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2006

## Nonnative Invasive Plants of Southern Forests

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# Nonnative Invasive Plants of Southern Forests

A Field Guide for Identification and Control



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## Author

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Available without charge from  
the Southern Research Station

### Front Cover

**Upper left**—Chinese lespedeza (*Lespedeza cuneata*) infestation that developed from dormant seed in the soil seed bank after a forest thinning operation.

**Upper right**—Kudzu (*Pueraria montana*) infestation on the urban-wildland interface.

**Lower left**—Chinese privet (*Ligustrum sinense*) and dormant kudzu invading and replacing a pine-hardwood stand.

**Lower right**—Cogongrass (*Imperata cylindrica*) infestation under mature slash pine (*Pinus elliottii*).

### Back Cover

**Upper left**—Stem injection using a hatchet and spray bottle to apply a hack-and-squirt treatment to control silktree (*Albizia julibrissin*).

**Upper right**—Hand pulling seedlings of Chinese privet (*Ligustrum sinense*).

**Lower left**—Prescribed burning can often assist in controlling garlic mustard (*Alliaria petiolata*).

**Lower right**—Containerized native plants for rehabilitation plantings.

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# **Nonnative Invasive Plants of Southern Forests**

**A Field Guide for Identification and Control**

**James H. Miller**

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### ABSTRACT

Invasions of nonnative plants into forests of the Southern United States continue to go unchecked and unmonitored. Invasive nonnative plants infest under and beside forest canopies and dominate small forest openings, increasingly eroding forest productivity, hindering forest use and management activities, and degrading diversity and wildlife habitat. Often called nonnative, exotic, nonindigenous, alien, or noxious weeds, they occur as trees, shrubs, vines, grasses, ferns, and forbs. This book provides information on accurate identification and effective control of the 33 nonnative plants and groups that are currently invading the forests of the 13 Southern States, showing both growing and dormant season traits. It lists other nonnative plants of growing concern, control strategies, and selective herbicide application procedures. Recommendations for preventing and managing invasions on a specific site include maintaining forest vigor with minimal disturbance, constant surveillance and treatment of new unwanted arrivals, and finally rehabilitation following eradication.

**Keywords:** Alien plants, exotic plant control, exotic weeds, herbicide weed control, integrated vegetation management, invasive exotic plants, invasive nonindigenous plants, noxious plant control.

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## Explanation of Codes and Conventions Used in Species Descriptions

### Scientific name



***Ailanthus altissima*** (P. Mill.) Swingle  
Synonyms: ailanthus, Chinese sumac, stinking sumac, paradise-tree, copal-tree

### International code



**AIAL**

### Common name



**Tree-of-Heaven**

### Forest Inventory and Analysis survey code



**0341**

**Plant.** Deciduous tree to 80 feet (25 m) in height and 6 feet (1.8 m) in diameter, with long pinnately compound leaves and circular glands under lobes on leaflet bases. Strong odor from flowers and other parts, sometimes likened to peanuts or cashews.

**Stem.** Twigs stout, chestnut brown to reddish tan, and smooth-to-velvety with light dots (lenticels) and heart-shaped leaf scars. Buds finely hairy, dome-shaped, and partially hidden by the leaf base. Branches light gray to dark gray, smooth and glossy, with raised dots becoming fissures with age. Bark light gray and rough with areas of light-tan fissures.



## Introduction

Invasions of nonnative plants into southern forests continue to go largely unchecked and only partially monitored. Invasive nonnative plants infest under and beside forest canopies and occupy small forest openings, increasingly eroding forest productivity, hindering forest use and management activities, and degrading diversity and wildlife habitat. Often called non-native, exotic, nonindigenous, alien, or noxious weeds, they occur as trees, shrubs, vines, grasses, ferns, and forbs. Some have been introduced into this country accidentally, but most were brought here as ornamentals or for livestock forage. These robust plants arrived without their natural predators of insects and diseases that tend to keep native plants in natural balance. Many have hybridized. Now they increase across the landscape with little opposition, beyond the control and reclamation measures applied by landowners and managers on individual land holdings.

The objective of this book is to provide information on accurate identification and effective control of the 33 plants or groups that are invading the forests of the 13 Southern States at an alarming rate, showing both growing and dormant season traits. It lists other nonnative invasive plants of growing concern and explains control recommendations and selective application procedures. The text and photographs were originally developed to assist in the first region-wide survey and monitoring of these invading species, conducted by the USDA Forest Service's Forest Inventory and Analysis Research Work Unit of the Southern Research Station in collaboration with State forestry management agencies. The four-number survey codes as well as the international plant codes are given for each species (see opposite page).

Integrated vegetation management programs are needed to combat invading nonnative plants. Strategies of surveillance and treatment of new arrivals will safeguard lands, and rehabilitation of existing infestations can be achieved by concerted control measures and reestablishment of native vegetation.



*Broadcast treatment of herbicide spray to kudzu.*

# Tree-of-Heaven

TREES



***Ailanthus altissima* (P. Mill.) Swingle AIAL**

Synonyms: ailanthus, Chinese sumac, stinking sumac, paradise-tree, copal-tree

**Plant.** Deciduous tree to 80 feet (25 m) in height and 6 feet (1.8 m) in diameter, with long pinnately compound leaves and circular glands under lobes on leaflet bases. Strong odor from flowers and other parts, sometimes likened to peanuts or cashews.

**Stem.** Twigs stout, chestnut brown to reddish tan, and smooth-to-velvety with light dots (lenticels) and heart-shaped leaf scars. Buds finely hairy, dome-shaped, and partially hidden by the leaf base. Branches light gray to dark gray, smooth and glossy, with raised dots becoming fissures with age. Bark light gray and rough with areas of light-tan fissures.

**Leaves.** Alternate, odd- or even-pinnately compound, 10 to 41 leaflets on 1- to 3-foot (30 to 90 cm) light-green to reddish-green stalks with swollen bases. Leaflets lanceolate and asymmetric and not always directly opposite, each 2 to 7 inches (5 to 18 cm) long and 1 to 2 inches (2.5 to 5 cm) wide. Long tapering tips and lobed bases with one or more glands beneath each lobe (round dots). Margins entire. Dark green with light-green veins above and whitish green beneath. Petioles 0.2 to 0.5 inch (5 to 12 mm) long.

**Flowers.** April to June. Large terminal clusters to 20 inches (50 cm) long of small, yellowish-green flowers, with five petals and five sepals. Male and female flower on separate trees.

**Fruit and seeds.** July to February. Persistent clusters of wing-shaped fruit with twisted tips on female trees, 1 inch (2.5 cm) long. Single seed. Green turning to tan then brown.

**Ecology.** Rapid growing, forming thickets and dense stands. Both shade and flood intolerant and allelopathic. Colonizes by root sprouts and spreads by prolific wind- and water-dispersed seeds. Viable seed can be produced by 2- and 3-year-old plants.

**Resembles** hickories, *Carya* spp., and sumacs, *Rhus* spp., but neither has glands at leaflet bases. Hickories distinguished by a braided bark, sumacs by shrub shape.

**History and use.** Introduced in 1784 from Europe, although originally from Eastern China. Ornamental.

States with suspected  
infestations are  
shown in gray.

**Tree-of-Heaven****0341**

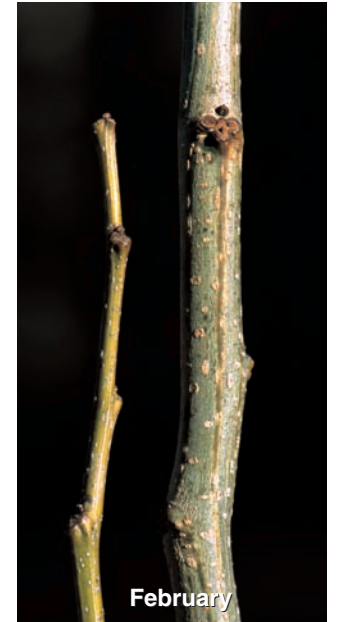
July

# Silktree, Mimosa

TREES



T. Bodner



***Albizia julibrissin* Durazz. ALJU**

Synonym: silky acacia

**Plant.** Deciduous leguminous tree 10 to 50 feet (3 to 15 m) in height with single or multiple boles, smooth light-brown bark, feathery leaves, and showy pink blossoms that continually yield dangling flat pods during summer. Pods persistent during winter.

**Stem.** Twigs slender to stout, lime green turning shiny grayish brown with light dots (lenticels). No terminal bud. Bark glossy, thin, light brown turning gray with raised corky dots and dashes.

**Leaves.** Alternate, bipinnately compound 6 to 20 inches (15 to 50 cm) long with 8 to 24 pairs of branches and 20 to 60 leaflets per branch, feathery and fernlike. Leaflets asymmetric, 0.4 to 0.6 inch (1 to 1.5 cm) long, dark green, with midvein nearer and running parallel to one margin. Margins entire.

**Flowers.** May to July (and sporadically to November). Terminal clusters at the base of the current year's twigs, each with 15 to 25 sessile flowers 1.4 to 2 inches (3.5 to 5 cm) long. Pom-pom like with numerous filaments, bright-pink feathery tufts with white bases. Fragrant.

**Fruits and seeds.** June to February. Legume pods in clusters, flat with bulging seeds, each pod 3 to 7 inches (8 to 18 cm) long, splitting in winter along the edges to release 5 to 10 oval seeds. Initially light green turning dark brown in fall and whitish tan in winter.

**Ecology.** Occurs on dry-to-wet sites and spreads along stream banks, preferring open conditions but also persisting in shade. Seldom found above 3,000 feet (900 m). Forms colonies from root sprouts and spreads by abundant animal- and water-dispersed seeds. Seeds remain viable for many years. Nitrogen fixer.

**Resembles** honeylocust, *Gleditsia triacanthos* L., which has longer leaflets—1 inch (2.5 cm) long. Seedlings resemble partridge pea, *Chamaecrista fasciculata* (Michx.) Greene, an annual plant with once pinnately compound leaves.

**History and use.** A traditional ornamental introduced from Asia in 1745. Potential use for forage and biofuel.

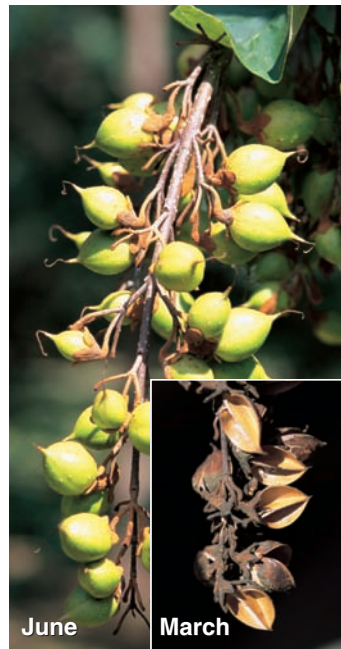
States with suspected infestations are shown in gray.

**Silktree, Mimosa****0345**

June

# Princesstree, Paulownia

TREES



***Paulownia tomentosa* (Thunb.) Sieb. & Zucc. ex Steud. PATO2**

Synonym: empresstree

**Plant.** Deciduous tree to 60 feet (18 m) in height and 2 feet (60 cm) in diameter with large heart-shaped leaves, fuzzy hairy on both sides, showy pale-violet flowers in early spring before leaves, and persistent pecan-shaped capsules in terminal clusters in summer to winter. Abundant flower buds present on erect stalks over winter.

**Stem.** Twigs and branches stout, glossy gray brown and speckled with numerous white dots (lenticels). No terminal bud. Lateral leaf scars raised, circular, and becoming larger, dark, and sunken. Bark light-to-dark gray, roughened, and becoming slightly fissured. Stem pith chambered or hollow and wood white.

**Leaves.** Opposite, heart-shaped and fuzzy hairy on both surfaces, 6 to 12 inches (15 to 30 cm) long and 5 to 9 inches (13 to 23 cm) wide. Leaves larger on resprouts, 16 to 20 inches (40 to 50 cm) across, with extra tips often extending at vein tips. Petioles rough hairy, 2 to 8 inches (5 to 20 cm) long.

**Flowers.** April to May. Covered with showy erect panicles of pale-violet flowers before leaves in early spring, tubular with five unequal lobes. Fragrant. Flower buds fuzzy, linear, and becoming ovoid in summer and persistent on erect stalks over winter.

**Fruit and seeds.** June to April. Terminal clusters of pecan-shaped capsules 1 to 2 inches (2.5 to 5 cm) long and 0.6 to 1 inch (1.5 to 2.5 cm) wide. Pale green in summer turning to tan in winter and eventually black and persistent into spring. Capsules splitting in half during late winter to release tiny winged seeds.

**Ecology.** Common around old homes, on roadsides, riparian areas, and forest margins in infested areas. Infrequently planted in plantations. Spreads by wind- and water- dispersed seeds. Invades after fire, harvesting, and other disturbances. Forms colonies from root sprouts.

**Resembles** southern catalpa, *Catalpa bignonioides* Walt., and northern catalpa, *C. speciosa* (Warder) Warder ex Engelm., which have leaves with sparsely hairy upper surfaces and rough hairy lower surfaces and long slender, persistent beans.

**History and use.** Introduced in the early 1800s from East Asia. Has been widely planted as an ornamental and grown in scattered plantations for speculative high-value wood exports to Japan.

States with suspected infestations are shown in gray.

**Princesstree, Paulownia****0712**

# Chinaberrytree

TREES



May

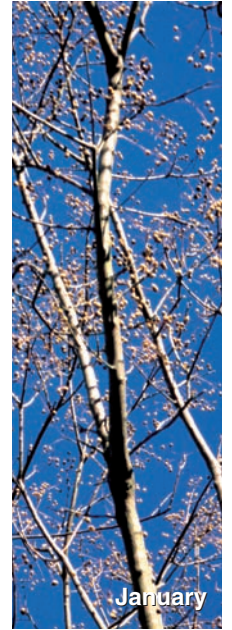
T. Bodner



July



November



January



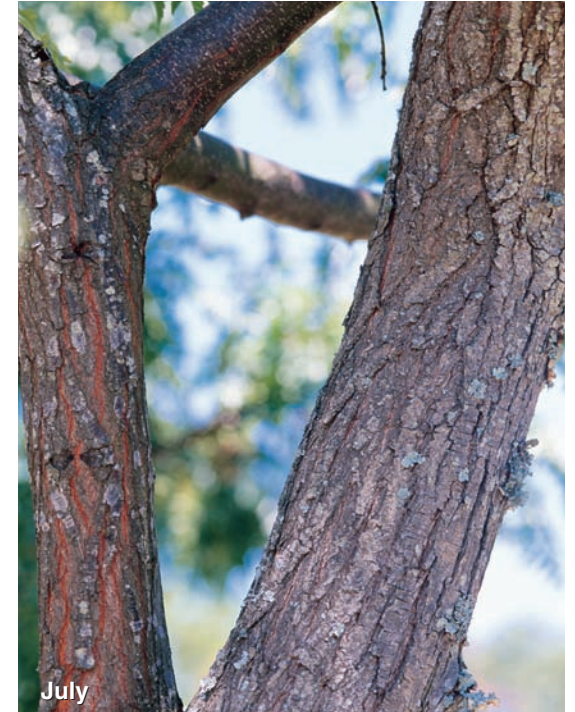
July



July



November



July

***Melia azedarach* L. MEAZ**

**Plant.** Deciduous tree to 50 feet (15 m) in height and 2 feet (60 cm) in diameter, much branched with multiple boles, lacy dark-green leaves having a musky odor, and clusters of lavender flowers in spring yielding persistent, poisonous yellow berries.

