

Planting and Care of Fine Hardwood Seedlings



Hardwood Tree Improvement and
Regeneration Center

Northern Research Station
USDA Forest Service

Department of Forestry and Natural Resources
Purdue University



Invasive Plant Species in Hardwood Tree Plantations

Rochelle R. Beasley

Department of Forestry and Natural Resources, Purdue University

Paula M. Pijut

Northern Research Station, USDA Forest Service

Department of Forestry and Natural Resources, Purdue University

Introduction

Invasive plants are species that can grow and spread aggressively, mature quickly, and invade an ecosystem causing economic and environmental damage. Invasive plants usually invade disturbed areas, but can also colonize small areas quickly, and may spread and dominate large areas in a few short years. Invasive plant species displace native or desirable forest vegetation, degrade the native food resources and cover for wildlife, threaten native plants (such as rare or endangered wildflowers or orchids), and can be expensive to control or eradicate. Invasive plants can be herbaceous or woody; annual, biennial, or perennial; grasses, shrubs, trees, or vines that reproduce by seeds, shoots, or roots; and plants that usually produce an abundance of seeds that can germinate easily. Recognition, prevention, and early control strategies can be keys to invasive plant management. Once an invasive species becomes established, it is much more difficult to control or eradicate.

Invasive plant species in hardwood tree plantations or native forestlands can be managed by mechanical, chemical, or physical methods, or through the approach of integrated vegetation management (Seifert et al. 2007). Mechanical control, such as mowing, tilling, or pulling by hand to physically remove the invasive species, can be effective for small invasions, but can also be expensive and labor intensive. However, this method can also increase regrowth of invasive species if the seeds, vegetative growth, and root systems are not completely removed from the area. Chemical control using herbicides can be the most effective means for killing invasive species, but *extreme care* needs to be taken so as not to impact nontarget species, including humans.

A limited number of pre- and post-emergent herbicides are labeled for forestry use (Stringer et al. 2009). Thus, general-use agricultural or right-of-way herbicides are frequently employed to control invasive species. These herbicides may possess attributes that



Reed Canarygrass

Phalaris arundinacea L. (Family: Poaceae): Perennial Graminoid

may harm native plant species, terrestrial vertebrates or invertebrates, and aquatic species. *The herbicide label is the law.* Therefore, landowners should consult their state or local Department of Natural Resources or University Extension personnel to confirm what herbicide treatment or control measure is best (or allowable) for the invasive species in question *before* the area is to be managed.

Herbicides are approved (labeled) for specific uses by the Environmental Protection Agency. ***Please read and follow all label information before using any herbicide for your personal protection and the safety of the environment.*** Below is information about three commonly used herbicides.

- Glyphosate [N-(phosphonomethyl)glycine] is a nonselective, foliar-applied herbicide that inhibits the synthesis of certain amino acids necessary for protein synthesis and growth in most annual and perennial plants (Ahrens 1994). Glyphosate can be applied using a sprayer or wand applicator. Glyphosate is absorbed through the foliage and

Purdue Extension

Knowledge to Go

1-888-EXT-INFO

translocated to the roots. Certain formulations of glyphosate include a nonionic surfactant to increase the efficacy of adsorption into plants. This makes the herbicide highly toxic to aquatic organisms; therefore it should not be used near water. There are a few herbicide formulations registered for use in aquatic areas, but in many states you need to be a certified applicator to utilize these formulations. Brand names of herbicides containing the active ingredient glyphosate include, but are not limited to, Roundup Pro®, Accord®, or Glypro®.

- Triclopyr [(3, 5,6-trichloro-2-pyridinyl)oxy]acetic acid] is a selective herbicide that can be foliar-applied, injected into stem cuts for controlling large trees, applied to cut stumps, and mixed with oil for bark treatment of young invasive trees (Ahrens 1994). Triclopyr's mechanism of action is similar to that of other auxin-type herbicides (at high concentrations it inhibits cell division and growth), and controls many woody and herbaceous broadleaf invasive species. One brand name of herbicide (there are several others)

commonly used in forestry containing the active ingredient triclopyr is Garlon®.

- The herbicide 2, 4-D [(2,4-dichlorophenoxy)acetic acid] is a selective, foliar-applied herbicide that is translocated within the plant (Ahrens 1994). Plants are most susceptible to 2, 4-D when young and actively growing. This herbicide can also act as a plant growth regulator, inducing rooting and blossom set when used at low rates. Brand names of herbicides containing the active ingredient 2,4-D include, but are not limited to, Weedone®, Weedestroy®AM-40, or Weedar®64.

This publication illustrates some of the major invasive plant species that can be found in hardwood tree plantations and forested areas, and provides links to resources with information on prevention, management, and control measures. Species listed in Table 1 are found in many states within the Central Hardwood Region, but are by no means comprehensive. The species presented in this publication are the most predominant and problematic.



2

► Amur maple

Acer ginnala Maxim. (Family: Aceraceae):
Perennial Tree/Shrub

Identification: Amur maple is a small, 4.1 to 4.6 m (13.5 to 15 ft), deciduous tree or large shrub that has been planted primarily as an ornamental. The trunk is multi-stemmed with grayish-brown bark and dark striation furrows. Twigs are reddish-brown with pale lenticels. Leaves are opposite and simple with three doubly serrate lobes that are 5.1 to 10.2 cm wide (2 to 4 in). The middle lobe is noticeably longer than the adjacent lobes (Fig. 1). Foliage is bright green in the summer and turns scarlet-red in the fall.

Impact: Amur maple displaces native trees and shrubs and can become established in a wide range of habitats and environmental conditions. This species may also inhibit germination of nearby native seedlings through the release of toxic compounds.

Management: *Mechanical*—Pulling and cutting small plants are effective methods for controlling this species. Trees should be cut back as close to



Figure 1. Amur maple foliage and fruit. (T. DeGomez, University of Arizona. Reproduced with permission. Bugwood.org)

the ground as possible, as they can resprout.

Chemical—Application of general-use herbicides is effective at controlling Amur maple invasions. Stump treatments using glyphosate or triclopyr are suggested after cutting to prevent resprouting.

See: http://www.na.fs.fed.us/fhp/invasive_plants/weeds/armur-maple.pdf

► Autumn Olive

Elaeagnus umbellata Thunb. (Family: *Elaeagnaceae*): Perennial Shrub

Identification: Autumn olive is a deciduous shrub that can grow to 6 m (20 ft) in height. Leaves are alternate, lance-shaped, and have silvery dots underneath (a distinguishing identifying characteristic) (Fig. 2). Autumn olive resembles Russian olive (*E. angustifolia*), which is also an invasive species. This shrub produces small, yellow flowers with a pungent odor and reddish-pink berries.

Impact: This species produces copious amounts of fruit, which are readily dispersed by birds. Its rapid growth rate crowds out native species. It has nitrogen-fixing capabilities which can also alter the nitrogen cycling in an invaded area.

Management: *Mechanical*—Small shrubs can be pulled by hand, but control depends on pulling up the entire root system. It has been noted that burning can cause vigorous resprouting, and cutting large bushes can result in denser growth. *Chemical*—Foliar applications of herbicide can be effective in controlling autumn olive infestations.



Figure 2. Shiny, silvery underside (small dots) of autumn olive leaves. (C. Evans, River to River CWMA. Reproduced with permission, Bugwood.org)

Large plants may be cut and stumps treated with triclopyr or glyphosate. A triclopyr and oil mixture may be sprayed on the lower 45.7 cm (18 in) of stems as a basal bark treatment.

See: http://www.na.fs.fed.us/fhp/invasive_plants/weeds/autumn-olive.pdf



3

► Black Locust

Robinia pseudoacacia L. (Family: *Fabaceae*): Perennial Tree

Identification: Black locust is a deciduous tree that can grow 9.1 to 24.4 m tall (30 to 80 ft). It has alternate, pinnately compound leaves with small leaflets that are dark-green on the top, and paler green on the underside. Each branch is armed with spines located at the base of the petioles. The pea-like flowers are white to yellow and hang in large bunches (Fig. 3). Fruit are long, 5 to 10 cm (2 to 3.9 in), smooth, thin pods which contain four to eight seeds. Young trees have smooth, green bark which becomes dark, deeply furrowed, and shaggy as it matures.

Impact: Black locust competes with native species for light. Dense stands of black locust prevent the growth of native ground vegetation. The large, fragrant flowers also lure in native bees, thereby preventing pollination of native species.



Figure 3. Black locust flowers. (L.J. Mehrhoff, University of Connecticut. Reproduced with permission, Bugwood.org)

Management: Since black locust can regenerate clonally by root suckers, *mechanical* removal is not recommended. *Chemical* treatment of black locust can be done using foliar, basal bark, or cut-surface applications.

