ditches, gas and power-line corridors, lawns and gardens. Japanese stilt grass threatens native understory vegetation in full sun to deep shade. Stilt grass readily invades disturbed shaded areas, like floodplains that are prone to natural scouring, and areas subject to mowing, tilling and other soil-disturbing activities including white-tailed deer traffic. It spreads opportunistically following disturbance to form dense patches, displacing native wetland and forest vegetation as the patch expands. Japanese stilt grass appears to be associated with moist, acidic to neutral soils that are high in nitrogen.

Japanese Stiltgrass is an annual in the grass family (Poaceae) resembling a small, delicate bamboo; mature plants are 2 to 3 feet in height. The leaves are pale green, lance-shaped, asymmetrical, about 3 inches in length, with a shiny midrib. The flowers, fruits and seeds are nondescript with delicate spikes of flowers emerge from slender tips in late summer and early fall. Fruits are produced shortly after flowering and then the entire plant dies. Japanese Stiltgrass spreads vegetatively by rooting at joints along the stem (a new plant can emerge from each node) and by seed. A single plant can produce 100 to 1,000 seeds that remain viable in the soil for at least three years, ensuring its persistence. Stiltgrass seed germinates readily following soil disturbance. Although dispersal is not fully understood, seeds are probably transported by movement of water (e.g. surface runoff, streams, and floodwaters), soil, plants and on the feet of other animals including people.

Because it is similar in appearance to several native grasses, it is important to know how to recognize and differentiate stilt grass from endemic species, such as Virginia cutgrass (*Leersia virginica*), Hairy Jointgrass or Small Carpetgrass (*Arthraxon hispidus*), and possibly other delicate grasses and wildflowers like Ladysthumb smartweed (*Polygonum persicaria*). The shiny midrib and asymmetrical leaves help to distinguish stilt grass. Early attention to new infestations should be a priority. Because it is shallow-rooted, stilt grass may be pulled by hand at any time. Flowering plants can be cut back using a mower or weed whip prior to seed production. For extensive infestations, contact and systemic herbicides may be more practical and effective.



Virginia cutgrass



Small carpetgrass



Ladysthumb smartweed

References & Further Information

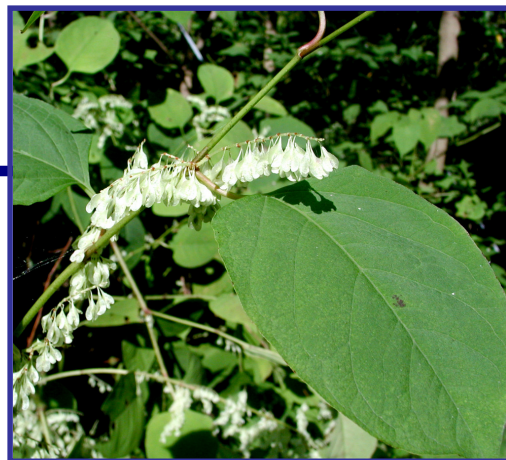
Plant Invaders of Mid-Atlantic Natural Areas. Herbaceous Plants.
<http://www.fws.gov/chesapeakebay/Bayscapes.htm>

Virginia Tech Weed Identification Guide. Available online at:

<http://www.ppws.vt.edu/weedindex.htm>

Fact Sheet #4

Japanese knotweed (*Polygonum cuspidatum*
SYN *Fallopia japonica*, *Reynoutria japonica*)



All Photos: Zak Skibo, University of Delaware

Description & Identification

Japanese Knotweed is a native of Japan, China, and the Korean Peninsula. First discovered in the mid-1700's, it was brought to Europe and subsequently distributed to the US for use as an ornamental and a source of animal forage sometime during the mid-1800's. One of the first documented samples of Japanese knotweed in Delaware is a sample held in the Delaware State herbarium which dates from the turn of the 20th century. In the United States, Japanese knotweed is known as *Polygonum cuspidatum*, while in the UK it is referred to as *Fallopia japonica*. In Europe, particularly Eastern Europe, it is most often called *Reynoutria japonica*. Recent research has indicated that the correct nomenclature is, in fact, *Fallopia japonica*.

Japanese knotweed is an herbaceous, rhizomatous perennial species which resembles bamboo when actively growing. Unlike bamboo, Japanese knotweed is extremely frost sensitive and goes dormant every fall. On the mid-Atlantic seaboard, Japanese knotweed emerges from basal rhizome buds mid to late March and may attain a height of 12 to 15 feet (3-4 meters) at maturity. The stems, called culms, are composed of several jointed sections with a thin membrane called an ocrea around each joint. The flowers of Japanese knotweed are quite fragrant, produced in abundance, and are known to be a good source of pollen and nectar for bees. These flowers each produce one triangular (trigonal) seed which is enclosed by a papery membrane left over from the flower. In the United Kingdom and Europe, most seeds of Japanese Knotweed are sterile due to a lack of male pollen. In the United States, genetic variation, as well as the availability of male pollen from the closely related Giant knotweed (*Polygonum sachalinensis*) allows the production of fully viable seed. The primary means by which Japanese knotweed reproduces is through vegetative propagation. Fragments of plant tissue, whether it be from leaves, culms, or rhizomes quickly roots and produces a new mother plant, clonally identical to its parent. Japanese knotweed has been successfully propagated from tissue samples weighing as little as 7 grams!

Japanese knotweed is typically found in riparian areas, along roadside and railway right-of-ways, forest margins, abandoned home sites, in disturbed areas, and increasingly, is seen on agricultural lands. Once established, Japanese knotweed forms dense stands which quickly out compete native flora. These stands do not provide suitable habitat for any other species, contribute to flooding, and prevent access to bodies of water. Activities such as mowing create millions of potential propagules, each capable of being carried off by either naturally, or through human interaction and may result in the establishment of new stands and subsequent spread of this noxious species.

Japanese knotweed is very difficult to control once it is established. Unfortunately, Japanese knotweed has no natural predators in the United States, nor is it suitable as a food source for animals. Mechanical control methods such as mowing, digging, or grubbing, and mulching require the complete removal of all portions of the plant, including all rhizome material. Mechanical control alone has shown to be ineffective at preventing the spread of this species and requires a substantial investment of time and labor. Herbicidal control has been shown to work when implemented over a number of years and when combined with other control methods such as mowing and removal, as well as prevention of spread to new areas. Systemic herbicides such as Glyphosate, Dicamba, and Triclopyr have shown good control over Japanese knotweed. Single season control with Glyphosate can be poor. However, when tank mixed with Carfentrazone, control is significantly increased with regards to biomass reduction. As Japanese knotweed is usually found in close proximity to water, make sure to use the appropriate herbicide and make sure to always follow the label.



Japanese knotweed stand along the Nanticoke River, Sussex Co., Delaware.

Fact Sheet #5

Russian Olive (*Elaeagnus angustifolia*),
Autumn Olive (*E. umbellata*)



Photos courtesy National Park Service

Description & Identification

A native of temperate Asia, from the Caucasus mountain range, through Iran, Afghanistan, and east to Mongolia and China, Russian Olive was imported to the US during the 1800's as an ornamental species. Even recently this species was recommended as a planting for windbreaks, wildlife habitat, and right-of-ways by the U.S. Soil Conservation Service. It has since escaped cultivation and has become a serious problem in riparian zones, where it can out compete most native plant species. Russian Olive is a small to medium sized deciduous tree species. Leaves have distinct silvery scales on their surfaces and the bark peels from the trunk in long stringy strips. Russian Olive is often found growing in close proximity with its close relative, Autumn Olive or Silverberry (*E. umbellata*). Autumn Olive, which is also an invasive species, may be differentiated from Russian Olive by height, as Autumn Olive rarely grows taller than 15ft at maturity while Russian Olive may reach 30ft. The silvery fruits of Russian Olive are preceded by yellow, highly fragrant flowers while the fruits of Autumn Olive are much smaller, reddish to pink in color. The fruits of Russian Olive and Autumn Olive are edible. While Russian Olive can become an important food source for wildlife, studies have suggested that species diversity is lower in Russian Olive monocultures than in undisturbed habitats. Russian Olive spreads primarily by seed dispersal, though vegetative propagation of shoot material is not uncommon.

Russian olive is most often found in disturbed, seasonally moist places. It is common in riparian zones, floodplain forests, sub-irrigated pastures, and irrigation ditches, but is also found in drier sites such as railroad beds, fence lines, along highways, and in grasslands. Russian olive tolerates a wide range of soil and moisture conditions, from sand to heavy clay, and can withstand flooding and silting. It grows best in deep sandy or loamy soils with only slight salt and alkali content. Russian Olive is highly tolerant of drought conditions. This species is also tolerant of considerable soil salinity or alkalinity. It can withstand temperatures ranging from -50 degrees F (-45 degrees C) to 115 degrees F (46 degrees C). Russian Olive is one of the few trees capable of nitrogen fixation and this fact allows established specimens to grow almost anywhere adequate moisture can be found.

Russian Olive may be obtained by mowing seedlings and cutting down mature specimens. Prevention of seed dispersal through tree destruction and removal should be the primary focus of any control measures. Cut stumps should be treated with systemic herbicides to control resprouting. Additionally, homeowners should be encouraged to plant native trees and shrubs as alternatives to both Russian Olive and Autumn Olive. A few examples of shrubs native to much of the eastern U.S. include spicebush (*Lindera benzoin*), witch hazel (*Hamamelis virginiana*), pawpaw (*Asimina triloba*), flowering dogwood (*Cornus florida*), Bursting-heart or strawberry-bush (*Euonymus americanus*) and arrowwood (*Viburnum dentatum*) (Muzika & Swearingen, 2005). Other native species options include Gray Dogwood (*Cornus racemosa*), Black Haw (*Viburnum prunifolium*), and Winterberry (*Ilex verticillata*).