**Stem.** Twigs stout, glossy greenish-brown with light dots (lenticels). No terminal bud. Numerous broad, V-shaped, raised leaf scars with three bundle scars below a domed fuzzy bud. Bark dark chocolate brown and becoming increasingly fissured with age. Wood soft and white.

**Leaves.** Alternately whorled, bipinnately compound, 1 to 2 feet (30 to 60 cm) long and 9 to 16 inches (23 to 40 cm) wide. Leafstalk lime green with base slightly clasping stem. Each leaflet lanceolate with tapering tips, 1 to 3 inches (2.5 to 8 cm) long and 0.5 to 1.2 inches (1 to 3 cm) wide. Margins varying from entire to coarsely crenate to serrate and wavy. Glossy dark green with light-green midvein above and pale green with lighter-green midvein beneath, becoming golden yellow in fall.

**Flowers.** March to May. Showy panicles from lower axils of new stems. Five pinkish-lavender to whitish petals, stamens united in dark-purple tube. Five green sepals. Fragrant.

**Fruit and seeds.** July to January. Berrylike spherical drupe 0.5 to 0.7 inch (1.2 to 1.8 cm) wide persisting through winter and containing a stone with one to six seeds. Light green turning yellowish green then yellowish tan. Poisonous to humans and livestock.

**Ecology.** Common on roadsides, at forest margins, and around old homesites but rare at high elevations. Semishade tolerant. Forms colonies from root sprouts or sprouts from root collars, and spreads by bird-dispersed abundant seeds.

**Resembles** common elderberry, *Sambucus canadensis* L., a spreading crowned shrub with once pinnately compound leaves, margins finely serrate, and green to dark-purple berries in flat-topped clusters.

**History and use.** Introduced in the mid-1800s from Asia. Widely planted as a traditional ornamental around homesites. Extracts potentially useful for natural pesticides.

States with suspected infestations are shown in gray.

**Chinaberrytree****0993**

June

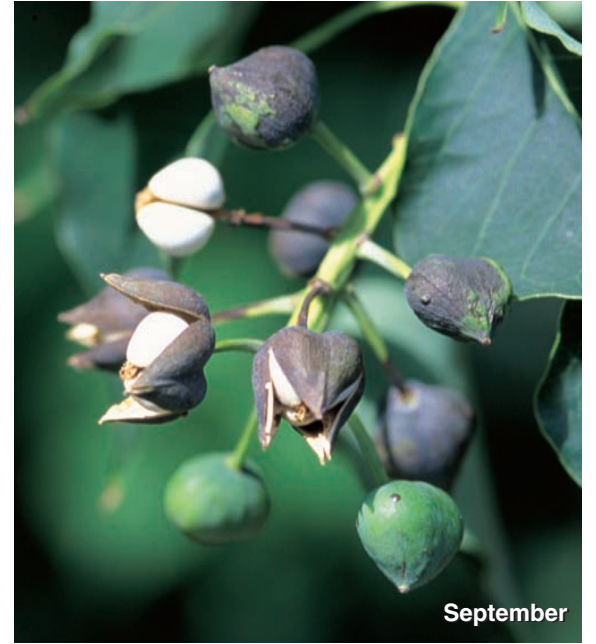
November

# Tallowtree, Popcorn tree

TREES



T. Bodner



F. Nation

***Triadica sebifera* (L.) Small TRSE6**

Synonym: Chinese tallowtree, *Sapium sebiferum* (L.) Roxb.

**Plant.** Deciduous tree to 60 feet (18 m) in height and 3 feet (90 cm) in diameter, with heart-shaped leaves, dangling yellowish spikes in spring yielding small clusters of three-lobed fruit that split to reveal popcorn-like seeds in fall and winter.

**Stem.** Terminal clusters of flowers and fruits result in whorled branching from lateral buds below fruit clusters. Twigs lime green turning gray with scattered brownish dots (lenticels) later becoming striations. Numerous semicircular leaf scars becoming raised with age. Bark light gray and fissured. Sap milky.

**Leaves.** Alternately whorled, distinctively heart-shaped with a rounded wide-angled base and a short or long attenuate tip. Blades 2 to 3 inches (5 to 8 cm) long and 1.5 to 2.5 inches (4 to 6 cm) wide. Dark-green with light-green mid- and lateral veins and turning yellow to red in fall. Hairless, lime-green petioles 1 to 3 inches (2.5 to 8 cm) with two tiny glands on upper side of juncture between blade and petiole (requires magnification).

**Flowers.** April to June. Slender, drooping spikes to 8 inches (20 cm) long of tiny flowers. Yellowish-green sepals but no petals. Female flowers at base and males along the spike.

**Fruit and seeds.** August to January. Small terminal clusters of three-lobed capsules (occasionally four to five lobed), each 0.5 to 0.75 inch (1.2 to 2 cm) across. Dark green in summer becoming black and splitting to reveal three white-wax coated seeds 0.3 inch (0.8 cm) long and 0.2 inch (0.5 cm) wide. Resemble popcorn and remain attached until winter.

**Ecology.** Invades stream banks, riverbanks, and wet areas like ditches as well as upland sites. Thrives in both freshwater and saline soils. Shade tolerant, flood tolerant, and allelopathic. Increasing widely through ornamental plantings. Spreading by bird- and water-dispersed seeds and colonizing by prolific surface root sprouts.

**Resembles** cottonwoods, *Populus* spp., which have wavy margined leaves and flaking bark.

**History and use.** Introduced from China to South Carolina in the 1700s and then in significant numbers to the gulf coast in the early 1900s. Plantings for seed oil recommended by the U.S. Department of Agriculture during 1920 to 1940. Ornamentals still sold and planted. Waxy seeds traditionally used to make candles. Honey plant for beekeeping.

States with suspected infestations are shown in gray.

**Tallowtree, Popcorn tree****0994**

May

# Russian Olive

TREES



P. Breen



© J. Randall



P. Breen



P. Breen



P. Breen



P. Breen

***Elaeagnus angustifolia* L. ELAN**

Synonym: oleaster

**Plant.** Deciduous, thorny tree or shrub to 35 feet (10 m) in height with a single bole, many long narrow leaves, and many yellow fruit covered with minute silvery scales.

**Stem.** Twigs slender, thorny, and silver scaly becoming glossy and greenish. Branches smooth and reddish brown. Pith pale brown to orange brown. Bark dark brown and densely fissured.

**Leaves.** Alternate, long lanceolate to oblanceolate measuring 1.5 to 4 inches (4 to 10 cm) long and 0.4 to 1.2 inches (1 to 3 cm) wide. Margins entire (rarely toothed). Green to slightly silvery above with dense silver scales beneath. Petioles short and silvery.

**Flowers.** April to July. Axillary clusters, each with 5 to 10 silvery-white to yellow flowers. Tubular with four lobes. Fragrant.

**Fruit and seeds.** August to October. Drupelike, hard fleshy fruit 0.5 inch (1.2 cm) wide and long, resembling an olive. Light green to yellow (sometimes tinged with red). One nutlet in each fruit.

**Ecology.** Found as scattered plants in forest openings, open forests, and along forest edges. Thrives in sandy floodplains. Shade intolerant. Spreads by bird- and other animal-dispersed seeds. A nonleguminous nitrogen fixer.

**Resembles** silverthorn or thorny olive, *E. pungens* Thunb., which is an evergreen with brown scaly and hairy twigs, flowers in late fall producing few reddish silver-scaly drupes in spring. **Also resembles** autumn olive, *E. umbellata* Thunb., which has leaves with nonscaly upper surfaces in summer, flowers in early summer, and many reddish, rounded berries in fall and early winter.

**History and use.** Native to Europe and western Asia, a recent (early 1900s) arrival in the upper part of the Southeast. Initially planted as a yard ornamental, for wind-breaks, surface mine reclamation, and wildlife habitat.

States with suspected  
infestations are  
shown in gray.

**Russian Olive****0997**

Summer

# Silverthorn, Thorny Olive

SHRUBS



T. Bodner

***Elaeagnus pungens* Thunb. ELPU2**

**Plant.** Evergreen, densely bushy shrub 3 to 25 feet (1 to 8 m) in height, with long limber projecting shoots, scattered thorny branches. Thick leaves, silver-brown scaly beneath. Often found as escaped single plants from animal-dispersed seeds.

**Stem.** Multiple stems and densely branched. Twigs brown and dense with brown scales and hairy when young. Short shoots with small leaves becoming sharp-branched or unbranched thorns 0.4 to 1.6 inches (1 to 4 cm) long, and in second year producing leafy lateral branches, followed by flowers in fall. Lateral branches distinctly long, limber, and in late summer to spring extending beyond bushy crown and ascending into trees. Bark dark drab and rough with projecting thorns.

**Leaves.** Alternate, oval to elliptic and thick, 0.4 to 4 inches (1 to 10 cm) long and 0.2 to 2 inches (0.6 to 5 cm) wide. Irregular and wavy margins. Blade surfaces silver scaly in spring becoming dark green or brownish green above and densely silver scaly with scattered brown scales beneath. Petioles 0.1 to 0.2 inch (4 to 5 mm) long, grooved above.

**Flowers.** October to December. Axillary clusters, each with one to three flowers, 0.4 inch (1 cm) long, silvery white to brown. Tubular with four lobes. Fragrant.

**Fruit and seeds.** March to June. Oblong, juicy drupe, 0.3 to 0.6 inch (1 to 1.5 cm) long, containing one nutlet. Whitish ripening to red and finely dotted with brown scales. Persistent shriveled calyx tube at tip.

**Ecology.** Fast-growing, weedy ornamental. Tolerant to shade, drought, and salt. Spreads by animal-dispersed seeds and occurs as scattered individuals, both in the open and under forest shade. Increases in size by prolific stem sprouts. Can climb into trees.

**Resembles** autumn olive, *E. umbellata* Thunb., and Russian olive, *E. angustifolia* L., both of which are deciduous and are further described in this book. Autumn olive has thin leaves with silver scales (not silver brown) and abundant reddish rounded berries in fall and early winter. Russian olive has silver scaly twigs and leaf surfaces, and many yellow olives in fall and winter.

**History and use.** Introduced as an ornamental from China and Japan in 1830. Frequently planted for hedgerows and on highway right-of-ways and still used for landscaping.

States with suspected infestations are shown in gray.

**Silverthorn, Thorny Olive****2037**

# Autumn Olive

SHRUBS



May



April



April



October



April



December



December

J. Gibson

***Elaeagnus umbellata* Thunb. ELUM**

**Plant.** Tardily deciduous bushy leafy shrub, 3 to 20 feet (1 to 6 m) in height, with scattered thorny branches. Leaves silvery scaly beneath, with many red berries in fall.

**Stem.** Twigs slender and silver scaly, spur twigs common, with some lateral twigs becoming pointed like thorns. Branches and main stems glossy olive drab with scattered thorns and many whitish dots (lenticels), becoming light gray to gray brown with age and eventually fissuring to expose light-brown inner bark.

**Leaves.** Alternate, elliptic 2 to 3 inches (5 to 8 cm) long and 0.8 to 1.2 inches (2 to 3 cm) wide. Margins entire and wavy. Bright green to gray green above with silver scaly midvein and densely silver scaly beneath. Petioles short and silvery.

**Flowers.** February to June. Axillary clusters, each with 5 to 10 tubular flowers with 4 lobes. Silvery white to yellow. Fragrant.

**Fruit and seeds.** August to November. Round, juicy drupe 0.3 to 0.4 inch (7 to 10 mm) containing one nutlet. Red and finely dotted with silvery to silvery-brown scales.

**Ecology.** Prefers drier sites. Shade tolerant. Spreads by animal-dispersed seeds and found as scattered plants in forest openings and open forests, eventually forming dense stands. A nonleguminous nitrogen fixer.

**Resembles** silverthorn or thorny olive, *E. pungens* Thunb., and Russian olive, *E. angustifolia* L. Silverthorn is an evergreen that has brown scaly and hairy twigs, flowers in late fall, and few reddish-silver scaly drupes in spring. Russian olive has silver scaly twigs and leaves, flowers in early summer, and many yellow olives in fall and winter. **Also resembles** minniebush, *Menziesia pilosa* (Michx. ex Lam.) Juss. ex Pers., a Southern Appalachian native at high elevations, which is distinguished by glands, not scales, on the midvein and leaves with finely serrate margins.

**History and use.** Introduced from China and Japan in 1830. Widely planted for wildlife habitat, strip mine reclamation, and shelterbelts.

States with suspected  
infestations are  
shown in gray.

**Autumn Olive****2038**

October

# Winged Burning Bush

SHRUBS



***Euonymus alatus* (Thunb.) Sieb. EUAL8**

Synonyms: wahoo, winged euonymus, burning bush

**Plant.** Deciduous, wing-stemmed, bushy shrub to 12 feet (4 m) in height, multiple stemmed and much branched. Canopy broad and leafy. Small and obovate leaves green and turning bright scarlet to purplish red in fall. Paired purple fruit in fall.

**Stem.** Four corky wings or ridges appearing along young lime-green squarish twigs and becoming wider with age. Numerous opposite branches, with bases encircled by corky rings. Larger branches and bark becoming light gray.

**Leaves.** Opposite, obovate, and thin, only 1 to 2 inches (2.5 to 5 cm) long and 0.4 to 0.8 inch (1 to 2 cm) wide. Tips tapering to an acute point. Margins finely crenate. Both surfaces smooth and hairless. Dark green with whitish midvein above and light green beneath turning bright crimson to purplish red in fall. Petioles 0.04 to 0.16 inches (1 to 4 mm) long.

**Flowers.** April to May. Axillary pairs of small flowers at the ends of a Y-shaped 1-inch (2.5-cm) stem. Flowers inconspicuous, 0.2 to 0.3 inch (6 to 8 mm) across, greenish-yellow, five-lobed, pistil elongating as fruit forms.

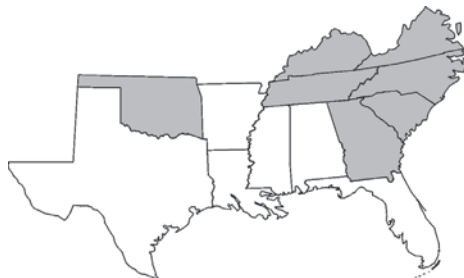
**Fruit and seeds.** August to January. Dangling paired (or single) reddish capsules in leaf axils turning purple and splitting in fall to reveal an orange fleshy-covered seed.