See: <http://www.invasive.org/species/weeds.cfm>

► Brittlestem Hempnettle

Galeopsis tetrahit L. (Family: Lamiaceae):
Herbaceous Annual

Identification: Brittlestem or common hempnettle is an annual herbaceous plant with square stems that have bristly hairs and swollen nodes. The leaves are opposite, 5 to 10 cm (2 to 3.9 in), and oblong with coarsely toothed margins. Flowers are purple and occur in dense stalkless clusters in the axils of the upper leaves July through October (Fig. 4).

Impact: This annual plant competes with other species for nutrients and soil moisture. It is a common contaminant of seed stocks and can serve as a reservoir for potato fungus.

Management: *Mechanical*—Mechanical control is difficult since hempnettle seed germinates in early spring. *Chemical*—This species can be controlled using 2-methyl-4-chlorophenoxyacetic acid (MCPA), a systemic post-emergence phenoxy



Figure 4. Brittlestem or common hempnettle. (M. Shephard, USDA Forest Service. Reproduced with permission, Bugwood.org)

herbicide, although results are variable. It *cannot* be controlled using 2,4-dichlorophenoxyacetic acid (2,4-D).

See: <http://www.invasive.org/species/weeds.cfm>



► Bull Thistle

Cirsium vulgare (Savi) Ten. (Family:
Asteraceae): Biennial Forb (Herb)

Identification: This is a biennial-perennial herb with spiny winged stems. Basal rosettes can attain a diameter of 0.9 m (3 ft) before bolting and flowering (Fig. 5). Lance-shaped leaves are alternately arranged, hairy, and have spines at the tips. Purple flowers have spine-tipped bracts, and occur at the ends of the shoots and branches from June to September.

Impact: Rosettes can grow up to 0.9 m wide and compete with native vegetation for space, nutrients, and water.

Management: *Mechanical*—Mow prior to seed set. *Chemical*—Bull thistle can be controlled with general-use herbicides (i.e., glyphosate or triclopyr).



Figure 5. Bull thistle basal rosette. (B. Million, National Park Service. Reproduced with permission, bugwood.org)

See: http://na.fs.fed.us/fhp/invasive_plants/weeds/bull-thistle.pdf

► Burning Bush

Euonymus alata (Thunb.) Siebold (Family: Celastraceae): Perennial Shrub

Identification: A key distinguishing feature of this species is the corky wings that run along both sides of the stem (Fig. 6). The oppositely arranged, dark-green leaves have finely serrated margins that taper at the tip. Burning bush has grayish-brown bark and, although it is slow growing, can reach 6.1 m (20 ft) in height and width.

Impact: Burning bush produces copious amounts of seed, which makes management difficult. It forms dense thickets that shade out native species.

Management: *Mechanical*—Small seedlings can be pulled by hand when the soil is moist. Larger individuals should be dug up along with the roots. Stumps should either be ground up or clipped when regrowth appears. *Chemical*—Stumps can be chemically treated using glyphosate. If the invasion



Figure 6. Burning bush. (R.A. Howard, ©Smithsonian Institution. Reproduced with permission)

is too large for cutting, glyphosate can be applied as a foliar spray.

See: <http://www.invasive.org/species/weeds.cfm>

► Bush Honeysuckles

Lonicera spp. (Family: Caprifoliaceae): Perennial Shrub/Vine

Identification: Bush honeysuckles are woody shrubs or vines with opposite, egg-shaped leaves. Fragrant, tubular flowers are borne in pairs and can be creamy-white to crimson-red (Fig. 7). Round, orange to red fruits occur in the fall and may persist into the winter.

Impact: Bush honeysuckles compete with native species for space, light, and nutrients.

Management: *Mechanical*—Pulling by hand when shrubs are small can be effective. For larger infestations, cutting is recommended and should be repeated during the growing season.

Chemical—Basal stump treatment or foliar



Figure 7. Exotic bush honeysuckle. (J.M. Randall, The Nature Conservancy. Reproduced with permission, Bugwood.org)

application of general use herbicides such as triclopyr or glyphosate are effective.

See: <http://www.invasive.org/species/weeds.cfm>





► **Callery Pear, Bradford Pear**
Pyrus calleryana Decne. (Family:
Rosaceae): Perennial Tree

Identification: Bradford pear is a medium sized, 10 to 20 m (32.8 to 65.6 ft), deciduous tree commonly planted as an ornamental. It has alternate, simple leaves that are dark-green on top and a paler green underneath. Leaves are shiny and leathery, and come to a point at the tip. Showy white flowers bloom in the spring before leaves emerge. The fruit resembles a small pear speckled with small reddish dots and is very bitter (Fig. 8).

Impact: This tree affects the establishment of mid- to late-succession tree species through competition for growing space. It has structural problems and is prone to breakage at 20 years of age.

Management: Small plants can be eliminated by pulling or digging, making sure to get rid of the roots, as this tree is capable of reproducing through



Figure 8. Leaves and fruit of Callery (Bradford) pear. (C. Bargeron, University of Georgia. Reproduced with permission, Bugwood.org)

suckering and sprouting. Trees can also be cut and stumps treated with a systemic herbicide to prevent resprouting.

See: http://www.na.fs.fed.us/fhp/invasive_plants/weeds/callery_pear.pdf

► **Canada Thistle**
Cirsium arvense L. (Scop.) (Family:
Asteraceae): Herbaceous Perennial

Identification: Canada thistle is a shade-tolerant, perennial plant that can grow 0.45 to 1.2 m tall (1.5 to 4 ft). It has hairy, ridged stems with alternate leaves. The leaves have prickly, irregularly shaped lobes with bases that are clasped around the stem. The globular, rose-purple flowers bloom June to October (Fig. 9).

Impact: Canada thistle displaces native vegetation through shading, resource competition, and a possible release of toxic chemicals to surrounding vegetation. Canada thistle is able to regenerate from root fragments and can be difficult to control once it becomes established. It has been associated with the elimination of some endangered and endemic plant species, and causes millions of dollars annually in crop losses and control. Seeds can remain viable in the soil for up to 20 years.

Management: *Mechanical*—Cutting or mowing should be performed prior to seed set and should be repeated until reserves in roots have been exhausted. Burning can stimulate thistle growth and



Figure 9. Flowers of Canada thistle. (M.E. Harte. Reproduced with permission, Bugwood.org)

should be conducted late in the growing season. *Chemical*—Small infestations can be controlled using spot applications of glyphosate. For larger infestations, a more specific herbicide (e.g., 2,4-D or triclopyr) is recommended to reduce negative effects on nontarget species. The herbicide clopyralid (Transline®) is particularly effective against thistles, while not damaging most hardwoods.

See: http://www.na.fs.fed.us/fhp/invasive_plants/weeds/canadian-thistle.pdf

► Chinese Elm

Ulmus parvifolia Jacq. (Family: Ulmaceae): Perennial Tree

Identification: Chinese elm is a fast-growing, medium sized 21 m (70 ft), deciduous tree. Shiny green leaves are elliptical with toothed margins and are alternately arranged on the twig (Fig. 10). Mature bark appears to be peeling, and is mottled green, gray, orange, and brown. Twigs have a zig-zag pattern with orange lenticels.

Impact: This elm species competes with native species for water, nutrients, and space.

Management: *Mechanical*—Small seedlings can be pulled by hand, but be sure to remove all the roots from the soil. *Chemical*—Stem injections, stump treatments, basal and foliar sprays, and soil spot treatments using general herbicides can be effective at controlling Chinese elm infestations.



Figure 10. Chinese elm leaves. (Reproduced from <http://www.boydnursery.net>)

See: http://na.fs.fed.us/fhp/invasive_plants/weeds/chinese-elm.pdf

► Chinese Yam

Dioscorea oppositifolia L. (Family: Dioscoreaceae): Perennial Vine

Identification: Chinese yam is a creeping and climbing perennial vine that has persistent root-like tubers that sprout annually. It has oppositely arranged simple leaves with a deeply lobed base (Fig. 11). Leaf shape is typically ovate, 4 to 8 cm long (1.6 to 3.1 in) with an acuminate tip. Flowers are small and greenish-white with a smell similar to cinnamon.

Impact: Chinese yam is a fast-growing species that can blanket the understory and shade out native species. It is also capable of breaking limbs of trees under its weight and smothering native shrubs.

Management: *Mechanical*—Small infestations can be controlled by manually pulling up the vine. *Chemical*—For larger infestations, glyphosate and triclopyr have been reported to be the most effective herbicides. Single applications are



Figure 11. Foliage of Chinese yam. (C. Evans, River to River CWMA. Reproduced with permission, Bugwood.org)

effective at killing newly germinating plants; however, repeated applications may be needed to kill underground tubers.

