



UNIVERSITY OF THE
DISTRICT OF
COLUMBIA
1851

PLANT INVADERS

IN THE DISTRICT OF COLUMBIA

Urban Gardening and Forestry Outreach
Cooperative Extension Service
www.udc.edu/causes/ces

ABOUT US

University of the District of Columbia

The College of Agriculture, Urban Sustainability, and Environmental Sciences (CAUSES)

Early on in United States history, higher education was a privilege that only a select few could afford. All of that changed in 1862 when President Abraham Lincoln signed what is now called the Morrill Act. Under the Morrill Act, each state was given land from the Federal Government, the proceeds of which were to be used to open the first public institutions of higher education in this country teaching agriculture and mechanical arts (engineering). Today these colleges are collectively known as the Land-Grant University System, and there is one in every state and territory of the United States. The University of the District of Columbia (UDC) is the District of Columbia's land-grant university; it is the only completely urban land-grant university in the system.

All of the land-grant universities receive funding from the United States Department of Agriculture's (USDA) National Institute of Food and Agriculture (NIFA). NIFA's mission is to advance knowledge for agriculture, the environment, human health and well-being, and communities. It fulfills this mission by supporting research, education, and extension programs in the Land-Grant University System.

At UDC, the College of Agriculture, Urban Sustainability, and Environmental Sciences (CAUSES) fulfills the university's land-grant function by integrating education, research, and outreach. Academic programs include Architecture and Urban Design, Environmental Science, and Nutrition and Food Science. The Agricultural Experiment Station (AES), Architecture Research Institute (ARI), and Water Resources Research Institute (WRRRI) are the research components, while the Cooperative Extension Service (CES) fulfills the outreach mission. The Cooperative Extension Service is comprised of three program areas that address key urban topics: the Center for Nutrition, Diet and Health; 4-H and the Center for Youth Development; and the newest addition, the Center for Sustainability. The mission is to improve the quality of life for District residents by providing fee based and free, non-credit educational programs, workshops, demonstrations as well as providing technical assistance to District residents.



The Urban Gardening and Forestry Outreach program is part of the Center for Sustainability. The gardening program provides District residents with instructional information about caring for edible gardens with special consideration given to the challenges and advantages of gardening in an urban setting. Through the forestry program, residents are educated about tree care, forestry niche crops, and the invasive species that threaten our ecosystem. Outreach methods include educational materials, demonstrations, technical assistance, site visits, phone consultations and workshops.



THE INVASIVE SPECIES PROBLEM

For as long as people have migrated around the world, we have intentionally and unintentionally brought other species with us. Many of these species are benign. Some, like wheat, have become societal mainstays and aren't even thought of as an exotic, non-native species. Unfortunately, many exotic species do have adverse effects within their new ecosystem, particularly in areas that are already stressed.

This publication is intended to familiarize District residents with 14 specific invasive plant species that are problematic in the Washington area. The invasive plant species highlighted herein

can all be controlled manually without the use of pesticides. Though there are far more than 14 invasive species (plant or otherwise) in the District, these are common sights throughout our city. See if you can spot them next time you are in Rock Creek Park or strolling through your neighborhood. It's alarming to realize that so much of the lush green that is around us is not a thriving ecosystem, but a struggling one overcome with invasive species.

There is hope. With increased awareness about the invasive species problem, people can take measures to hinder their spread. Controlling invasive

species in an area or region is possible. With the help of concerned citizens that take an active role, invasive species have, and continue to be, eradicated in particular regions. So whether you're removing invasive plants on your own property, participating in larger abatement events, replacing invasive plants with non-invasive plants in your own landscape, spotting and informing the correct authorities about incoming (not existing) invasive species, or simply spreading the word about this problem, you are making a difference in the effort to stop the spread of invasive species.

WHAT IS AN INVASIVE SPECIES?

The USDA defines invasive species as, "plants, animals, and other organisms that are alien to the ecosystem under consideration, and whose introduction can cause harm". The National Invasive Species Council determined that for a species to be qualified as invasive it must overcome five barriers. The species in question has to first overcome a geographical barrier, such as an ocean or mountain range, which previously confined the species to its native range. In the new environment the exotic species then has to be able to survive in the existing conditions. Is there sufficient heat, water, light, nutrients? Is the soil pH within a parameter in which the species can live? If the species prevails it has overcome the survival barrier, but it also must be able to successfully reproduce and establish a self-sustaining population in order to overcome the establishment barrier. Additionally, the species in question has to escape containment and spread to other sites, and at an acceler-

ated rate, to breach the dispersal and spread barrier. Even then the species still isn't considered invasive unless it causes economic harm, environmental harm, or harm to human health.

Typically, species that are considered invasive have competitive advantages over native and non-invasive species that allow them to monopolize limited natural resources like habitat, light, nutrients, and water. For example, an invasive species that is out of its native range won't have the natural controls that once helped keep its population in check, nor will it have the predators of its old habitat. Often times the species in question can withstand a wide range of environmental conditions, and can be extremely adaptable. Frequently, the species reach maturation and can begin to reproduce earlier, or be able to reproduce faster and in quick succession, often times reproducing at a highly prolific rate.

With the aid of humans, invasive species easily move from one site to others by means of import and export activities, as well as through travel by car, boat, plane, or foot. Edges along natural areas, like roads, also serve as conduits for invasive species to move into sites previously not infested. Areas that have been disturbed, such as construction sites, are particularly susceptible to infestations. But invasive species are also spread through flooding, winds, by animals dispersing seeds, and other natural means.

Our goal is to increase awareness and knowledge about invasive species so that rather than accepting them as a part of our ecosystem, we can change our behavior and implement measures that will ensure the well being of the District of Columbia's urban forests.



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CLIMBING EUONYMUS

Euonymus fortunei
Staff-tree family (Celastraceae)

Native Range

China

Description

Climbing euonymus, also known as wintercreeper, Emerald'n Gold, and Gaiety, is an evergreen, clinging vine. It can form a dense groundcover or shrub up to 3 feet in height, or climb 40-70 foot high vertical surfaces with the aid of aerial roots. Dark green, shiny, egg-shaped leaves, from 1-2 ½ inches long, with toothed margins and silvery veins, occur in pairs along the stems. Stems are narrow, minutely warty, and have abundant rootlets or trailing roots. Clusters of inconspicuous green-white flowers are produced on a long stalk from June to July and are followed in the autumn by pinkish to red capsules that split open to expose seeds adorned with a fleshy orange seed coat, or aril.

Ecological Threat

Traits that make climbing euonymus a desirable ornamental plant, such as its rapid growth, evergreen nature

and tolerance of harsh conditions, also make euonymus a threat to natural areas. Climbing euonymus can out-compete native vegetation by depleting soil moisture and nutrients, blocking sunlight, and by forming a dense vegetative mat that impedes the growth of seedlings of native species. Vines on trees continue climbing and can eventually overtop them, covering the leaves and preventing photosynthesis.

Distribution In The United States

Climbing euonymus is currently scattered throughout the eastern U.S. in populated areas.

Habitat In The United States

Climbing euonymus tolerates a variety of environmental conditions, including poor soils, full sun to dense shade, and a wide pH range. It does not do well in heavy wet soils. Natural forest openings resulting from wind throw, insect defoliation or fire are vulnerable to invasion and provide conditions for satellite populations of climbing euonymus to get started.

Background

Climbing euonymus was introduced into the U.S. in 1907 as an ornamental ground cover.

Biology & Spread

Climbing euonymus spreads vegetatively with the help of lateral shoots produced along its long main branches, and by new plants that emerge from rootlets also produced along the stem at short intervals. Vines climb rocks, trees, and other supporting structures.



Flowers formed in the summer produce mature fruits by fall that are equipped with fleshy edible structures (arils) that are fed upon by birds and other wildlife, which then disperse the seed. Climbing euonymus also escapes from neglected gardens and is carried by water to undisturbed forest and riparian areas.

Management Options

A variety of mechanical and chemical methods are available for management of climbing euonymus. Grubbing, a rather labor intensive method, is effective for small populations or environmentally sensitive areas where herbicides cannot be used. Using a pulaksi or similar digging tool, remove

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the entire plant, including all roots and runners. Juvenile plants can be hand-pulled when the soil is moist and root systems are small. Any portions of the root system remaining may re-sprout. All plant parts, including stem fragments and mature fruits, should be bagged and disposed of in a trash dumpster to prevent re-establishment.

Chemical

Cut stem application

Cut stem treatment, using systemic herbicides applied to freshly cut stems, is effective in areas where vines are well established on or around non-target plants, or where they have grown into tree canopies or other vertical surfaces. Cut the stem as close to the ground as possible and immediately apply a 25% solution of glyphosate (e.g., Roundup®) or triclopyr (e.g., Garlon) and water to the cut stem. This procedure is effective at temperatures as low as 40° F. Subsequent foliar applications of these herbicides may be required.



Cutting without the application of herbicides is generally not recommended because this will lead to root sprouting.

Foliar application

Foliar applications of herbicide can be used to control large populations. It may be necessary to precede foliar sprays with cut stem treatments to reduce the risk of damage to non-target plants. Apply a 2% solution of glyphosate or triclopyr and water plus a 0.5% non-ionic surfactant to thoroughly wet all foliage, but not so heavily that it drips off leaves and potentially affects desirable plants. Glyphosate is a non-selective systemic (i.e., travels through the plant vessels) herbicide that may kill even partially sprayed plants. Triclopyr is selective to broad leaf species and is a better choice if desirable native grasses are present. Ambient air temperature should be above 65° F.

Use pesticides wisely: Always read the entire pesticide label carefully. Follow all mixing and application instructions. Always wear all recommended personal protective equipment. Contact your local Cooperative Extension office for any additional pesticide information.

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Suggested Alternative Plants

There are a variety of native creeping or climbing vines that make good alternatives for climbing euonymus. Some examples from the eastern U.S. include trumpet creeper (*Campsis radicans*), Dutchman's pipe (*Aristolochia macrophylla*), crossvine (*Bignonia capreolata*), trumpet honeysuckle (*Lonicera sempervirens*), American bittersweet (*Celastrus scandens*), and American wisteria (*Wisteria frutescens*), our only native wisteria*.

NOTE: When purchasing or planting wisteria, make certain it is native American wisteria (*Wisteria frutescens*), and not the exotic Chinese or Japanese varieties (*Wisteria sinensis* and *Wisteria floribunda*, respectively). Chinese and Japanese varieties of wisteria are both aggressive, exotic invaders of natural areas and are difficult to control.