**Ecology.** Shade tolerant. Colonizes by root suckers and spreads by animal-dispersed seeds.

**Resembles** the larger leaved species of blueberry, *Vaccinium* spp., but their leaves are alternate. **Possibly resembles** rusty blackhaw, *Viburnum rufidulum* Raf., which also has opposite leaves, but distinguished by their larger size and leathery texture. Dormant twigs **may resemble** winged elm, *Ulmus alata* Michx., and sweetgum, *Liquidambar styraciflua* L., which are usually two-winged instead of four-winged.

**History and use.** Introduced from northeast Asia in the 1860s. Widely planted as an ornamental and for highway beautification.

States with suspected infestations are shown in gray.

**Winged Burning Bush****2042**

# Chinese/European Privet

SHRUBS



T. Bodner



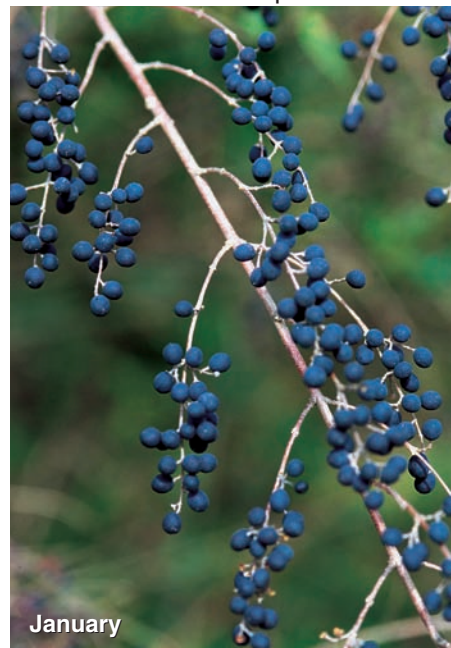
T. Bodner



Chinese privet shown in all images



T. Bodner



***Ligustrum sinense* Lour./*L. vulgare* L. LISI/LIVU**

**Plant.** Semievergreen to evergreen, thicket-forming shrubs to 30 feet (9 m) in height that are multiple stemmed and leaning-to-arching with long leafy branches. Essentially indistinguishable except at flowering. Chinese privet is the most widely occurring.

**Stem.** Opposite or whorled, long slender branching that increases upward with twigs projecting outward at near right angles. Brownish gray turning gray green and short hairy (rusty or grayish) with light dots (lenticels). Leaf scars semicircular with one bundle scar. Bark brownish gray to gray and slightly rough (not fissured).

**Leaves.** Opposite in two rows at near right angle to stem, thin, ovate to elliptic with rounded tip (often minutely indented), 0.8 to 1.6 inches (2 to 4 cm) long and 0.4 to 1.2 inches (1 to 3 cm) wide. Margins entire. Lustrous green above and pale green with hairy midvein beneath (European privet not hairy beneath). Petioles 0.04 to 0.2 inch (1 to 5 mm) long, rusty hairy. Leaves usually persistent during winter.

**Flowers.** April to June. Abundant, terminal and upper axillary clusters on short branches forming panicles of white flowers. Corolla four-lobed, tube 0.06 to 0.1 inch (1.5 to 2 mm) long and equal or shorter than the lobes, with stamens extending from the corolla on Chinese privet and within the corolla on European privet. Fragrant.

**Fruit and seeds.** July to March. Dense ovoid drupes hanging or projecting outward, 0.2 to 0.3 inch (6 to 8 mm) long and 0.16 inch (4 mm) wide, containing one to four seeds. Pale green in summer ripening to dark purple and appearing almost black in late fall to winter.

**Ecology.** Aggressive and troublesome invasives, often forming dense thickets, particularly in bottom-land forests and along fencerows, thus gaining access to forests, fields, and right-of-ways. Shade tolerant. Colonize by root sprouts and spread widely by abundant bird- and other animal-dispersed seeds.

**Resemble** Japanese privet, *L. japonicum* Thunb., which has larger leaves and is further described in this book. **Also resemble** upland swampprivet, *Forestiera ligustrina* (Michx.) Poir., which occurs mainly on rocky sites and has short twigs and sparse flowers and fruit.

**History and use.** Introduced from China and Europe in the early to mid-1800s. Traditional southern ornamentals. Deer browse Chinese privet sprouts.

States with suspected infestations are shown in gray.

**Chinese/European Privet****2103**

# Japanese / Glossy Privet

SHRUBS



T. Bodner

***Ligustrum japonicum* Thunb./*L. lucidum* Ait. f. LIJA/LILU2**

**Plant.** Evergreen to 20 feet (6 m) in height for Japanese privet and 35 feet (10 m) in height for glossy privet, with spreading crowns, thick opposite leaves, conical clusters of white flowers in spring, and green to purple-black fruit in summer and winter.

**Stem.** Twigs hairless and pale green becoming brownish to reddish tinged. Branches opposite and brownish gray with many raised corky dots (lenticels). Bark light gray and smooth except for scattered horizontal, discontinuous ridges.

**Leaves.** Opposite, leathery, ovate to oblong, bases rounded and tips blunt or tapering often with a tiny sharp tip. Two to four inches (5 to 10 cm) long and 1 to 2 inches (2.5 to 5 cm) wide. Margins entire and often yellowish rimmed and turned upward with glossy privet and slightly rolled under with Japanese privet. Upper blades lustrous dark green with 6 to 8 pairs of light-green veins with glossy privet and 4 to 6 pairs of indistinct veins with Japanese privet that protrude slightly from light green lower surfaces. Petioles 0.4 to 0.8 inch (1 to 2 cm) long for glossy privet and 0.2 to 0.4 inch (6 to 12 mm) long for Japanese privet, light green and glossy privet sometimes reddish tinged.

**Flowers.** April to June. Loosely branching, terminal- and upper-axillary, conical clusters of many small white four-petaled flowers. Fragrant.

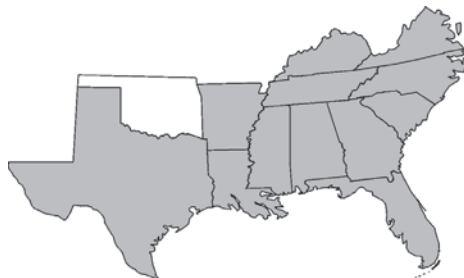
**Fruit and seeds.** July to February. Conical-shaped, branched terminal clusters of ovoid drupes, each 0.2 to 0.5 inch (5 to 12 mm) long and 0.2 inch (5 mm) wide. Pale green in summer ripening to blue black in winter.

**Ecology.** Single plants or thicket-forming, occurring in the same habitats as Chinese privet, but generally not as abundant, depending upon location. Invade both lowland and upland habitats, but usually more prevalent in lowlands. Shade tolerant. Colonize by root sprouts and spread by abundant bird- and other animal-dispersed seeds.

**Resembles** Chinese privet, *L. sinense* Lour., which has smaller and thinner leaves, is further described in this book. **Also resembles** redbtip, also named photinia, *Photinia x fraseri* Dress, an ornamental shrub that has similar but alternate leaves.

**History and use.** Introduced from Japan and Korea in 1845 and 1794, respectively. Widely planted as ornamentals and escaped.

States with suspected infestations are shown in gray.

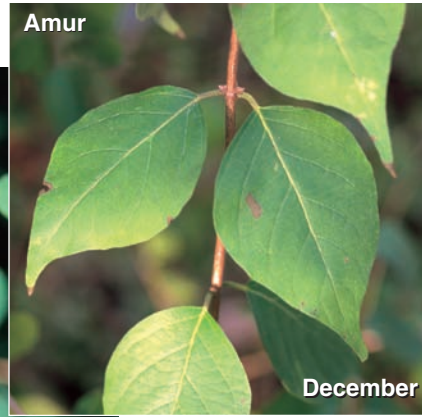
**Japanese / Glossy Privet****2104**

Glossy privet

June

# Bush Honeysuckles

SHRUBS



**Amur honeysuckle, *Lonicera maackii*** (Rupr.) Herder **LOMA6**  
**Morrow's honeysuckle, *L. morrowii*** Gray **LOMO2**  
**Tatarian honeysuckle, *L. tatarica*** L. **LOTA**  
**Sweet-breath-of-spring, *L. fragrantissima*** Lindl. & Paxton **LOFR**  
**Bell's honeysuckle, *L. xbella*** Zabel **LOBE**  
 (hybrid Morrows and Tatarian)

**Plant.** Tardily deciduous, upright, arching-branched shrubs to small trees. Amur to 30 feet (9 m) in height and spindly in forests, Morrow's to 6.5 feet (2 m) in height, Tatarian and sweet-breath-of-spring to 10 feet (3 m) in height, and Bell's to 20 feet (6 m) in height. Much branched and arching in openings, multiple stemmed, dark-green opposite leaves, showy white to pink or yellow flowers, and abundant orange to red berries.

**Stem.** Opposite branched, light tan with braided-strand appearance. Bark often flaking. Older branches hollow.

**Leaves.** Opposite in two rows, ovate to oblong with rounded to subcordate bases, 1.2 to 4 inches (3 to 10 cm) long. Persistent into winter. Margins entire. Amur tapering to a long slender tip; Bell's to a medium tapering tip; and others with short pointed tips. Morrow's with wrinkled upper surface and both Amur and Bell's soft-hairy lower surface, others with hairless leaves. Petioles 0.1 to 0.4 inch (2.5 to 10 mm) long.

**Flowers.** February to June. Axillary, bracted short-stemmed clusters, each with one to several white to yellow (some pink to red) flowers. Petals tubular flaring to five lobes in two lips (upper lip four-lobed, lower lip single-lobed). Five extended stamen. Fragrant.

**Fruit and seeds.** June to February. Abundant spherical, glossy berries paired in leaf axils, each 0.2 to 0.5 inch (6 to 12 mm). Green becoming pink and ripening to red (sometimes yellow or orange). Usually persistent into winter.

**Ecology.** Often forms dense thickets in open forests, forest edges, abandoned fields, pastures, roadsides, and other open upland habitats. Relatively shade tolerant. Colonize by root sprouts and spread by abundant bird- and other animal-dispersed seeds. Seeds long-lived in the soil.

**Resemble** the woody vine, Japanese honeysuckle, *L. japonica* Thunb, as far as leaves and flowers. Also resemble the native shrub American fly honeysuckle, *L. canadensis* Bartr. ex Marsh., which has hairy margined leaves, blue fruit, and found at high elevations in mountains. Also resemble the native bush honeysuckles, *Diervilla* spp., which have similar leaves but terminal flowers in cymes and capsules for fruit.

**History and use.** All introduced from Asia in the 1700s and 1800s. Mistakenly used as ornamentals and wildlife plants.

States with suspected  
infestations are  
shown in gray.



## Bush Honeysuckles

2105



Amur honeysuckle

November

# Sacred Bamboo, Nandina

SHRUBS



F. Naiton



***Nandina domestica*** Thunb. **NADO**

**Plant.** Evergreen erect shrub to 8 feet (2.5 m) in height, with multiple bushy stems that resemble bamboo, glossy bipinnately compound green (or reddish) leaves, white to pinkish flowers in terminal clusters, and bright red berries in fall and winter.

**Stem.** Large compound leaves resembling leafy branches, woody leafstalk bases persisting as stubby branches, and overlapping sheaths encasing the main stem. Stubby branches whorled alternately up the stem and tightly stacked near terminals for a given year's growth. The overlapping sheaths on the main stem give the appearance of bamboo, thus, the common name. Stem fleshy and greenish gray near terminal, becoming woody barked and tan to brown with fissures towards the base. Wood bright yellow.

**Leaves.** Alternately whorled, bipinnately compound on 1.5 to 3 feet (0.5 to 1 m) slender leafstalks, often reddish tinged with joints distinctly segmented. Leafstalk bases clasping stems with a V-notch on the opposite side of attachment. Nine to eighty-one nearly sessile leaflets, lanceolate to diamond-shaped, 0.5 to 4 inches (1.2 to 10 cm) long and 0.4 to 1.2 inches (1 to 3 cm) wide. Glossy light green to dark green sometimes red tinged or burgundy.

**Flowers.** May to July. Terminal (or axillary) panicles of several hundred flowers, 4 to 10 inches (10 to 25 cm) long. Pink in bud, opening to three (two to four) lanceolate deciduous petals, white to cream, with yellow anthers 0.2 to 0.3 inch (6 to 8 mm) long. Fragrant.

**Fruit and seeds.** September to April. Dense terminal and axillary clusters of fleshy, spherical berries 0.2 to 0.3 inch (6 to 8 mm). Light green ripening to bright red. Two hemispherical seeds.

**Ecology.** Occurs under forest canopies and near forest edges. Shade tolerant. Seedlings frequent in vicinity of old plantings. Varying leaf colors in the various cultivars, some of which do not produce viable seeds. Colonizes by root sprouts and spreads by animal-dispersed seeds.

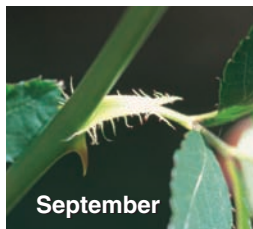
**History and use.** Introduced from eastern Asia and India in the early 1800s. Widely planted as an ornamental, now escaped and spreading from around old homes and recent landscape plantings. Sterile seeded reddish cultivars available.

States with suspected infestations are shown in gray.

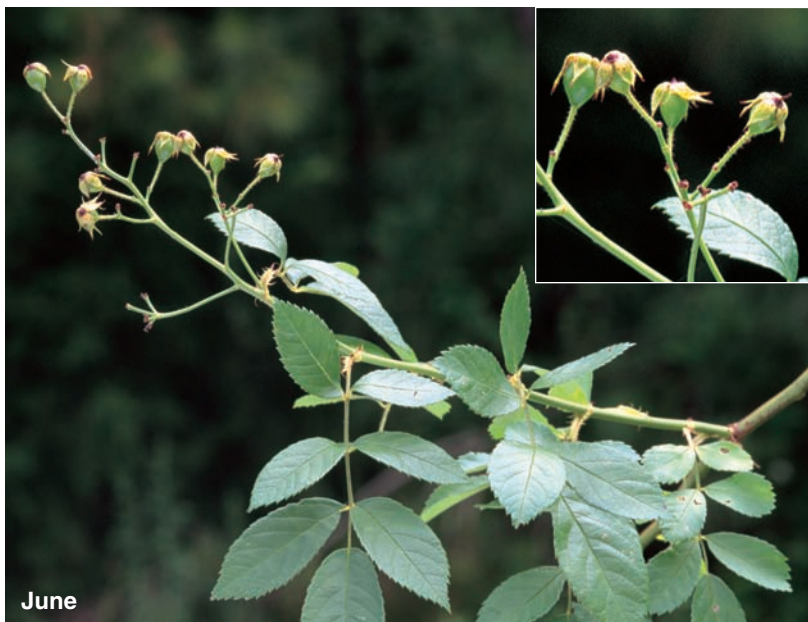
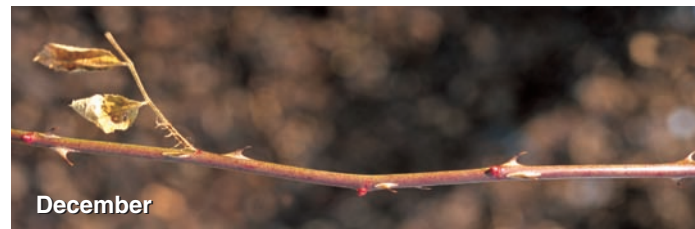
**Sacred Bamboo, *Nandina*****2113**

# Nonnative Roses

SHRUBS



Multiflora rose shown in all images



T. Bodner

**Multiflora rose, *Rosa multiflora*** Thunb. ex Murr. **ROMU**  
**Macartney rose, *R. bracteata*** J.C. Wendl. **ROBR**  
**Cherokee rose, *R. laevigata*** Michx. **ROLA**

**Plant.** Evergreen except multiflora. Erect climbing, arching, or trailing shrubs to 10 feet (3 m) in height or length. Clump forming. Pinnately compound leaves, frequent recurved and straight thorns, clustered or single white flowers in early summer, and red rose hips in fall to winter.