References & Further Information

- Deiter, Laura, 2006. California Invasive Plant Council (Cal-IPC). Available online at:
<http://ucce.ucdavis.edu/datastore/detailreport.cfm?usernumber=46&surveynumber=182>
- Muzika, Rose Marie, and J.M. Swearingen, 2005. Russian Olive (*Elaeagnus angustifolia*) Fact Sheet.
<http://www.nps.gov/plants/alien/fact/elan1.htm>



Fact Sheet #6

Norway maple (*Acer platanoides*)



Photo courtesy: John Frett, University of Delaware

Description & Identification

Norway maple (*Acer platanoides*) is a tree that is usually grows to 12-18 m (40-60 ft.) in height, but can reach heights of 30 m (100 ft.). The bark of the tree is grayish and regularly and shallowly grooved. The palmately lobed leaves are opposite and have 5 to 7 sharply acuminate lobes. These leaves are 10-18 cm (4-7 in.) wide. The margins have few, large teeth. When the petiole of a leaf is broken, it exudes a white sap. The leaves are usually green in color, but there are some cultivars that have dark red leaves. The fall color of the normal green tree is yellow. The flowers appear in April and May and are yellow-green in color. Each flower is 5-6 mm (0.25 in.) wide. The pendulous fruit measure 4-5 cm (1.5-2 in.) in length. The fruit, called 'samaras', are green when young and turn yellow, then brown, with age (IPANE, 2005). The wings are divergent and are nearly 180 degrees to each other, unlike those of the Sugar maple (*Acer saccharum*), which are closer together, ± 45 degrees.

Norway Maple is ranked number one on a list of the ten most invasive species still sold as ornamentals in Delaware (Plants for a Liveable Delaware, 2004). Norway Maple reproduces both vegetatively through root extension and sexually through seed production and dispersal. When allowed to grow uncontrolled, Norway maple tends to produce dense stands or monocultures which crowd out other less competitive species.

Before enacting any control programs on Norway maple, make sure that you are not dealing with a lookalike species! Norway maple can be confused with many maples species, especially sugar maple (*Acer saccharum*), because of similar looking leaves. It can be distinguished from native maples by the presence of a milky white sap that oozes out of leaf veins and stalks when broken. Norway maple is easily spotted in the autumn when its leaves turn yellow late in the season. That said, Norway maple can be controlled in a number of ways. The first, and easiest is to plant other tree species which are not invasive and preferably are native. Some recommended replacement species include: American beech (*Fagus grandifolia*), Red maple (*Acer rubrum*), Sourwood (*Oxydendrum arboreum*), Sweet gum (*Liquidambar styraciflua*), Willow oak (*Quercus phellos*), and Black gum (*Nyssa sylvatica*). Other methods of control include hand-pulling seedlings, mechanical control of saplings through mowing or cutting, and chemical control of mature trees. With regards to chemical control, one must cut and remove the tree itself and treat the stump with a systemic herbicide such as glyphosate or triclopyr. Cut stumps will most likely have to be treated multiple times to control resprouting.



Acer platanoides Seed

Photo: Stacy Leicht



Acer platanoides Fall Color

Photo: Mehrhoff, Leslie J



Acer saccharum Seed

Photo: Stacy Leicht

References & Further Information

- Invasive Plant Atlas of New England (IPANE), 2005. <http://webapps.lib.uconn.edu/ipane/browsing.cfm?descriptionid=32>
- Livable neighborhoods: Plants for a Livable Delaware Campaign, 2004. Available online at: http://www.state.de.us/planning/livedel/information/ln_native.shtml

Fact Sheet #7

Common Reed (*Phragmites australis*)



Photo: Markku Savela

Description & Identification

Common reed (*P. australis*) is a tall, warm-season, perennial, sod-forming grass. The stems, called culms, are erect, rigid, smooth, and hollow. They may be nearly an inch in diameter and from 6 to 16 feet tall. Leaves arise from the culm and are mostly 25-50 cm long and 1-5 cm wide. It has an extensive rhizome network and occasionally produces aboveground roots, or stolons, as well. Roots grow down to a depth of about 3 feet. The feathery, plume-like flower head is 13-40 cm long and composed of many long branches that point upwards. Narrow clusters of flowers are arranged densely along the branches. The flowers are surrounded by silky white hairs that are purplish at first, becoming tawny to dark brown at maturity. Seeds are brown, thin and delicate. A long, narrow bristle is attached to each seed. The seed and bristle together measure approximately 8 mm long.

Peat core sampling has revealed the possibility that *Phragmites australis* has been present to some degree in North America for at least the past 40,000 years (Hansen, 1978). What isn't fully understood are the causal factors behind the population explosion documented in this species since the turn of the 20th century. One theory holds that increased human activities and changes in land use have driven the expansion. An alternative hypothesis focuses on the introduction of more invasive European haplotypes of *P. australis*. Genetic analysis has found about 27 known variants of Common Reed worldwide, 11 of which are native to North America. Four of these eleven haplotypes, AA, F, Z, and S are endemic to the Northeast. Only two variants are found worldwide and of these two, only one, haplotype M is common here. This variant is considered the ancestral variant and is found throughout Asia, Africa, and Europe (Saltonstall, 2001).

Phragmites is typically the dominant species on areas that it occupies. It is capable of vigorous vegetative reproduction and often forms dense, virtually monospecific stands. The plants generally flower and set seed between July and September and may produce great quantities of seed. In the northeast, seeds are dispersed between November and January. The seeds are normally dispersed by wind but may be transported by birds such as red-winged blackbirds that nest among the reeds. Once a new stand of Phragmites takes hold it spreads, predominantly through vegetative reproduction. Individual rhizomes live for 3 to 6 years and buds develop at the base of the vertical type late in the summer each year. These buds mature and typically grow about 1 meter (up to 10 m in newly colonized, nutrient-rich areas) horizontally before terminating in an upward apex and going dormant until spring. The apex then grows upward into a vertical rhizome which in turn produces buds that will form more vertical rhizomes. Vertical rhizomes also produce horizontal rhizome buds, completing the vegetative cycle. These rhizomes provide the plant with a large absorbent surface that brings the plant nutrients from the aquatic medium. The aerial shoots arise from the rhizomes (Marks et al, 1993).

Phragmites is difficult to control once established due to the amount of biomass produced, the ease with which it spreads via vegetative propagation, and due to the nature of the areas where it is typically found. Mowing and digging can be used to remove small stands though care must be taken to remove all of the tissue to prevent reestablishment. Burning has been used quite effectively throughout the mid-Atlantic region. Systemic herbicides such as glyphosate are also effective. Make sure that products are chosen which are labeled for use on or near water. Any control program will involve multiple treatments and a requirement to provide follow up visits to ensure that remaining live plants do not reestablish.

References & Further Information

- Hansen, R.M., 1978. *Paleobiology* 4, 302-319.
- Marks, M., B. Lapin, and J. Randall, 1993. Elemental Stewardship Abstract for *Phragmites australis*, Common Reed. TNC, 1815 North Lynn Street, Arlington, Virginia 22209 (703) 841 5300
- Saltonstall, Kristin. 2001. Cryptic invasion by a non-native genotype of the common reed, *Phragmites australis*, into North America. PNAS February 19, 2002 vol. 99 no. 4 2445-2449

Available online at: <http://www.invasiveplants.net/phragmites/PNAS.pdf>

Fact Sheet #8



Photo: Vic Ramey, 1999

Hydrilla (*Hydrilla verticillata*)

Description & Identification

While there is only one species of Hydrilla in the world, *Hydrilla verticillata*, there are two types that may be found. A dioecious type (plants with female flowers only) and a monoecious type (plants with male and female flowers). The dioecious type is thought to have originated from southern India, while the monoecious type most likely came from Korea (Madeira *et al.* 1997). Hydrilla occurs on all continents except Antarctica. A female dioecious plant was introduced into Florida in the mid-to-late 1950s and this form of Hydrilla has since spread throughout the southeastern states including Georgia, Alabama, Virginia, and South Carolina. Hydrilla is found as far west as Texas and California. Monoecious Hydrilla is found in lakes in North Carolina and the Potomac River near Washington D.C. and also has been reported in Maryland and Delaware. Washington State represents the northernmost occurrence of Hydrilla in the United States. Hydrilla was first identified in DE in 1981 and within 3 years had spread to most (Miller, 1998) Sussex County ponds. Control of Hydrilla accounts for the largest portion of DE's aquatic weed control budget.

This plant is a perennial aquatic species, occurring in fresh or brackish water, lakes, rivers, marshes, and tidal zones; and can be found at depths of only a few inches up to 20 feet. The stems of a single plant may reach 25 feet in length. Hydrilla does not require high nutrient conditions to grow. Hydrilla is somewhat winter-hardy, tolerating a temperature gradient of 68- 81° F (Kasselman 1995). In the southern US, Hydrilla overwinters as a perennial species, while in the north, including Delaware, it dies back every winter and re-sprouts from underground roots, or tubers, in the spring. The primary factor giving Hydrilla a competitive edge against our native aquatic plant species is its tolerance to low light conditions. Hydrilla has been found to grow in only 1% sunlight! Low light compensation and saturation points and low CO₂ compensation point make it a competitive plant because it can start growing in low light before other plants do (Van et al. 1976; Bowes 1977). In both types, the leaves are 2 - 4 mm wide (or as small as 1 mm wide on monoecious plants) and 6 - 20 mm long. They occur in whorls of 3 - 10 leaves along the stem. They generally have sharp spines along the leaf margin which give the leaves a toothed appearance, visible without magnification. They also often have spines along the lower midrib of the leaf which will cause the plant to feel rough (more common in the dioecious form). The midrib of each leaf is often reddish when fresh. There are small, axillary leaf scales found next to the stem and inserted at the base of the leaf, a character that distinguishes hydrilla from other family members.

Reproduction of Hydrilla is by two methods. The most common is vegetative propagation, where stem fragments are transported naturally or by man to new areas which then take root. The other method is through tubers and axillary buds, called turions. The tubers can remain viable in the soil for more than four years (Van & Steward 1990). Both types of hydrilla produce tubers and turions in abundance in the fall as dormant overwintering structures. The monoecious form will also make tubers in the spring and will produce non-dormant turions throughout the growing season. The monoecious variety can set viable seed. However, the presence of seedlings appears to be rare, so seed production may be a minor means of reproduction.



Hydrilla leaf arrangement



Hydrilla infested pond

Control

The biggest issues for aquatic plant managers are tuber and turion production. It has been shown that one tuber can lead to the production of over 5,000 new tubers per square meter. The tubers and turions can withstand ice cover, drying, ingestion and regurgitation by waterfowl, and herbicides. The monoecious form apparently puts more of its energy into tuber and turion production than the dioecious form, and so has a greater potential for spread by these means. *Hydrilla verticillata* is an invisible menace, invisible that is until it fills the lake or river that it infests, "topping out" at the surface. Hydrilla can grow an inch a day. When Hydrilla invades, ecologically-important native submersed plants such as pondweeds are shaded out by Hydrilla's thick mats, or are simply outcompeted, and eliminated (van Dyk 1985). Dense Hydrilla infestations can alter water chemistry and oxygen levels (Pesacreta 1988). Aside from destroying native plant species habitats, *Hydrilla verticillata* greatly slows water flow and clogs irrigation and flood-control canals. Additionally, Hydrilla seriously interferes with boating, both recreational and commercial, and prevents swimming and fishing; major infestations limit sportfish weight and size (Colle & Shireman 1980).