See: http://www.na.fs.fed.us/fhp/invasive_plants/weeds/chinese-yam.pdf



► Common Buckthorn

Rhamnus cathartica L. (Family: Rhamnaceae): Perennial Tree/Shrub

Identification: Common or European buckthorn is a small, 2 to 6 m (6.6 to 19.7 ft) deciduous shrub or small tree. Leaves are oppositely arranged, shiny with minutely toothed margins and incurved veins (Fig. 12). Twigs often have small, sharp spines at the ends. Female trees produce clusters of round, black, pea-sized fruit which ripen in late summer. This plant leafs out in early spring and retains its leaves into the fall.

Impact: This plant produces dense thickets, which prevent the regeneration of native shrubs and trees. It is an alternate host of crown rust, which can affect oats and impact agricultural yields.

Management: *Mechanical*—Plants can be removed by pulling and digging prior to fruit set. Prescribed burning has been demonstrated to be effective (and the preferred treatment) for controlling buckthorn, although this needs to be repeated for five or more years in order to completely eradicate the plants.



Figure 12. Fruit and leaves of common buckthorn. (L.J. Mehrhoff, University of Connecticut. Reproduced with permission, Bugwood.org)

Chemical—Applications of systemic herbicides to cut stumps, foliar applications of Garlon 3A®, and basal bark treatments have been shown to also be effective at controlling buckthorn, although applications will need to be repeated because of sprouting and the extensive root system of this species.

See: http://www.na.fs.fed.us/fhp/invasive_plants/weeds/common-buckthorn.pdf

► Common St. Johnswort

Hypericum perforatum L. (Family: Clusiaceae): Herbaceous Perennial

Identification: This perennial herb has two life stages: basal growth in the fall/winter, and vertical stem growth in the spring/summer. Stems are woody at the base and become branched farther up the stem. Numerous yellow flowers with black glands along the margin occur at the tip of the stem (Fig. 13). Leaves are opposite and elliptical, and contain numerous translucent glands on the underside.

Impact: This plant displaces and prevents the establishment of native species. It contains toxic compounds that can cause photosensitivity in grazing livestock and can lead to a decrease in weight and health condition. In rare circumstances, livestock may die. Dried stems of this plant may also pose a fire hazard.

Management: *Mechanical*—Fire and pulling by hand is not recommended, as this species can



Figure 13. Flowering common St. Johnswort. (Ohio State Weed Lab Archive, The Ohio State University. Reproduced with permission, Bugwood.org)

regenerate vegetatively. **Chemical**—Applications of glyphosate or a combination of 2,4-D plus 2,2-dichloropropionic acid sodium salt (2,2-DPA) have been effective at controlling invasions.

See: http://www.na.fs.fed.us/fhp/invasive_plants/weeds/common-st-johns-wort.pdf



► English Ivy

Hedera helix L. (Family: Araliaceae):
Perennial Vine

Identification: English ivy has dark, three- to five-lobed leaves with white veins, alternately arranged (Fig. 14). The stem has root-like structures which exude a sticky substance to help it adhere to tree trunks and other substrates. It can be found creeping along the ground or climbing up trees and buildings.

Leaves of English ivy contain glycosides that may cause toxicosis if ingested. Symptoms of this include diarrhea, stomach upset, fever, difficulty breathing, coma, dilated pupils, muscle weakness, excessive thirst, hyperactivity, and lack of coordination.

Impact: Grows densely over ground vegetation and prevents native seedling establishment. English ivy grows up trees preventing light penetration and causing dieback and eventual death. The added weight also makes the tree more susceptible to blow-down and limb breakage, creating hazards. English ivy is also a reservoir for bacterial leaf scorch which infects oaks, maples, and other native plant species.



Figure 14. English ivy foliage. (R.D. Wallace. Reproduced with permission, Bugwood.org)

Management: *Mechanical*—Cutting vines or pulling by hand can be effective control. Cutting can promote regrowth and should be monitored for any signs of regrowth. *Chemical*—Treat cut vines and stems after cutting using general use herbicides. Foliar applications and basal bark applications can also be effective for controlling English ivy.

See: http://na.fs.fed.us/fhp/invasive_plants/weeds/english-ivy.pdf



► European Privet

Ligustrum vulgare L. (Family: Oleaceae):
Perennial Shrub

Identification: Common or European privet is a perennial, multibranched, deciduous, 4.5 m tall (14.8 ft) shrub. Leaves are dark-green and oval with a waxy appearance and turn purple in the fall. Clusters of white flowers occur at the end of the branches and have a pungent odor (Fig. 15). Small black berries appear in late summer to early autumn.

Impact: Privet forms dense thickets that displace native vegetation.

Management: *Mechanical*—Digging or pulling the plant is effective when the plant is small. Any remaining root fragments in the soil should be removed to prevent resprouting. *Chemical*—Larger plants can be cut and the stumps can be treated using glyphosate.



Figure 15. Foliage of European privet. (L.J. Mehrhoff, University of Connecticut. Reproduced with permission, Bugwood.org)

See: http://www.na.fs.fed.us/fhp/invasive_plants/weeds/european-privet.pdf

► Fescue

Festuca spp. (Family: Poaceae):
Perennial Grass

Identification: Fescues are perennial cool-season grasses that grow in dense clumps (bunchgrasses) or can be creeping and rhizomatous. The most common *Festuca* spp. is tall fescue (Fig. 16). It grows 0.6 to 1.2 m tall (2 to 4 ft.) with stout un-branched stems and flat lanceolate leaves. It becomes dormant in summer with whitish stems, and growth resumes fall into the winter.

Impact: Fescue grows very tall, shading out native species and decreasing diversity. The thick root mat competes for underground resources.

Management: *Mechanical*—Burning early in the growing season followed by spot spraying with glyphosate is effective. Because of the dense root mat, pulling is not recommended and is



Figure 16. Tall fescue plant. (J.H. Miller, USDA Forest Service. Reproduced with permission, Bugwood.org)

ineffective. *Chemical*—Applications of general use herbicide can be used to control fescue invasions.

See: <http://www.invasive.org/species/weeds.cfm>



10

► Fig Buttercup

Ranunculus ficaria L. (Family:
Ranunculaceae): Herbaceous Perennial

Identification: Fig buttercup is a low growing perennial herb with shiny, dark-green, kidney-shaped leaves that are arranged as a basal rosette. Fig buttercup flowers in early spring (March to April), and each rosette produces a single, 2.5 cm (1 in) yellow flower with eight shiny petals (Fig. 17).

Impact: This plant will form dense monospecific stands, which crowd out native spring ephemeral herbs.

Management: *Mechanical*—Pulling by hand can be effective for small infestations, although both the above-ground part of the plant and the underground tubers need to be completely removed. *Chemical*—Application of a systemic herbicide in the late winter to early spring will have the greatest negative impact on the population.



Figure 17. Fig buttercup. (J.M. Randall, The Nature Conservancy. Reproduced with permission, Bugwood.org)

Please take special care when identifying and implementing control measures of this species, as fig buttercup resembles marsh marigold, a native wetland herb.

See: <http://www.nps.gov/plants/alien/fact/rafi1.htm>

► Garlic Mustard

Alliaria petiolata (M. Bieb.) Cavara & Grande (Family: Brassicaceae): Annual, Biennial Forb (Herb)

Identification: This biennial herb forms a basal rosette with toothed, heart-shaped leaves the first year and bolts with flowers the second year (Fig. 18). When crushed, the leaves emit a garlic odor. They remain green throughout the winter. Small, white flowers with four petals in the shape of a cross open early in the spring.

Impact: Garlic mustard is an aggressive invader and is able to compete with native vegetation for light, space, nutrients, and water. It is also contributing to the decline of the rare West Virginia white butterfly by extirpating toothworts; the primary food source of the caterpillar stage of this species.

Management: Prevention of seed set is the key in management of this species. Annually monitor areas and remove garlic mustard when you first discover it to prevent establishment and further spread of this aggressive invader. *Mechanical*—Pulling plants by hand and cutting prior to seed set (seeds can remain viable in the soil for up to 6 years) can be effective, although this can be labor-intensive for larger infestations. If cutting the plants, they should be



Figure 18. Garlic mustard in flower. (D. Cappaert, Michigan State University. Reproduced with permission, Bugwood.org)

clipped as close to ground level as possible, because the leaf axils can produce flowers. If seed pods are present on the plants, remove the seed pods, bag them, and remove them from the site for disposal. *Chemical*—General-use herbicides can be effective for larger infestations; 2,4-D and acifluorfen are not recommended.