**Stem.** Long arching or climbing by clinging using recurved or straight thorns. Green with leaf and branch scars linear and spaced like nodes. Flower buds of multiflora often red in winter. Bark dark brown with streaks of light brown or green.

**Leaves.** Alternate, odd-pinnately compound with three to nine elliptic to lanceolate leaflets, each 1 to 3 inches (2.5 to 8 cm) long. Margins finely and sharply serrate. Leafstalk bases clasping, channeled, and often bristled on margins with toothed hairs.

**Flowers.** April to June. Terminal or axillary branched clusters or single flowers. Five white petals. Many yellow anthers in center.

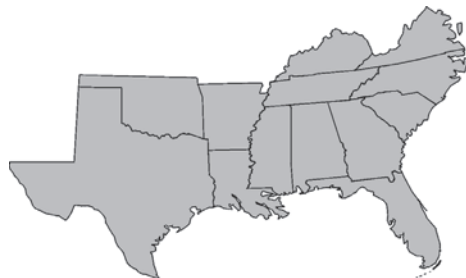
**Fruit and seeds.** July to December. Rose hip, spherical, and fleshy, 0.25 to 0.4 inch (0.6 to 1 cm). Green to yellow and ripening to glossy red.

**Ecology.** Form small-to-large infestations often climbing up into trees. Multiflora widely planted and often spreading along right-of-ways and invading new forests and forest margins. Colonize by prolific sprouting and stems that root, and spread by animal-dispersed seeds.

**Resemble** native Carolina rose, *R. carolina* L., swamp rose, *R. palustris* Marsh., and climbing rose, *R. setigera* Michx., all of which have pink flowers in spring and nonbristled leafstalk bases, but none forming extensive infestations except swamp rose in wet habitat.

**History and use.** Introduced from Asia. Traditionally planted as ornamentals, livestock containment, and wildlife habitat. Multiflora widely planted for “living fences” or screening.

States with suspected  
infestations are  
shown in gray.



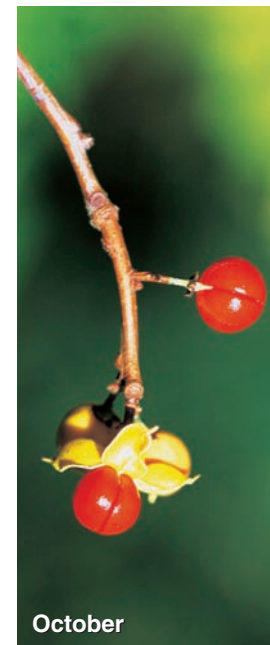
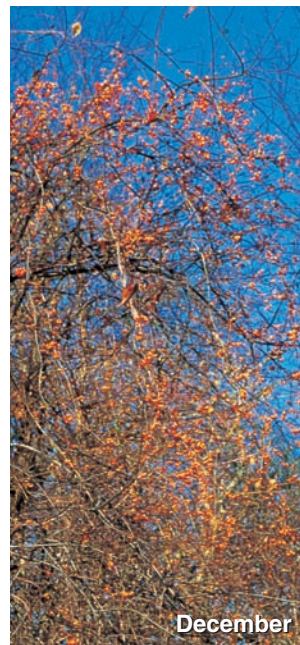
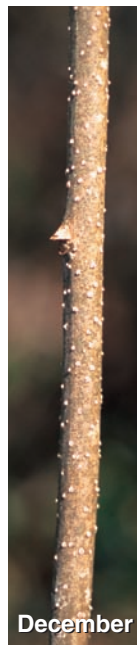
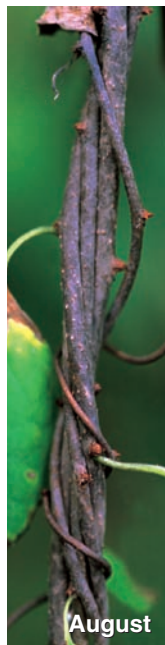
## Nonnative Roses

2160



# Oriental Bittersweet

VINES



***Celastrus orbiculatus* Thunb. CEOR7**

Synonym: Asian bittersweet

**Plant.** Deciduous, twining and climbing woody vine to 60 feet (20 m) in tree crowns, forming thicket and arbor infestations. Elliptic to rounded leaves, axillary dangling clusters of inconspicuous yellowish flowers in spring, and green spherical fruit that split to reveal three-parted showy scarlet berries in winter.

**Stem.** Woody vine to 4 inches (10 cm) diameter, twining and arbor forming, with many alternate drooping branches growing at angles and eventually becoming straight. Olive drab with many raised whitish corky dots (lenticels) becoming tan to gray. Branch scars of fruit clusters semicircular, each with a tiny corky shelf projection.

**Leaves.** Alternate, 1.2 to 5 inches (3 to 12 cm) long. Variable shaped, long tapering tipped when young becoming larger and round tipped when mature. Margins finely blunt toothed. Dark green becoming bright yellow in late summer to fall. Base tapering into 0.4- to 1.2-inch (1- to 3-cm) petiole.

**Flowers.** May. Numerous tiny-branched axillary clusters (cymes), each with three to seven inconspicuous orange-yellow flowers. Five petals.

**Fruit and seeds.** August to January. Dangling clusters of spherical 0.5-inch (1.2-cm) capsules, tipped with a persistent pistil. Green turning yellow orange then tan. In winter, splitting and folding upward to reveal three fleshy scarlet sections, each containing two white seeds. Persistent in winter at most leaf axils.

**Ecology.** Occurs on a wide range of sites mainly along forest edges. Found as scattered plants to extensive infestations in forest openings, margins, and roadsides as well as in meadows. Shade tolerant but densest infestations along forest edges and in openings. Colonizes by prolific vine growth and seedlings, and spreads by bird- and other animal-dispersed seeds and humans collecting decorative fruit-bearing vines.

**Resembles** American bittersweet, *C. scandens* L., which has only terminal flowers and fruit, and leaves usually twice as large but absent among the flowers and fruit. Hybridization suspected between the two species. **Also resembles** grape vines, *Vitis* spp., in winter, but can be distinguished by persistent scarlet fruit versus grapes.

**History and use.** Introduced from Asia in 1736. Very showy ornamental with berried vines that are traditionally collected as home decorations in winter, which promotes spread when discarded.

States with suspected infestations are shown in gray.

**Oriental Bittersweet****3026**

# Climbing Yams

VINES



F. Nation



F. Nation



F. Nation



**Air yam, *Dioscorea bulbifera* L. DIBU**

**Chinese yam, Cinnamon vine, *D. oppositifolia* L., formerly *D. batatas* Dcne. DIOP**

**Water yam, *D. alata* L. DIAL2**

Synonym: air potato

**Plant.** Herbaceous, high climbing vines to 65 feet (20 m) long, infestations covering shrubs and trees. Twining and sprawling stems with long-petioled heart-shaped leaves. Spreading by dangling potato-like tubers (bulbils) at leaf axils and underground tubers. Monocots.

**Stem.** Twining and covering vegetation, branching, hairless. Internode cross sections round for air yam to angled for Chinese and water yams. Water yam nodes winged and reddish. All stems dying back in winter leaving some small bulbils attached.

**Leaves.** Alternate (air) or combination alternate and opposite (Chinese and water). Heart-shaped to triangular with elongated tips, thin and hairless, 4 to 8 inches (10 to 20 cm) long and 2 to 6 inches (5 to 15 cm) wide. Long petioled. Basal lobes broadly rounded (air) or often angled (Chinese and water). Margins smooth. Veins parallel and converging at base. Dark green with slightly indented curved veins above (quilted appearing) and lighter green beneath. Chinese yam leaves turning bright yellow in fall.

**Flowers.** May to August. Rare, small, male and female flowers in panicles or spikes on separate plants, to 4.5 inches (11 cm) long in axils. Green to white. Fragrant, with Chinese yam having a cinnamon fragrance (thus the common name cinnamon vine).

**Fruit and seeds.** June to September (and year-round). Aerial tubers (bulbils) resembling miniature potatoes being the most notable fruit with 1 to 4 occurring at leaf axils that drop and sprout to form new plants. Shape spherical (air and Chinese) to oblong (water). Texture smooth (air) to warty (Chinese) to rough (water). Air yam to 5 inches (12 cm) long, Chinese yam to 1 inch (2.5 cm) long, and water yam to 1.2 inches (3 cm) long and 4 inches (10 cm) wide. Very rarely have capsules and winged seeds, which have questionable viability.

**Ecology.** Rapid growing and occurring on open to semishady sites: water yams in Florida, air yams extending from Florida to adjacent States, and Chinese yams in all States except Florida. All dying back during winter but able to cover small trees in a year, with old vines providing trellises for regrowth. Spread and persist by underground tubers and abundant production of aerial yams, which drop and form new plants and can spread by water.

**Resemble** greenbrier, *Smilax* spp., which has thorns and green-to-purple berries but no aerial potatoes. **Also resemble** several native *Dioscorea* species that do not form dense vine infestations nor have aerial tubers (bulbils): fourleaf yam, *D. quaternata* J.F. Gmel.; wild yam, *D. villosa* L., with hairy upper leaf surfaces; native Florida yam, *D. floridana* Bartlett; and, only in Florida, non-native Zanzibar yam, *D. sansibarensis* Pax.

**History and use.** Introduced from Africa (air) and Asia (Chinese and water) as possible food sources in the 1800s. Ornamentals often spread by unsuspecting gardeners intrigued by the dangling yams. Presently cultivated for medicinal use.

States with suspected infestations are shown in gray.



## Climbing Yams

3030



Air Yam

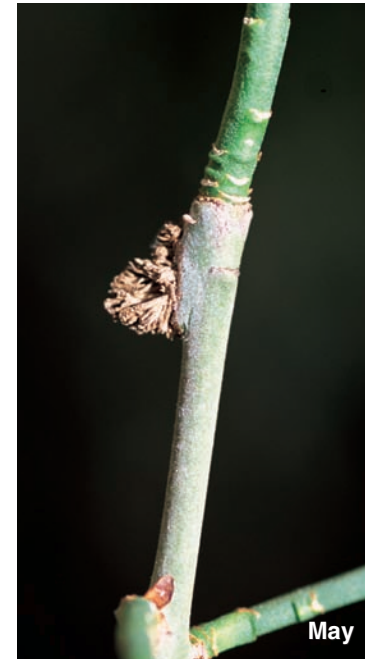
September

F. Naiton

# Winter Creeper



K. Langdon



***Euonymus fortunei* (Tursz.) Hand.-Maz. EUFO5**

Synonyms: climbing euonymus, gaity

**Plant.** Evergreen woody vine climbing to 40 to 70 feet (12 to 22 m) and clinging by aerial roots or rooting at nodes, or standing as a shrub to 3 feet (1 m) in height. Leaves thick and dark green or green-white variegated on green stems. Pinkish-to-red capsules splitting open in fall to expose fleshy orange seeds.

**Stem.** Twigs stout, lime green, and hairless becoming increasingly dusted and streaked with light-gray reddish corky bark. Patches or lines of protruding aerial roots underneath or along surfaces used for attachment. Branches opposite, leaf scars thin upturned white crescents, and branch scars jutting and containing a light semicircle. Older stems covered with gray corky bark becoming fissured and then checked.

**Leaves.** Opposite broadly oval, moderately thick, with bases tapering to petiole. One to 2.5 inches (2.5 to 6 cm) long and 1 to 1.8 inches (2.5 to 4.5 cm) wide. Margins finely crenate, somewhat turned under, to wavy. Blades smooth glossy, hairless, dark green with whitish mid- and lateral veins (or variegated green white above and light green beneath). Petioles 0.15 to 0.4 inch (0.4 to 1 cm) long.

**Flowers.** May to July. Axillary clusters of small greenish-yellow inconspicuous flowers at the ends of Y-shaped stems, each flower 0.1 inch (2 to 3 mm) wide. Five petals. Pistils soon elongating with fruit.

**Fruit and seeds.** September to November. Dangling paired or single pinkish-to-red capsules, 0.2 to 0.4 inch (5 to 10 mm) long, splitting to reveal a fleshy orange-to-red covered seed.

**Ecology.** Forms dense ground cover and can climb trees eventually overtopping them. Shade tolerant occurring under dense stands but avoiding wet areas. Colonizes by trailing and climbing vines that root at nodes, and spreads by bird-, other animal-, and water-dispersed seeds.

**Resembles** the larger leaved species of blueberry, *Vaccinium* spp., but their leaves are alternate. **Possibly resembles** the opposite- and thick-leaved rusty blackhaw, *Viburnum rufidulum* Raf., which is distinguished by dark buds in each axil.

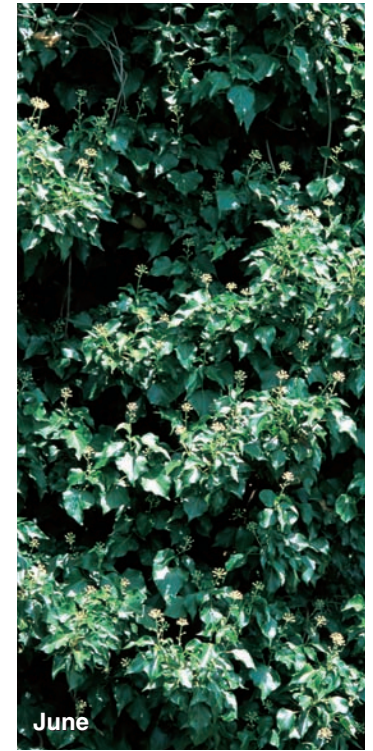
**History and use.** Introduced from Asia in 1907. Ornamental ground cover.

States with suspected  
infestations are  
shown in gray.