ENGLISH IVY

Hedera helix L.
Ginseng family (Araliaceae)

Native Range

Europe, western Asia, and northern Africa

Description

English ivy is an evergreen climbing vine that attaches to the bark of trees, brickwork, and other surfaces by way of small root-like structures that exude a sticky substance that helps the vine adhere to various surfaces. Older vines have been reported to reach 1 foot in diameter. Leaves are dark green with white veins, waxy to somewhat leathery, and arranged alternately along the stem. Leaf forms include a 3 to 5-lobed leaf (the most common) and an unlobed rounded leaf often found on mature plants in full sun that are ready to flower. Vines may grow for up to ten years before producing flowers. Under sufficient light conditions, terminal clusters of small, pale yellow-green flowers are produced in the fall. The flowers are attractive to flies and bees in search of late season nectar sources. The black-purple fruits

have a thin fleshy outer covering, contain one to three hard, stone-like seeds and may persist through the winter if not eaten first.

Ecological Threat

English ivy is a vigorous growing vine that impacts all levels of disturbed and undisturbed forested areas, growing both as a ground cover and a climbing vine. As the ivy climbs in search of increased light, it engulfs and kills branches by blocking light from reaching the host tree's leaves. Branch dieback proceeds from lower to upper branches. The host tree eventually succumbs entirely from this insidious and steady weakening. In addition, the added weight of the vines makes infested trees much more susceptible to blow-over during high rain and wind events and heavy snowfalls. Trees heavily draped with ivy can be hazardous if near roads, walkways, homes and other peopled areas. On the ground, English ivy forms dense and extensive monocultures that exclude native plants. English ivy also serves as a reservoir for Bacterial Leaf Scorch (*Xylella fastidiosa*), a plant pathogen that is harmful to elms, oaks, maples and other native plants.

Distribution in the United States

English ivy has been reported to be invasive in natural areas in 18 states and the District of Columbia.



Habitat in the United States

English ivy infests woodlands, forest edges, fields, hedgerows, coastal areas, salt marsh edges, and other upland areas, especially where some soil moisture is present. It does not grow well in extremely wet conditions. It tolerates a wide range of soil pH but prefers slightly acidic soil (pH=6.5). English Ivy is often associated with some form of land disturbance, either human-caused or natural.

Background

English ivy was probably first introduced to the U.S. by European immigrants for its ornamental appeal. It persists as a popular plant for homeowners, businesses, landscape designers and others. Some Cooperative Extension offices continue to recommend English ivy for

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use as a low maintenance alternative to lawns because it is evergreen, relatively pest free, very cold hardy and a fast-growing groundcover that requires little care once established.

Biology & Spread

English ivy spreads locally through vegetative growth. New plants can grow from cut or broken pieces of stem that are able to root in the soil. It disperses longer distances via seed, which is carried to new areas by frugivorous birds including the Cedar Waxwing, Northern Robin, Stellar Jay, Mockingbird, European Starling, and House Sparrow.

Management Options

Manual, mechanical and chemical control methods are all effective in removing and killing English ivy. Employing a combination of methods often yields the best results and may reduce potential impacts to native plants, animals and people. The method you select depends on the extent and type of infestation, the amount of native vegetation on the site and the time, labor and other resources available to you.

Manual and Mechanical

Vines growing as a ground cover can be pulled up by hand (with some difficulty), bagged and disposed of as trash. Always wear gloves. For climbing vines, first cut the vines near the ground at a comfortable height to kill upper portions and relieve the tree canopy. A large screw driver or forked garden tool can be used to pry the vines away from the tree trunks. Try to minimize damage to the bark of the host tree. Rooted portions will remain alive and should be pulled, repeatedly cut to the ground or treated with herbicide. Cutting will likely result in vigorous regrowth. Vigilance is required to ensure long-term control.

Chemical

Systemic herbicides like triclopyr (e.g., Garlon® 3A and Garlon® 4) and glypho-

sate (e.g., Accord®, Glypro®, Rodeo®) are absorbed into plant tissues and carried to the roots, killing the entire plant within about a week. The evergreen nature of English ivy means that it continues to grow through the winter months, though at a reduced rate. Herbicide applications can be made any time of year as long as temperatures are above 55 or 60 degrees Fahrenheit for several days and rain is not expected for at least 24 hours. Fall and winter applications will avoid or minimize impacts to native plants and animals. Repeated treatments are likely to be needed.

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Mulching

Mulching may be an effective choice for smaller infestations when herbicides are not appropriate. Cover the entire infestation with several inches of mulch. Shredded or chipped wood may be the best option since hay and grass may potentially carry weed seeds. The mulch should stay in place for at least two growing seasons and may need to be augmented several times.

Suggested Alternative Plants

A wide variety of attractive, and ecologically adapted, beneficial native plants can be substituted for English ivy. Select plants adapted to the level of light available on the site. Plants that will eventually spread to cover an area of ground include flowering plants like eastern prickly pear cactus (*Opuntia humifusa*), blue phlox (*Phlox divaricata*), wild ginger (*Asarum canadense*), Allegheny spurge (*Pachysandra procumbens*), and green and gold (*Chrysogonum virginianum*); ferns like Christmas fern (*Polystichum acrostichoides*), northern maid-



enhair fern (*Adiantum pedatum*), northern lady fern (*Athyrium filix-femina*), sensitive fern (*Onoclea sensibilis*), and cinnamon fern (*Osmunda cinnamomea*); grasses like red fescue (*Festuca rubra*), wild oats (*Chasmanthium latifolium*), bottlebrush grass (*Elymus hystrix*) and switch grass (*Panicum virgatum*); and sedges like Pennsylvania sedge (*Carex pennsylvanica*) and tussock sedge (*Carex stricta*). Native vines that are good replacements for English ivy include trumpet creeper (*Campsis radicans*), Virginia creeper (*Parthenocissus quinquefolia*), passion-flower vine (*Passiflora lutea*), Dutchman's pipe (*Aristolochia macrophylla*), and native wisteria (*Wisteria frutescens*).





GARLIC MUSTARD

Alliaria petiolata
Mustard family (Brassicaceae)

Native Range

Europe

Description

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 3-½ feet in height and produce button-like clusters of small white flowers, each with four petals in the shape of a cross.

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. The S-shaped crook at the base of plant helps to distinguish this species.

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Adapted by Mary E. Farrah from: Plant Conservation Alliance, Alien Plant Working Group. <http://www.nps.gov/plants/alien/fact/alpe1.htm>

Ecological Threat

Garlic mustard poses a severe threat to native plants and animals in forest communities in much of the eastern and mid-western U.S. Many native wildflowers 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 outcompetes 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. Garlic mustard also poses a threat to one of our rare native insects, the West Virginia white butterfly (*Pieris virginensis*). 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.

Distribution In The United States

Garlic mustard ranges from eastern Canada, south to Virginia and as far west as Kansas and Nebraska.

Habitat In The United States

Garlic mustard frequently occurs in



moist, shaded soil of river floodplains, forests, roadsides, edges of woods and trail edges and forest openings. Disturbed areas are most susceptible to rapid invasion and dominance. Though invasive under a wide range of light and soil conditions, garlic mustard is associated with calcareous soils and does not tolerate high acidity. Growing season inundation may limit invasion of garlic mustard to some extent.

Background

Garlic mustard was first recorded in the United States about 1868 in Long Island, New York. It was likely introduced by settlers for food or medicinal purposes.

Biology & Spread

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, called

siliques, beginning in May. Siliques 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 seed-pods that may remain and hold viable seed throughout the summer.

A single plant can produce thousands of seeds, which scatter as much as several meters from the parent plant. Depending upon conditions, garlic mustard flowers either self-fertilize or are cross-pollinated by a variety of insects. Self-fertilized seed is genetically identical to the parent plant, enhancing its ability to colonize an area. 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 seed-bed through trampling.

Management Options

Effective management requires a long

term commitment because garlic mustard seeds can remain viable in the soil for five years or more. The goal is to prevent seed production until the stored seed is exhausted. Hand removal of plants is possible for light infestations and when desirable native species co-occur. Care must be taken to remove the plant with its entire root system because new plants can sprout from root fragments. This is easiest when the soil is moist. Pulled plants should be removed from the site if at all possible, especially if flowers are present.

For larger infestations of garlic mustard, or when hand pulling isn't practical, flowering stems can be cut at ground level, or within several inches of the ground, to prevent seed production. If stems are cut too high, the plant may produce additional flowers at leaf axils. Once seed-pods are present, but before the seeds have matured or scattered, the stalks can be clipped, bagged and removed from the site to help prevent continued buildup of seed stores. This can be done through much of the summer.

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 over-wintering rosettes), as long as the temperature is above 50° F and rain is not expected for about 8 hours. Extreme care must be taken not to get glyphosate on desirable plants as the product is non-selective and will kill almost any plant it contacts. Spray shields may be used to better direct herbicide and limit non-intentional drift.

Researchers are investigating potential biological control agents for garlic mustard, which may greatly improve the control of this insidious weed.

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JAPANESE BARBERRY

Berberis thunbergii

Barberry family (Berberidaceae)

Native Range

Japan

Description

Japanese barberry is a dense, deciduous, spiny shrub that grows 2 to 8 ft. high. The branches are brown, deeply grooved, somewhat zig-zag in form and bear a single very sharp spine at each node. The leaves are small (½ to 1 ½ inches long), oval to spatula-shaped, green, bluish-green, or dark reddish purple. Flowering occurs from mid-April to May in the northeastern U.S. Pale yellow flowers about ¼ in (0.6 cm) across hang in umbrella-shaped clusters of 2-4 flowers each along the length of the stem. The fruits are bright red berries about 1/3 in (1 cm) long that are borne on narrow stalks. They mature during late summer and fall and persist through the winter.

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.

Ecological Threat

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.



Distribution In The United States

Japanese barberry has been reported to be invasive in twenty states and the District of Columbia. Due to its ornamental interest, barberry is still widely propagated and sold by nurseries for landscaping purposes in many parts of the U.S.

Habitat In The United States

Barberry is shade tolerant, drought resistant, and adaptable to a variety of open and wooded habitats, wetlands and disturbed areas. It prefers to grow in full sun to part shade but will flower and fruit even in heavy shade.

Background

Japanese barberry was introduced to the U.S. and New England as an ornamental plant in 1875 in the form of seeds sent from Russia to the Arnold Arboretum in Boston, MA. In 1896, barberry shrubs grown from these seeds

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were planted at the New York Botanic Garden. Japanese barberry was later promoted as a substitute for common barberry (*Berberis vulgaris*) which was planted by settlers for hedgerows, dye and jam, and later found to be a host for the black stem grain rust. Because Japanese barberry has been cultivated for ornamental purposes for many years, a number of cultivars exist.

Biology & Spread

Japanese barberry spreads by seed and by vegetative expansion. Barberry produces large numbers of seeds which have a high germination rate, estimated as high as 90%. Barberry seed is transported to new locations with the help of birds (e.g., turkey and ruffed grouse) and small mammals that eat it. Birds frequently disperse seed while perched on power lines or on trees at forest edges. Vegetative spread is through branches touching the ground that can root to form new plants and root fragments remaining in the soil that can sprout to form new plants.