There are some native plants that resemble garlic mustard, such as toothworts (*Dentaria* spp.), sweet cicely (*Osmorhiza claytonia*), and early saxifrage (*Saxifraga virginica*), therefore proper identification is important.

See: http://na.fs.fed.us/fhp/invasive_plants/weeds/garlic_mustard.pdf



► Giant Hogweed

Heracleum mantegazzianum Sommier & Levier (Family: Apiaceae): Herbaceous Perennial

Identification: Giant hogweed grows 4 to 6 m tall (13.1 to 19.7 ft) with a spotted leaf stalk and a reddish-purple stem. Leaves are compound and deeply lobed. The inflorescence contains many small white flowers and can reach a diameter of 76 cm (30 in) (Fig. 19).

Extreme caution must be taken when working with or encountering this species, as the stem and stalks contain bristles with a photosensitive compound that, when it comes into contact with exposed skin, causes severe burns.

Impact: Giant hogweed impedes the growth of native species. It also causes severe burns when it comes in contact with skin exposed to sunlight (photo-dermatitis).

Management: *Mechanical*—This species is most often controlled using physical removal,



Figure 19. Giant hogweed infestation. (T. English, USDA APHIS PPQ. Reproduced with permission, Bugwood.org)

although proper precautions must be taken to prevent the skin from coming in contact with the plant. *Chemical*—Glyphosate has been effective at controlling hogweed infestations.

See: http://www.na.fs.fed.us/fhp/invasive_plants/weeds/giant-hogweed.pdf

► Glossy Buckthorn

Frangula alnus Mill. (Family: Rhamnaceae):
Perennial Tree/Shrub

Identification: Glossy buckthorn is a small shrub or tree that can attain 6.4 m in height (21 ft.). Shiny green leaves are alternately arranged, elliptical, and simple with smooth margins and pubescence on the underside (Fig. 20). The bark is grayish-brown with white, elongated lenticels. Flowers are pale yellow. The round, pea-sized fruit ripen progressively from red to dark purple in late summer to fall.

Impact: This plant is a fast-growing, aggressive invader able to outcompete and shade native vegetation. It also reduces the abundance and diversity of tree seedlings in an invaded area, and may also reduce the growth and survival of naturally regenerating seedlings. Because of a shallow and extensive root system, this species may also be an efficient underground competitor.

Management: *Mechanical*—Repeated cuttings (two or more per season) can reduce shoot growth if done for successive years. Removal by grubbing



Figure 20. *Frangula alnus*. (J.H. Miller, USDA Forest Service. Reproduced with permission, Bugwood.org)

can be effective at removing larger infestations, but this disturbs the soil and may open the site up to further invasions. *Chemical*—Stump treatment (20% glyphosate), basal (2-4% 2,4-D in diesel fuel), and wick (2.5-3% glyphosate) applications can be used to control this species (wiki.bugwood.org).

See: http://www.na.fs.fed.us/fhp/invasive_plants/weeds/glossy-buckthorn.pdf

► Himalayan Blackberry

Rubus armeniacus Focke (Family:
Rosaceae): Perennial SubShrub

Identification: This perennial bramble can grow 3 m tall (9.8 ft) and has trailing stems that can reach 12 m (39.4 ft) (Fig. 21). Stems have curved prickles 0.6 to 1 cm long (0.2 to 0.4 in). White to pink flowers are borne in large terminal clusters. Fruits are a succulent red to black berry. This plant has a tendency to grow in wet sites.

Impact: This bramble forms dense thickets which are impenetrable and cause dense shading, thereby reducing native diversity at the invaded site. The denseness can also inhibit movement of mammals and other wildlife to water and food sources, as well as inhibit movement of humans and livestock to waterways and pastures. The accumulation of leaf litter can also create a potential fire hazard. *Rubus armeniacus* is capable of hybridizing with native *Rubus* spp.

Management: *Mechanical*—Manual removal is not recommended because of its capability of root



Figure 21. *Himalayan blackberry*. (J.M. Randall, The Nature Conservancy. Reproduced with permission, Bugwood.org)

suckering. *Chemical* – Picloram or triclopyr has been shown to be effective at controlling blackberry infestations. Picloram applied at a rate of 0.9 kg per 0.4 ha (2 lb per acre) has been demonstrated to give complete control in 5 months.

See: <http://www.invasivespeciesinfo.gov/plants/controlplans.shtml#gm>



► Japanese Barberry

Berberis thunbergii DC. (Family: Berberidaceae): Perennial Shrub

Identification: Japanese barberry is a shade-tolerant deciduous shrub, 0.6 to 2.4 m tall (2 to 8 ft) with smooth oval- or spatula-shaped leaves (Fig. 22). Spines occur at each node along the stem. It is one of the first shrubs to leaf out in the spring. Following the leaves, pale-yellow flowers bloom mid-April to May and hang in clusters. Bright red fruits occur in late summer and can persist into the winter.

Impact: Japanese barberry forms dense stands which compete with native vegetation. It is capable of invading a variety of open- and closed-habitats because of its shade tolerance. Barberry can root if branches come into contact with the ground.

Management: *Mechanical*—Small barberry bushes can be easily pulled up. If plants have fruit on them, it is recommended to bag the plant remnants to prevent seed dispersal. Mowing and cutting are also effective methods for controlling



Figure 22. Japanese barberry. (J.H. Miller, USDA Forest Service. Reproduced with permission, Bugwood.org)

barberry invasion, and the plants should be cut as close to the ground as possible, at least once per growing season. *Chemical*—For large infestations, foliar spray is recommended where nontarget species are not a concern. If desirable species are present, stump treatments are recommended.

See: http://www.na.fs.fed.us/fhp/invasive_plants/weeds/japanese-barberry.pdf



► Japanese Honeysuckle

Lonicera japonica Thunb. (Family: Caprifoliaceae): Perennial Vine

Identification: Japanese honeysuckle is an evergreen to semi-evergreen vine with oppositely arranged oval leaves (Fig. 23). Stems are hollow and reddish-brown, and appear to be peeling. White to yellow tubular flowers, 2.5 to 5 cm (1 to 2 in), appear in the summer that turn to a black berry in the autumn.

Impact: This vine competes with native vegetation for light and nutrients. It is capable of smothering and toppling small trees and shrubs, which can open up the forest floor for further invasions.

Management: *Mechanical*—Manually removing honeysuckle can control the spread, but will not completely eliminate it. Burning is effective and will kill aboveground stems, but will not destroy the roots, which can resprout. *Chemical*—A foliar spray of 1.5% glyphosate



Figure 23. Japanese honeysuckle. (L.J. Mehrhoff, University of Connecticut. Reproduced with permission, Bugwood.org)

shortly after the first frost appears to be effective at controlling honeysuckle. A combination of burning and chemical application appears to be the best control strategy.

See: http://www.na.fs.fed.us/fhp/invasive_plants/weeds/japanese_honeysuckle.pdf

► Japanese Knotweed

Polygonum cuspidatum Siebold & Zucc.
(Family: Polygonaceae): Perennial
SubShrub/Forb (Herb)

Identification: This is a fast growing, shrub-like herbaceous perennial. Leaves are oppositely arranged on the stem, and are oval with pointed tips. Stems (or canes) are hollow and have purple speckles. A sheath surrounds each joint at the base of the stem. White flowers occur from late summer to early autumn (Fig. 24). The rhizome has an orange core with an orange-yellow outer ring.

Impact: Japanese knotweed forms dense stands, crowding out native species, preventing natural regeneration, and decreasing biodiversity. This species is very aggressive and can be difficult to eradicate from an invaded area. This species can also increase flooding and erosion in riparian habitats.

Management: *Mechanical*—Pulling, cutting, and mowing can be effective for small infestations of knotweed. However, the treatment must be repeated over a long period to be effective. *Chemical*—Immediate treatment of cut stems with



Figure 24. Japanese knotweed inflorescence close-up. (L.J. Mehrhoff, University of Connecticut. Reproduced with permission, Bugwood.org)

a 25% solution of glyphosate or triclopyr can be effective at controlling knotweed and is good to use in areas where there are sensitive species. Stems should be cut at least 5 cm (2 in) above ground level prior to stem treatment. A foliar spray of glyphosate can also be used for large invaded areas and where nontarget species are not a concern.

See: http://na.fs.fed.us/fhp/invasive_plants/weeds/japanese-knotweed.pdf

► Japanese Meadowsweet

Spiraea japonica L. f. (Family: Rosaceae):
Perennial Shrub

Identification: Japanese spiraea or meadowsweet is a deciduous perennial shrub growing up to 2 m tall (6.6 ft). Stems are reddish-brown and sometimes hairy. Leaves are alternate with toothed margins and an oval-shape. Flowers are pink and occur at the tips of the branches (Fig. 25).