**Winter Creeper****3042**

# English Ivy

VINES



***Hedera helix* L. HEHE**

**Plant.** Evergreen woody vine climbing to 90 feet (28 m) by clinging aerial roots and trailing to form dense ground cover. Thick dark-green leaves with whitish veins and three to five pointed lobes when juvenile. Maturing at about 10 years into erect plants or branches with unlobed leaves and terminal flower clusters that yield purplish berries. Toxic to humans when eaten and triggering dermatitis in sensitive individuals.

**Stem.** Woody slender vines when a ground cover and growing to 10 inches (25 cm) in diameter when climbing infested trees and rocks by many fine to stout aerial rootlets. Vines pale green (sometimes reddish tinged), rooting at nodes, becoming covered with gray-brown shiny bark, segmented by encircling and raised leaf scars, and roughened by tiny ridges. Bark light gray to brown, bumpy and gnarly, with aerial rootlets developing along the side where clinging to vertical structures. Aerial rootlets exuding a glue-like substance. Older vines sometimes grown together where crossed.

**Leaves.** Alternate, with shapes varying according to age—typical juvenile plants having three to five pointed lobes and mature plants broadly lanceolate and unlobed, 2 to 4 inches (5 to 10 cm) long and 2.5 to 5 inches (6 to 12 cm) wide. Thick and waxy, smooth and hairless, dark green with whitish veins radiating from the petiole and pale green beneath. Petioles to 6 inches (15 cm) long, pale green and often reddish tinged.

**Flowers.** June to October. Terminal hairy-stemmed umbel clusters of small greenish-yellow flowers on mature plants. Five thick and pointed petals, 0.1 inch (3 mm) long. Each petal radiating from a five-sided domed green floral disk, 0.1 inch (3 mm) wide, tipped by a short pistil.

**Fruit and seeds.** October to May. Clusters of spherical drupes, 0.2 to 0.3 inch (7 to 8 mm). Pale green in late summer ripening to dark blue to purplish in late winter to spring.

**Ecology.** Thrives in moist open forests, but adaptable to a range of moisture and soil conditions, including rocky cliffs. Shade tolerance allowing early growth under dense stands, but becoming adapted to higher light levels with maturity. Avoids wet areas. Amasses on infested trees, decreasing vigor, and increasing chance of windthrow. Serves as a reservoir for bacterial leaf scorch that infects oaks (*Quercus* spp.), elms (*Ulmus* spp.), and maples (*Acer* spp.). Spreads by bird-dispersed seeds and colonizes by trailing and climbing vines that root at nodes. Drupes mildly toxic, discouraging over consumption by birds.

**Resembles** grape, *Vitis* spp., which has a leaf that is similarly shaped but not thick and often hairy.

**History and use.** Introduced from Europe in colonial times. Traditional ornamental and still widely planted as an ornamental. Source of varnish resin, dye, and tanning substances.

States with suspected infestations are shown in gray.

**English Ivy****3071**

# Japanese Honeysuckle

VINES



May

T. Bodner



October

T. Bodner



November



May



September

***Lonicera japonica*** Thunb. LOJA

**Plant.** Semievergreen to evergreen woody vine, high climbing and trailing to 80 feet (24 m) long, branching and often forming arbors in forest canopies and/or ground cover under canopies and forming long woody rhizomes that sprout frequently.

**Stem.** Slender woody vine becoming stout to 2 inches (5 cm) in diameter, with cross section round and opposite branching. Brown and hairy becoming tan barked, fissured, and sloughing with age. Rooting at low nodes.

**Leaves.** Opposite, broadly ovate to elliptic to oblong, base rounded, tips blunt-pointed to round. Length 1.6 to 2.6 inches (4 to 6.5 cm) and width 0.8 to 1.5 inches (2 to 4 cm). Margins entire but often lobed in early spring. Both surfaces smooth to rough hairy, with undersurface appearing whitish.

**Flowers.** April to August. Axillary pairs, each 0.8 to 1.2 inches (2 to 3 cm) long, on a bracted stalk. White (or pink) and pale yellow. Fragrant. Thin tubular flaring into five lobes in two lips (upper lip four-lobed and lower lip single-lobed), with the longest lobes roughly equal to the tube. Five stamens and one pistil, all projecting outward and becoming curved. Persistent sepals.

**Fruit and seeds.** June to March. Nearly spherical, green ripening to black, glossy berry 0.2 inch (5 to 6 mm) on stalks 0.4 to 1.2 inches (1 to 3 cm) long. Two to three seeds.

**Ecology.** Most commonly occurring invasive plant, overwhelming and replacing native flora in all forest types over a wide range of sites. Occurs as dense infestations along forest margins and right-of-ways as well as under dense canopies and as arbors high in canopies. Shade tolerant. Persists by large woody rootstocks and spreads by rooting at vine nodes and animal-dispersed seeds.

**Resembles** yellow jessamine, *Gelsemium sempervirens* (L.) St. Hil., which has thinner leaves and hairless stems. **Also resembles** native honeysuckles, *Lonicera* spp., that usually have reddish hairless stems and hairless leaves and do not form extensive infestations.

**History and use.** Introduced from Japan in the early 1800s. Traditional ornamental, valued as deer browse, with some value for erosion control. Still planted in wildlife food plots.

States with suspected infestations are shown in gray.

**Japanese Honeysuckle****3101**

April

# Kudzu

VINES



T. Bodner

T. Bodner

T. Bodner

***Pueraria montana* (Lour.) Merr. PUMOL**

Synonyms: *P. lobata* (Willd.) Ohwi, *P. montana* var. *lobata* (Willd.) Maesen & S. Almeida

**Plant.** Deciduous twining, trailing, mat-forming, ropelike woody leguminous vine, 35 to 100 feet (10 to 30 m) long with three-leaflet leaves. Large semiwoody tuberous roots reaching depths of 3 to 16 feet (1 to 5 m). Leaves and small vines dying with first frost and matted dead leaves persistent during winter.

**Stem.** Woody vines to 10 inches (25 cm) in diameter, round in cross section, with infrequent branching. Stems yellow green with dense erect golden hairs and upward matted silver hairs, aging to ropelike, light gray, and hairless. Frequent unswollen nodes that root when on the ground. Mature bark eventually rough, rigid, and usually dark brown.

**Leaves.** Alternate, pinnately compound three-leaflet leaves, each leaflet 3 to 7 inches (8 to 18 cm) long and 2.5 to 8 inches (6 to 20 cm) wide. Usually slightly lobed (unless in shade): a two-lobed symmetric middle leaflet and two one-lobed side leaflets, all petioles swollen near leaflets. Tips pointed. Margins thin membranous and fine golden hairy. Leafstalks 6 to 12 inches (15 to 30 cm) long, long hairy, base swollen, with deciduous stipules.

**Flowers.** June to September. Axillary slender clusters (racemes), 2 to 12 inches (5 to 30 cm) long, of pealike flowers in pairs (or threes) from raised nodes spiraling up the stalk, opening from the base to top. Petals lavender to wine colored with yellow centers.

**Fruit and seeds.** September to January. Clustered dry, flattened legume pods (bulging above the seeds) each 1.2 to 3 inches (3 to 8 cm) long and 0.3 to 0.5 inch (8 to 12 mm) wide. Green ripening to tan with stiff golden-brown hairs. Splitting on one to two sides to release a few ovoid seeds.

**Ecology.** Occurs in old infestations, along right-of-ways and stream banks. Forms dense mats over the ground, debris, shrubs, and mature trees forming dense patches by twining on objects less than 4 inches (10 cm) in diameter. Colonizes by vines rooting at nodes and spreads by wind-, animal-, and water-dispersed seeds. Seed viability variable. Leguminous nitrogen fixer.

**History and use.** Introduced from Japan and China in early 1900s with continued seed importation. Erosion control, livestock feed, and folk art.

States with suspected infestations are shown in gray.

**Kudzu****3123**

# Vincas, Periwinkles

VINES



Bigleaf periwinkle

Bigleaf periwinkle



April

Bigleaf periwinkle



April



Common periwinkle  
leaves and flower

Bigleaf periwinkle  
leaves and flower

May



Summer

B. Rice

**Common periwinkle, *Vinca minor* L. VIMI2**  
**Bigleaf periwinkle, *V. major* L. VIMA**

**Plant.** Evergreen to semievergreen vines, somewhat woody, trailing or scrambling to 3 feet (1 m) long and upright to 1 foot (30 cm). Violet pinwheel-shaped flowers.

**Stem.** Slender (common periwinkle) to stout (bigleaf periwinkle), succulent becoming somewhat woody (tough to break) with flowering branches erect and jointed at axils. Hairless and smooth. Dark green at base to light green upward with a reddish tinge.

**Leaves.** Opposite. Glossy and hairless, somewhat thick, with margins slightly rolled under. Common periwinkle narrow elliptic, 0.8 to 1.8 inches (2 to 4.5 cm) long and 0.4 to 1 inch (1 to 2.5 cm) wide, with petioles 0.1 inch (1 to 3 mm) long. Bigleaf periwinkle heart-shaped to somewhat triangular to elliptic, 1.5 to 2.5 inches (4 to 6 cm) long and 1 to 1.5 inches (2.5 to 4 cm) wide, with petioles 0.2 to 0.4 inch (5 to 10 mm) long. Blades dark green with whitish lateral and midveins above and lighter green with whitish midveins beneath. Some varieties variegated.

**Flowers.** April to May (sporadically May to September). Axillary, usually solitary. Violet to blue lavender (to white), with five petals radiating pinwheel-like at right angles from the floral tube. Common periwinkle 1 inch (2.5 cm) wide with a 0.3- to 0.5-inch (8- to 12-mm) long tube. Bigleaf periwinkle 1.5 to 2 inches (4 to 5 cm) wide with a 0.6- to 0.8-inch (1.5- to 2-cm) long tube. Five sepals long lanceolate, about 0.4 inch (1 cm), hairy margined.

**Fruit and seeds.** May to July. Slender, cylindrical fruit to 2 inches (5 cm) long. Becoming dry and splitting to release three to five seeds.

**Ecology.** Found around old homesite plantings and scattered in open to dense canopied forests. Form mats and extensive infestations even under forest canopies by vines rooting at nodes, with viability of seeds yet to be reported.

**Resemble** partridgeberry, *Mitchella repens* L., which has cordate leaves, white twin flowers, and red berries. **Also, may resemble** yellow jasmine, *Gelsemium sempervirens* (L.) St. Hil., which has wider spaced leaves and reddish stems, often white waxy.

**History and use.** Introduced from Europe in 1700s. Ornamental ground cover, commonly sold and planted by gardeners.

States with suspected  
infestations are  
shown in gray.



## Vincas, Periwinkles

3211



Bigleaf periwinkle

April

# Nonnative Wisterias

VINES



May

T. Bodner



September

T. Bodner



May

Chinese wisteria shown in images



March

T. Bodner

**Chinese wisteria, *Wisteria sinensis* (Sims) DC. WISI**  
**Japanese wisteria, *W. floribunda* (Willd.) DC. WIFL**

**Plant.** Deciduous high climbing, twining, or trailing leguminous woody vines (or cultured as shrubs) to 70 feet (20 m) long. Chinese and Japanese wisteria difficult to distinguish due to possible hybridization.

**Stem.** Woody vines to 10 inches (25 cm) in diameter with infrequent alternate branching. Twigs densely short hairy. Older bark of Chinese wisteria tight and dark gray with light dots (lenticels) compared to white bark of Japanese wisteria.

**Leaves.** Alternate, odd pinnately compound 4 to 16 inches (10 to 40 cm) long, with 7 to 13 leaflets (Chinese) or 13 to 19 leaflets (Japanese), and stalks with swollen bases. Leaflets oval to elliptic with tapering pointed tips 1.6 to 3 inches (4 to 8 cm) long and 1 to 1.4 inches (2.5 to 3.5 cm) wide. Hairless to short hairy at maturity but densely silky hairy when young. Margins entire and wavy. Sessile or short petioled.

**Flowers.** March to May. Dangling and showy, stalked clusters (racemes) appearing when leaves emerge, 4 to 20 inches (10 to 50 cm) long and 3 to 3.5 inches (7 to 9 cm) wide. All blooming at about the same time (Chinese) or gradually from base (Japanese). Pealike flowers, corolla lavender to violet (to pink to white). Fragrant.

**Fruit and seeds.** July to November. Flattened legume pod, irregularly oblong to oblanceolate, 2.5 to 6 inches (6 to 15 cm) long and 0.8 to 1.2 inches (2 to 3 cm) wide. Velvety hairy, greenish brown to golden, splitting on two sides to release one to eight flat round brown seeds, each 0.5 to 1 inch (1.2 to 2.5 cm) in diameter.

**Ecology.** Form dense infestations where previously planted. Occur on wet to dry sites. Colonize by vines twining and covering shrubs and trees and by runners rooting at nodes when vines covered by leaf litter. Seeds water-dispersed along riparian areas. Large seed size a deterrent to animal dispersal.

**Resemble** native or naturalized American wisteria, *W. frutescens* (L.) Poir., which does not form extensive infestations, occurs in wet forests, flowers in June to August after leaves developed, and has 6-inch (15-cm) flower clusters, 9 to 15 leaflets, hairless pods, and slender old vines. **Also may resemble** trumpet creeper, *Campsis radicans* (L.) Seem. ex Bureau, which has leaflets with coarsely toothed margins.

**History and use.** Introduced from Asia in the early 1800s. Traditional southern porch vines.

States with suspected infestations are shown in gray.



## Nonnative Wisterias

3251



Chinese wisteria

April

# Giant Reed



***Arundo donax* L. ARDO4**

**Plant.** Giant reed grass, cornlike stems, thicket forming in distinct clumps to 20 feet (6 m) in height, with gray-green and hairless stems, long-lanceolate leaves alternately jutting from stems and drooping at the ends, and large plumelike terminal panicles. Seed infertile. Spreading from tuberous rhizomes. Dried grass remaining standing in winter and spring.

**Stem.** Somewhat succulent and fibrous, with round cross section to 1 inch (2.5 cm). Solid jointed every 1 to 8 inches (2.5 to 20 cm) and covered by overlapping leaf sheaths. Gray to yellowish green. Initially white pithed and becoming hollow between joints. Old stems sometimes persistent into the following summer.

**Leaves.** Alternate, cornlike, long lanceolate with both surfaces hairless, and clasping stem with conspicuous whitish base. Eighteen to thirty inches (45 to 76 cm) long and 1 to 4 inches (2.5 to 10 cm) wide near base. Margins and ligule membranous (about 1 mm). Midvein whitish near base becoming inconspicuous towards tip. Veins parallel. Sheaths overlapping, hairless, and semiglossy.

**Flowers.** August to September. Terminal erect dense plumes of whorled stemmed flowers to 36 inches (1 m) long. Husks hairy, membranous with several veins, and greenish to whitish to purplish.

**Seeds.** October to March. Dense terminal plume, spindle-shaped, densely hairy. Grain never appears.

**Ecology.** Occurs mainly on upland sites as scattered dense clumps along roadsides and forest margins, migrating from old home plantings by displaced rhizome fragments. Persistent infestations by dense branching tuberous rhizome growth. Probable spread by movement of stem parts in soil or by road shoulder grading. Plants believed to be sterile and not producing viable seeds.