Management Options

Do not plant Japanese barberry. Because it is a prolific seed-producer with a high germination rate, prevention of seed production should be a management priority. Because barberry can resprout from root fragments remaining in soil, thorough removal of root portions is important. Manual control works well but may need to be combined with chemicals in large or persistent infestations.

Chemical

Treatments using the systemic herbicides glyphosate (e.g., Roundup®) and triclopyr (e.g., Garlon) have been effective in managing Japanese barberry infestations that are too large for hand pulling. For whole plant treatment, apply a 2% solution of glyphosate mixed with water and a surfactant. This non-selective herbicide should be used with care

to avoid impacting non-target native plants. Application early in the season before native vegetation has matured may minimize non-target impacts. However, application in late summer during fruiting may be most effective. Triclopyr or glyphosphate may be used on cut stumps or as a basal bark application in a 25% solution with water, covering the outer 20% of the stump.

Manual

Because Japanese barberry leafs out early, it is easy to identify and begin removal efforts in early spring. Small plants can be pulled by hand, using thick gloves to avoid injury from the spines. The root system is shallow, making it easy to pull plants from the ground, and it is important to get the entire root system. The key is to pull when the soil is damp and loose. Young plants can be dug up individually using a hoe or shovel. Hand pulling and using a shovel to remove plants up to about 3 feet high is effective if the root system is loosened up around the primary tap root first before digging out the whole plant.

Mechanical

Mechanical removal using a hoe or Weed Wrench® can be very effective and may pose the least threat to non-target species and the general environment at the site. Tools like the Weed Wrench® are helpful for uprooting larger or older shrubs. Shrubs can also be mowed or cut repeatedly. If time does not allow for complete removal of barberry plants at a site, mowing or cutting in late summer prior to seed production is advisable.

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Suggested Alternative Plants

Many attractive native shrubs are available that make great substitutes for Japanese barberry. A few examples include bayberry (*Myrica pensylvanica*), ink-berry (*Ilex glabra*), winter-berry (*Ilex verticillata*), arrow-wood (*Viburnum dentatum*), mountain laurel (*Kalmia latifolia*), ninebark (*Physocarpus opulifolius*) and hearts-a-bustin' (*Euonymus americana*). Please check with your state native plant nursery for suggestions for plants appropriate to your area.





JAPANESE HONEYSUCKLE

Lonicera japonica
Honeysuckle family (Caprifoliaceae)

Native Range

Japan and Korea

Description

Japanese honeysuckle is a perennial vine that climbs by twisting its stems around vertical structures, including limbs and trunks of shrubs and small trees. Leaves are oblong to oval, sometimes lobed, have short stalks, and occur in pairs along the stem. In southern and Mid-Atlantic States, Japanese honeysuckle often remains evergreen – its leaves remain attached through the winter. In colder northern climates, the leaves may fall off after exposure to prolonged winter temperatures. Flowers are tubular, with five fused petals, white to pink, turning yellow with age, are very fragrant, and occur in pairs along the stem at leaf junctures. Stems and leaves are sometimes covered with

fine, soft hairs. Japanese honeysuckle blooms from late April through July and sometimes into October. Small black fruits are produced in autumn, each containing 2-3 oval to oblong, dark brown seeds about 1/4 inch across.

Ecological Threat

In North America, Japanese honeysuckle has few natural enemies, which allows it to spread widely and out-compete native plant species. Its evergreen to semi-evergreen nature gives it an added advantage over native species in many areas. Shrubs and young trees can be killed by girdling when vines twist tightly around stems and trunks, cutting off the flow of water through the plant. Dense growths of honeysuckle covering vegetation can gradually kill plants by blocking sunlight from reaching their leaves. Vigorous root competition also helps Japanese honeysuckle spread and displace neighboring native vegetation.

Distribution in the United States

Japanese honeysuckle occurs across the southern U.S. from California to New England and the Great Lakes region. Escaped populations also occur in Hawaii. Severe winter temperatures and low precipitation may limit its distribution in northern latitudes and in the West, respectively.

Habitat in the United States

A ubiquitous invader, Japanese honeysuckle thrives in a wide variety of habitats including fields, forests, wetlands, barrens, and all types of disturbed lands.



Background

Japanese honeysuckle was introduced to the U.S. in the early to mid-1800's as an ornamental plant, for erosion control, and for wildlife forage and cover. Its highly fragrant flowers provide a tiny drop of honey-flavored nectar enjoyed by children.

Biology & Spread

Growth and spread of Japanese honeysuckle is through vegetative (plant growth) and sexual (seed) means. It produces long vegetative runners that develop roots where stem and leaf junctions (nodes) come in contact with moist soil. Underground stems (rhizomes) help to establish and spread the plant locally. Long distance dispersal is by birds and other wildlife that readily

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Adapted by Mary E. Farrah from: Plant Conservation Alliance, Alien Plant Working Group. <http://www.nps.gov/plants/alien/fact/loja1.htm>

consume the fruits and defecate the seeds at various distances from the parent plant.

Management Options

Several effective methods of control are available for Japanese honeysuckle, including chemical and non-chemical, depending on the extent of the infestation and available time and labor.

Manual and Mechanical

For small patches, repeated pulling of entire vines and root systems may be effective. Hand pull seedlings and young plants when the soil is moist, holding low on the stem to remove the whole plant along with its roots. Monitor frequently and remove any new plants. Cut and remove twining vines to prevent them from girdling and killing shrubs and other plants. An effective method for removal of patches of honeysuckle covering the ground is to lift up and hold a portion of the vine mass with a rake and have a chain saw operator cut the stems low to the ground. Mowing large patches of honeysuckle may be useful if repeated regularly but is most effective when combined with herbicide application (see below). Mow at least twice a year, first in mid-July and again in mid-September. Plants can also be grubbed out using a pulaski or similar digging tool, taking care to remove all roots and runners. Burning removes above ground vegetation but does not kill the underground rhizomes, which will continue to sprout. In certain situations, tethered goats have been used to remove honeysuckle growth, but they must be monitored to prevent their escape to the wild where they would become an added ecological threat.

Chemical

In moderate cold climates, Japanese honeysuckle leaves continue to photosynthesize long after most other plants have lost their leaves. This allows for



application of herbicides when many native species are dormant. However, for effective control with herbicides, healthy green leaves must be present at application time and temperatures must be sufficient for plant activity. Several systemic herbicides (e.g., glyphosate and triclopyr) move through the plant to the roots when applied to the leaves or stems and have been used effectively on Japanese honeysuckle.

Following label guidelines, apply a 2.5% rate of glyphosate (e.g., Rodeo® for wetlands; Roundup® for uplands) mixed with water and an appropriate surfactant, to foliage from spring through fall. Alternatively, apply a 2% concentration of triclopyr (e.g., Garlon 3A) plus water to foliage, thoroughly wetting the leaves but not to the point of drip-off. A coarse, low-pressure spray should be used. Repeat applications may be needed. Treatment in the fall, when many non-target plants are going dormant, is best. Also, a 25% glyphosate or triclopyr solution mixed with water can be applied to cut stem surfaces any time of year as long as the ground is not frozen.

Use pesticides wisely: Always read the entire pesticide label carefully. Follow all mixing and application instructions. Always wear all recommended personal protective equipment. Contact your local Cooperative Extension office for any additional pesticide information.

Notice: Mention of pesticide products does not constitute endorsement of any material.

Suggested Alternative Plants

Vines that make good substitutes for Japanese honeysuckle include false jasmine (*Gelsemium sempervirens*), trumpet honeysuckle (*Lonicera sempervirens*), trumpet creeper (*Campsis radicans*), crossvine (*Bignonia capreolata*), native wisteria (*Wisteria frutescens*), jackman clematis (*Clematis jackmanii*), and others. Check with your state native plant society, or a reputable native plant nursery, for recommendations for plants that are appropriate for your area and conditions.





JAPANESE HOP

Humulus japonicus
Hemp family (Cannabaceae)

Native Range

Temperate Asia (China, Japan, Korea, Taiwan and Russia) and tropical Asia (Vietnam)

Description

Japanese hop is a herbaceous, annual vine that lacks tendrils and climbs by twining. It's shallow-rooted, but can climb to heights of ten feet or more with the help of rough-textured stems that are covered with short, sharp, downward pointing prickles. The leaves are rough textured, paired, and palmate with 5 to 7 lobes. The margins of the leaves are toothed. The leaf stems (petioles) tend to be as long as the leaves and have a pair of small bracts at the base. Male and female flowers are borne on separate plants. The male flowers are very small, greenish-yellow and occur in branched panicles.

The female flowers are in pale green, plump, drooping, cone-like structures with overlapping scales called hops. The hop scales and the seeds are covered with yellow glands. The seeds are about 1/8 in. in diameter, roundish with a blunt tip, and light brown with darker specks.

Ecological Threat

Japanese hop can spread to cover large areas of open ground or low vegetation, including understory shrubs and small trees. The vines grow rapidly during summer, climbing over everything in their path and forming dense mats several feet deep, blocking the light from plants underneath. Hop vines also twine around shrubs and trees, causing them to break or fall over. Japanese hop is invasive in riparian and flood-plain habitats where it displaces native vegetation, prevents new plants from emerging, and kills newly planted trees installed for habitat restoration.

Distribution in the United States

Japanese hop occurs in scattered locations from Nebraska to Maine to Georgia. It is most common in the Northeastern U.S. and eastern Canada. It has been reported to be invasive in natural areas in Connecticut, Delaware, Indiana, Maryland, Pennsylvania, Virginia and Washington, DC.

Habitat in the United States

Japanese hop prefers sunlight and moist, exposed soil. It is commonly found along stream banks and floodplains. Growth is less vigorous in shady, dry areas. It grows in disturbed areas

with fairly moist soils, including roadsides, old fields, and forest edges. In milder climates it can survive the winter.

Background

Japanese hop was imported in the late 1800's to be used as an ornamental vine and as an ingredient in Asian medicine. Common hop contains bitter acids and essential oils used as a preservative and flavoring in beer, but the chemistry of Japanese hop is less desirable for that purpose.

Biology & Spread

Hop spreads by seed that germinates in early spring. If sunlight and moisture are available, new plants may continue to emerge as the season progresses. Once hot weather arrives hop grows very rapidly. Many thousands of hop plants per acre may be produced, eventually blanketing the land and underlying vegetation. In the Mid-Atlantic region, flowering occurs in July and August with seeds maturing through September. By autumn the growth slows and plants begin to decline. The first hard frost kills the vines, but not before they have produced a crop of seeds for next year's infestation. Seeds are dispersed by animals (including people), machinery and floodwaters.

Management Options

Cultural

Japanese hop is intolerant of heavy shade and will cease to be a problem once the tree canopy closes. Minimize tall weeds, shrubs, or low tree branches up which hop will climb. In order

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to prevent and control hop, it's important to act early on infestations before climbing begins.