Hydrilla can be controlled, though generally not eradicated, either through chemical (herbicide applications) or biological (fish) methods. There are several herbicides that are effective with hydrilla; those containing diquat, endothall, complexed copper, or fluridone as the active ingredient. Sonar PR (precision release – active ingredient fluridone) has been used most recently in the public ponds of Delaware. Chemicals provide relatively fast-acting control, but may have to be applied at one or two year intervals due to the presence of the tubers which continue to sprout (C. Martin, DNREC, personal communication).

An alternative method for control is through the use of triploid grass carp, a plant-eating fish. Delaware has a grass carp policy which allows possession of this non-native fish only with a permit from the Division of Fish and Wildlife. The guidelines for possession, designed to protect aquatic habitat in Delaware, require: no possibility of escape from pond where stocked, presence of a preferred plant food species, a restriction on stormwater basins, etc. An onsite inspection of each pond is made following receipt of an application for grass carp. Permits are granted only for triploid grass carp – considered to be sterile. The complete policy and a briefing report on grass carp are available online at www.dnrec.delaware.gov/fw/warmfish.htm. The possession of grass carp in Maryland is strictly prohibited because of concerns that they may impact Chesapeake Bay plant restoration efforts. No permits are granted for Delaware ponds which drain directly into tributaries of the Chesapeake Bay (C. Martin, DNREC, personal communication).

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Fact Sheet #9

Mile-a-minute (*Polygonum perfoliatum* SYN
Ampelgynonum perfoliatum, *Persicaria perfoliata*)



Description & Identification

Mile-a-minute is also known as Minute weed, Giant climbing tearthumb, Asiatic Tearthumb, and Devil's tearthumb. It is a native of Eastern Asia, China, and from Japan to the Philippines. One of the first records of mile-a-minute in North America was in Beltsville, Maryland (1937). This site was eliminated and did not establish a permanent population. A later introduction of mile-a-minute in the late 1930's with contaminated nursery stock in York County, Pennsylvania resulted in a successful population. The owner of the nursery was interested in the plant and allowed it to reproduce; unfortunately, subsequent efforts to eradicate it were not successful. Mile-a-minute has radiated from original introduction site into Maryland, Virginia, West Virginia, Pennsylvania, New, York, New Jersey, and Delaware (J. A. Gerlach-Okay, PCA).

This species is a summer annual vine reaching 7 meters in length at maturity. Seedlings emerge in late April and grow rapidly. Capable of climbing shrubs, trees, and structural elements and quickly forms dense mats of vegetation which can choke out less competitive species. The leaves are triangular to heart-shaped, similar to those of Wild Buckwheat. The leaf stems and the vine itself are covered with recurved spines, a fact which allows distinguishing this species from Wild Buckwheat. The flowers of this species are inconspicuous and appear in June, persisting through August in the mid-Atlantic region. This species readily self-pollinates and produces an abundance of seed. The fruits are light blue to dark violet berries and ripen from late August through November. The primary means by which this species spreads is via seed dispersal, usually carried by birds or through contaminated soil. Mile-a-minute, being a tender annual species, is frost susceptible and dies with the first light frost. Seedlings will not emerge until well after the frost-free date. Mile-a-minute readily colonizes woodlot edges, stream banks, roadsides, and fencerows and may become a problem in nursery and forest crops which do not get mowed or tilled regularly.

Mile-a-minute can be controlled with a combination of physical, mechanical, cultural, and chemical methods. These control methods will be easier to implement and more likely to succeed if implemented prior to the establishment of large stands and prior to seed production. A variety of control measures, including physical, mechanical, cultural and chemical, can be used for management of mile-a-minute weed. Hand pulling of seedlings is best done before the recurved barbs on the stem and leaves harden. But may be done afterwards with the help of thick gloves. Removal of vines by hand may be conducted throughout the summer, if tough gloves and protective clothing (coveralls) are worn to avoid the skin shredding ability of the recurved hooks. The delicate vines can be reeled in fairly easily and balled up in piles that can be left to dehydrate for several days before disposal. The site must be rechecked at frequent intervals, and removal of new plants continued until the seed germination period is complete, roughly early April until early July in the middle Atlantic states. Repeated mowing or trimming of mile-a-minute plants will prevent the plants from flowering and thus reduce or eliminate fruit and seed production (PCA, 2006). Biological control may become an option in the future thanks to research being done at the University of Delaware using (Colpetzer et al, 2004a,b). A stem-boring weevil, *Rhyncomimus latipes*, was determined to be host-specific to mile-a-minute weed and a permit application for field release was approved in July 2004. Mass rearing of weevils is currently being investigated and several release sites are being monitored. It is estimated that the substantial populations required for control of mile-a-minute are still several years off. As such, successful control will most likely be a result of combination of the above techniques.

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Fact Sheet #10

Clematis (*Clematis terniflora* SYN.
C. paniculata, *C. maximowicziana*)



Photo courtesy: Missouri Botanical Garden

Description & Identification

A native of eastern Asia, China, and Japan, *Clematis terniflora* is now naturalized across much of the US due to escape from cultivation. Clematis is a member of the buttercup family, Ranunculaceae. In most areas of introduction it is a deciduous to semi-evergreen species. Clematis has the potential to grow over 30 feet at maturity with a main stem diameter exceeding four inches. Clematis requires support as it is a vine and will do just as well on a tree as it does on a trellis. Unfortunately, given enough time, Clematis can overwhelm smaller trees and slowly kill them. Clematis derives its invasive potential from its rapid seasonal growth which may quickly overwhelm slower growing trees and shrubs and from the wide dispersal of its wind-borne seeds. While *C. terniflora* is not native to the US, a close relative, *C. virginiana*, is. The easiest way to tell these two vines apart is to examine the leaves. Those of our native clematis are "toothed" while those of the invasive form are smooth.

Clematis is a perennial species, emerging from previous year's growth. The dark green leaves may have a silver central band present. Flowering occurs from late summer into early fall. The flowers are abundant, sweet-scented, and star shaped. The flowers cover the vine and last into early fall. The seed begins to develop by October and are usually mature by November, after which time the plant will go dormant. As Clematis is self pollinating, many of these seeds will be viable. A major issue in controlling this species is preventing the spread of these seeds by wildlife or through the activities of humans.

Stands of Clematis may be controlled through a variety of method. Seedlings may be pulled by hand or mowed and mature plants can be mowed or cut by hand. It may be easier to cut larger plants in the winter while they are dormant. As for chemical control options, Glyphosate-based products or growth regulator herbicides such as 2,4-D and Dicamba may be employed. As with all invasive plant species, the easiest method of control will lie in prevention.

One thing the homeowner can do to stop the spread of invasive Clematis species is to plant non-invasive native Clematis species. Instead of planting the Sweet Autumn Clematis, consider our native Virgin's-bower, *Clematis virginiana*. It too is a handsome flowering vine most suitable for landscape planting and is a vigorous climber that will display many clusters of small flowers from midsummer to early fall. The Virgin's Bower Clematis is a showy perennial native vine that will make an excellent landscape feature. It prefers partial shade or partial sun. If in full sun, it is likely to bloom more prolifically but its roots need to be shaded. So, give it plenty of mulch as a protection against the summer sun. Soil should also be moist for best performance. A soil pH range of 6.0 to 7.0 is acceptable. Space the vines 7 to 10 feet apart. An arbor, trellis or fence will be necessary to support and display this native vine that will be a fantastic addition to any garden (Kerry Johnson, MSU Extension Service).



C. virginiana flowers
Photo: Eleanor S. Saulys, 2000

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Fact Sheet #11

Privet (*Ligustrum obtusifolium*, *L. vulgare*,
L. sinensis, *L. japonicum*, *L. ovalifolium*)



Photo courtesy TNC

Description & Identification

The name 'Privet' actually refers to about eight *Ligustrum* species currently in cultivation and commonly sold in the ornamental trade as border species. Of these eight species, four which may be encountered with highest frequency across the US are Border privet (*Ligustrum obtusifolium*), European privet (*L. vulgare*), Chinese privet (*L. sinensis*), and Japanese privet (*L. japonicum*). California privet (*L. ovalifolium*) may also be encountered as a result of the ornamental trade. The various species of privet were introduced to the United States at various times as ornamentals and are commonly employed as border species. "European privet was introduced sometime during the 1700s, obtuse-leaved privet in 1860, Japanese privet in 1945 and Chinese privet in 1952. They escaped cultivation and are now established throughout the eastern part of the country. European privet occurs in scattered locations across the United States. Chinese and Japanese privet are found in the Southeast and Midwest. Border privet is found in most of the Northeast" (Swearingen *et al*, 2002). Border privet grows to 3 m with spreading or arching branches. European privet grows to 5 m with spreading branches. Chinese privet is a shrub or small tree to 7 m. Japanese privet generally grows to 3 m, rarely to 6 m (Batcher, M.S., 2000).

Ligustrum spp. can form dense thickets that outcompete native vegetation. The privets can invade natural areas such as floodplain forests, woodlands, and disturbed agricultural fields. They generally expand along fence-rows, windbreaks and roadsides (Haragan 1996). In New Zealand, *L. sinense* may displace the shrub layer and marginal shrubs of alluvial forests, and remain persistent in these areas. *L. japonicum* and *L. sinense* invade woodlands in the eastern and southeastern U.S. (Faulkner *et al*. 1989; Stone 1997). Forest gaps can also become invaded since birds often disperse *Ligustrum* seeds (Batcher *et al*, 2000). Privet species will slowly escape cultivation by vegetative propagation through the formation of adventitious root and shoot formation. Of much greater concern is the dispersal of *Ligustrum* species seed by wildlife as dispersal by this method occurs over much greater distances and allows for the rapid spread of this species. Germination rates have shown to range from a low of 5-7% up to 77%. In North America, *Ligustrum* spp. have no important pests or predators. The various species are widespread and occasionally locally abundant (Batcher, M.S., 2000).