Impact: Seeds from this plant remain viable for many years in the soil, making this species difficult to control. It rapidly invades an area forming dense thickets that compete with and crowd out native vegetation.

Management: *Mechanical*—Cutting and mowing are appropriate where populations of meadowsweet are small. Repeated cutting and mowing will control the spread, but will not completely eradicate this species. *Chemical*—Foliar herbicide



Figure 25. Flowers of Japanese meadowsweet. (Great Smoky Mountains National Park Resource Management Archive. Reproduced with permission, Bugwood.org)

application can be used to control this species. The cut-stump method may also be used, as long as you make sure the entire cut surface is treated.

See: <http://www.nps.gov/plants/alien/fact/spja1.htm>



► Johnsongrass

Sorghum halepense (L.) Pers. (Family: Poaceae): Perennial Graminoid

Identification: Johnsongrass is a tall, 2.4 m (8 ft), perennial grass that has a fleshy rhizome. Alternate, lance-shaped leaves with distinct white midribs can be 0.6 m (2 ft) long. Purplish flowers occur in loose panicles (Fig. 26).

Impact: This grass forms dense colonies that displace native vegetation. This plant is a prolific seed producer with an extensive rhizome system. It also inhibits establishment of native tree seedlings and inhibits germination of native vegetation. Johnsongrass is an alternate host for many pathogens that attack crops and can become an economic pest for agricultural crops.

Management: *Mechanical*—Pulling clumps of johnsongrass by hand when the ground is soft is effective for very small infestations. Because johnsongrass can grow in a range of



Figure 26. Johnsongrass flowering. (K.A. Rawlins, University of Georgia. Reproduced with permission, Bugwood.org)

environments, it is difficult to control. *Chemical*—General-use herbicides such as glyphosate can be effective, but may need to be used for several years.

See: http://www.na.fs.fed.us/fhp/invasive_plants/weeds/johnsongrass.pdf

► Kudzu

Pueraria montana (Lour.) Merr. var. *lobata* (Willd.) Maesen & S. Almedia (Family: Fabaceae): Perennial Vine

Identification: Kudzu is a deciduous, climbing perennial vine with alternate leaves. The leaves are compound with entire or deeply lobed leaflets with hairy margins. Flowers are purple and borne in long clusters that hang down from the stem and bloom in mid-summer (Fig. 27).

Impact: Kudzu covers the ground and trees, smothering native vegetation. The weight of kudzu in trees can cause limb breakage, thereby opening up the understory to further invasions.

Management: *Mechanical*—Bulldozing is conducted on sites prior to development to prevent spread. The most successful control has been repeated herbicide applications and overgrazing. The planting of pine and pasture grasses has also been effective at controlling infestations.



Figure 27. Kudzu leaf and flower. (D.J. Moorhead, University of Georgia. Reproduced with permission, Bugwood.org)

See: http://www.na.fs.fed.us/fhp/invasive_plants/weeds/kudzu.pdf



► Mimosa, Silk Tree

Albizia julibrissin Durazz. (Family: Fabaceae): Perennial Tree/Shrub

Identification: This umbrella-shaped tree has alternate, fern-like leaves. Fragrant flowers are borne at the ends of the branches in large pink clusters that resemble pom-poms. The bark is smooth and light-gray to brown in color. Fruit are a gray-brown pod, 12.7 to 17.8 cm (5 to 7 in) and remain on the tree into the winter (Fig. 28).

Impact: Dense stands of this plant reduce the light and nutrients available to native vegetation. Mimosa produces large amounts of seed, which compete with germination of native trees and shrubs. Seeds can remain dormant for many years, and in one study, 90% of the seeds were viable after 5 years.

Management: *Mechanical*—Seedlings can be pulled by hand, although the entire root systems need to be removed to prevent resprouting. Small trees should be cut to the ground and then treated



Figure 28. *Mimosa tree.* (J.R. Allison, Georgia Dept. of Natural Resources. Reproduced with permission, Bugwood.org)

with herbicide. *Chemical*—Herbicides such as glyphosate (nonselective) and triclopyr (selective) are effective at controlling mimosa.

See: http://www.na.fs.fed.us/fhp/invasive_plants/weeds/silk-tree-mimosa_.pdf



► Multiflora Rose

Rosa multiflora Thunb. (Family: Rosaceae): Perennial Vine/SubShrub

Identification: Multiflora rose is a perennial shrub growing 1.8 to 3 m tall (5.9 to 9.8 ft). Stems are multibranched and contain curved prickles. The tips of the branches are capable of rooting after contact with the soil. Leaves are alternately arranged and pinnately compound with toothed margins. White flowers emerge in May to June and are borne on panicles (Fig. 29).

Impact: This plant spreads rapidly and creates an impenetrable thicket, which inhibits native vegetative growth. This dense growth can also restrict wildlife movement for water and food resources.

Management: *Mechanical*—Prescribed burning has been proven to be an effective management tool for extensive infestations. Periodic mowing can also restrict new seedling establishment. *Chemical*—Foliar herbicide applications applied during the growing season when leaves are fully



Figure 29. *Multiflora rose flowering.* (J.H. Miller, USDA Forest Service. Reproduced with permission, Bugwood.org)

developed have been effective at controlling infestations. Basal bark applications are effective during the dormant season and reduce negative effects on nontarget species.

See: http://www.na.fs.fed.us/fhp/invasive_plants/weeds/multiflora-rose.pdf

► Norway Maple

Acer platanoides L. (Family: Aceraceae):
Perennial Tree

Identification: Norway maple is a deciduous tree, 28 m (92 ft), with smooth gray bark when young. that the bark gets darker and furrowed with interlacing ridges as the tree matures. Leaves are opposite and simple with five to seven lobes with pointed teeth (Fig. 30). A milky-white sap is exuded when the leaf veins are broken. Leaves turn yellow in the fall, and the tree retains its leaves longer than many other trees.

Impact: This plant reduces species richness and native tree regeneration. Norway maple releases toxins that also reduce the growth and reproduction of native species.

Management: *Mechanical*—Removal of overstory trees as well as of understory seedlings and saplings is necessary to reduce seed sources. Because Norway maple produces dense stands,



Figure 30. Norway maple in flower. (L.J. Mehrhoff, University of Connecticut. Reproduced with permission, Bugwood.org)

removal of all trees may alter site conditions by opening up the site. *Chemical*—General-use herbicides such as glyphosate or triclopyr can be effective in controlling Norway maple.

See: http://www.na.fs.fed.us/fhp/invasive_plants/weeds/norway-maple.pdf

► Oriental Bittersweet

Celastrus orbiculatus Thunb. (Family: Celastraceae): Perennial Vine

Identification: Oriental bittersweet is a deciduous, perennial, woody vine. It has shiny, round leaves with finely toothed margins that are alternately arranged on the stem. Flowers are borne in greenish-white clusters. Each fruit has a yellow covering which, upon ripening, opens up to reveal a bright red aril (Fig. 31).

Impact: Bittersweet grows over native vegetation, shading out plants and preventing photosynthesis. It can also cause uprooting of other plants as a result of its weight. Oriental bittersweet is threatening the native bittersweet, *Celastrus scandens* L. (American bittersweet) through hybridization and competition.

Management: *Mechanical*—Pulling and cutting can be effective when population levels are low, and should be conducted prior to flowering or seed set. *Chemical*—Foliar applications of glyphosate and triclopyr plus 2,4-D can be effective, although



Figure 31. Oriental bittersweet in fruit. (J.M. Swearingen, USDI National Park Service. Reproduced with permission, Bugwood.org)

these chemicals will also affect nontarget species. Cutting the vine and applying glyphosate to the cut area can be effective when the vines are climbing up trees.

See: http://www.na.fs.fed.us/fhp/invasive_plants/weeds/oriental-bittersweet.pdf



► Red Brome

Bromus rubens L. (Family: Poaceae):
Annual Graminoid

Identification: Red brome is a cool season annual bunchgrass. Bunchgrass is a general name for perennial grass species that tend to grow in discrete tufts or clumps, rather than in sod-like carpets. A red brome clump, 20 to 50 cm (7.9 to 19.7 in), has a dense panicle with a purplish tinge (Fig. 32).

Impact: Red brome has little herbaceous competition. There is a possible increase in fire frequency as a result of accumulation of dead biomass. Nitrogen addition has been shown to increase red brome and suppress native bunchgrass germination.

Management: *Mechanical*—Red brome is easily removed through hoeing and pulling by hand. Annual removal of seed heads will prevent the addition of seed source into the soil.