Manual and Mechanical

Manual control is the most targeted management option; however, it is slow and labor-intensive. Japanese hop does not develop an extensive root system and is fairly easy to remove. Hand weeding needs to be started early in the growing season (April – May) while the roots are small and before the vines become entangled with other vegetation. Care must be taken to remove the root and not just break the stem. Monthly pulling and monitoring will be needed until the infestation is eradicated. It is important to wear gloves and protective clothing to avoid contact with the plant's prickles.

Cutting or mowing the hop vines as close to the ground as possible is an acceptable control method as long as certain guidelines are followed. Cutting must be started in late spring, the entire site must be cut thoroughly, and the process must be repeated frequently until the plants die back in fall. Vines quickly re-grow from the cut stems and from uncut vines around trees.

Chemical

Pre-Emergent Herbicide

The use of pre-emergent herbicides, which typically kill weed seeds as they germinate, is potentially valuable in controlling hop. Because hop seeds are large (about 3 mm), it is harder to prevent their successful germination. Depending on the product, rate and timing, pre-emergents may be used safely over and around young trees, causing minimal to no damage to other perennial vegetation, and they prevent the weed problem from occurring.

Pre-emergent applications should be made in mid-March, although products that possess both pre- and early

post-emergent properties may be used through mid-April. Sulfometuron methyl (Oust® XP at a rate of 1 oz./acre) was found in trials to have the most long-lasting control (through July), with the added benefit of relatively low cost. Metsulfuron methyl, simazine, pendimethalin, and imazapic also provided good pre-emergent control but did not control seeds germinating after June.

Post-Emergent Herbicide

Post-emergent herbicides are the most common approach for weed control. They target seedling to adult stages of plant growth and are effective for management of hop. Ideally, the first application would be made after most seeds have germinated (mid-April to mid-May) and before hop vines are covering the trees (early June to late July) or before seed formation starts (August). Treatments in August or later can lessen the damage from hop vines and reduce seed production. Of the products tested in the Mid-Atlantic, metsulfuron methyl (Escort XP® at 1 oz./ac.) and glyphosate (Accord Concentrate® at 1 qt./ac.) provided the greatest control.

Two treatments are recommended in order to protect trees from damage by the hop vines and to prevent or reduce seed production. Effective combinations include a pre-emergent herbicide in early March, or slightly later if using a product with post-emergent properties, followed by post-emergent application in mid-summer, or two post-emergent treatments (mid and late summer) to prevent the fall seed set. According to The Nature Conservancy, hop seeds in the soil are unlikely to last more than three years. Repeat treatments for two to three years should be expected especially in areas subject to flooding that may receive influx of seed from upstream infestations.



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Suggested Alternative Plants

Virginia creeper (*Parthenocissus quinquefolia*), Coral or trumpet honeysuckle (*Lonicera sempervirens*), Purple passionflower (*Passiflora incarnata*), Trumpet creeper (*Campsis radicans*), and Crossvine (*Bignonia capreolata*) are native plants that grow well in sunny sites preferred by Japanese hop.





JAPANESE KNOTWEED

Polygonum cuspidatum
Buckwheat family (Polygonaceae)

Native Range

Eastern Asia

Description

Japanese knotweed is an upright, shrub-like, herbaceous perennial that can grow to over 10 feet in height. As with all members of this family, the base of the stem above each joint is surrounded by a membranous sheath. Stems of Japanese knotweed are smooth, stout and swollen at joints where the leaf meets the stem. Although leaf size may vary, they are normally about 6 inches long by 3 to 4 inches wide, broadly oval to somewhat triangular and pointed at the tip. The minute greenish-white flowers occur in attractive, branched sprays in summer and are followed soon after by small winged fruits. Seeds are triangular, shiny, and very small, about 1/10 of an inch long.

Ecological Threat

Japanese knotweed spreads quickly to form dense thickets that exclude



native vegetation and greatly alter natural ecosystems. It poses a significant threat to riparian areas, where it can survive severe floods and is able to rapidly colonize scoured shores and islands. Once established, populations are extremely persistent.

Distribution In The United States

Current distribution of Japanese knotweed includes 36 states in the lower 48 from Maine to Wisconsin south to Louisiana, and scattered Midwest and western states. It is not currently known to occur in Hawaii.

Habitat In The United States

Japanese knotweed can tolerate a variety of adverse conditions including full shade, high temperatures, high salinity, and drought. It is found near water sources, such as along streams and rivers, in low-lying areas, waste places, utility rights-of-way, and around old home sites. It can quickly become

an invasive pest in natural areas after escaping from cultivated gardens.

Background

Japanese knotweed was probably introduced to the U.S. in the late 1800's. Also known as crimson beauty, Mexican bamboo, Japanese fleece flower, or Reynoutria, it was first introduced as an ornamental and has also been used for erosion control and for landscape screening. It is now found throughout the eastern US, in several western states, and Alaska, which has few exotic invasive plants to date.

Biology & Spread

Japanese knotweed spreads primarily by vegetative means with the help of its long, stout rhizomes. It is often transported to new sites as a contaminant in fill/dirt seeds, sometimes distributed by water, and carried to a lesser extent by the wind. Escapees from neglected gardens and discarded cuttings are common routes of dispersal from urban areas.

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Adapted by Mary E. Farrah from: Plant Conservation Alliance, Alien Plant Working Group. <http://www.nps.gov/plants/alien/fact/faja1.htm>



Management Options

Grubbing is effective for small initial populations or environmentally sensitive areas where herbicides cannot be used. Using a pulaski or similar digging tool, remove the entire plant including all roots and runners. Juvenile plants can be hand pulled depending on soil conditions and root development. Any portions of the root system not removed will potentially re-sprout. All plant parts (including mature fruit) should be bagged and disposed of in a trash dumpster to prevent re-establishment.

Chemical

Cut stem application

Use this method in areas where plants are established within, or around, non-target plants or where vines have grown into the canopy. This treatment remains effective at low temperatures as long as the ground is not frozen. Cut the stem about 2 inches above ground level. Immediately apply a 25% solution of glypho-

sate (e.g., Roundup®, or use Rodeo® if applying in or near wetland areas) or triclopyr (e.g., Garlon) and water to the cross-section of the stem. A subsequent foliar application of glyphosate may be required to control new seedlings.

Foliar application

Use this method to control large populations. It may be necessary to precede foliar applications with stump treatments to reduce the risk of damaging non-target species. Apply a 2% solution of glyphosate or triclopyr and water to thoroughly wet all foliage. Do not apply so heavily that herbicide will drip off leaves. A 0.5% non-ionic surfactant is recommended in order to penetrate the leaf cuticle. Ambient air temperature should be above 65 °F.

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al protective equipment. Contact your local Cooperative Extension office for any additional pesticide information.

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Suggested Alternative Plants

Many attractive native herbs and shrubs are available that make excellent alternatives to Japanese knotweed. Contact the native plant society in your state for more information.





JAPANESE STILTGRASS

Microstegium vimineum
Grass family (Poaceae)

Native Range

Japan, Korea, China, Malaysia and India

Description

Japanese stiltgrass, or Nepalese brown-top, is an annual grass with a sprawling habit. It germinates in spring and grows slowly through the summer months, ultimately reaching heights of 2 to 3½ ft. The leaves are pale green, lance-shaped, asymmetrical, 1 to 3 in. long, and have a distinctive shiny midrib. Slender stalks of tiny flowers are produced in late summer and dry fruits called achenes are produced soon afterwards.

Ecological Threat

Japanese stiltgrass is especially well adapted to low light conditions. It threatens native plants and natural habitats in open to shady, and moist to dry locations. Stiltgrass spreads to form extensive patches, displacing native species. Where white-tail deer are over-

abundant, they may facilitate its invasion by feeding on native plant species and avoiding stiltgrass. Japanese stiltgrass may impact other plants by changing soil chemistry and shading other plants. The interaction between stiltgrass and the Northern Pearly Eye (*Enodia anthedon*), a member of the brush-footed butterfly family Nymphalidae, is unclear.

This butterfly is rare to uncommon along the Potomac River in the Washington, DC area. Further investigation is needed to study the potential impacts of stiltgrass on this, and possibly other, butterfly species that utilize stiltgrass as an alternative host plant.

Distribution In The United States

Japanese stiltgrass has been reported to be invasive in natural areas in 15 eastern states (Connecticut, Delaware, Georgia, Indiana, Kentucky, Maryland, Massachusetts, New Jersey, New York, North Carolina, Pennsylvania, Tennessee, Virginia, West Virginia, and Washington, DC).

Habitat In The United States

Stiltgrass occurs in a wide variety of habitats including moist ground in open woods, floodplain forests, wetlands, uplands, fields, thickets, paths, clearings, roadsides, ditches, utility corridors, and gardens. It readily invades areas subject to regular mowing, tilling, foot traffic, and other soil disturbing activities as well as natural disturbances



such as the scouring associated with flooding. Stiltgrass appears to prefer moist, acidic to neutral soils that are high in nitrogen.

Background

First documented in Tennessee around 1919, stiltgrass may have accidentally escaped as a result of its use as a packing material for porcelain.

Biology & Spread

Japanese stiltgrass is an annual grass, with all plants dying each fall. It is a colonial species that spreads during the summer and fall by rooting at stem nodes that touch the ground. Individual plants may produce 100 to 1,000 seeds that fall close to the parent plant from both self-fertilizing and cross-fertilizing flowers. Seed may be carried further by water currents during heavy rains or moved in contaminated hay, soil, or potted plants, and on footwear and vehicles. Stiltgrass seed remains viable in the soil for five or more years. Deer and other grazers do not browse it, though they have been found to spread the seeds. Stiltgrass leaves a thick layer

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of thatch after dieback each year in heavily invaded areas, and, while leaves decompose quickly, stems do not. Stiltgrass is physiologically adaptive; it is able to withstand low light levels where nutrient levels are sufficient, and able to withstand low nutrient levels where light levels are sufficient. Stiltgrass can photosynthesize in low light and respond quickly to the changing light conditions found on the forest floor, but the very low light conditions found beneath a multilayered forest canopy will limit its growth.

Management Options

A variety of control methods are available for stiltgrass, depending on the extent of the infestation, the type of habitat, and the availability of labor and other resources. Preventing the introduction of stiltgrass from infested to non-infested areas should be a priority. Early control of new infestations will also reduce the likelihood of establishment and expansion. Manual removal of plants results in unavoidable disturbance to the soil, which can result in additional germination of stiltgrass seed. Using an herbicide leaves the plants and soil in place, thus minimizing that likelihood.