Privet species control methods include mowing and cutting, seedling removal, herbicide application, and burning. Mowing and cutting are appropriate for small initial populations or environmentally sensitive areas where herbicides cannot be used. Stems should be cut at least once per growing season as close to ground level as possible. Repeated mowing or cutting will control the spread of *Ligustrum* spp., but may not eradicate it. *Ligustrum* spp. can also be effectively controlled by manual removal of young seedlings. Herbicide control measures include foliar spraying in late autumn or early spring with glyphosate, triclopyr, or metsulfuron; cut stump applications using glyphosate or triclopyr; and basal bark applications of triclopyr. Some reports indicate that burning top-kills *L. vulgare* and *L. sinense* and, if repeated, can eliminate them over time (Batcher, M.S., 2000). Alternative, native plantings include Inkberry (*Ilex glabra*), Spicebush (*Lindera benzoin*), Blackhaw (*Viburnum prunifolium*), and Chokecherry (*Aronia spp.*).

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Photo by J. Miller, IPANE

Fact Sheet #12



Photo: Janet Novak, 2000

Sweetflag (*Acorus calamus*)

Description & Identification

Sweetflag (*Acorus calamus*) is an herbaceous, perennial forb species found throughout the United States. There are two species of *Acorus* found in the Eastern United States, both referred to as Sweetflag. One, *A. americanus*, is a native species, while the other, *A. calamus*, was introduced by early European settlers as a medicinal plant. In general, *A. calamus* may be differentiated from its native relative by the fact that it has larger, longer leaves and a larger flower-like structure, known as a spadix. This spadix is found held at a right angle from the rest of the plant and is unique to Sweetflag. Both Sweetflag species have bright green foliage which makes them easy to spot in their preferred habitat of bogs, marshy areas, in riparian zones, and near residences. *Calamus americanus* is often found growing near old native American village sites and it is thought that the distribution of this species is largely a result of trade amongst the various tribes. The rhizomes and leaves of Sweetflag give off a sweet odor when crushed.

The growth habit of Sweetflag is very much like that of the common Iris. Sweetflag will be found in areas of full sun all the way through partial shade. Propagation is primarily via rhizome fragmentation due to flooding or animal/ human interactions with stands of this plant. Flowering occurs in early spring and continues through early summer. The native Sweetflag is known to set viable seed while the introduced Sweetflag is a sterile species, and as such, does not set viable seed. Therefore, propagation is entirely vegetative. Sweetflag rhizomes propagate easily, and the introduced species has spread throughout the northeast and central United States (Motley, 1994). Unfortunately, with regards to controlling the spread of European Sweetflag on a national level, this may be an impossibility. Many nursery centers still sell a variegated cultivar of *Acorus calamus*, *Acorus calamus* 'Variegatus', often noting that it is not invasive. Furthermore, the difficulty in distinguishing native Sweetflag from its European cousin has led even some people involved in site remediation to plant *A. calamus* rather than *A. americanus*. Locally, you can do something. Educate those involved in the nursery and ornamental trade to propagate *A. americanus* rather than *A. calamus*. If you have planted European Sweetflag on your property, prevent its spread to unintended areas, or remove this species and replace it with American Sweetflag. Hand pulling of Sweetflag plants is the most likely method of eradication. Systemic herbicides which are suitable for use around waterways, such as glyphosate, may be an option for very large Sweetflag stands.



C. calamus

Photo: Denverplants.com, 2006



C. variegatus

Photo: Tripplebrookfarms.com, 2006



Sweetflag spadix

Photo: Crocus.co.uk, 2006

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Fact Sheet #13

Wineberry (*Rubus phoenicolasius*)



Photo: Jil M. Swearingen

Description & Identification

A member of the Rose family, Wineberry is native to Japan, China, and the Korean Peninsula. It was introduced to the US in the 1890's as breeding stock for other raspberry species and cultivars. Wineberry is now found from New England and eastern Canada south to North Carolina and west to Michigan and Tennessee. It is considered an invasive plant of natural areas in Maryland, Pennsylvania, Tennessee, Virginia, North Carolina, West Virginia, and the District of Columbia (N.R. Spencer, 2000). Wineberry is frequently encountered in fields, forest margins, railroad and highway right-of-ways, and may be found on abandoned home sites.

Wineberry has long stems, called canes, that grow in arches and are covered with distinctive red hairs and spines. The hairs give the canes a reddish color when seen from a distance. Leaves are compound, with three heart-shaped, serrated leaflets with purplish veins and silvery white hairs on the underside. Small greenish flowers with white petals and reddish hairs occur in Spring. The sepals are longer than the petals, and for this reason, the flowers often appear to be "unopened". The very edible raspberry-like fruit is bright red, has small reddish hairs, and ripens during June and July (Spencer, 2005). Wineberry may grow to 10 feet tall in a season. Wineberry spreads through seed production and dispersal as well as through vegetative propagation of root and shoot cuttings. The arching canes will form roots where they come into contact with the soil, allowing Wineberry to form dense thickets when allowed to grow uncontrolled.

Wineberry is closely related to the domestic raspberry and for this reason is often used as a virus indicator for several economically important plant viruses such as Black Raspberry necrosis virus, Raspberry leaf curl luteovirus, and Wineberry latent virus. Unfortunately, this species can also act as a reservoir for these same viruses and provide a source of infectious material for any cultivated species grown nearby. Wineberry can be controlled through cutting and mowing of established stands and through herbicidal treatment of seedlings and resprouts using systemic herbicides such as triclopyr or glyphosate.

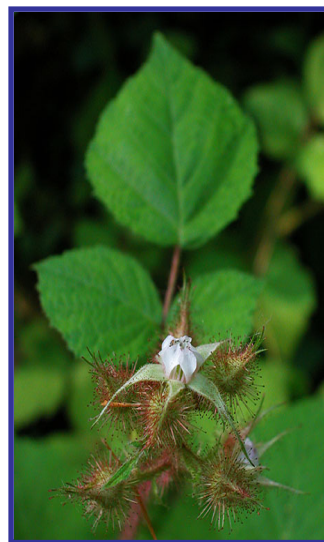


Wineberry stems.

Britt Slattery, USFWS



Wineberry fruit



Closed growth habit of Wineberry flower

www.DelawareWildflowers.org

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Fact Sheet #14

Bamboo: *Phyllostachys bambusoides*, *P. aurea*,
P. heterocycla, *P. aureosulcata*, *P. nigra*,
Pleioblastus pygmea, *P. variegatus*



Photo: Forest & Kim Starr

Description & Identification

The term 'Bamboo' actually encompasses quite a few distinct species of subfamily Bambusoideae, with a majority of the invasive species coming from genus *Phyllostachys* and *Pleioblastus*. They are commonly sold in the US ornamental trade as ground covers for difficult or low maintenance areas as well as for screening and shading purposes. Unfortunately, many are planted with inadequate barriers to prevent their subsequent spread to unintended areas, where they become increasingly difficult to control once established. **Clumping bamboos** have rhizomes (roots) that grow only a short distance before sending up new shoots called culms. Most clumping bamboos cannot tolerate more than a few degrees of frost. **Running bamboos** have rhizomes that produce long offshoots before sending up new culms. It is the more aggressive species of running bamboo that have caused bamboo to suffer so much bad press. Many running bamboos can tolerate frost down to about 0 degrees F or lower. Bamboo follows an annual growth cycle that is somewhat different from other plants. For running bamboos, this cycle begins with the onset of warm weather in March or April. At this time, last year's leaves are shed on the older culms and replaced with new leaves. This process has led to an unusual Japanese term for the spring season: "Bamboo autumn." At about the same time, new shoots emerge from the underground rhizome. Within a matter of weeks, most of the bamboo shoots "telescope" into new culms. The growth rate of the culms during these few weeks can be very rapid, especially in the larger bamboo species. Once the culm has grown to its full height, all vertical growth ceases. Gradually side branches appear on the new culm, followed by leaves. The culm does not become entirely woody until its third or fourth year. Individual culms rarely live for more than ten years and start to decline after about the fifth year. (Will Roberds, 2005)

Clumping bamboos follow a slightly different growth cycle. New growth usually begins in June or July with the onset of hot, rainy weather. Shooting continues most of the summer and can continue until frost. On clumping bamboos, the new culms will often not develop branches or leaves until the next summer. Most of the below-ground growth of bamboo occurs in the late summer and fall. At this time the bamboo rhizomes put out new underground branches in preparation for the next year's growth. Found across the mid-Atlantic and southern US, most, if not all *Phyllostachys* species are highly invasive and difficult to keep under control in a landscape environment.

At maturity, the culms may reach 40' in height and 2 ¼" in diameter. *Phyllostachys nigra* may reach 60' in height with a culm diameter of 3 ¼". *Phyllostachys* species are drought tolerant once established and grow in full sun to part shade given adequate soil moisture. They tolerate a wide range of soil conditions from basic to alkaline and thrive where other species may not. Dormant in the winter, these species may tolerate temperatures as low as 0 degrees Fahrenheit. The two species of *Pleioblastus*, *P. pygmea* and *P. variegatus*, are easily distinguished from their larger cousins in genus *Phyllostachys*, as their maximum height tends not to exceed 4' and their culms are generally quite slender (1/4").



Phyllostachys aureosulcata

Control

If you intend to plant bamboo as an ornamental on your property, make sure you determine its species so that you may adequately control its growth and prevent intrusion into other areas, including your neighbor's property. You may be held liable for cleanup under Delaware TITLE 3, PART II, CHAPTER 27. NUISANCE PLANTS. Once established, bamboo can be extremely difficult to control and/or eradicate. This difficulty may be compounded if the stand crosses a boundary between the homeowner's property and a neighbor or onto state or federal lands.

To prevent a running bamboo from spreading, a "rhizome barrier" is essential. A barrier two or three feet deep is effective. It should be slanted outward at the top so that when the rhizomes hit the barrier they will bend upwards. A barrier does not stop a running rhizome; it only deflects it. The barrier should project an inch or two above ground level. Check the barrier once a year, and cut off rhizomes that arch over the top. Barriers can be concrete, or metal, or plastic. The usual recommendation is high-density polypropylene, 40 mil or heavier, glued or taped at junctions, or clamped with stainless-steel clamps. This material comes in rolls, or as hinged sections, and is available from some landscape suppliers and bamboo nurseries, frequently termed *root barrier*. More elaborate barriers with corner posts that hold the material at the proper angle are also available (Shor, 2004). Do not confuse these heavy duty root barriers with the lightweight plastic sheeting sold as weed blocking material for use in landscape bedding. These light gauge plastic sheets will not stop bamboo rhizomes from penetrating into unwanted areas! If you insist on planting a bamboo species, stick with a clumping species such as those from genus *Fargesia*. *F. nitida*, *F. murielae*, *F. dracocephala*, *F. robusta*, and *F. rufa* (Lucas, 2004).