Figure 32. Red brome. (J.M. Randall, The Nature Conservancy. Reproduced with permission, Bugwood.org)

Chemical—Pre-emergent herbicides are recommended, as this will affect root formation during germination and at the seedling stage.

See: <http://www.invasive.org/species/weeds.cfm>



► Reed Canarygrass

Phalaris arundinacea L. (Family:
Poaceae): Perennial Graminoid

Identification: Reed canarygrass is a cool-season perennial grass, 1.8 m (6 ft) with long, 0.3 to 1.2 m (1 to 4 ft) flat leaves that taper at the end (Fig. 33). Flowers can be green, brown, or purple in color and occur in dense, branched panicles.

Impact: This grass forms dense monospecific stands that exclude native plant and animal species. Reed canarygrass is undesirable for wildlife. This species has a shallow root system that can promote erosion and increase silt deposition.

Management: *Mechanical*—For small stands, pulling by hand can be effective if repeated two to three times each year over a 5-year period. Covering infestations with black plastic to reduce light levels to 40% of normal levels can also control infestations. Cutting or mowing can also be effective and should be repeated at least five times throughout the



Figure 33. Reed canarygrass infestation. (C. Evans, River to River CWMA. Reproduced with permission, Bugwood.org)

growing season to ensure control. *Chemical*—Herbicides have been effective at controlling reed canarygrass and should be applied for several years to ensure effective control. Glyphosate and fluzifop butyl have been proven to be the best herbicides for controlling reed canarygrass infestations.

See: <http://www.invasive.org/species/weeds.cfm>

► Russian Olive

Elaeagnus angustifolia L. (Family: *Elaeagnaceae*): Perennial Tree/Shrub

Identification: Russian olive is a small, 9.1 m (30 ft), thorny shrub or tree. Leaves have a greenish-gray (upper surface) to silvery (lower surface) appearance because of scales on the leaf surfaces (Fig. 34). Leaves are alternately arranged and have smooth margins. Creamy yellow flowers are highly aromatic and appear June to July.

Impact: Competes with native species and interferes with nutrient cycling and natural succession. Russian olive is a nitrogen-fixing species and can dominate riparian and nutrient-poor areas.

Management: *Mechanical*—Mow or cut shrubs and remove vegetation from infested areas. *Chemical*—Stem injection, foliar, and



Figure 34. Russian olive foliage and flowers. (L.J. Mehrhoff, University of Connecticut. Reproduced with permission, Bugwood.org)

stump treatment using general-use herbicides are effective methods for controlling this species.

See: <http://www.nps.gov/plants/alien/fact/elan1.htm>

► Siberian Elm

Ulmus pumila L. (Family: *Ulmaceae*): Perennial Tree/Shrub

Identification: Siberian elm is a deciduous tree up to 21 m tall (70 ft). Leaves are alternate, simple, and toothed along the margins (Fig. 35). The bark is light-gray and has irregularly shaped furrows. Green, inconspicuous flowers occur in the spring. This plant resprouts when cut.

Impact: This tree forms dense thickets, which exclude native vegetation and decrease forage for livestock and other wildlife species. This drought- and cold-resistant plant can grow where other trees cannot.

Management: *Mechanical*—Girdling or pulling small trees is effective. Girdling must be done properly or the tree can resprout. It will take 1 to 2 years for the tree to die once it is girdled. If the tree is girdled too deeply it will resprout. To girdle properly, make two parallel cuts 7.6 to 10 cm (3 to 4 in) apart, and knock the bark off with a blunt object. The xylem needs to remain intact when



Figure 35. Siberian elm foliage. (S. Dewey, Utah State University. Reproduced with permission, Bugwood.org)

girdling. *Chemical*—Stump treatments and basal bark injections with systemic herbicides are effective at controlling Siberian elm infestations. A single girdling cut and application of triclopyr or picloram in the cut is also an effective control.

See: http://www.na.fs.fed.us/fhp/invasive_plants/weeds/siberian-elm.pdf





► Smooth Brome

Bromus inermis Leyss. (Family: Poaceae):
Perennial Graminoid

Identification: This perennial, cool season, sod-forming grass spreads through a creeping rhizome. It has hairless stems, 1.5 m (4.9 ft), and leaves. Leaves are grayish-blue on the upper side and green on the lower side (Fig. 36). Seeds are elliptical and range from pale yellow to dark brown, 1.2 cm (0.5 in).

Impact: This grass shades out native species thereby decreasing biodiversity. It can also impede succession processes and is an alternate host for some viral crop diseases. The thatch left by smooth brome affects the survival and germination of the native grassland herb, *Anemone patens* (Pasque Flower).

Management: *Mechanical*—Cutting smooth brome while the flowers are still in the sheath (boot stage) is the best way to control this species. Cutting repeatedly throughout the season has also



Figure 36. *Smooth brome infestation.* (C. Evans, River to River CWMA. Reproduced with permission, Bugwood.org)

been shown to be a good control measure.

Chemical—Early spring application of glyphosate has been shown to control the spread of smooth brome.

See: <http://www.invasive.org/species/weeds.cfm>

► Spotted Knapweed

Centaurea stoebe L. (Family: Asteraceae):
Biennial, Perennial Forb (Herb)

Identification: This herbaceous plant has many stems, most of which are branched in the upper half. In the first year, a basal rosette of leaves with lanceolate leaflets forms, and in the second year it flowers. Leaves are alternately arranged and decrease in size as you move toward the top of the plant. Flowers bloom June to October and are pink to purple in color, and rarely can be white (Fig. 37). Black margins occur on the flower bract tips.

Impact: This is a fast-growing species that can quickly crowd out native species, as well as decrease the quality of forage for livestock through competition. Spotted knapweed can increase surface runoff and sedimentation by decreasing the water-holding capacity of the soil.

Management: *Mechanical*—Pulling plants by hand, making sure to remove the entire taproot, can be effective for small infestations. *Chemical*—Picloran and 2,4-D can control invasions of knapweed, although 2,4-D will not inhibit or prevent



Figure 37. *Spotted knapweed flowers.* (C. Hoopes, Montana Statewide Noxious Weed Awareness and Education Program Archive. Reproduced with permission, Bugwood.org)

germination of seed. Picloran will persist for 3 to 5 years and then will allow reinfestation and germination if not reapplied. Clopyralid can be applied during the bolt or bud growth stage to prevent seeding.

See: http://na.fs.fed.us/fhp/invasive_plants/weeds/spotted-knapweed.pdf

► Tree of Heaven

Ailanthus altissima (Mill.) Swingle (Family: Simaroubaceae): Perennial Tree

Identification: Tree of heaven is a medium sized, 24 m (79 ft), deciduous tree with smooth gray bark. Leaves are compound and alternately arranged with lance-shaped leaflets that are toothed along the margin (Fig. 38). When crushed, the leaves emit a strong, distinct odor.

Impact: Tree of heaven spreads prolifically through seedlings and root suckers. It out-competes native vegetation for light, space, and nutrients. It also produces a chemical that can be toxic and inhibit growth of surrounding vegetation. Tree of heaven has an extensive root system.

Management: *Mechanical*—Young seedlings can be pulled by hand from invaded sites, ensuring that above-ground stems and the entire root system are removed. *Chemical*—Foliar, basal bark, hack and spray, and cut-stump treatments have been effective at managing tree of heaven



Figure 38. Tree of heaven foliage. (P. Wray, Iowa State University. Reproduced with permission, Bugwood.org)

invasions. Basal bark treatment is the preferred method since it reduces resprouting from the root system.

See: http://www.na.fs.fed.us/fhp/invasive_plants/weeds/tree-of-heaven.pdf

► Winter Creeper

Euonymus fortunei (Turcz.) Hand.-Maz. (Family: Celastraceae): Perennial Vine/Small Shrub

Identification: Winter creeper is a fast growing evergreen vine or small shrub with shiny, dark-green leaves and silvery veins (Fig. 39). Leaves are egg-shaped and paired along the stem with toothed margins. During the summer, clusters of greenish-white flowers occur in long stalks. These turn into pinkish-red capsules in the autumn.

Impact: Because of its aggressive nature, winter creeper is able to out-compete native vegetation for light, nutrients, and soil moisture. It grows along the ground producing a dense carpet, which also prevents the natural regeneration of native seedlings.

Management: *Mechanical*—Removal of the entire plant is recommended for complete eradication of this species, as winter creeper can resprout from any root fragments remaining in the soil. Grubbing (digging up roots and stump) can



Figure 39. Winter creeper. (J.H. Miller, USDA Forest Service. Reproduced with permission, Bugwood.org)

be done in areas that are environmentally sensitive, where herbicides cannot be used. *Chemical*—Cut-stem and foliar herbicide applications have been effective at controlling winter creeper using glyphosate or triclopyr.