Chemical

For extensive stiltgrass infestations, use of a systemic herbicide such as glyphosate (e.g., Roundup Pro®) is a practical and effective method if used with some caution. Glyphosate is a non-specific herbicide that will kill or damage almost any herbaceous plant and possibly some woody plants it contacts. Roundup Pro® is surfactant-loaded with a surfactant that isn't lethal to amphibians and aquatic invertebrates as is the polyoxyethyleneamine surfactant in Roundup Classic®. When treating stiltgrass in wetland sites, use Rodeo® or other formulations labeled for wetlands. Apply a 2% solution of Roundup® or Rodeo® mixed with water (8 oz. per 3 gals. mix) and a surfactant in late

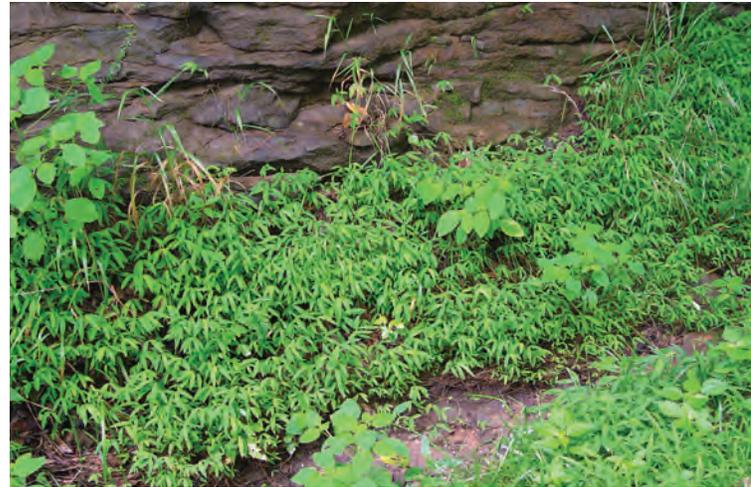
summer. Be careful to avoid application to non-target plants.

Some researchers have also found success using the pre-emergent herbicide imazapic which is the active ingredient found in Journey®. Imazapic is most effective against stiltgrass when applied in March in the Mid-Atlantic states. The best rate for maximum selectivity is 4 oz. per acre, applied as a broadcast application with backpack sprayers. Sprayers should be fitted with an 8003E flat fan nozzle and calibrated at 15 to 20 gpa. Journey® can be applied continually through germination. No surfactant is necessary for pre-emergent applications. As germination nears, begin to add 1/4% non-ionic surfactant to the mixture.

Another option is to apply a pre-emergent (only) treatment with Pendulum® Aquacap™ (active ingredient is pendimethalin) at 2.4 qts. to 4.8 qts. per acre (15 to 20 gpa). The higher rates have provided season long control.

Manual

Stiltgrass is a shallow-rooted annual that can be pulled by hand throughout the growing season, especially when the soil is moist and entire plants with roots can be removed. Pulling is easier and probably more effective in mid-to-late summer when the plants are much taller and more branched. Plants can be easily removed by grabbing the basal portion of a plant and pulling firmly. Stiltgrass can be pulled and piled up to dehydrate on site. If plants are already in the fruiting stage, they should be bagged and disposed of offsite to prevent dispersal of seed. Try to avoid pulling native grasses that often grow intermingled with stiltgrass and may be difficult to



distinguish. Late season pulling will avoid the likelihood of seed germination of stiltgrass seed from previous seasons. Hand pulling of plants will need to be continued for many seasons until the seed bank is exhausted.

Mechanical

Stiltgrass can be mowed in late summer when the plants are flowering but before seed is produced. Stiltgrass is primarily an annual plant; cutting late in the season before the plants die back naturally avoids the possibility of regrowth. Stiltgrass plants that are cut early in the summer respond by regrowing and flowering much earlier than they would normally flower, another reason to consider cutting in late summer to fall.

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KUDZU

Pueraria montana
Pea family (Fabaceae)

Native Range

Asia

Description

Kudzu is a climbing, semi-woody, perennial vine in the pea family. Deciduous leaves are alternate and compound, with three broad leaflets up to 4 inches across. Leaflets may be entire or deeply lobed with hairy margins. Individual flowers, about ½ inch long, are purple, highly fragrant and borne in long hanging clusters. Flowering occurs in late summer and is soon followed by production of brown, hairy, flattened seed pods, each of which contains three to ten hard seeds.

Ecological Threat

Kudzu kills or degrades other plants by smothering them under a solid blanket of leaves, by girdling woody stems and tree trunks, and by breaking branches or uprooting entire trees and shrubs through



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Adapted by Mary E. Farrah from: Plant Conservation Alliance, Alien Plant Working Group. <http://www.nps.gov/plants/alien/fact/pumo1.htm>

the sheer force of its weight. Once established, Kudzu plants grow rapidly, extending as much as 60 feet per season at a rate of about one foot per day. This vigorous vine may extend 32–100 feet in length, with stems ½–4 inches in diameter. Kudzu roots are fleshy, with massive tap roots 7 inches or more in diameter, 6 feet or more in length, and weighing as much as 400 pounds. A single root crown may grow as many as thirty vines.

Distribution In The United States

Kudzu is common throughout most of the southeastern U.S. and has been found as far north as Pennsylvania.

Habitat In The United States

Kudzu grows well under a wide range of conditions and in most soil types. Preferred habitats are forest edges, abandoned fields, roadsides, and disturbed areas, where sunlight is abundant. Kudzu grows best where winters are mild, summer temperatures are above 80° F and annual rainfall is 40 inches or more.

Biology & Spread

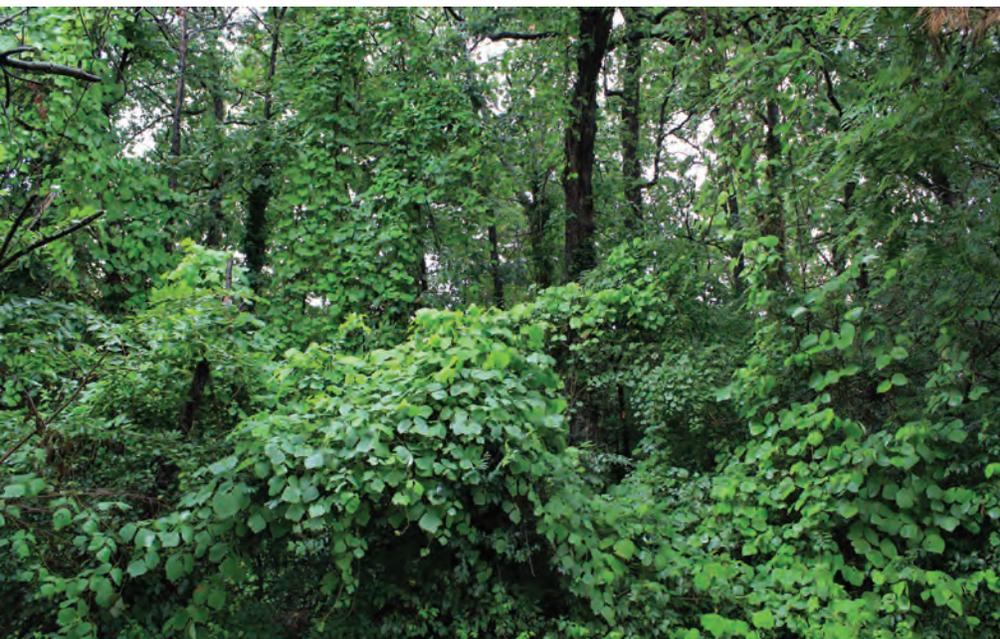
The spread of kudzu in the U.S. is currently limited to vegetative expansion by runners and rhizomes and by vines that root at the nodes to form new plants.

Kudzu also spreads somewhat through seeds, which are contained in pods, and which mature in the fall. However, only one or two viable seeds are produced per cluster of pods and these hard-coated seeds may not germinate for several years.

Background

Kudzu was introduced into the U.S. in 1876 at the Philadelphia Centennial

Exposition, where it was promoted as a forage crop and an ornamental plant. From 1935 to the mid-1950s, farmers in the south were encouraged to plant kudzu to reduce soil erosion, and Franklin D. Roosevelt's Civilian Conservation Corps planted it widely for many years. Kudzu was recognized as a pest weed by the U.S. Department of Agriculture and, in 1953, was removed from its list of permissible cover plants



Management

For successful long term control of kudzu, the extensive root system must be destroyed. Any remaining root crowns can lead to reinfestation of an area. Mechanical methods involve cutting vines just above ground level and destroying all cut material. Close mowing every month for two growing seasons or repeated cultivation may be effective. Cut kudzu can be fed to livestock, burned or enclosed in plastic bags and sent to a landfill. If conducted in the spring, cutting must be repeated as regrowth appears to exhaust the plant's stored carbohydrate reserves. Late season cutting should be followed up with immediate application of a systemic herbicide (e.g., glyphosate) to cut stems, to encourage transport of the herbicide into the root system. Repeated applications of several soil-active herbicides have been used effectively on large infestations in forestry situations. Efforts are being organized by the U.S. Forest Service to begin a search for biological control agents for kudzu.

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Suggested Alternative Plants

Native vines such as trumpet creeper (*Campsis radicans*), pipevine (*Aristolochia macrophylla*), passionflower (*Passiflora lutea*), trumpet honeysuckle (*Lonicera sempervirens*), and native bittersweet (*Celastrus scandens*) have attractive flowers and fruits, provide food for wildlife and make excellent substitutes for kudzu. These plants should be used in landscaping and for land restoration where they are known to occur as natives.





FIG BUTTERCUP

Ficaria verna (previously *Ranunculus ficaria* L.)
Buttercup family (Ranunculaceae)

Native Range

Eurasia including Europe, Northern Africa, Western Asia, Caucasus, and Siberia

Description

Fig buttercup, also called lesser celandine and pilewort, is a perennial herbaceous flowering plant that completes its life cycle during the winter and spring. The name is derived from *Ficaria* (Latin for fig) and *verna* (spring). Plants consist of a basal rosette of tender, succulent, dark green, shiny, stalked kidney- to heart-shaped leaves. Flowers are symmetrical, bright buttery yellow with a slightly darker center, have 8 (typical) to 12 petals, and are borne singly on delicate stalks that rise above the leaves. Tiny cream colored bulblets are produced in stem axils and become apparent later in the flowering period. Abundant finger-like tubers are produced by the roots and are easily visible when plants are pulled up. Fruiting heads are globose composed of many achenes that are pubescent and

usually abortive. When in bloom, large infestations of lesser celandine appear as a green carpet with yellow dots, spread across the forest floor. There are many varieties of lesser celandine including a double-flowered form with many petals and dark green leaves mottled with silvery markings.

NOTE: Fig buttercup may be confused with marsh marigold (*Caltha palustris*), a native plant found in wetland habitats 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. It also resembles celandine (*Chelidonium majus*) and celandine poppy (*Stylophorum diphylum*), both of which belong to the poppy family and can be distinguished from the invasive buttercup by having flowers with four petals.