Left to Right: *Fargesia nitida*, *F. murielae*, *F. robusta*, and *F. rufa*

Photos: Ned Jaquith, 2005

To control established stands of Bamboo, start with physically removing as much of the rhizome and root mass as possible. For large infestations, this will require the use of power equipment. It will be impossible to remove all pieces; therefore, follow-up treatment with herbicides will generally be required. Few herbicides are effective on bamboo. The only treatment regime that has been proven to be effective are winter applications of diclobenil (Casoron or Barrier) combined with summer spot sprays with glyphosate (Roundup). Diclobenil will kill many of the rhizomes and prevent others from re-establishing through early summer. After that time new sprouts will emerge and must be controlled to prevent re-establishment. Recent research has shown that glyphosate (Roundup, Roundup-Pro, Glyfos, others) works better than other postemergence herbicides (such as Finale) for this purpose. However, Roundup does not translocate well to the rhizomes and bamboo will re-sprout. Reapply Roundup whenever new growth is present. It will take at least two years of this regime to attain control. In that time you will not be able to plant herbaceous ornamentals, hemlocks, or many other shrubs because diclobenil can kill these ornamental species. If the bamboo is growing in plant beds where these herbicides cannot be used, remember bamboo is a grass and can be suppressed with selective grass herbicides such as fluazifop-p (Fusilade II, Ornamec, or Grass-B-Gon) or clethodim (Envoy). Such selective grass herbicides can be applied over the top of many broadleaf ornamentals but are not as effective as glyphosate (Neal, 2005).

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Fact Sheet #15

Japanese barberry (*Berberis thunbergii*)



Photo: Britt Slattery, USFWS

Description & Identification

Japanese barberry was introduced to the United States as an ornamental in 1875. Seeds were sent from Russia to the Arnold Arboretum in Boston, Massachusetts. In 1896, it was planted at the New York Botanic Garden. It was eventually promoted as a substitute for *Berberis vulgaris*, an exotic plant introduced and used by early settlers from Europe for hedgerows, dyes and jams, and later found to be a host for the black stem rust of wheat. In the United States, Japanese barberry occurs throughout much of New England and the Northeast, south to North Carolina and west to Michigan and Missouri. Barberry forms dense stands in a variety of habitats, including closed canopy forests and open woodlands, wetlands, pastures, meadows and wastelands. This highly shade-tolerant exotic shrub displaces a variety of native herb and shrub species in areas where it is well established (Swearingen et al, 2002).

Japanese barberry is a small deciduous shrub from 2 to 8 feet tall. The thin, grooved branches have thin, straight spines. The leaves are small and wedge-shaped. The pale-yellow flowers are abundant on the plant. The berries ripen to a bright red color. Japanese barberry invades a variety of habitats from shaded woodlands to open fields and wetlands. It is very shade-tolerant and can form dense stands which shade out and displace native species. The berries are readily eaten and dispersed by birds, allowed Japanese barberry to spread rapidly. It is still widely planted for landscaping and hedges (www.invasive.org). Japanese barberry may be confused with American barberry (*Berberis canadensis*), the only native species of barberry in North America, and common or European barberry (*Berberis vulgaris*) which is an introduced, sometimes invasive plant (Swearingen, 2005)..

Japanese barberry reproduces from prolific seeds, rhizomes, or layering. Seeds have a germination rate as high as 90%, and are distributed by birds including ruffed grouse, bobwhite, pheasant, and wild turkey. Because barberry is shade tolerant, an extensive population can become established in a short time under a closed forest canopy. Severe drought or extreme winters have little effect on overall mortality or seed production (SE-EPPC, 2005).

Japanese barberry forms dense stands in natural habitats including canopy forests, open woodlands, wetlands, pastures, and meadows and alters soil pH, nitrogen levels, and biological activity in the soil. Once established, barberry displaces native plants and reduces wildlife habitat and forage. White-tailed deer apparently avoid browsing barberry, preferring to feed on native plants, giving barberry a competitive advantage. In New Jersey, Japanese barberry has been found to raise soil pH (i.e., make it more basic) and reduce the depth of the litter layer in forests (Swearingen, 2005).

Japanese barberry may be controlled through the application of systemic herbicides such as glyphosate, triclopyr, and dicamba. This species has a shallow, fibrous root system and is relatively easy to pull out when small, especially when the soil is moist. Hand removal of small stands or individual plants in ecologically sensitive areas may be the best option. If time does not allow for herbicidal treatment, mowing prior to flower set and subsequent seed production may help to prevent further spread. Suggest alternative species to homeowners and nurseries such as Spicebush (*Lindera benzoin*), blueberry (*Vaccinium* spp.), or Northern bayberry (*Myrica pensylvanica*).



Japanese barberry flowers

Photo: Leslie J. Mehrhoff, UConn

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Fact Sheet #16

Common Periwinkle (*Vinca minor*)



Photo Credit: Peter A Hogg Photography

Description & Identification

Common periwinkle, also known as Creeping myrtle or myrtle, is a common invader throughout most of the United States. Evergreen to semi-evergreen, this trailing vine reaches length up to 3 feet. The stems are slender, somewhat woody and green in color. The opposite, glossy leaves are approximately 1 inch long and narrowly elliptical in shape. Some varieties have variegated leaf colors. Flowers are violet to blue (possibly white) in color, 1 inch wide, and 5-petaled. Common periwinkle invades open to shady forests, often around former plantings at old home sites, and cemeteries. A common name that seems to have fallen out of usage is 'Flower-of-death' which may stem from its use as a marker of family burial plots. This species was also used as an ornamental at the funerals of children and infants. Another possible source of this odd name may come from medieval times when crowns of *V. minor* were placed on the heads of criminals sentenced to execution! It forms dense and extensive mats along forest floors that exclude native vegetation. It is native to Europe and was first introduced into America in the 1700s as an ornamental. It is still commonly sold as an ornamental ground cover.

Prevent the spread of periwinkle by not planting it in the landscape. Many native plants make excellent evergreen groundcovers and can be used in place of periwinkle, such as creeping phlox (*Phlox stolonifera*), partridgeberry (*Mitchella repens*) and three-toothed cinquefoil (*Potentilla tridentata*). Periwinkle can be removed mechanically by digging or by lifting up the runners with a rake and mowing the plants. Be sure to remove all of the plant, as the stems root easily wherever the nodes touch the ground. Periwinkle also is controlled by cutting the plants during active growth in early to late spring, followed by an application of a glyphosate herbicide such as Roundup. Any remaining plants can be removed by hand or spot-treated with the herbicide. Follow label directions when applying any herbicide (J. Courtney, 1997).

Native species that can be planted in place of *Vinca* include the vines Crossvine (*Bignonia capreolata*) and Virginia creeper (*Parthenocissus quinquefolia*). Other species that can be substituted as groundcovers include Wild ginger (*Asarum canadense*), Lady fern (*Athyrium filix-femina*), evergreen wood fern (*Dryopteris marginalis* or *intermedia*), Partridgeberry (*Mitchella repens*), Creeping phlox (*Phlox stolonifera*), New York fern (*Thelypteris noveboracensis*), and Foam flower (*Tiarella cordifolia*) (Swearingen et al, 2002).



Vinca flower

Photo: Dan Tenaglia

Vinca can be controlled in a number of ways, including hand pulling established plants and herbicide application. Systemic herbicides such as glyphosate or triclopyr may be most effective in controlling this species. Care should be taken when applying herbicides, especially if the *Vinca* is located on or around desirable species. *Vinca* will resprout from any remaining root tissue left behind, so follow up treatments, whether mechanical or chemical, should be planned for to prevent reinfestations.



Consider planting the alternative species Crossvine

Photo: Don Kurz, Smithsonian Institution

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Fact Sheet #17

Garlic mustard (*Alliaria petiolata*)



Description & Identification

Classified as an invasive or noxious species in Alabama, Connecticut, Minnesota, New Hampshire, Vermont, and Washington, Garlic mustard is found across the Eastern United States from Maine to Georgia, and as far west as Washington. First records of this species come from Long Island, New York, 1868. Garlic mustard is a cool season biennial herb with stalked, triangular to heart-shaped, coarsely toothed leaves that give off an odor of garlic when crushed. First-year plants appear as a rosette of green leaves close to the ground. Rosettes remain green through the winter and develop into mature flowering plants the following spring. Flowering plants of garlic mustard reach from 2 to 3-1/2 feet in height and produce buttonlike clusters of small white flowers, each with four petals in the shape of a cross. After spending the first half of its two-year life cycle as a rosette of leaves, garlic mustard plants develop rapidly the following spring into mature plants that flower, produce seed and die by late June. In the mid-Atlantic Coastal Plain region, seeds are produced in erect, slender, four-sided pods, beginning in May. These seed pods become tan and papery as they mature and contain shiny black seeds in a row. By late June, most of the leaves have faded away and garlic mustard plants can be recognized only by the dead and dying stalks of dry, pale brown seedpods that may remain and hold viable seed throughout the summer. A single plant can produce thousands of seeds. Although water may transport seeds of garlic mustard, they do not float well and are probably not carried far by wind. Long distance dispersal is most likely aided by human activities and wildlife. Additionally, because white-tailed deer prefer native plants to garlic mustard, large deer populations may help to expand it by removing competing native plants and exposing the soil and seedbed through trampling (Rowe & Swearingen, 2004).

Garlic mustard also poses a threat to the West Virginia White butterfly (*Pieris virginiensis*), an endangered insect species, native to the US. Several species of spring wildflowers known as "toothworts" (*Dentaria*), also in the mustard family, are the primary food source for the caterpillar stage of this butterfly. Invasions of garlic mustard are causing local extirpations of the toothworts, and chemicals in garlic mustard appear to be toxic to the eggs of the butterfly, as evidenced by their failure to hatch when laid on garlic mustard plants. Recognition of garlic mustard is critical. Several white-flowered native plants, including toothworts (*Dentaria*), sweet cicely (*Osmorhiza claytonii*), and early saxifrage (*Saxifraga virginica*), occur alongside garlic mustard and may be mistaken for it (Rowe & Swearingen, 2004).

Garlic mustard poses a severe threat to native plants and animals in forest communities in much of the eastern and midwestern U.S. Many native flowers that complete their life cycles in the springtime (e.g., spring beauty, wild ginger, bloodroot, Dutchman's breeches, hepatica, toothworts, and trilliums) occur in the same habitat as garlic mustard. Once introduced to an area, garlic mustard out competes native plants by aggressively monopolizing light, moisture, nutrients, soil and space. Wildlife species that depend on these early plants for their foliage, pollen, nectar, fruits, seeds and roots, are deprived of these essential food sources when garlic mustard replaces them. Humans are also deprived of the vibrant display of beautiful spring wildflowers (Rowe & Swearingen, 2004).