**Resembles** golden bamboo, *Phyllostachys aurea* Carr. ex A. & C. Rivière, another large grasslike plant that is woody in character. **Closely resembles** common reed, *Phragmites australis* (Cav.) Trin. ex Steud., which has similar large hairy seed heads, but not erect and fanned in a loose plume, and which occurs mainly near swamps, marshes, and wet habitats.

**History and use.** Introduced from western Asia, northern Africa, and southern Europe in the early 1800s. Ornamental.

States with suspected infestations are shown in gray.

**Giant Reed****4008**

# Tall Fescue



April

T. Bodner



May

T. Bodner



July



May

T. Bodner



January

***Lolium arundinaceum*** (Schreb.) S.J. Darbyshire **LOAR10**

Synonyms: *Festuca arundinacea* Shreb., *F. elatior* L., meadow fescue, Kentucky 31 fescue, *Schedonorus phoenix* (Scop.) Holub

**Plant.** Erect, tufted cool-season perennial grass 2 to 4 feet (60 to 120 cm) in height, green in winter and spring, during which it is the most common green bunchgrass. Dark-green leaves appearing in late winter, usually flowering in spring (infrequently in late summer). Semidormant during heat of summer, with whitish seedstalks persisting. Growth resuming in fall and continuing into early winter.

**Stem.** Moderately stout, unbranched, hairless with round cross section and one to three swollen light-green nodes widely spaced near the base.

**Leaves.** Mostly basal and a few alternate, flat and long-lanceolate, 4 to 18 inches (10 to 45 cm) long and 0.1 to 0.3 inch (3 to 8 mm) wide. Whitish to yellow-green flared collars, with collar backs often at an angle to the stem. Blades smooth to rough, with one to two leaves along the stem becoming smaller upward. Midvein not apparent. Ligule a tiny white membrane.

**Flowers.** March to June (to October). Loosely branched terminal panicles, 4 to 12 inches (10 to 30 cm) long, that are erect or nodding at tips, narrow then spreading in spring, and then narrow again in summer. Spindle-shaped clusters along branches. Branches shorter upward, with four to seven flowers per branch. Flowers greenish white and shiny becoming purplish. Spikelets hairless, ellipsoid with a pointed tip.

**Seeds.** May (to November). Husked grain, spindle-shaped, 0.1 to 0.2 inch (3 to 5 mm) long. Whitish straw-colored husks, usually tipped with a short hair.

**Ecology.** The predominant cool-season bunchgrass. Occurs as tufted clumps or small to extensive colonies along forest margins and right-of-ways, and widely escaped to invade new forest plantations, roads, openings, and high-elevation balds. Grows on wet to dry sites. Spreads by expanding rootcrowns and less by seeds. Replaces warm season grassland communities and prairies to the detriment of unique plants and birds. Certain varieties poisonous to livestock and wildlife by infecting them with an endophytic fungus.

**Resembles** other grasses, especially other fescues and ryegrasses (*Lolium* spp.) but distinguished by forming extensive colonies and infestations, growing green in late winter, and having long rounded stems with lower swollen nodes and whitish-flared collars at the base of leaves. Ryegrasses distinguished by producing alternate seed heads on opposite sides of seedstalks in spring.

**History and use.** Introduced from Europe in the early to mid-1800s. Recognized as a valuable forage grass in 1930s when the ecotype Kentucky 31 was discovered. Now widely distributed most everywhere in the World. Established widely for turf, forage, soil stabilization, and wildlife food plots.

States with suspected infestations are shown in gray.

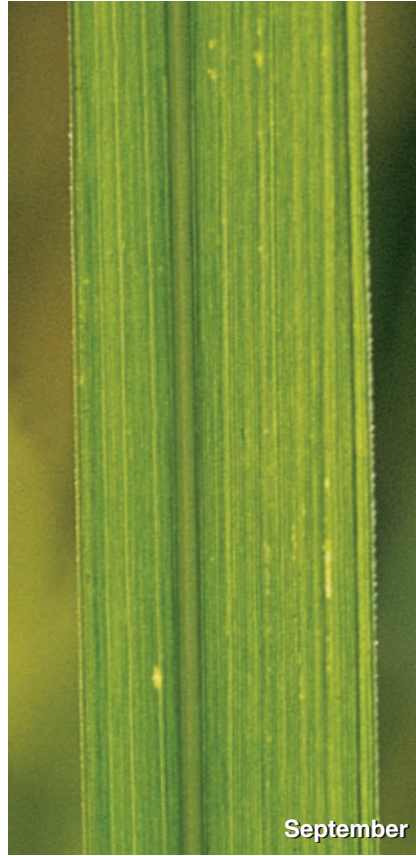
**Tall Fescue****4051**

# Cogongrass

GRASSES



September



September

T. Bodner



September

T. Bodner



January



March

C. Bryson



May



September

***Imperata cylindrica* (L.) Beauv. IMCY**

Synonyms: japgrass, bloodroot grass (red varieties), Red Barron (red varieties)

**Plant.** Aggressive, colony-forming dense perennial grass 1 to 6 feet (30 to 150 cm) in height, often leaning in mats when over 3 feet (90 cm) in height. Stemless tufts of long leaves, blades yellow green, with off-center midveins and silver-plumed flowers and seeds. Plants arising from branching sharp-tipped white-scaly rhizomes.

**Stem.** Upright to ascending, stout, not apparent, and hidden by overlapping leaf sheaths.

**Leaves.** Mainly arising from near the base, long lanceolate, 1 to 4 feet (30 to 120 cm) long and 0.5 to 1 inch (12 to 25 mm) wide, shorter upward. Overlapping sheaths, with outer sheaths often long hairy and hair tufts near the throat. Blades flat or cupped inward, bases narrowing, tips sharp and often drooping. Most often yellowish green. White midvein on upper surface slightly-to-mostly off center (varies in an area). Margins translucent and minutely serrated (rough). Ligule a fringed membrane to 0.04 inch (1.1 mm).

**Flowers.** February to May (or year-round in Florida). Terminal, silky spikelike panicle, 1 to 8 inches (2.5 to 20 cm) long and 0.2 to 1 inch (0.5 to 2.5 cm) wide, cylindrical and tightly branched on a reddish slender stalk. Spikelets paired, each 0.1 to 0.2 inch (3 to 6 mm) long, obscured by silky to silvery-white hairs to 0.07 inch (1.8 mm).

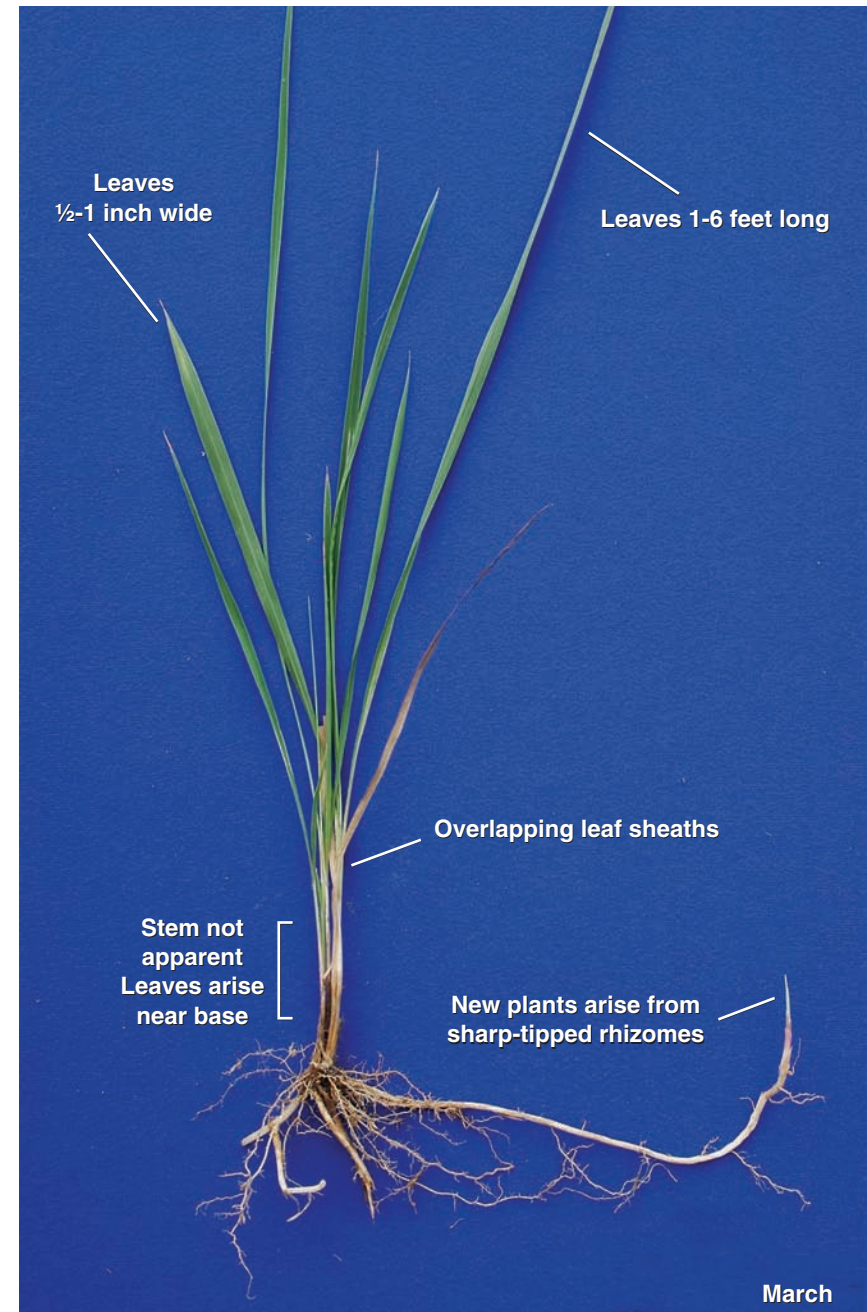
**Seeds.** May to June. Oblong brown grain, 0.04 to 0.05 inch (1 to 1.3 mm) long, released within silvery hairy husks for wind dispersal.

**Ecology.** Grows in full sunlight to partial shade, and, thus, can invade a range of sites. Often in circular infestations with rapidly growing and branching rhizomes forming a dense mat to exclude most other vegetation. Aggressively invades right-of-ways, new forest plantations, open forests, old fields, and pastures. Absent in areas with frequent tillage. Colonizes by rhizomes and spreads by wind-dispersed seeds and promoted by burning. Highly flammable and a severe fire hazard, burning extremely hot especially in winter.

**Resembles** Johnsongrass, *Sorghum halepense* (L.) Pers.; purpletop, *Tridens flavus* (L.) A.S. Hitchc.; silver plumegrass, *Saccharum alopecuroidum* (L.) Nutt.; and sugarcane plumegrass, *S. giganteum* (Walt.) Pers.—all having a stem and none having an off-center midvein.

**History and use.** Introduced from Southeast Asia into Florida and southern Louisiana, southern Alabama, and southern Georgia in the early 1900s. Initially for soil stabilization. Expectations for improved forage unrealized. A Federal listed noxious weed.

States with suspected infestations are shown in gray.

**Cogongrass****4055**

# Nepalese Browntop



T. Bodner



T. Bodner



T. Bodner



T. Bodner



T. Bodner



T. Bodner

***Microstegium vimineum*** (Trin.) A. Camus **MIVI**  
 Synonyms: Japanese stilt grass, Mary's grass, basketgrass

**Plant.** Sprawling, annual grass, 0.5 to 3 feet (15 to 90 cm) in height. Flat short leaf blades, with off-center veins. Stems branching near the base and rooting at nodes to form dense and extensive infestations. Dried whitish-tan grass remains standing in winter.

**Stem.** Ascending to reclining, slender and wiry, up to 4 feet (120 cm) long, with alternate branching. Covered by overlapping sheaths with hairless nodes and internodes. Green to purple to brown. Aerial rootlets descend from lower nodes.

**Leaves.** Alternate (none basal) projecting out from stem, lanceolate to oblanceolate, 2 to 4 inches (5 to 10 cm) long and 0.07 to 0.6 inch (2 to 15 mm) wide. Blades flat, sparsely hairy on both surfaces and along margins. Midvein whitish and off center. Throat collar hairy. Ligule membranous with a hairy margin.

**Flowers.** July to October. Terminal, thin and spikelike raceme, to 3 inches (8 cm) long. Unbranched or with one to three lateral branches on an elongated wiry stem. Other thin racemes of self-pollinating flowers enclosed or slightly extending from lower leaf sheaths. Spikelets paired, with the outer stemmed and inner sessile.

**Seeds.** July to December. Husked grain, seed head thin, grain ellipsoid, 0.1 inch (2.8 to 3 mm) long, with seedstalks partially remaining during winter.

**Ecology.** Flourishes on alluvial floodplains and streamsides, mostly colonizing flood-scoured banks, due to water dispersal of seed and flood tolerance. Also common at forest edges, roadsides, and trailsides, as well as damp fields, swamps, lawns, and along ditches. Occurs up to 4,000 feet (1200 m) elevation. Very shade tolerant. Consolidates occupation by prolific seeding, with each plant producing 100 to 1,000 seeds that can remain viable in the soil for 3 years. Spreads on trails and recreational areas by seeds hitchhiking on hikers' and visitors' shoes and clothes.

**Resembles** crabgrass, *Digitaria* spp., and nimblewill, *Muhlenbergia schreberi* J.F. Gmel., both having broad short leaves, but distinguished from Nepalese browntop by branching seed heads and stout stems. **Also resembles** whitegrass, *Leersia virginica* Willd., which is a perennial with flat, compressed seed heads.

**History and use.** Native to temperate and tropical Asia, and first identified near Knoxville, TN, around 1919. Ground cover with little wildlife food value.

States with suspected infestations are shown in gray.



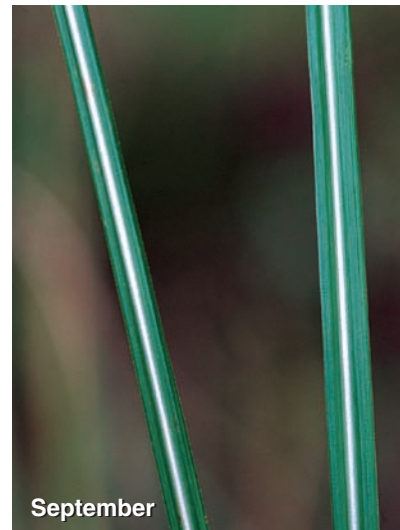
## Nepalese Browntop

4080



September

# Chinese Silvergrass



GRASSES

***Miscanthus sinensis*** Anderss. **MISI**

**Plant.** Tall, densely bunched, perennial grass, 5 to 10 feet (1.5 to 3 m) in height. Long-slender upright-to-arching leaves with whitish upper midveins. Many loosely plumed panicles in late summer turning silvery to pinkish in fall. Dried grass standing with some seed heads during winter, but seed viability spotty.