Ecological Threat

Fig buttercup is a vigorous growing vernal plant that forms large, dense patches in floodplain forests and some upland sites, displacing many native plant species, especially those with the similar spring-flowering life cycle. Spring ephemerals complete the reproductive part of their life cycle and most



of their above-ground development in the increasing light of late winter and spring, before woody plants leaf out and shade the forest floor. Some examples of native spring ephemerals include bloodroot, wild ginger, spring beauty, harbinger-of-spring, twinleaf, squirrel-corn, trout lily, trilliums, Virginia bluebells, and many, many others. These plants provide critical nectar and pollen for native pollinators, and fruits and seeds for other native insects and wildlife species. Because fig buttercup emerges well in advance of the native species, it has a developmental advantage which allows it to establish and overtake areas rapidly.

Distribution in the United States

Fig buttercup is reported to be invasive in at least seventeen states in the northeastern U.S. from Wisconsin to New Hampshire south to Tennessee and, to date, in one western state, Oregon.

Habitat In The United States

Fig buttercup occurs in low open woods, floodplains, meadows and waste places and seems to prefer sandy soils.

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Adapted by Mary E. Farrah from: Plant Conservation Alliance, Alien Plant Working Group. <http://www.nps.gov/plants/alien/fact/rafi1.htm>

Background

Fig buttercup was introduced to the United States as an ornamental plant. It is still available commercially in the U.S. along with many colorful varieties. All varieties should be assumed to be potentially invasive and should not be allowed to escape from plantings.

Biology & Spread

Fig buttercup is a vernal or spring ephemeral perennial plant that spends much of the year (summer through early winter) underground as thickened, fingerlike tubers or underground stems. During the winter, leaves begin to emerge and photosynthesize in preparation for flowering. In the Mid-Atlantic region, most flowering occurs from late winter through mid-spring (March through May), depending on conditions. After flowering, the above-ground portions begin to die back and the plants are mostly gone by June. Fig buttercup spreads primarily by vegetative means through abundant tubers and bulblets, each of which can grow into a new plant once separated from the parent plant. The prolific tubers may be unearthed and scattered by the digging activities of some animals, including well-meaning human weed pullers, and spread to new sites during flood events.

Management Options

Due to its short life cycle, the window of opportunity for controlling fig buttercup is very short but it can be accomplished with persistence over time using methods that are appropriate for the site and size of infestation. While manual methods are possible for some (small) infestations, the use of systemic herbicide is more effective because it kills the entire plant including the roots and minimizes soil disturbance.

Chemical

In order to have the greatest negative impact to celandine and the least impact to desirable native wildflower spe-

cies, herbicide should be applied in late winter-early spring, generally February through March. Start applications prior to flowering and up until about 50 percent of the plants are in flower, around April 1, then stop. After that, control success declines and many more native wildflowers have emerged that could be killed by spray. Native amphibians would also be emerging and could be harmed. Apply a 1 to 1.5% rate of a 53.8% active ingredient glyphosate isopropylamine salt (e.g., Rodeo® which is labeled for use in wetland areas), mixed with water and a non-ionic surfactant to foliage, avoiding application to anything but the celandine. Glyphosate is systemic; that is, the active ingredient is absorbed by the plant and translocated to the roots, eventually killing the entire plant. The full effect on the plant may take 1-2 weeks. Retreatment the following year will likely be needed. Applications can be made during the winter season as long as the temperature is 50 degrees Fahrenheit or above, and no rain is anticipated for at least 12 hours. Because glyphosate is non-specific, spray should be directed such that it contacts only fig buttercup and does not drift onto desirable native plants. To minimize impacts to sensitive-skinned frogs and salamanders, some experts recommend applying herbicide in March and then switching to manual methods.

Manual-Mechanical

For small infestations, fig buttercup may be pulled up by hand or dug up using a hand trowel or shovel. It is very important to remove all bulblets and tubers. Due to the abundant tiny bulblets and tubers, all material must be bagged up, removed from the site and disposed properly in a landfill or incinerator. A major consideration when

manually removing invasive plants like this is the disturbance to the soil which can encourage the target invasive as well provide openings for invasion by other exotic species. For these reasons,



manual and mechanical removal is probably inappropriate for larger infestations in high quality natural areas.

Use pesticides wisely: Always read the entire pesticide label carefully. Follow all mixing and application instructions. Always wear all recommended personal protective equipment. Contact your local Cooperative Extension office for any additional pesticide information.

NOTICE: Mention of pesticide products does not constitute endorsement of any material.

Suggested Alternative Plants

Many lovely native perennial, spring-flowering plants are available as alternatives to fig buttercup. Plants native the eastern U.S. that are available from native plant nurseries include wild ginger (*Asarum canadense*), bloodroot (*Sanguinaria canadensis*), twinleaf (*Jeffersonia diphylla*), and various species of trilliums. Contact your local native plant society for additional suggestions and assistance for which species are appropriate for your area. Buying from reputable sources will ensure that the plants you buy are not collected from the wild.



MILE-A-MINUTE

Persicaria perfoliata (previously *Polygonum perfoliatum*)
Buckwheat family (Polygonaceae)

Native Range

India to Eastern Asia, China and the Islands from Japan to the Philippines, including Nepal, Burma, Manchuria, China, Korea, Taiwan and the Malay Peninsula

Description

Mile-a-minute weed, or Asiatic tear-thumb, is an herbaceous, annual, trailing vine. Stems are armed with re-curved barbs that are also present on the underside of the leaf blades. The light green colored leaves are shaped like an equilateral triangle and alternate along the narrow, delicate stems. Distinctive circular, cup-shaped leafy structures, called ocreae, surround the stem at nodes, thus the name “perfoliatum”. Flowers and fruits emerge from within the ocreae. Flowers are small, white and inconspicuous. The fruits are attractive, deep blue and arranged in clusters at terminals. Each berry-like fruit contains a single glossy, black or reddish-black hard seed called an achene.

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Adapted by Mary E. Farrah from: Plant Conservation Alliance, Alien Plant Working Group. <http://www.nps.gov/plants/alien/fact/pepe1.htm>

Ecological Threat

Mile-a-minute grows rapidly, scrambling over shrubs and other vegetation, blocking the foliage of covered plants from available light, and reducing their ability to photosynthesize, which stresses and weakens them. In addition, the weight and pressure of the vine causes distortion of stems and branches of covered plants. Large infestations of mile-a-minute eventually reduce native plant species in an area and can eliminate populations of extremely rare plants entirely. Because it can smother tree seedlings, mile-a-minute has a negative effect on Christmas tree farms, forestry operations on pine plantations and re-forestation of natural areas. It has the potential to be a problem to nursery and horticulture crops that are not regularly tilled as a cultivation practice.

Distribution In The United States

Mile-a-minute has been found in parts of Connecticut, Delaware, Massachusetts, Maryland, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Virginia, West Virginia, and Washington, DC. It is considered to be a temperate species with subtropical tendencies and therefore has the potential to invade those portions of the contiguous United States that have the appropriate climate to provide a minimal eight week cold vernalization period. A temperature of 10°C or below must be sustained for an eight week period to stimulate germination. It has also been reported to be invasive in nine national parks in four Mid-Atlantic states.



Habitat In The United States

Mile-a-minute weed generally colonizes open and disturbed areas, along the edges of woods, wetlands, stream banks, and roadsides, and uncultivated open fields, resulting from both natural and human causes. It also occurs in environments that are extremely wet with poor soil structure. It will tolerate shade for a part of the day, but needs a good percentage, 63-100% of the available light. The ability of mile-a-minute to attach to other plants with its recurved barbs, and climb over them to reach the light, is a key to its survival. It can survive in areas with relatively low soil moisture, but prefers high soil moisture.

Background

The first records of mile-a-minute in North America are from Portland, OR (1890) and Beltsville, MD (1937), but populations did not take hold until later

in the 1930's when introduced to a nursery in York, PA via imported holly seed. The owner of the nursery was interested in the plant and allowed it to reproduce; unfortunately, subsequent efforts to eradicate it were not successful.

Biology & Spread

Mile-a-minute weed is primarily a self-pollinating plant with occasional out-crossing. Vines generally die with the first frost. Mile-a-minute is a prolific seeder, producing many seeds on a single plant over a long season, from June until October. Seed persists in the soil for as long as 7 years, with staggered germination over the years. Birds are probably the primary long-distance dispersal agents of mile-a-minute, feeding on the berries and subsequently dispersing the seeds under utility lines, bird feeders, fence lines and other perching locations. Native seed-carrying ants may play an important role in the survival and germination of the seeds by transporting the seeds short distances. Other animals observed eating mile-a-minute fruits are chipmunks, squirrels and deer.

Water is also an important mode of dispersal for mile-a-minute. The long vines frequently hang over waterways, allowing fruits that detach to be carried away in the water current. Fruits may remain buoyant for 7-9 days, dispersing seed long distances. During storm events the potential spread of this plant is greatly increased throughout watersheds.

Management Options

A variety of control measures can be used for management of mile-a-minute depending on the level of infestation and resources available.

Biological

After surveys and trials, the US Forest Service's biological control program uses the host specific weevil, *Rhinocymimus latipes*, for mile-a-minute abatement. Adult weevils feed on foliage

and larvae feed within nodes, causing sufficient damage and reducing seed production. The weevils are active from early spring through the fall, completing multiple generations.

Weevils have been released in Delaware, Maryland, New Jersey, Pennsylvania and West Virginia, and have established at every release site. Substantial plant damage has been observed at some sites several years after release of the weevil. Studies are ongoing concerning impact and the best way to use these insects for control.

Chemical

Mile-a-minute is sensitive to moderate rates of widely used herbicides. However, because it can begin setting seed by mid-June, and will grow onto and over desirable vegetation, selective control with herbicides is difficult. Extensive infestations in high-priority areas can be treated with a pre-emergence herbicide to kill plants as they germinate in the early spring, with follow-up applications using post-emergence herbicides to eliminate escapees. Sparse populations are better treated with post-emergence herbicides. Pre-emergent and post-emergent herbicides are available to treat mile-a-minute effectively depending on the site value and extent of infestation. For most situations, the post-emergent herbicides triclopyr (Garlon 3A) and glyphosate (Glyphomate 41), with little to no soil activity respectively, are the best choice. Both products are labeled for aquatic use and pose little threat to other organisms.

Cultural

Cultural methods can be utilized to discourage the introduction of mile-a-minute to an area. It's important to maintain vegetative community stability and to avoid creating gaps or openings in existing vegetation. Maintaining broad vegetative buffers along streams and forest edges will help to shade out and prevent establishment of mile-a-minute weed. This will also help to



reduce the dispersal of fruits by water.