See: http://www.na.fs.fed.us/fhp/invasive_plants/weeds/winter_creeper.pdf



Table 1. Invasive species commonly found in tree plantations and forested areas in the Central Hardwood Region.

| Scientific Name | Common Name ¹ | Duration and Growth Habit ² |
|------------------------------------|---------------------------|--|
| <i>Acer ginnala</i> | Amur maple | Perennial Tree, Shrub |
| <i>Acer negundo</i> | Boxelder | Perennial Tree |
| <i>Acer platanoides</i> | Norway maple | Perennial Tree |
| <i>Agrostis capillaris</i> | Colonial bent grass | Perennial Graminoid |
| <i>Ailanthus altissima</i> | Tree of heaven | Perennial Tree |
| <i>Akebia quinata</i> | Chocolate vine | Perennial Vine |
| <i>Albizia julibrissin</i> | Mimosa, Silk tree | Perennial Tree, Shrub |
| <i>Alliaria petiolata</i> | Garlic mustard | Annual, Biennial Herb |
| <i>Ampelopsis brevipedunculata</i> | Amur peppervine | Perennial Vine |
| <i>Berberis thunbergii</i> | Japanese barberry | Perennial Shrub |
| <i>Brassica elongata</i> | Elongated mustard | Perennial Herb |
| <i>Bromus inermis</i> | Smooth brome | Perennial Graminoid |
| <i>Bromus rubens</i> | Red brome | Annual Graminoid |
| <i>Bromus tectorum</i> | Cheatgrass | Annual Graminoid |
| <i>Caragana arborescens</i> | Siberian peashrub | Perennial Tree, Shrub |
| <i>Carduus acanthoides</i> | Spiny plumeless thistle | Biennial Herb |
| <i>Carduus nutans</i> | Nodding plumeless thistle | Biennial, Perennial Herb |
| <i>Celastrus orbiculatus</i> | Oriental bittersweet | Perennial Vine |
| <i>Centaurea diffusa</i> | Diffuse knapweed | Annual, Perennial Herb |
| <i>Centaurea melitensis</i> | Maltese star-thistle | Annual, Biennial Herb |
| <i>Centaurea solstitialis</i> | Yellow star-thistle | Annual Herb |
| <i>Centaurea stoebe</i> | Spotted knapweed | Biennial, Perennial Herb |
| <i>Cinnamomum camphora</i> | Camphor tree | Perennial Tree |
| <i>Cirsium arvense</i> | Canada thistle | Perennial Herb |
| <i>Cirsium vulgare</i> | Bull thistle | Biennial Herb |
| <i>Clematis terniflora</i> | Sweet autumn virginsbower | Perennial Vine |
| <i>Commelina benghalensis</i> | Jio; Tropical spiderwort | Annual, Perennial Herb |
| <i>Coronilla varia</i> | Crown vetch | Perennial Herb, Vine |
| <i>Cotinus coggygria</i> | European smoketree | Perennial Tree, Shrub |
| <i>Cortaderia selloana</i> | Uruguayan pompass grass | Perennial Graminoid |
| <i>Cynoglossum officinale</i> | Gypsyflower | Biennial Herb |
| <i>Cytisus scoparius</i> | Scotch broom | Perennial Shrub |
| <i>Dioscorea bulbifera</i> | Air yam | Perennial Vine, Herb |
| <i>Dioscorea oppositifolia</i> | Chinese yam | Perennial Vine, Herb |
| <i>Elaeagnus angustifolia</i> | Russian olive | Perennial Tree, Shrub |
| <i>Elaeagnus pungens</i> | Thorny olive | Perennial Shrub |
| <i>Elaeagnus umbellata</i> | Autumn olive | Perennial Shrub |
| <i>Elytrigia repens</i> | Quackgrass | Perennial Graminoid |
| <i>Erodium cicutarium</i> | Redstem stork's bill | Annual, Biennial Herb |
| <i>Euonymus alata</i> | Burningbush | Perennial Shrub |
| <i>Euonymus fortunei</i> | Winter creeper | Perennial Vine, Shrub |
| <i>Eupatorium cannabinum</i> | Hemp agrimony | Perennial Herb |
| <i>Euphorbia esula</i> | Leafy spurge | Perennial Herb |
| <i>Festuca spp.</i> | Fescue | Perennial Graminoid |
| <i>Frangula alnus</i> | Glossy buckthorn | Perennial Tree, Shrub |
| <i>Galeopsis tetrahit</i> | Brittlestem hempnettle | Annual Herb |
| <i>Hedera helix</i> | English ivy | Perennial Vine |
| <i>Heracleum mantegazzianum</i> | Giant hogweed | Perennial Herb |
| <i>Humulus japonicus</i> | Japanese hop | Annual or Perennial Vine, Herb |



Table 1. (continued)

| Scientific Name | Common Name ¹ | Duration and Growth Habit ² |
|-------------------------------------|-------------------------------|--|
| <i>Hypericum perforatum</i> | Common St. Johnswort | Perennial Herb |
| <i>Iris pseudacorus</i> | Paleyellow iris | Perennial Herb |
| <i>Lepidium latifolium</i> | Broad leaved pepperweed | Perennial Herb |
| <i>Lespedeza cuneata</i> | Sericea lespedeza | Perennial SubShrub, Herb |
| <i>Ligustrum lucidum</i> | Glossy privet | Perennial Tree, Shrub |
| <i>Ligustrum sinsense</i> | Chinese privet | Perennial Tree, Shrub |
| <i>Ligustrum vulgare</i> | European privet | Perennial Shrub |
| <i>Lonicera japonica</i> | Japanese honeysuckle | Perennial Vine |
| <i>Lonicera spp.</i> | Bush honeysuckles | Perennial Vine, Shrub |
| <i>Lotus corniculatus</i> | Bird's-foot trefoil | Perennial Herb |
| <i>Lygodium japonicum</i> | Japanese climbing fern | Perennial Vine, Herb |
| <i>Lythrum salicaria</i> | Purple loosestrife | Perennial SubShrub, Herb |
| <i>Melia azedarach</i> | Chinaberry tree | Perennial Tree, Shrub |
| <i>Melilotus alba</i> | White sweet clover | Biennial, Perennial Herb |
| <i>Microstegium vimineum</i> | Nepalese browntop, Stiltgrass | Annual Graminoid |
| <i>Miscanthus sinensis</i> | Chinese silvergrass | Perennial Graminoid |
| <i>Onopordum acanthium</i> | Scotch cottonthistle | Biennial Herb |
| <i>Paederia foetida</i> | Stinkvine | Perennial Vine, Shrub |
| <i>Panicum repens</i> | Torpedo grass | Perennial Graminoid |
| <i>Paulownia tomentosa</i> | Princess tree | Perennial Tree |
| <i>Pennisetum ciliare</i> | Buffelgrass | Perennial Graminoid |
| <i>Pennisetum clandenstinum</i> | Kikuyugrass | Perennial Graminoid |
| <i>Pennisetum macrourum</i> | African feathergrass | Perennial Graminoid |
| <i>Pennisetum polystachia</i> | Mission grass | Perennial Graminoid |
| <i>Pennisetum setaceum</i> | Crimson fountaingrass | Perennial Graminoid |
| <i>Phalaris arundinaceae</i> | Reed canarygrass | Perennial Graminoid |
| <i>Phragmites australis</i> | Common reed | Perennial Shrub, Graminoid |
| <i>Polygonum cuspidatum</i> | Japanese knotweed | Perennial SubShrub, Herb |
| <i>Polygonum perfoliatum</i> | Asiatic tearthumb | Annual Herb |
| <i>Populus alba</i> | White poplar | Perennial Tree |
| <i>Psidium guajava</i> | Guava | Perennial Tree, Shrub |
| <i>Pueraria montana var. lobata</i> | Kudzu | Perennial Vine |
| <i>Pyrus calleryana</i> | Callery (Bradford) pear | Perennial Tree |
| <i>Ranunculus ficaria</i> | Fig buttercup | Perennial Herb |
| <i>Rhamnus cathartica</i> | Common buckthorn | Perennial Tree, Shrub |
| <i>Ricinus communis</i> | Castorbean | Annual, Perennial Shrub, Herb |
| <i>Robinia pseudoacacia</i> | Black locust | Perennial Tree |
| <i>Rosa bracteata</i> | Macartney rose | Perennial Vine, SubShrub |
| <i>Rosa multiflora</i> | Multiflora rose | Perennial Vine, SubShrub |
| <i>Rottboellia cochinchinensis</i> | Itchgrass | Annual Graminoid |
| <i>Rubus armeniacus</i> | Himalayan blackberry | Perennial SubShrub |
| <i>Sagina procumbens</i> | Birdeye pearlwort | Perennial Herb |
| <i>Salix cinerea</i> | Large gray willow | Perennial Tree, Shrub |
| <i>Salsola tragus</i> | Prickly Russian thistle | Annual Herb |
| <i>Solanum sisymbriifolium</i> | Sticky nightshade | Annual Herb |
| <i>Solanum viarum</i> | Tropical soda apple | Perennial SubShrub |
| <i>Sorghum halepense</i> | Johnsongrass | Perennial Graminoid |
| <i>Spiraea japonica</i> | Japanese meadowsweet | Perennial Shrub |