**Stem.** Upright-to-arching, originating in tufts from base and unbranched. Covered with overlapping leaf sheaths until stem appears with flower plume in late summer.

**Leaves.** Alternate, long linear, upright-to-arching (persisting and curly tipped when dried) to 40 inches (1 m) long and less than 0.8 inch (2 cm) wide. Blades green to variegated (light green striped) with whitish collars. Midvein white above and green ridged beneath. Tufted hairs at throat, sheath margins, and ligule, but otherwise hairless. Margins rough.

**Flowers.** August to November. Much branched and drooping terminal plumed panicles, 4 to 15 inches (10 to 38 cm) long and 2 to 8 inches (5 to 20 cm) wide. Silvery to pinkish, showiest in fall. Stalk appressed rough hairy.

**Seeds.** September to January. Grain hidden, husks membranous, yellowish brown to slightly reddish, sparsely hairy, with twisted tip.

**Ecology.** Forms extensive infestations by escaping from older ornamental plantings to roadsides, forest margins, and adjacent disturbed sites, especially after burning. Shade tolerant. Highly flammable and a fire hazard.

**History and use.** Introduced from eastern Asia. Still widely sold and increasingly planted as an ornamental. Several varieties imported and sold. Cultivars vary widely in fertility and percent of seed viability.

States with suspected infestations are shown in gray.

**Chinese Silvergrass****4085**

November

# Bamboos



Golden bamboo shown in all images

GRASSES

**Golden bamboo, *Phyllostachys aurea* Carr. ex A. & C. Rivière PHAU8 and other invasive bamboos, *Phyllostachys* spp. and *Bambusa* spp.**

**Plant.** Perennial infestation-forming bamboos, 16 to 40 feet (5 to 12 m) in height, with jointed cane stems and bushy tops of lanceolate leaves in fan clusters on grass-like stems, often golden green. Plants arising from branched rhizomes.

**Stem.** Solid jointed canes 1 to 6 inches (2.5 to 15 cm) in diameter. Hollow between joints. Golden to green to black. Branches wiry and grasslike from joints. Lower shoots and branches with loose papery sheaths that cover the ground when shed.

**Leaves.** Alternate, grasslike, often in fan clusters. Blades long and lanceolate, 3 to 10 inches (8 to 25 cm) long and 0.5 to 1.5 inches (1.3 to 4 cm) wide. Veins parallel. Often golden, sometimes green or variegated. Hairless except for large hairs at base of petiole, which shed with age. Sheaths encasing stem.

**Flowers.** Flowers very rarely.

**Seeds.** Seeds very rarely.

**Ecology.** Common around old homesites and now escaped. Colonize by rhizomes with infestations rapidly expanding after disturbance. General dieback periodically after flowering and seeding (about every 7 to 12 years) resulting in standing dead canes and new shoots.

**Resemble** switchcane, *Arundinaria gigantea* (Walt.) Muhl., the only native bamboo-like cane in the South, distinguished by its lower height—usually only 6 to 8 feet (2 to 2.5 m)—and its persistent sheaths on the stem and absence of long opposite branches.

**Also resemble** giant reed, *Arundo donax* L., also described in this book.

**History and use.** All native to Asia. Widely planted as ornamentals and for fishing poles.

States with suspected infestations are shown in gray.



## Bamboos

4130



Golden bamboo

July

# Japanese Climbing Fern



September

T. Bodner



September



January



July

FERNS

***Lygodium japonicum*** (Thunb. ex Murr.) Sw. LYJA

**Plant.** Perennial viney fern, climbing and twining, to 90 feet (30 m) long, with lacy finely divided leaflets along green to orange to black wiry vines, often forming mats of shrub- and tree-covering infestations. Tan-brown fronds persisting in winter, while others remain green in Florida and in sheltered places further north. Vines arising as branches (long compound leaves) from underground, widely creeping rhizomes that are slender, black, and wiry.

**Stem.** Slender but difficult to break, twining and climbing, wiry. Green to straw-colored or reddish. Mostly deciduous in late winter.

**Leaves (fronds).** Opposite on vine, compound once- or twice-divided, varying in appearance according to the number of divisions, generally triangular in outline. Three to 6 inches (8 to 15 cm) long and 2 to 3 inches (5 to 8 cm) wide. Highly dissected leaflets, appearing lacy. Light green turning dark to tan brown in winter.

**Flowers.** Fertile fronds usually smaller segments with fingerlike projections around the margins, bearing sporangia (spore producing dots) in double rows under margins.

**Seeds.** Tiny, wind-dispersed spores.

**Ecology.** Occurs along highway right-of-ways, especially under and around bridges, invading into open forests, forest road edges, and stream and swamp margins. Scattered in open timber stands and plantations, but can increase in cover to form mats, smothering shrubs and trees. Persists and colonizes by rhizomes and spreads rapidly by wind-dispersed spores. Dies back in late winter in the more northern areas, with dead vines providing a trellis for reestablishment.

**Resembles** Old World climbing fern, *L. microphyllum* (Cav.) R. Br., and American climbing fern, *L. palmatum* (Bernh.) Sw., both of which are distinguished by five to seven palmately lobed, finger-like fronds. American climbing fern—a native occurring in swamps, stream beds, and ravines—does not spread beyond small areas to form extensive infestations. Old World climbing fern, also introduced, is a major invasive pest in southern Florida.

**History and use.** Native to Asia and tropical Australia and introduced from Japan in 1930s. An ornamental still being spread by unsuspecting gardeners.

States with suspected infestations are shown in gray.

**Japanese Climbing Fern****5171**

# Garlic Mustard



May

S. Ross



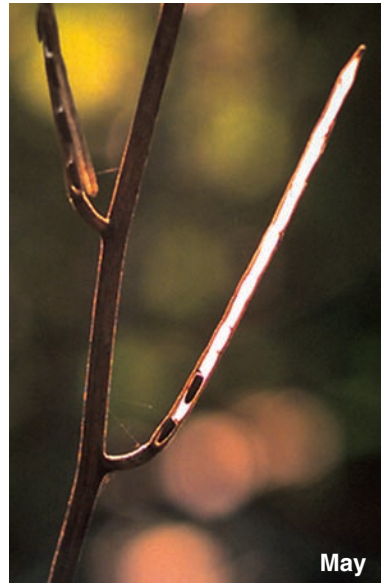
May

J. Meade



May

J. Shimp



May

H. Wilson



May

J. Shimp

**Alliaria petiolata** (Bieb.) Cavara & Grande **ALPE4**

**Plant.** Cool-season biennial forb with a slender taproot found in small to extensive colonies. Basal rosettes of leaves in the first year remaining green during winter and producing one to several 2- to 4-foot (60- to 120-cm) tall flower stalks in the second year, and then dying after seed formation in midsummer. Dead plants remain standing after June as long slender seedstalks with many upturned thin seed capsules and a characteristic crook at the stalk base. A faint to strong garlic odor emitted from all parts of the plant when crushed, becoming milder as fall approaches.

**Stem.** Erect, slightly ridged, light green, hairless above and hairy below. One to several stems from the same rootstock.

**Leaves.** Early basal rosette of kidney-shaped leaves and later alternate heart-shaped to triangular leaves, 1.2 to 3.6 inches (3 to 9 cm) long and 1 to 4 inches (2.5 to 10 cm) wide. Margins shallow to coarsely wavy toothed. Tips elongated on stem leaves. Petioles 0.4 to 3 inches (1 to 8 cm) long and reduced upward.

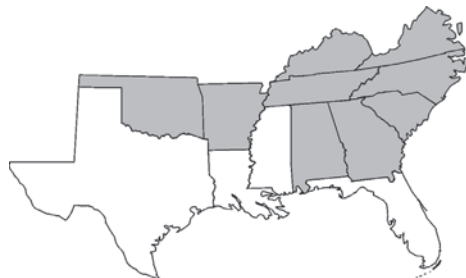
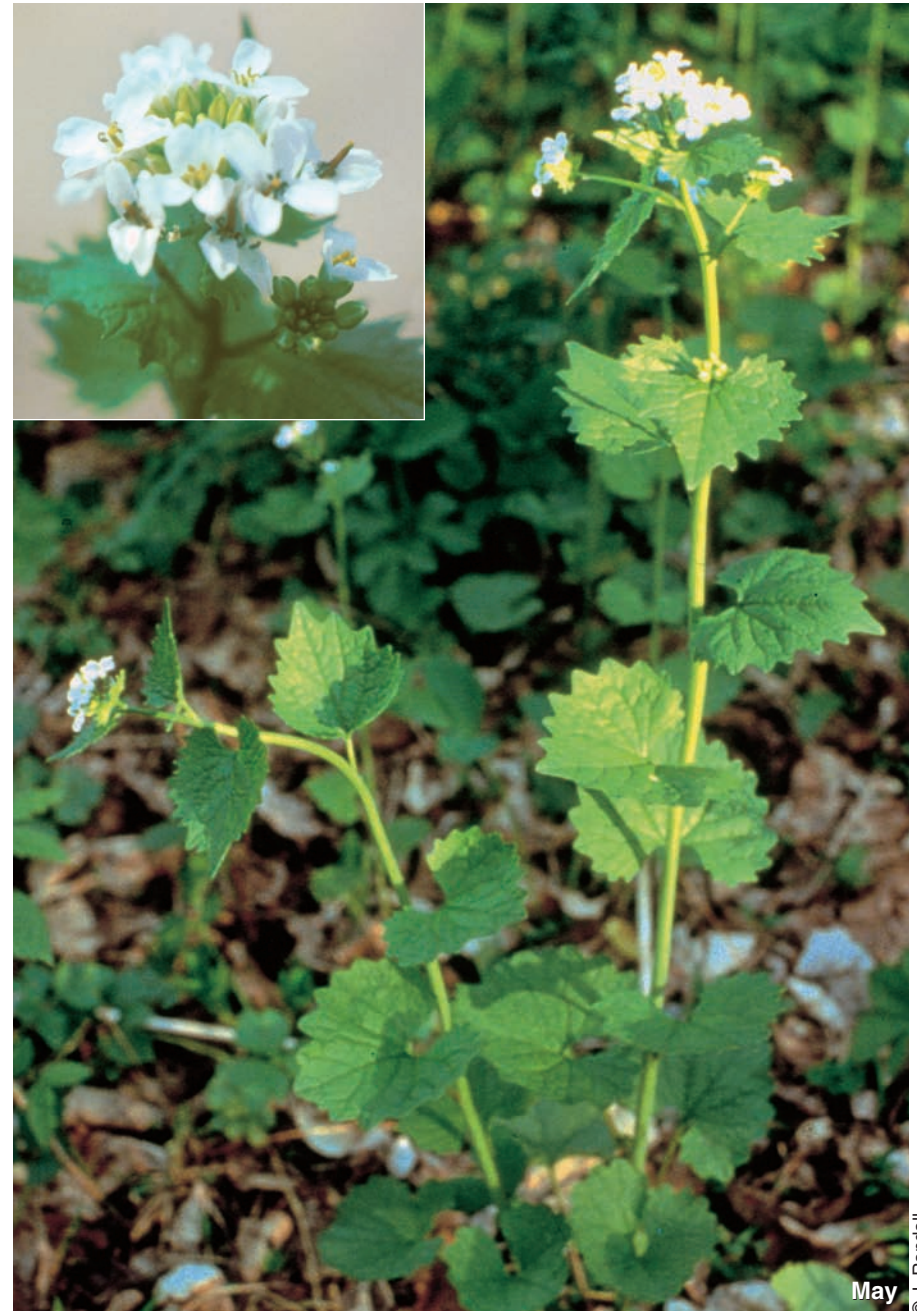
**Flowers.** April to May. Terminal, tight clusters of small white four-petaled flowers, each 0.2 to 0.3 inch (5 to 7 mm) long and 0.4 to 0.6 inch (10 to 14 mm) wide. Flowering progressing upward as seedpods form below.

**Fruit and seeds.** May to June. Four-sided, erect-to-ascending, thin pod, 1 to 5 inches (2.5 to 12 cm) long and 0.06 inch (1.5 mm) wide. Initially appearing to be stem branches that are alternately whorled along the stalk. Green ripening to tan and papery, exploding to expel tiny black seeds arranged in rows.

**Ecology.** Occurs in small to extensive colonies on floodplains, under forest canopies, and at forest margins and openings. Shade tolerant. Capable of ballistic seed dispersal of up to 10 feet (3 m). Spreads by human-, animal-, and water-dispersed seeds, which lie dormant for 2 to 6 years before germinating in spring. Experiences year to year variations in population densities. Allelopathic, emitting chemicals to kill surrounding plants and microbes.

**History and use.** Introduced from Europe in the 1800s and first sighted as an escaped weed in 1868 on Long Island, NY. Originally cultivated for medicinal use, but no known value now.

States with suspected infestations are shown in gray.

**Garlic Mustard****6002**

May

© J. Randall

FORBS

# Shrubby Lespedeza



***Lespedeza bicolor* Turcz. LEBI2**

Synonyms: bicolor lespedeza, bicolor, shrub bushclover

**Plant.** Perennial much branched, leguminous forb or ascending shrub, 3 to 10 feet (1 to 3 m) in height with three-leaflet leaves, many small purple-to-white pea flowers, and single-seeded pods from a woody rootcrown. Dormant brown plants remain upright most of the winter.

**Stem.** Arching branched, upright-to-ascending stems, 0.2 to 0.8 inch (0.5 to 2 cm) in diameter. Often gray green. Appressed hairy to hairless.

**Leaves.** Alternate, three-leaflet leaves. Each leaflet elliptic to ovate with a hairlike tip, 0.8 to 2 inches (2 to 5 cm) long and 0.4 to 1.2 inches (1 to 3 cm) wide. Lower surface lighter green than upper surface. Petioles 0.8 to 1.6 inches (2 to 4 cm) long. Stipules narrowly linear, 0.04 to 0.3 inch (1 to 8 mm) long.

**Flowers.** June to September. Clusters (racemes) 4 to 6 inches (10 to 15 cm) long—each subtended by a tiny ovate bract—of 5 to 15 well-spaced, pealike flowers. Each flower 0.3 to 0.4 inch (8 to 11 mm) long, growing from upper leaf axils and beyond the upper leaves. Petals usually rosy purple in center and often grading to lighter shades, but can vary to white. Calyx (sepals) sparsely to very hairy with lobes 0.1 to 0.2 inch (2.5 to 4.5 mm) long.

**Fruit and seeds.** August to March. Flat legume pod 0.2 to 0.3 inch (6 to 8 mm) long, broadly elliptic with pointed hairlike tip. Green becoming gray and densely appressed hairy. Single black seed 0.12 to 0.16 inch (3 to 4 mm) long.

**Ecology.** Planted widely in forest openings for wildlife food plots and soil stabilization to later encroach into adjoining stands. Reproduces and spreads even under a medium-to-dense overstory. Spread encouraged by burning. Leguminous nitrogen fixer.