Manual

Hand pulling of seedlings is best done before the re-curved barbs on the stem and leaves harden, but may be done afterwards with the help of thick gloves. Manual removal of vines may be conducted throughout the summer. Try to pull up the whole plant including its roots. Depending on the site and situation, piles can either be bagged and disposed of in a landfill or left until the following year and monitored for emergence of new seedlings. Previously infested sites need to be re-checked several times a year, and new plants removed until the seed germination period is complete (roughly early April until early July in the Mid-Atlantic states).

Mechanical

For low growing infestations that cover the ground, repeated mowing or weed whacking of vines will reduce the plants' reserves and prevent or reduce flowering, which in turn reduces fruit and seed production.

Use pesticides wisely: Always read the entire pesticide label carefully. Follow all mixing and application instructions. Always wear all recommended personal protective equipment. Contact your local Cooperative Extension office for any additional pesticide information.

NOTICE: Mention of pesticide products does not constitute endorsement of any material.



ORIENTAL BITTERSWEET

Celastrus orbiculatus
Staff Tree family (*Celastraceae*)

Native Range

Eastern Asia, Korea, China and Japan

Description

Oriental bittersweet is a deciduous woody perennial which grows as a climbing vine and a trailing shrub. Stems of older plants have been reported to be 4 inches in diameter. The leaves are alternate, glossy and nearly as wide as they are long (round), with finely toothed margins. There are separate female (fruiting) and male (non-fruiting) plants. Female plants produce clusters of small greenish flowers in axillary clusters (from most leaf axils), and each plant can produce large numbers of fruits and seeds. The fruits are three-valved, yellow, globular capsules that at maturity split open to reveal three red-orange, fleshy arils each containing one or two seeds. The abundance of showy fruits has made Oriental bittersweet extremely popular for use in floral arrangements.

Note: Oriental bittersweet can be confused with the rare native American bittersweet (*Celastrus scandens*). Make

sure that correct identification is made before any control is begun. Hybrids of the two occur, making identification difficult. For more information contact the Cooperative Extension Service.

Ecological Threat

Oriental bittersweet is a vigorously growing vine that climbs over and smothers vegetation which may die from excessive shading or breakage. When bittersweet climbs high up on trees the increased weight can lead to uprooting and blow-over during high winds and heavy snowfalls. In addition, Oriental bittersweet is displacing our native American bittersweet (*Celastrus scandens*) through competition and hybridization.

Distribution In The United States

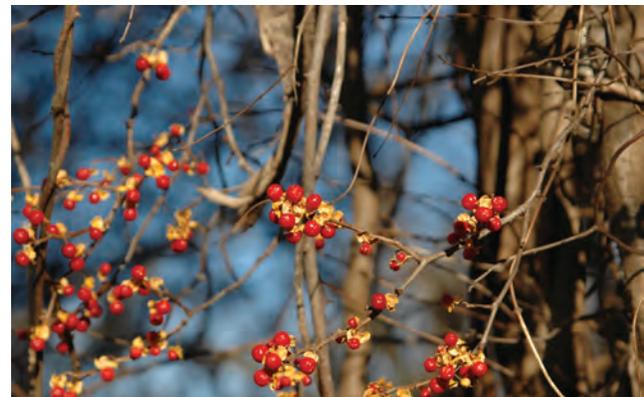
Oriental bittersweet has been reported to be invasive in natural areas in 21 states (CT, DE, IL, IN, KY, MA, MD, ME, MI, MO, NC, NH, NJ, NY, PA, RI, TN, VA, VT, WI, and WV) and at least 14 national parks in the eastern U.S.

Habitat In The United States

Oriental bittersweet infests forest edges, woodlands, fields, hedgerows, coastal areas and salt marsh edges, particularly those suffering some form of land disturbance. It's often found in open, sunny sites, but its tolerance for shade allows it to invade forested areas.

Background

Introduced into the U.S. in the 1860's as an ornamental plant, Oriental bit-



tersweet is often associated with old home sites, from which it has escaped into surrounding natural areas. Oriental bittersweet is still widely planted and maintained as an ornamental vine, further promoting its spread.

Biology & Spread

Oriental bittersweet reproduces prolifically by seed, which is readily dispersed to new areas by many species of birds including mockingbirds, blue jays and European starlings. The seeds germinate in late spring. It also expands vegetatively through root suckering.

Management Options

Manual, mechanical and chemical control methods are all effective in removing and killing Oriental bittersweet. Employing a combination of methods often yields the best results and may reduce potential impacts to native plants, animals and people.

Chemical

Systemic herbicides like triclopyr (e.g., Garlon® 3A and Garlon® 4) and glyphosate (e.g., Accord®, Glypro®, Rodeo®)

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Adapted by Mary E. Farrah from: Plant Conservation Alliance, Alien Plant Working Group. <http://www.nps.gov/plants/alien/fact/ceor1.htm>

are absorbed into plant tissues and carried to the roots, killing the entire plant within about a week. This method is most effective if the stems are first cut by hand or mowed and herbicide is applied immediately to cut stem tissue. Herbicide applications can be made any time of year as long as temperatures are above 55° to 60°F for several days and rain is not expected for at least 24 hours. Fall and winter applications will minimize impacts to native plants and animals. Repeated treatments are likely to be needed. In areas where spring wildflowers or other native plants occur, application of herbicides should be conducted prior to their emergence, delayed until late summer or autumn, after the last killing frost occurs, or carefully targeted. Herbicidal contact with desirable plants should always be avoided. If native grasses are intermingled with the bittersweet, triclopyr should be used because it is selective for broad-leaved plants and will not harm grasses. Follow-up monitoring should be conducted to ensure effective control.

Glyphosate products referred to in this fact sheet are sold under a variety of brand names (Accord®, Rodeo®, Roundup Pro® Concentrate) and in concentrations (41.0, 50.2 and 53.8% active ingredient). Other glyphosate products sold at home improvement stores may be too dilute to obtain effective control.

Cut stem application

Use this method in areas where vines are established within or around non-target plants or where vines have grown into the canopy. Cut each vine stem close to the ground (about 2 in. above ground) and immediately apply a 25% solution of glyphosate mixed with water to the cut surface of the stem. The glyphosate application is effective at temperatures as low as 40°F.

Foliar application

Use this method to control extensive patches of solid bittersweet. It may be necessary to precede foliar applications with stump treatments to reduce the risk

of damaging non-target species. Apply a 2% solution (8 oz per 3 gal. mix) of triclopyr ester or triclopyr amine mixed in water with a non-ionic surfactant to the leaves. Thoroughly wet the foliage but not to the point of runoff. The ideal time to spray is after much of the native vegetation has become dormant (October–November) to avoid affecting non-target species. A 0.5% concentration of a non-ionic surfactant is recommended in order to penetrate leaf cuticle. If the 2% rate is not effective try an increased rate of 3–5%. Ambient air temperature should be above 65°F.

For dense, low patches of bittersweet another alternative is to cut the entire patch to the ground early in the growing season. About one month later, apply 1–2% solution of triclopyr ester (Garlon® 4) or triclopyr salt (Garlon® 3A) in water to the previously cut patch using a backpack sprayer. This method has resulted in complete rootkill of the bittersweet and no off-target damage or root uptake by adjacent plants.

Manual and Mechanical

Small infestations can be hand-pulled but the entire plant should be removed including all the root portions. If fruits are present, the vines should be bagged in plastic trash bags and disposed of in a landfill. Always wear gloves and long sleeves to protect your skin from poison ivy and barbed or spined plants. For climbing vines, first cut the vines near the ground to kill upper portions and relieve the tree canopy. Vines can be cut using pruning snips or pruning saw for smaller stems or a hand axe or chain saw for larger vines. Try to minimize damage to the bark of the host tree. Rooted portions will remain alive and should be pulled, repeatedly cut to the ground, or treated with herbicide. Cutting without herbicide treatment will require vigilance and repeated cutting because plants will resprout from the base.

Use pesticides wisely: Always read the entire pesticide label carefully. Follow



all mixing and application instructions. Always wear all recommended personal protective equipment. Contact your local Cooperative Extension office for any additional pesticide information.

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Suggested Alternative Plants

Several attractive native vines are available that provide nectar, seed and host plant material for butterflies, hummingbirds, and other wildlife. American bittersweet (*Celastrus scandens*) is native to the eastern U.S. and should only be planted in areas where Oriental bittersweet is not established or is controlled to prevent hybridization. Trumpet honeysuckle (*Lonicera sempervirens*), trumpet creeper (*Campsis radicans*), passionflower vine (*Passiflora lutea*), Dutchman's pipe (*Aristolochia macrophylla*) and native wisteria (*Wisteria frutescens*)* are good alternatives.

*Make sure the wisteria is a native species. Chinese wisteria (*Wisteria sinensis*) and Japanese wisteria (*Wisteria floribunda*), are exotic invasives.





PORCELAINBERRY

Ampelopsis brevipedunculata
Grape family (Vitaceae)

Native Range

Northeast Asia—China, Korea, Japan, and the Russian Far East

Description

Porcelainberry is a deciduous, woody, perennial vine. It twines with the help of non-adhesive tendrils that occur opposite the leaves. The stem pith of porcelainberry is white and continuous across the nodes, the bark has lenticels and does not peel. 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 in cymes opposite the leaves from June through August (in contrast to grape species that have flowers with petals that touch at tips and occur in panicles). The fruits appear in September-October and are colorful, chang-



ing from green to pale lilac, to a bright blue. Porcelainberry is often confused with species of grape (*Vitis*) and may be confused with several native species of *Ampelopsis*—*Ampelopsis arborea* and *Ampelopsis cordata*.

Rhode Island, Virginia, West Virginia, Wisconsin and Washington, DC.

Habitat In The United States

Porcelainberry grows well in most soils, especially forest edges, pond margins, stream banks, thickets, and waste places, where there is full sunlight to partial shade, and where it is not permanently wet. Porcelainberry appears to be less tolerant of heavily shaded areas, like those found in mature forest interiors.

Background

Porcelainberry was originally cultivated around the 1870's as a bedding and landscape plant. In spite of its aggressiveness in some areas, it is still used in the horticultural trade (for example, the ornamental *A. brevipedunculata* 'Elegans' is often recommended as a landscape plant with a cautionary note that “care must be taken to keep it from overtaking

Ecological Threat

Porcelainberry is a vigorous invader of open and wooded habitats. It grows and spreads quickly in areas with high to moderate light. As it spreads, it climbs over shrubs and other vegetation, shading out native plants and consuming habitat.

Distribution in the United States

Porcelainberry is found from New England to North Carolina and west to Michigan and is reported to be invasive in twelve states in the Northeast: Connecticut, Delaware, Massachusetts, Maryland, New Jersey, New York, Pennsylvania,

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Adapted by Mary E. Farrah from: Plant Conservation Alliance, Alien Plant Working Group. <http://www.nps.gov/plants/alien/fact/ambr1.htm>

and shading out small plants”). The same characteristics that make porcelainberry a desirable plant for the garden — its colorful berries, good ground coverage, trellis-climbing vines, pest-resistance, and tolerance of adverse conditions — are responsible for its presence in the United States as an undesirable invader.