For very heavy infestations, where the risk to desirable plant species is minimal, application of the systemic herbicide glyphosate (e.g., Roundup) is also effective. Herbicide may be applied at any time of year, including winter (to kill overwintering rosettes), as long as the temperature is above 50 degrees F. and rain is not expected for about 8 hours (Rowe & Swearingen, 2004).

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West Virginia White
(*Pieris virginiensis*)
Photo: Will Cook

Fact Sheet #18

Euonymus (*Euonymus alatus*)



All photos courtesy TNC, 2005

Description & Identification

Euonymus alatus is a slow growing, deciduous shrub species. The name Burning Bush comes from the intense red coloration of the leaves in the fall. This species may also be referred to as Winged Euonymus due to the corky ridges or wings that run down the stems. Winter hardy to USDA zone 4, this species is also tolerant of full shade, allowing it to dominate forest understory and out compete most native flora. A native of northeastern Asia, Euonymus, or Burning Bush, has been a popular ornamental shrub species since the mid-1800's. Reports of escape from cultivation have been reported since 1980 and this species may now be found throughout the northeast to the Midwest. The primary methods of dispersal of this species are through seed production and subsequent dispersal by mammals and birds and through escape from cultivation. Asexual propagation of stem and root cuttings is possible. Euonymus is a prodigious seed producer and tends to form dense thickets when allowed to grown uncontrolled. Once established, these thickets can be quite difficult to remove due to the amount of seed produced.

Hand pull seedlings and dig out established plants. For the largest specimens, cut the above ground tissue down and remove the stump. Stumps may be left in the ground, but regrowth will occur and follow-up treatments must be planned for. Those stumps left in place should be painted with a systemic herbicide such as glyphosate or triclopyr. For areas where cutting plants out is not an option, foliar treatments of these systemic herbicides may work. Control work by The Nature Conservancy (TNC) has suggested that the optimum timing for foliar herbicide applications may be early summer, prior to the onset of flowering and subsequent seed production.

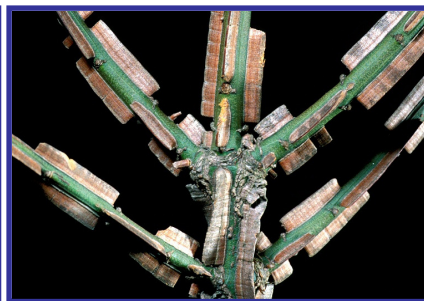
In addition to controlling established stands of Euonymus, homeowners can plant native and/or non-invasive species such as spicebush (*Lindera benzoin*), Strawberry bush (*Euonymus americanus*), maple-leaf viburnum (*Viburnum acerifolium*), wild hydrangea (*Hydrangea arborescens*), highbush blueberry (*Vaccinium corymbosum*), native red chokeberry (especially the cultivar *Aronia arbutifolia* 'Brilliantissima') or the non-invasive exotic Korean spice viburnum (*Viburnum carlesii*). Ask your local native plant society for further alternatives (TNC,2005).



Euonymus Fruits



Euonymus Leaves



Euonymus Stems

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Fact Sheet #19

Porcelain-berry (*Ampelopsis brevipedunculata*)



Photo: J.M. Swearingen

Description & Identification

Porcelain-berry is a native of China, Japan, and Eastern Russia and was originally brought to the United States around the 1870's as an ornamental species. Porcelain-berry is now recognized as an invasive plant. Once established it can quickly overwhelm and displace native plants. The vigorous vines of Porcelain-berry out compete trees and shrubs by reducing the availability of light, water, nutrients, and space. It has already invaded and destroyed native vegetation in the Delaware landscape. It also spreads by seed and through layering. Without controls Porcelain-berry will continue to spread.

Porcelain-berry is a deciduous, woody, perennial vine. It twines with the help of non-adhesive tendrils that occur opposite the leaves and closely resembles native grapes in the genus *Vitis*. The stem pith (center) of porcelain-berry is white (grape is brown) and the bark does not peel (grape bark peels). The leaves are alternate, broadly ovate with a heart-shaped base, palmately 3-5 lobed or more deeply dissected, and have coarsely toothed margins. The inconspicuous, greenish-white flowers with "free" petals occur opposite the leaves from June through August. The fruits appear in September-October and are colorful, changing from green to bright blue. Porcelain-berry is often confused with our native species of grape (*Vitis labrusca*), the fox grape, and may also be confused with several native species of *Ampelopsis*, such as *Ampelopsis arborea* (peppervine) and *Ampelopsis cordata* or Heartleaf-peppervine (Young, 2005)



Ampelopsis arborea
Peppervine



*Ampelopsis
brevipedunculata*
Porcelain-berry



Ampelopsis cordata
Heartleaf Peppervine

Control

Mechanical control works best when new seedlings are noted, prior to the establishment of mature vines. Once established, a combination of hand pulling, mowing or bushhogging, and chemical controls are most effective. Many systemic herbicides (those which translocate into the root system) such as Glyphosate and Triclopyr are effective on Porcelain-berry. Smaller plants and seedlings may be treated directly with a foliar application of these herbicides. Larger plants may be more effectively treated by cutting the stems and painting each stem with a concentrated mix of herbicide. Always read the entire label BEFORE using any herbicides! As these herbicides are nonselective, they will affect any plants they come in contact with, so use caution when working around desirable species.

SUGGESTED ALTERNATIVE PLANTS

Many non-invasive vines are available. Some native substitutes to consider include trumpet honeysuckle (*Lonicera sempervirens*), American wisteria (*Wisteria frutescens*), Virginia creeper (*Parthenocissus quinquefolia*), and Goldflame Honeysuckle (*Lonicera heckrottii*). In the southeast, several species of native *Ampelopsis* occur and should be considered if the habitat is appropriate. Please consult the native plant society in your state for more suggestions and information on sources of native plants (Young, 2005).



Lonicera sempervirens

Trumpet honeysuckle



Wisteria frutescens

American Wisteria



Parthenocissus quinquefolia

Virginia Creeper



Lonicera heckrottii

Goldflame Honeysuckle

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Fact Sheet #20

Bradford Pear (*Pyrus calleryana*)



Photo: Britt Slattery, USFWS

Description & Identification

Bradford pear is a cultivar of the Callery pear that is widely used to landscape residential developments, parking lots and roadsides. The original 'Bradford' cultivar was introduced to Maryland in the early 1900s and had sterile fruits. However, new hybrids, developed to correct the tendency of the tree to split and fall apart under wind and snow events, were not sterile. Bradford pear has escaped plantings and is invading natural habitats in the eastern United States. Grown throughout the United States, Bradford pear grows best in full sun but will tolerate partial shade and a variety of soil types and conditions, including occasional wet soils or drought. New hybrids produce viable seeds through cross-pollination with the Bradford cultivar. The descendents are aggressively invading natural and disturbed open areas, displacing native plant communities and disrupting natural succession (USFWS, 2004).

Bradford Pear is a deciduous tree species, grows rapidly and may reach 30 to 50 feet tall at maturity and has a relatively short life span of 25 to 30 years. Depending upon the cultivar, the leaves may exhibit moderate to bright-red coloration in the fall. Trees flower early spring, prior to leaf expansion, and produce an abundance of clustered white flowers, very similar in appearance to those of the apple (*Malus* spp.) and cherry. The fruits are very small, round, and brown and are inedible to most mammals. The seeds are dispersed when consumed by birds and are the primary means of dispersal for this species.

As an ornamental species, one primary concern with Bradford Pear is a tendency to crack or split during heavy winds or under heavy snow and ice loads. Cultivation has resulted in newer varieties which do not crack as easily. However, these newer cultivars are also non-sterile and can produce viable seed as well as hybridize with older varieties.

Bradford Pear has many desirable qualities associated with ornamental tree species such as tolerance of partial shade, tolerance of poor soil quality and nutrition, and high drought tolerance. Unfortunately, these same qualities make Bradford Pear an ideal invasive tree species. Seed dispersal and germination has resulted in the spread of this species into unmanaged areas as well as into public and private forest land. As a quick growing, short lived tree species, Bradford Pear consumes forest resources and prevents the establishment of indigenous species. As an alternative to planting Bradford Pear, try these suggested native species: Blackhaw (*Viburnum prunifolium*), Serviceberry (*Amelanchier canadensis*), redbud (*Cercis canadensis*), Southern arrowwood (*Viburnum dentatum*), and Fringtree (*Chionanthus virginicus*).



Bradford Pear in Flower

Photo: Dan Tenaglia

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Bradford Pear fruits

Photo: Chuck Barger

Fact Sheet #21

Marsh Dewflower (*Murdannia keisak* SYN *Aneilema keisak*)



Description & Identification

Marsh Dewflower may also be known by the common names of Marsh swampflower, Asiatic spiderwort, and Asian dayflower but should not be confused with its relative, the Asiatic dayflower, or *Commelina communis*. It is often still referred to as Aneilame, an older scientific name for this species. Another name that may be seen is “Wart-removing herb”, though the author cannot attest to the effectiveness of this treatment on warts!

Marsh dewflower seeds may have been accidentally imported to the US as a contaminant in rice seed. This species is a native of eastern Asia, Japan, and the Korean Peninsula. The first reports of escape were reported in the 1935 in South Carolina and it is now found across the southeastern US, as well as in Oregon and Washington. Marsh dewflower is an annual, emergent plant that invades wetlands throughout the southeastern and pacific northwestern United States. Plant stems are succulent, root at the nodes, and grow prostrate along the ground. Leaves appear on alternating sides of each stem, are lance-shaped, and up to 3 inches long. Small, pink, 3 petaled flowers occur singly or in small clusters, terminally and where the leaf joins the stem. Marsh dewflower invades water edges and marshes, often growing emersed. It forms dense mats of vegetation which out-compete native vegetation. Marsh dewflower spreads aggressively via vegetative propagation as well as by seed dispersal and a single plant may produce thousands of seeds per year. Migratory waterfowl may play a large part in the dispersal of seed up the mid-Atlantic seaboard.