Table 1. (continued)

| Scientific Name | Common Name ¹ | Duration and Growth Habit ² |
|---------------------------------|--------------------------|--|
| <i>Striga asiatica</i> | Asiatic witchweed | Annual Herb |
| <i>Tamarix ramosissima</i> | Saltcedar | Perennial Tree, Shrub |
| <i>Tradescantia fluminensis</i> | Small-leaf spiderwort | Perennial Herb |
| <i>Triadica sebifera</i> | Chinese tallow | Perennial Tree |
| <i>Tussilago farfara</i> | Coltsfoot | Perennial Herb |
| <i>Ulmus parvifolia</i> | Chinese elm | Perennial Tree |
| <i>Ulmus pumila</i> | Siberian elm | Perennial Tree, Shrub |
| <i>Verbascum thapsus</i> | Common mullein | Biennial Herb |
| <i>Verbena brasiliensis</i> | Brazilian vervain | Annual SubShrub, Herb |
| <i>Verbena rigida</i> | Tuberous vervain | Perennial Herb |
| <i>Vinca major</i> | Bigleaf periwinkle | Perennial Vine, Herb |
| <i>Vincetoxicum spp.</i> | Swallow-wort | Perennial Vine |
| <i>Wisteria floribunda</i> | Japanese wisteria | Perennial Vine |
| <i>Wisteria sinensis</i> | Chinese wisteria | Perennial Vine |

¹Compiled from: USDA, Natural Resources Conservation Service, The PLANTS Database (<http://plants.usda.gov>, 17 May 2010). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

²*Graminoid*: Grass or grasslike plant, including grasses, sedges, rushes, arrow-grasses, and quillworts.

Herb: Vascular plant without significant woody tissue above or at the ground. Forbs and other herbs may be annual, biennial, or perennial, but always lack significant thickening by secondary woody growth and have perennating buds borne at or below the ground surface.

Shrub: Perennial, multi-stemmed woody plant that is usually less than 4 to 5 m (13 to 16 ft) in height. Shrubs typically have several stems arising from or near the ground, but may be taller than 5 m or single-stemmed under certain environmental conditions.

SubShrub: Low-growing shrub usually under 0.5 m (1.5 ft) tall, never exceeding 1 m (3 ft) tall at maturity.

Tree: Perennial, woody plant with a single stem (trunk), normally greater than 4 to 5 m (13 to 16 ft) in height; under certain environmental conditions, some tree species may develop a multi-stemmed or short growth form (less than 4 m or 13 ft in height). *Vine*: Twining and climbing plant with relatively long stems; can be woody or herbaceous.



Literature Cited

- Ahrens, W.H. 1994. *Herbicide Handbook*, Weed Science Society of America, Champaign, IL, 7th ed. 352 p.
- Seifert, J.R., Selig, M.F., and Morrissey, R.C. 2007. *Weed competition control in hardwood plantations*. In: *Planting and Care of Fine Hardwood Seedlings*, Pijut, P.M. (ed.), FNR-235. USDA Forest Service, Northern Research Station, Hardwood Tree Improvement and Regeneration Center and Purdue University, Dept. of Forestry and Natural Resources, West Lafayette, IN. FNR-224, 8 p.
- Stringer, J.W., Clatterbuck, W., and Seifert, J. 2009. Site preparation and competition control guidelines for hardwood tree plantings. Professional Forestry Note. The University of Tennessee Cooperative Extension Service Publication Series., 35 p. <http://www.utextension.utk.edu/publications/pbfiles/PB1783.pdf>

Websites with Descriptions of Herbicide Options for Invasive Plant Management:

- Invasipedia:** <http://wiki.bugwood.org/Invasipedia>
- Invasive Plants Association of Wisconsin:** <http://www.ipaw.org/herbicides.aspx>
- Invasive Species Management, Dow AgroSciences:** <http://www.dowagro.com/ivm/invasive/invasive.htm>
- Minnesota Department of Natural Resources:** <http://www.dnr.state.mn.us/invasives/terrestrialplants/herbicides.html>
- National Invasive Species Information Center:** <http://www.invasivespeciesinfo.gov/plants/controlplans.shtml>
- Plant Conservation Alliance Alien Plant Working Group:** <http://www.nps.gov/plants/ALIEN/factmain.htm>

State Invasive Plant Species Websites:

Alabama: <http://www.se-eppc.org/alabama/>
Connecticut: <http://www.hort.uconn.edu/cipwg/>
Georgia: <http://www.gaepcc.org/>
Illinois: <http://dnr.state.il.us/orep/ctap/invasive/>
Indiana: <http://www.in.gov/dnr/naturepreserve/4736.htm>
Iowa: <http://www.iowadnr.gov/forestry/invasive.html>
Kansas: http://www.ksda.gov/plant_protection/content/183/cid/607
Kentucky: <http://www.se-eppc.org/ky/>
Maryland: http://www.mdinvasivesp.org/invasive_species_md.html
Massachusetts: <http://www.massnrc.org/MIPAG/invasive.htm>
Michigan: http://www.michigan.gov/dnr/0,1607,7-153-10370_12146_12214---,00.html
Minnesota: <http://www.dnr.state.mn.us/invasives/terrestrialplants/index.html>
Mississippi: <http://www.se-eppc.org/mississippi/>
Missouri: <http://mdc.mo.gov/landwater-care/plant-management/invasive-plant-management>
Nebraska: <http://www.agr.state.ne.us/division/bpi/nwp/nwp1.htm>
New Hampshire: <http://www.amherstnh.gov/acc/invasives.html>
New York: <http://www.ipcnys.org/>
North Carolina: http://www.dfr.state.nc.us/forest_health/invasives.htm
Ohio: <http://www.dnr.state.oh.us/tabid/2005/Default.aspx>
Oklahoma: <http://www.ok-invasive-plant-council.org/>
Pennsylvania: <http://www.dcnr.state.pa.us/forestry/wildplant/invasive.aspx>
Rhode Island: <http://www.rinhs.org/what-we-do/invasives/ri-invasive-species-resources/invasive-list/>
Tennessee: <http://www.tneppc.org/>

Texas: <http://www.texasinvasives.org/>
Virginia: http://www.dcr.virginia.gov/natural_heritage/invspdflist.shtml
West Virginia: <http://www.wvdnr.gov/wildlife/invasivevw.shtml>
Wisconsin: <http://dnr.wi.gov/invasives/plants.asp>

Other On-Line Resources:

Center for Invasive Species and Ecosystem Health—Bugwood Network:
<http://www.bugwood.org/>
Global Invasive Species Database:
<http://www.invasivespecies.net/database/welcome/>
Invasive Plant Atlas of the United States:
<http://www.invasiveplantatlas.org/>
Missouri Vegetation Management Manual:
<http://host.mdc.mo.gov/landwater-care/plant-management/invasive-plant-management/resource/missouri-vegetation-management-ma>
Southeast Exotic Pest Plant Council:
<http://www.se-eppc.org/index.cfm>
USDA National Invasive Species Information Center: <http://www.invasivespeciesinfo.gov/index.shtml>
USDA Natural Resources Conservation Service PLANTS Database: <http://plants.usda.gov/>
USDA Forest Service, Northeastern Area:
http://na.fs.fed.us/fhp/invasive_plants/index.shtml
USDA Forest Service, Northeastern Area State and Private Forestry: <http://na.fs.fed.us/spfo/invasiveplants/index.asp>
Weeds Gone Wild—Alien Plant Invaders of Natural Areas: <http://www.nps.gov/plants/alien/index.htm>



25

Mention of a trademark, proprietary product, or vendor does not constitute a guarantee or warranty of the product by the U.S. Department of Agriculture and does not imply its approval to the exclusion of other products or vendors that also may be suitable.

This publication is printed on recycled paper using soy-based inks.



It is the policy of the Purdue University Cooperative Extension Service that all persons have equal opportunity and access to its educational programs, services, activities, and facilities without regard to race, religion, color, sex, age, national origin or ancestry, marital status, parental status, sexual orientation, disability or status as a veteran.

Purdue University is an Affirmative Action institution. This material may be available in alternative formats.