Biology & Spread

Porcelainberry spreads by seed and through vegetative means. The colorful fruits, each with two to four seeds, attract birds and other small animals that eat the berries and disperse the seeds in their droppings. The seeds of porcelainberry germinate readily to start new infestations. Porcelainberry is often found growing in riparian areas downstream from established patches, suggesting they may also be dispersed by water. The taproot of porcelainberry is large and vigorous. Resprouting will occur in response to cutting of above-ground portions.

Management Options

Because porcelainberry vines can grow up to 15 ft. in a single growing season, especially when rainfall is abundant, and seed may be viable in the soil for several years, effective control requires dedicated follow-up. Treatment measures must often be repeated during the growing season, and for several years afterward, to fully eradicate the plant. Prevention of flowering, fruiting and production of mature seeds will help reduce its spread.

Manual

Hand pulling of vines in the fall or spring will prevent flower buds from forming the following season. Where feasible, plants should be pulled up by hand before fruiting to prevent the production and dispersal of seeds. If the plants are pulled while in fruit, the fruits should be bagged and disposed of in a landfill. For vines too large to pull out, cut them near

the ground and either treat cut stems with systemic herbicide or repeat cutting of regrowth as needed.

Chemical

Chemical control in combination with manual and mechanical methods is effective and likely to be necessary for large infestations. The systemic herbicides triclopyr (e.g., Garlon® 3A and Garlon 4) and glyphosate (e.g., Roundup® and Rodeo®) have been used successfully by many practitioners.

Foliar application

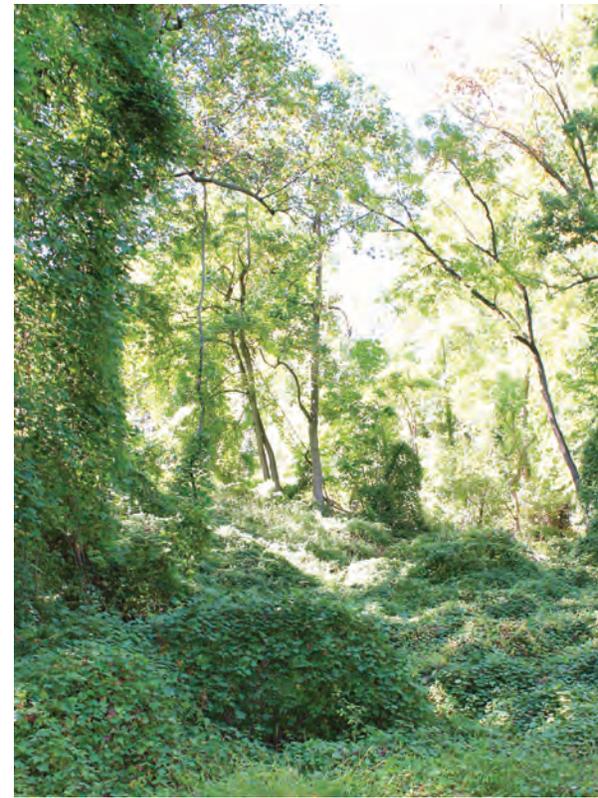
The most effective control has been achieved using triclopyr formulations. From summer to fall, apply a water-based solution of 2.5% Garlon 3A (triclopyr amine) to foliage or cut plants first, allow time for regrowth, and then reapply the mixture. Smaller infestations can be controlled to some extent with spot applications of glyphosate to leaves, used sparingly to avoid contact of desirable plants. Cut the vines back during the summer and allow to resprout before applying herbicide, or apply glyphosate to leaves in early autumn, just prior to senescence.

Basal bark application

Apply a mixture of 20-30% Garlon® 4 (triclopyr ester) mixed with commercially available basal oil, horticultural oil, diesel fuel, No. 1 or No. 2 fuel oil, or kerosene, to 2 - 3 ft. long sections of stem near the base of the vines.

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Suggested Alternative Plants

Many lovely non-invasive vines are available. Some native substitutes to consider include trumpet honeysuckle (*Lonicera sempervirens*), trumpet creeper (*Campsis radicans*), American wisteria* (*Wisteria frutescens*), Virginia creeper (*Parthenocissus quinquefolia*), and goldflame honeysuckle (*Lonicera heckrottii*). In the south-east, 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.

*Make sure the wisteria is a native species. Chinese wisteria (*Wisteria sinensis*) and Japanese wisteria (*Wisteria floribunda*), are exotic invasives.





TREE OF HEAVEN

Ailanthus altissima
Quassia family (Simaroubaceae)

Native Range

Central China

Description

Tree-of-heaven, also known as ailanthus, Chinese sumac, and stinking sumac, is a rapidly growing, deciduous tree in the mostly tropical quassia family (Simaroubaceae). Mature trees can reach over 80 feet in height. Ailanthus has smooth stems with pale gray bark and twigs that are light chestnut brown. Its large compound leaves, 1-4 feet in length, are composed of 11-25 smaller leaflets and alternate along the stems. Each leaflet has one to several glandular teeth near the base. In late spring, clusters of small, yellow-green flowers appear near the tips of branches. Seeds are produced on female trees in late summer to early fall in flat, twisted, papery structures called samaras. The wood of ailanthus is soft, weak, coarse-grained, and creamy white to light brown in color. All parts of the tree have a strong, offensive odor.

NOTE: Several native shrubs and trees, like sumac, ash, black walnut and pe-



can, can be confused with ailanthus.

Ecological Threat

Tree-of-heaven is a prolific seed producer, grows rapidly, and can overrun native vegetation. Once established, it can quickly take over a site and form an impenetrable thicket. Ailanthus trees produce toxins that prevent the establishment of other plant species. The root system is aggressive enough to cause damage to infrastructure.

Distribution in the United States

Tree-of-heaven is widely distributed, occurring in forty-two states, from Maine to Florida and west to California.

Background

Tree-of-heaven was first introduced to America in 1784. By 1840, it was commonly available from nurseries. The species was also brought into California during the gold rush in the mid-1800s and is still frequently found in abandoned mining sites.

Biology & Spread

Tree-of-heaven reproduces both sexually (seeds) and asexually (vegetative sprouts). Flowering occurs late in the spring (June in the Mid-Atlantic region of eastern US). The species is dioecious, with male and female flowering on separate trees. Fruits are papery, somewhat twisted, winged structures called samaras that are tan to pink-colored. Samaras occur in large clusters from September to October of the same year, and may persist on the tree through the following winter. One study reports that an individual tree can produce as many as 325,000 seeds per year. Established trees also produce numerous suckers from the roots and resprout vigorously from cut stumps and root fragments.

Management Options

Elimination of tree-of-heaven requires diligence, due to its abundant seed production, high seed germination rate, and vegetative reproduction. Follow up

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Adapted by Mary E. Farrah from: Plant Conservation Alliance, Alien Plant Working Group. <http://www.nps.gov/plants/alien/fact/aial1.htm>

monitoring and treatment, when needed, should be an integral part of any serious management program. Regardless of the method selected, treated areas should be rechecked one or more times a year and any new suckers or seedlings treated (cut, sprayed or pulled) as soon as possible before they are able to rebuild root reserves. Establishing a thick cover of native, non-invasive trees or grass sod will help shade out and discourage establishment of tree-of-heaven seedlings.

Mechanical

Cutting alone is usually counter-productive because of the large numbers of stump sprouts and root suckers ailanthus produces. Initial cutting should be in early summer. Repeated cutting over time can exhaust the plants' reserves and may be successful if continued for many years. Cutting large seed producing female trees would at least temporarily reduce spread by this method.

Chemical

The most effective method of ailanthus control seems to be through the use of herbicides, which may be applied as a foliar (to the leaves), basal bark, cut stump, or hack and squirt treatment. It is relatively easy to kill the above ground portion of this tree, but you'll need to kill – or seriously damage – the root system to limit stump sprouting and root suckering.

Foliar spray

Foliar sprays applied when trees are in full leaf are very effective and should be the method of choice where ailanthus size and distribution allow spray coverage of all foliage without contacting any desirable vegetation. Where ailanthus is with other exotic weed species, foliar spray allows treatment of the entire area at one time. Limitations are the seasonal time frame, the need to transport a large, dilute volume of spray material, and that rapid growing ailanthus may be out of effective reach.

Basal bark

Basal bark application is one of the easiest methods. It doesn't require cutting and allows lower concentrations of herbicide to be used. The base of the tree stem must be free of snow, ice, or water on the bark. Precipitation after application is inconsequential. Application during late winter/early spring (February 15-April 15) is generally the best, but summer (June 1-September 15) works well as long as vegetation is not a hindrance. The basal bark method is generally used for trees that are less than 6 inches in diameter, though slightly larger specimens may also be treated effectively by thoroughly treating bark up to 24 inches in height. Follow up foliar herbicide applications to basal sprouts and root suckers may be necessary.

Hack-and-squirt

The hack-and-squirt or injection method is very effective and minimizes sprouting and suckering when applied during the summer. Root suckering will be an increasing problem in the fall, winter and spring. Monitor the treatment area and be prepared to follow-up with a foliar application the next year to control any basal sprouts or root suckers that might emerge.

Cut Stump Method

The cut stump method is useful in areas where the trees need to be removed from the site and will be cut as part of the process. This method is likely to be most successful during the growing season, with diminishing success through the early fall. Dormant season applications may prevent resprouting from the stump itself, but will do little to inhibit root suckering. However, at any time of year, if the tree must be cut, it is better than not to treat the stump. Be prepared to follow-up with a foliar application the next year to control any stump sprouts or root suckers.

Biological

A potential biological control for tree-of-



heaven may lie in several fungal pathogens (*Verticillium dahliae* and *Fusarium oxysporum*) that have been isolated from dead and dying ailanthus trees in New York and in southern and western Virginia.

Use pesticides wisely: Always read the entire pesticide label carefully. Follow all mixing and application instructions. Always wear all recommended personal protective equipment. Contact your local Cooperative Extension office for any additional pesticide information.

NOTICE: Mention of pesticide products does not constitute endorsement of any material.

Suggested Alternative Plants

Many native trees and shrubs make excellent substitutes for Ailanthus and are readily available. Some examples for the eastern United States include deciduous shrubs such as staghorn sumac (*Rhus typhina*), smooth sumac (*Rhus glabra*), box elder (*Acer nigrum*), fringetree (*Chionanthus virginicus*), ash (*Fraxinus spp.*), and black walnut (*Juglans nigra*). Because US native plants can become invasive outside their natural, historical ranges, be sure to use plant species native to the ecological region in which you live. Check with your local native plant society for recommendations of species and sources of native plants.







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