Marsh dewflower prefers damp soil at the edge of freshwater tidal marshes, around ponds and along slow moving streams. Its aggressive growth enables it to out compete native plants by forming dense mats. Seeds are dispersed by wildlife. It also spreads when floods distribute root fragments to new locations (USFWS, 2004). Mechanical control of Marsh dewflower is not recommended due to the ease with which it may resprout from missed plants as well as from cuttings. Furthermore, as this species is commonly found in wetlands and marshes, it may not be possible to get any equipment near the site. Biodegradable, systemic herbicides labeled for use along waterways and riparian areas will prove to be most effective with this species. See your county extension agent or your herbicide company representative for options.



Commelina communis
'Asiatic dayflower'
Photo: Ted Bodner, SWSS



Murdannia keisak
'Marsh Dew flower'
Photo: LSU Ag Center



M. keisak growth habit
Photo: LSU Ag Center

Lesser Celandine (*Ranunculus ficaria*)



Photo: Jim Stasz

Description & Identification

Lesser Celandine (*Ranunculus ficaria*), also known as Fig Buttercup, is a short (up to 12 inches) herbaceous perennial that invades forests throughout the East, Midwest and Pacific Northwest regions of the United States. It emerges in the early spring and the aboveground vegetation is only seen for a brief time. For this reason, it is classified as a spring ephemeral, along with such species as Crocus (*Crocus spp.*), Dogtooth Violet (*Erythronium americanum*) and Mayapple (*Podophyllum peltatum*). The leaves of Lesser Celandine are dark green, shiny, and kidney- to heart-shaped. Flowers are showy, bright yellow, with 8 petals. It emerges very early in the spring from underground bulblets and quickly develops infestations of a creeping green blanket along the forest floor. These creeping mats of vegetation out compete other spring ephemerals, including native marsh marigold (*Caltha palustris*).

Lesser Celandine is native to Europe and was first introduced into the United States as an ornamental. *Ranunculus ficaria* is native to north Africa as well as Europe from the United Kingdom in the north to Italy in the south, Portugal in the west to Turkey and Russia in the east. It is currently sold and widely planted as an ornamental. It is reported to be invasive in nine states (Connecticut, Delaware, Maryland, New Jersey, Oregon, Pennsylvania, Virginia, Wisconsin, West Virginia), and the District of Columbia. The primary means of reproduction in this species is through production and dispersal of the underground bulblets or tubers. These are then spread during flood events and by the activities of man and mammals.

Lesser celandine closely resembles marsh marigold (*Caltha palustris*), a native wetland plant that occurs in the eastern United States. Marsh marigold is a robust plant with glossy, rounded or kidney-shaped leaves and flowers on stalks that are 8 in (20.3 cm) or more in height and consist of five to nine deep yellow "petals" (actually sepals). Marsh marigold does not produce tubers or bulblets, nor does it form a continuous carpet of growth. Extreme care should be taken to correctly identify lesser celandine before undertaking any control measures to avoid impacts to this plant (Swearingen, A. 2004).

R. ficaria is very difficult to control but it can be managed with persistence over time using methods that are site appropriate. While manual methods are possible for some small infestations, the use of systemic herbicide kills the entire plant tip to root and minimizes soil disturbance. The window of opportunity for controlling *R. ficaria* is very short, due to its life cycle. In order to have the greatest negative impact to *R. ficaria* and the least impact to desirable native wildflower species, herbicide should be applied in late winter-early spring. Apply glyphosate isopropylamine salt mixed with water and a non-ionic surfactant to foliage, avoiding application to anything but the *R. ficaria*. To minimize impacts to sensitive-skinned frogs and salamanders, some experts recommend applying herbicide in March and then switching to manual methods (Swearingen, 2004).

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Ranunculus ficaria bulblets

Photo: Leslie J. Mehrhoff

Fact Sheet #23

Purple Loosestrife (*Lythrum salicaria*)



Description & Identification

Purple Loosestrife is an herbaceous perennial which is commonly seen in moist, marshy areas and may also be seen in pastures, fields, along roadside right-of-ways, and in boggy areas. As a member of the mint family, Purple Loosestrife is easily identified by its square stem, though it sometimes has six sided stems as well. Purple loosestrife is a native of Eurasia, from Great Britain across the two continents to Japan. Introduced during the 1800s to northeastern U.S. and Canada for ornamental and medicinal purposes, purple loosestrife spread quickly across the continent. In many places today, except Minnesota, Wisconsin, and Illinois, purple loosestrife is still widely sold as an ornamental. Purple loosestrife adapts readily to different types of wetland environments such as freshwater wet meadows, pond edges, reservoirs, ditches, tidal and non-tidal marshes, and river and stream banks. According to the U.S. Fish and Wildlife Service, purple loosestrife now occurs in every state except Florida (National Park Service, MNRRA).

There are very few other plants with which to confuse Purple Loosestrife. Purple Loosestrife grows 1-2 meters tall and has many small branches. It produces thick fleshy roots and a dense crown root near the soil surface. The leaves are lance shaped, and wrap around the stem of the plant and do not have a petiole or stem. Most notable about this species are its bright, purple to magenta flower spikes, which are produced from mid-summer through the fall.

Purple Loosestrife is a serious invader of wetlands and open range. As *L. salicaria* becomes established, it out competes and replaces native grasses, sedges, and other flowering plants that provide a higher quality food source and habitat for wildlife. *Lythrum* stands can deleteriously impact wildlife habitat used by birds and furbearers. *L. salicaria* forms dense homogeneous stands that restrict native wetland plant species, including some endangered plants. *L. salicaria* can overrun wetlands and almost entirely eliminate open water habitat if left untreated. The recreational and aesthetic value of wetlands and waterways is diminished as dense stands of *L. salicaria* choke waterways and decrease biodiversity (Global Invasive Species Database).

Purple Loosestrife reproduces by seed and vegetatively. A mature plant over 2 meters tall can have as many as thirty flowering stems and produce two to three million seeds per year. Seeds are very small and are transported by wind, water, wildlife, vehicles, construction equipment, and humans. Seed survival can be as high as 70%, creating an extensive seed bank. Seedling establishment occurs in late spring and early summer or after soil disturbances including chemical applications. Shoots from vegetative reproduction grow at a rate of approximately 0.3m/yr per year (Global Invasive Species Database).

Herbicides can be used to control purple loosestrife in areas too large to be controlled by digging. Also, herbicides can be applied to individual plants selectively in landscape situations to prevent killing desirable plants. Infestations growing along streams or in marshy areas may require specialized equipment and application by trained professionals. Glyphosate will provide good control of purple loosestrife when applied from July to early September. Many formulations of glyphosate are sold but only those labeled for aquatic use can be applied in or near water. Since glyphosate does not provide residual control, treated areas will need to be monitored for regrowth from the roots or seedlings for several years. Other herbicides which have been effective for use on Purple Loosestrife include triclopyr and the growth regulator herbicide 2,4-D. Regardless of the herbicide applied, the infested areas should be monitored to ensure that purple loosestrife does not reinfest from root or seed (Lym, 2004).

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Fact Sheet #24

Reed Canarygrass (*Phalaris arundinacea*)



All photos courtesy TNC, Inc.

Description & Identification

Reed Canarygrass, (*Phalaris arundinacea*), is a vigorous, productive, long-lived, perennial, sod- forming grass. It is a widespread species native of the northwestern U.S., as well as Europe and Asia. The numerous broad, moderately harsh, erect leaves are dominantly basal. The coarse, erect stems may reach a height of 6 to 8 feet. Reed Canarygrass reproduces by seed dispersal and vegetatively through rhizome extension or fragmentation. Seed is borne in an open panicle which ripens from the top down and shatters readily as it matures. The seed has a short storage life and may not survive very long in the soil, though it may stay viable for up to 5 years. This species has been recommended in the past as a forage species for use in areas of poor soil quality or those areas which are frequently flooded. Unfortunately, the forage quality of this species decreases as it matures. Additionally, this species has been shown to be highly invasive in wetland areas, especially those areas which are not actively managed. This species is also a problem in irrigation and drainage ditches, something that Delaware has in abundance! Reed canarygrass has excellent frost tolerance and is well suited to wet soils that are poorly drained or subject to flooding. It also has good drought tolerance. Growth begins in early spring and continues through the growing season. Regrowth following mowing or grazing is rapid on fertile sites. Forage quality is good prior to heading but then declines rapidly (USDA-NRCS, 2006).

Reed Canarygrass (*Phalaris arundinacea*), may be confused with Ribbon-grass (*Phalaris arundinacea* 'Picta') which is grown and sold in the US as an ornamental. Ribbon-grass may be differentiated from Reed canarygrass by the fact that the leaves of Ribbon-grass have distinct green-and-white stripes. When young and newly emerged, Reed canarygrass may also be confused with Common Reed (*Phragmites australis*) and Giant Reed (*Arundo donax*). However, both of the latter species grow much taller than Reed canarygrass and their inflorescences, or flower structures, are more open and airy than that of Reed canarygrass. Reed Canarygrass may be difficult to control once established depending on the area infested. It has been suggested that Reed Canarygrass will not tolerate repeated mowings (Gillespie and Murn, 1992). Mechanical control has not been overly successful with regards to control. Often, it can be difficult to get equipment into the marshy areas where Reed canarygrass is likely to be found. Covering smaller stands with heavy plastic may work, but these materials may be washed away before the completely control the stand. With regards to chemical control, systemic herbicides such as glyphosate have been shown to be effective, especially when combined with controlled burnings to kill seedlings. Control by any method has a higher chance of success if the program is undertaken as a multi-year project. Within the first year, attention should be focused on treating the majority of the stand or stands of Reed Canarygrass. Follow-up treatments for the next few years should monitor the original site or sites and mop up resprouts, seedlings, and invasion from neighboring lands.

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Fact Sheet #25

Honeysuckle species (*Lonicera japonica*, *L. maackii*, *L. morrowii*, *L. tatarica*)



Description & Identification

Japanese honeysuckle (*L. japonica*), Amur honeysuckle (*Lonicera maackii*), Morrow's honeysuckle (*L. morrowii*), and Tatarian honeysuckle (*L. tatarica*) are just four of many Honeysuckle species found throughout the world. Not all *Lonicera* species are invasive, as the US has several endemic species. The four listed here are known as 'bush types' and have a shrubby growth characteristic when compared to the vine-like growth of our native species, such as Grape honeysuckle (*Lonicera proliifera*), Yellow honeysuckle (*Lonicera flava*), and Red honeysuckle (*Lonicera dioica*). Generally, if the honeysuckle is shrubby in growth habit, it may be regarded as an invasive. One major exception is Japanese honeysuckle, *L. japonica*, which is vine-like in its growth habit, just like our native species. However, it may be separated easily from our native honeysuckle vines by its leaves. The leaves near tips of the vines of Japanese honeysuckle are opposite and not united, while leaves of native honeysuckles (3 species) are united at the base, forming a single leaf surrounding the stem.

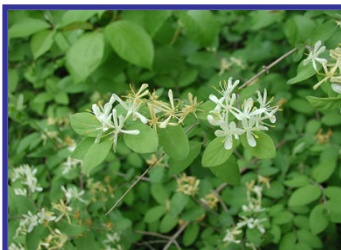
The four species of honeysuckle shrubs planted (Tartarian, Morrow's, Belle and Amur) that cause most of the observed invasive problems will be referred to as bush honeysuckles. Bush honeysuckles are native to Asia and Western Europe. Tatarian honeysuckle was introduced to North America in 1752. The other species were introduced in the late 1800's and 1900's. Although their distribution is closely related to horticultural outlets, especially near larger urban areas, where used as ornamentals, rural infestations are common when the species are used to improve wildlife habitat (R. Nyboer, 2000). Japanese honeysuckle was introduced from Japan around the turn of the 1800's and quickly spread across the US; first as an escape from cultivation and later by seed dispersal.

Bush honeysuckles grow to heights of 6-20 feet (1.8-6 meters). Differences between individual species of non-native honeysuckles are dependent on the presence of pubescence or hair on leaves and flowers and the length of flowers and their stems. Bush honeysuckles flower during May and June. Flowers of Tartarian honeysuckle are generally pink, but may vary from white to bright red. Amur and Morrow's honeysuckle flowers are white, fading to yellow as they age. Belle's honeysuckle is a hybrid cross between Tartarian and Morrow's honeysuckles and has many characteristics of both parents. Fruits may be red or yellow and found in pairs in the axils of the leaves. Although individual species may have certain environmental tolerances (e.g. Tartarian in drier habitats, Morrow's in moister areas) at least one of the four types is capable of inhabiting most natural communities. Affected natural communities include: lake and stream banks, marsh, fens, sedge meadow, wet and dry prairies, savannas, floodplain and upland forests.



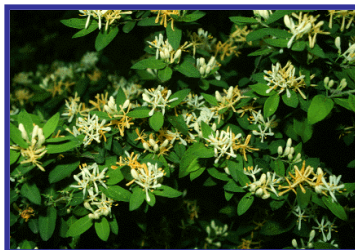
Tartarian Honeysuckle

Photo: Gary Fewless, 2004



Morrow's Honeysuckle

Photo: L. J. Mehrhoff, UConn



Belle's Honeysuckle

Photo: K. R. Robertson, INHS



Amur Honeysuckle

Photo: L. J. Mehrhoff, University of Connecticut

References & Further Information

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Tree of Heaven (*Ailanthus altissima*)



Photo: James H. Miller, USDA Forest Service

Description & Identification

A member of the tropical Quassia family, Tree of Heaven, a highly invasive tree species, was first introduced into the United States from England to Philadelphia, PA, in 1784. Extensive plantings in cities during the 1800's has resulted in its naturalization across the United States (Miller et al, 1990). It rapidly escaped cultivation and has since become naturalized. It is found across most of the United States and is a testament to the wide range of growing conditions which this species will tolerate. Tree of Heaven will grow rapidly in high light conditions and thrives in soils which do not support many plant species. Tree of heaven is commonly seen in frequently disturbed areas such as flood plains and in low maintenance areas such as highway and railroad right-of-ways. This species is also quite tolerant of heavy clay soils and soils with low nutrient levels and soils which are low in available oxygen.

The yellowish-green flowers of *Ailanthus* appear from mid-April to July, south to north, depending on latitude. The flowers are arranged in large panicles at the ends of new shoots. A dioecious species, it bears male and female flowers on different trees. Male flowers are more conspicuous than female ones, emitting a disagreeable odor that attracts numerous insects. The foul odor of the male flowers makes the tree less favored for ornamental plantings in cities. Pollination occurs in the spring and clusters of seed ripen from September to October. The fruit is a samara with the seed in the center of a thin, oblong wing, well adapted for wind dispersal. The ripe samaras are greenish yellow or reddish brown (Miller et al, 1990). This species propagates both sexually, through prolific seed production, as well as asexually or by vegetative propagation of root and shoot cuttings. A single *Ailanthus* tree can produce an estimated 350,000 seeds per year with a very high rate of successful germination. Once established, *Ailanthus* seedlings develop taproots within three months. The seed usually persists on the female tree through the winter, characterizing their appearance, but can be dispersed any time from October to the following spring (Miller, 1990). The species is a prolific seeder; the most abundant seed production is from trees that are 12 to 20 years. Seedlings are capable of growing 1-2 meters (3-6 feet) during their first year. At maturity and given optimum growing conditions, *Ailanthus* may reach a height of 90 feet, though the typical specimen will range anywhere from 50 feet and up. *Ailanthus* is noted as being short-lived, surviving up to 50 years (USDA, 1949).

Tree of Heaven tends to form dense stands through a combination of seedling establishment and root or shoot extension which then quickly outcompete other species. Additionally, Tree of Heaven produces allelopathic, or plant toxic, compounds, similar to those of the Black Walnut (*Juglans nigra*) which inhibit the growth of other species growing nearby. Another issue with Tree of Heaven is the fact that the vigorous roots can damage structural foundations as well as underground water and power lines. Once the main stem is injured or killed, *Ailanthus* produces numerous root shoots which can grow just as tall within a single year.

Tree of Heaven is difficult to control once established and it is for this reason that planting should be discouraged. Use of persistent systemic herbicides such as triclopyr, imazapyr, and other similar compounds can be effective. Mechanical control alone will probably not contain this species but may facilitate control when coupled with chemical control means.

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Fact Sheet #27

Spotted Knapweed (*Centaurea biebersteinii*)



Photos courtesy: Richard K. Zollinger, 1992

Description & Identification

A native of Europe, Spotted Knapweed was introduced in North America sometime in the 1890's as a result of contaminated alfalfa seed. It is a short-lived herbaceous biennial or perennial plant with a deep tap-root that invades open areas and pastures throughout most of the United States. Its name is derived from the black margins of the flower bract tips, giving the flower heads a spotted look. A basal rosette of deeply lobed leaves is produced the first year. Flowering occurs from June through October. Flowering stems are 6-24 inches tall and branched and the flowers are purple to pink in color with black tips. The seeds of Spotted Knapweed are very small (< 0.1 inch), black to brown with pale lines. An individual Knapweed plant may produce up to 600 seeds which may remain dormant in soil for many years. Spotted Knapweed spread predominantly by seed dispersal, and as such, control methods should focus on prevention of seed development and spread.

Of the 25 known species of Knapweeds found in North America, Spotted Knapweed is the most widely distributed. Spotted knapweed invades a wide variety of habitats including pastures, open forests, prairies, meadows, old fields, and disturbed areas. It displaces native vegetation and reduces the forage potential for wildlife and livestock (www.invasive.org). Spotted Knapweed may form hybrids with other Knapweed species, such as Diffuse knapweed, resulting in the hybrid *C. x psammogena*. These hybrids may then go on to display increases in invasive potential, and distribution.

Several insect species feed on Spotted Knapweed and may be used in a biological control program. For more information on these species, please visit www.Invasive.org. It is unlikely that any one of these species alone could successfully control knapweed. Successful control is more likely to result from a combination of control methods such as chemical, mechanical, biological, and cultural practices which place a constant stress and pressure on the knapweed population. Spotted Knapweed has the capability to completely transform biologically diverse grasslands and open forests into single-species stands of non-native weeds that provide little native food or habitat for grazing animals or native wildlife.

The easiest method to control Spotted Knapweed is to prevent establishment of a seeding population. For areas already infested with Knapweed, the herbicides Picloram, Dicamba, 2-4,D, and Clopyralid have all been shown to have efficacy in controlling Spotted Knapweed. Contact your local herbicide company representative or your county extension agent for the recommended application rates for your area and be sure to always read the label before applying herbicides.

References & Further Information

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Photo courtesy: Rodney G. Lym



Photo: Larry Allain

Fact Sheet #28

Butterfly Bush (*Buddleja davidii* Franch.)



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Description & Identification

This invasive species is actually just one of an estimated 100 members of the genus *Buddleja*. You'll encounter individuals with almost any flower color, ranging from deepest purple to blue, pink, and even white. You may even see some plants with yellow flowers, though these are most likely a related hybrid *Buddleja x weyeriana*, also in common use as an ornamental. The native range of Butterfly bush includes most of Asia and it is now found nearly worldwide, thanks to escape from cultivation. Butterfly bush is commonly found in disturbed areas such as railway right-of-ways and road edges, building sites, waste lands, abandoned farms, mixed forest stands, along riparian zones. Dense infestations of *Buddleia* compete with indigenous vegetation of rivers and impede the growth and reproduction of other species of trees and shrubs. Dense stands of *Buddleia* impede human and animal access to rivers. A mature, flowering plant may release many seeds (3 million seeds per year per plant) which are transported long distances by wind, water or motor vehicles. Seeds can remain dormant in the ground for many years. *Buddleia* is able to colonize a new zone in one to two years from seeding. These seedlings, which have superficial rooting, are easily carried away in floods and may form blockages, causing erosion of banks. This shrub has a very fast growth rate and grows back from the stump if it is cut. It can be propagated along rivers by stem cuttings. A shrub can flower and bear fruit in the first year. It can reach a height of 2 m one year after being cut at the base. *Buddleia* is a colonizer of short lifespan (the oldest individual having been found is 37 years old). The largest densities of invasion would normally be observed in the first ten years (Invasive Species Specialist Group, ISSG, 2005).

Butterfly bush can be controlled through chemical or mechanical means. Spent flowers can be cut off and disposed of every season to reduce seed dispersal. This is most feasible for individual plantings as may be found in ornamental plantings. Homeowners may find that the most successful way to control butterfly bush is to find an alternative plant for the garden. According to the Washington Invasive Species Coalition (<http://www.invasivespeciescoalition.org>), alternatives to butterfly bush are: California lilac, red-flowering currant, Chilean potato vine, chaste tree, orange-ball butterfly bush, *Buddleja x weyeriana* hybrid butterfly bush or *B. x fallowiana* butterfly bush. For large stands in non-ornamental settings, systemic herbicides, such as glyphosate and triclopyr, may be most effective, especially when combined with mechanical control methods.



Photo: Richard Stell

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