**History and use.** Introduced from Japan as an ornamental in the late 1800s. Later programs promoted use for wildlife food and soil stabilization and improvement. Still planted for quail food plots.

States with suspected  
infestations are  
shown in gray.

**Shrubby Lespedeza****6052**

August

T. Bodner

FORBS

# Chinese Lespedeza



***Lespedeza cuneata* (Dum.-Cours.) G. Don** LECUSynonym: *sericea lespedeza*

**Plant.** Perennial ascending-to-upright leguminous forb, 3 to 6 feet (1 to 2 m) in height, with one-to-many leafy slender stems often branching at midplant, three-leaflet leaves, and tiny whitish flowers. Plant arising from a woody rootcrown. Dormant brown plants remaining upright during most of the winter.

**Stems.** Often gray green with lines of hairs along the stem.

**Leaves.** Alternate, crowded and numerous, three-leaflet leaves. Each leaflet oblong to linear with a hairlike tip, 0.4 to 0.8 inch (1 to 2 cm) long and 0.1 to 0.3 inch (3 to 8 mm) wide. Green above and dense whitish hairy to light gray green beneath. Hairy petioles 0.2 to 0.6 inch (5 to 15 mm) long, absent for upper leaves. Stipules narrowly linear.

**Flowers.** July to September. Clusters of 1 to 3 pealike flowers crowded in upper leaf axils. Flowers white with purple marks, 0.1 to 0.3 inch (4 to 7 mm) long and shorter than leaves. Hairy five-lobed calyx shorter than petals.

**Fruit and seeds.** October to March. Flat ovate to round single-seeded legume pod 0.12 to 0.15 inch (3 to 4 mm) wide. Pods clustered in terminal axils, scattered along the stem, and clasped by persistent sepals. Green becoming tan.

**Ecology.** Occurs in new and older forest openings, dry upland woodlands to moist savannas, old fields, right-of-ways, and cities. Flood tolerant. Forms dense stands by sprouting stems from rootcrowns that prevent forest regeneration and land access. Cross- and self-pollinates. Spreads slowly from plantings by seeds that have low germination, but remain viable for decades. Nitrogen fixer.

**Resembles** native lespedeza, *L. virginica* (L.) Britt., which grows in tufted clumps instead of infestations, has crowded clusters of pink-purple to violet flowers and somewhat larger leaflets 0.6 to 1.2 inches (1.5 to 3 cm) long, and brown stems.

**History and use.** Introduced from Japan in 1899—first near Arlington, VA, and soon afterwards in north-central Tennessee—and escaped. Benefited from government programs that promoted plantings for erosion control. Still planted for quail food plots, soil stabilization, and grazing. Plant improvement breeding programs still underway.

States with suspected infestations are shown in gray.

**Chinese Lespedeza****6053**

July

T. Bodner

FORBS

# Tropical Soda Apple



C. Bryson



C. Bryson



C. Bryson



J. Everest



J. Everest

***Solanum viarum*** Dunal **SOVI2**

**Plant.** Upright, thorny perennial subshrub or shrub, 3 to 6 feet (1 to 2 m) in height, with leaves shaped like oak leaves, clusters of tiny white flowers, and green-to-yellow golf-ball size fruit. Fruit sweet smelling and attractive to livestock and wildlife. Remains green over winter in most southern locations.

**Stem.** Upright-to-leaning, much branched, hairy, covered with broad based white-to-yellow thorns.

**Leaves.** Alternate, 4 to 8 inches (10 to 20 cm) long and 2 to 6 inches (5 to 15 cm) wide. Margins deeply lobed (shaped like oak leaves). Velvety hairy with thorns projecting from veins and petioles. Dark green with whitish midveins above and lighter green with netted veins beneath.

**Flowers.** May to August (year-round in Florida). Terminal small clusters of five-petaled white flowers. Petals first extended, then becoming recurved. Yellow-to-white stamen projecting from the center.

**Fruit and seeds.** June to November (year-round in Florida). Spherical, hairless, pulpy berry 1 to 1.5 inches (2.5 to 4 cm). Mottled green ripening to yellow. Each berry producing 200 to 400 reddish-brown seeds.

**Ecology.** Occurs on open to semishady sites. Viable seed in green or yellow fruit but not in white fruit. Reaches maturity from seed within 105 days. Persists by green stems or rootcrowns in warmer areas. Rapidly spreading by cattle and other livestock transportation and by wildlife-dispersed seeds as well as seed-contaminated hay, sod, and machinery.

**Resembles** horsenettle, *S. carolinense* L., an 8- to 30-inch (20- to 80-cm) forb, which has similar but smaller fruit, long elliptic-to-ovate lobed leaves 3 to 5 inches (8 to 12 cm) long and 1 to 3 inches (2.5 to 8 cm) wide, and prickly yellow spines on stems and lower leaf veins.

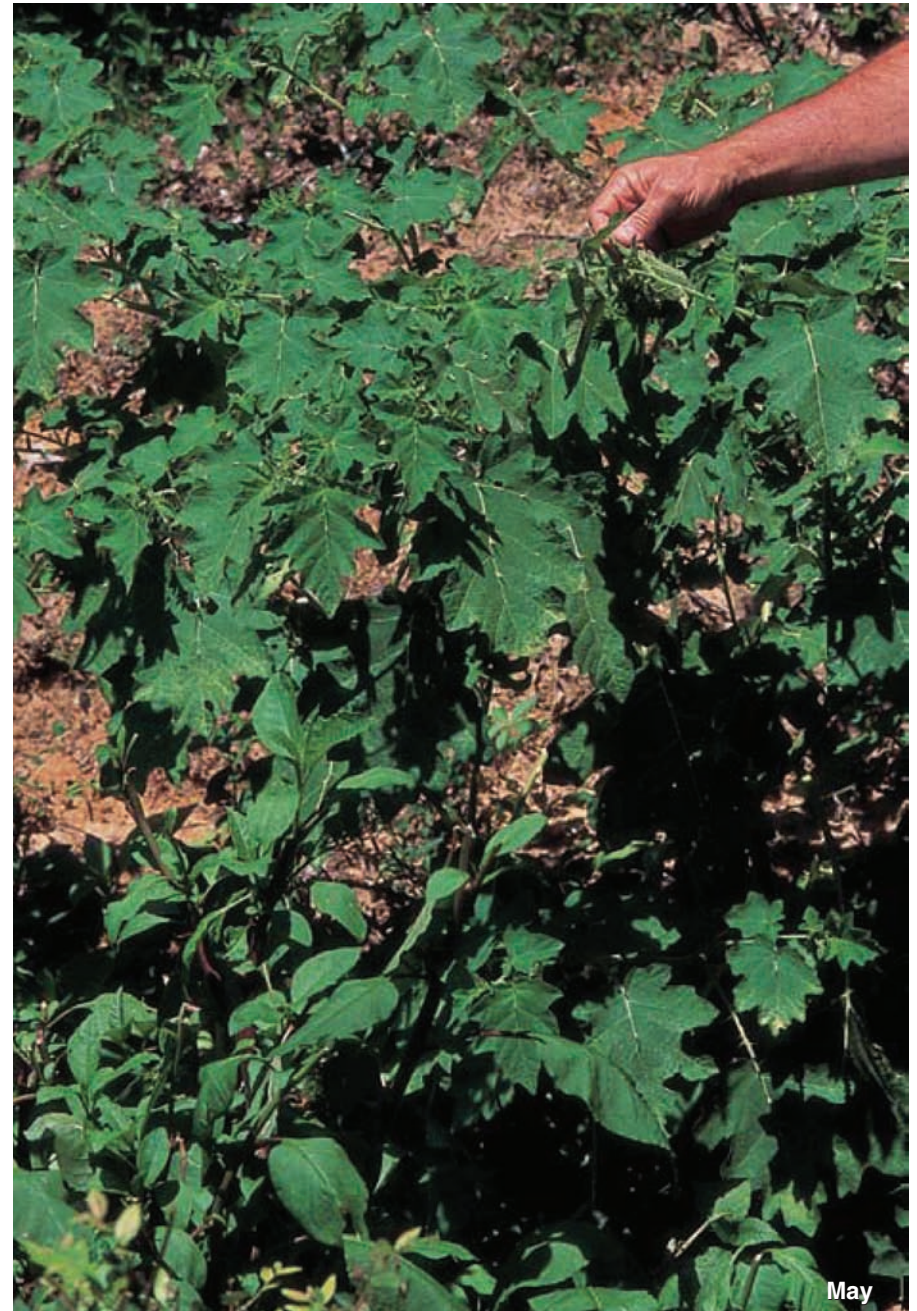
**History and use.** Native to Argentina and Brazil and introduced into Florida in the 1980s. No known use. A Federal listed noxious weed with an eradication program underway.

States with suspected  
infestations are  
shown in gray.



## Tropical Soda Apple

6095





## General Principles for Controlling Nonnative Invasive Plants

The best defense against nonnative plant takeovers is constant surveillance of right-of-ways, streambanks, and internal roads and trails followed by effective control measures at the first appearance of new arrivals. Early detection and treatment will minimize efforts and costs that come with treating well-established plants or full-blown infestations. More effort is required for successful eradication of established infestations, but it still can be accomplished with proper treatments, although costs may be prohibitive. In severe cases, large-scale conversion of existing infestations is the only solution, involving eradication procedures that incorporate integrated management treatments and reestablishment of native plants. Fortunately, in southern forests native plants in the soil seed bank or plants from surrounding areas will naturally reestablish once the invaders are eliminated.

### Effective Treatments

If an infestation is spotted or already occurs, then proper and aggressive eradication measures should be undertaken to avoid the inevitable spread. Continued treatment and retreatments will be necessary. Most nonnative invasive plants are perennials, having extensive tough roots and runners. This means that effective herbicide applications offer the best means of containment or eradication, because herbicides can kill roots and do so



Broadcast treatment of herbicide spray to kudzu.

without baring soil for reinvasion or erosion. To be successful with herbicide treatments:

1. Use the most effective herbicide for the species.
2. Follow the application methods prescribed on the label.
3. Choose an optimum time period to apply treatments; for foliar-applied herbicides this is usually mid-summer to early fall and not later than a month before expected frost. Evergreens and semi-evergreens with leaves can be treated effectively in the winter.
4. Adhere to all label prohibitions, precautions, and Best Management Practices during herbicide transport, storage, mixing, and application.
5. Remember that some herbicides require up to a month or more before herbicidal activity is detectable as yellowing of foliage or leaves with dead spots or margins. Thus, after application, be patient; allow herbicides to work for several months before resorting to other treatment options.

### Selective Herbicide Application Methods

Although treating extensive inaccessible infestations may require broadcast treatments of herbicide sprays or pellets by helicopter or tractor-mounted application systems, the best approach is usually selective applications of herbicides to target nonnative plants while avoiding or minimizing application to desirable plants. The selective methods described are directed foliar sprays, stem injection, cut-treat, basal sprays, and soil spots.

#### Directed Foliar Sprays

Directed foliar sprays are herbicide-water sprays aimed at target plant foliage to cover all leaves to the point of run off, usually applied with a backpack sprayer (use low pressure, drift retardants, and spray shields to avoid drift). Herbicide application by directed foliar spray is the most cost-effective method for treating most types of invasive plant species. With this method, herbicides are thoroughly mixed in water,



Directed foliar sprays with a backpack sprayer.



*A spray shield fashioned from a used gallon milk jug (bottom removed and cap bored.)*



*Spray gun with swivel that holds two tips—narrow and wide angle.*

often with a non-ionic surfactant, and applied to the foliage and growing tips of woody plants or to completely cover herbaceous plants. Foliar sprays are usually most effective when applied from midsummer to late fall, although spring and winter applications have use on specific plants and situations. Selective treatment is possible because the applicator directs the spray towards target plants and away from desirable plants. The addition of a water-soluble dye can assist in tracking treatment and detecting spray drift on desirable plants. Although dyes are messy and short-lived as a visible marker, they are helpful in training and tracking critical applications. Another safeguard is to only use foliar active herbicides, because directed sprays of soil-active herbicides can damage or kill surrounding plants when their roots are within the treatment zone. Never use herbicides with soil activity to treat invasive plants under desirable trees or shrubs.

Directed sprays are usually applied with a backpack sprayer and a spray wand equipped with a full cone, flat fan, or adjustable cone spray tip. These tips and spraying pressures of 20 to 30 pounds per square inch can ensure



*Higher spray heights achieved with narrow-angle nozzle, wand extension, and higher pressure.*

productivity with only a few fine droplets that may drift to surrounding plants. To safeguard surrounding plants from damage by spray drift, suspend applications during windy conditions. A spray shield that attaches to the end of the wand can further minimize drift. Adding a drift retardant to the spray mixture can eliminate drift although effectiveness may be diminished.

Plants up to 6 feet tall can be treated with this equipment, while the addition of a commercially available wand extension can slightly increase height capabilities. To treat plants up to about 18 feet tall, use higher spray pressures with a straight-stream or narrow flat fan tip.

Directed foliar sprays are also applied using wands on hoses attached to spraying systems mounted on all-terrain vehicles, trucks, or tractors. Also, a spray gun with a narrow flat fan tip can replace a wand for some applications. Another useful alternative for treating different sized woody plants is a spray gun with a swivel that holds two tips—narrow and wide-angled—that can be quickly changed during application.

### Stem Injection

Stem injection (including hack-and-squirt) involves herbicide concentrate or herbicide-water mixtures applied into downward incision cuts spaced around woody stems made by an ax, hatchet, machete, brush ax, or tree injector. Tree injection, including the hack-



**A**



**B**

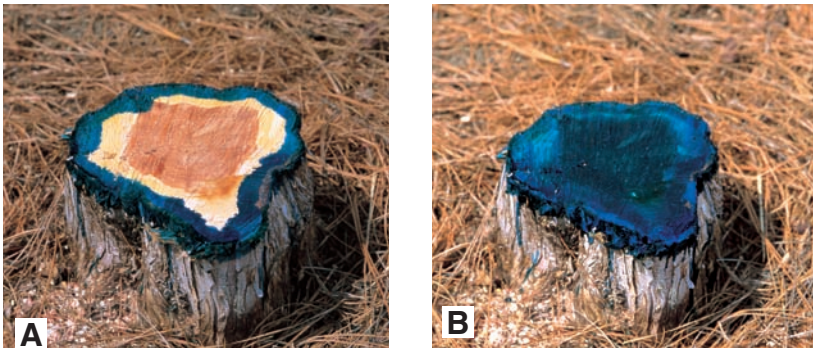
*Stem injection using a hatchet and spray bottle for hack-and-squirt (A) and a tree injector (B).*

and-squirt technique, is a selective method of controlling larger trees and shrubs (more than 2 inches in diameter) with minimum damage to surrounding plants. It requires cuplike downward incisions spaced around the stem with a measured amount of herbicide applied into each of the incisions. Special tree injectors are available to perform this operation, or a narrow-bit ax, hatchet, or machete along with a spray bottle can be used in sequence to perform the hack-and-squirt method. Completely frilling the stem with edge-to-edge cuts or injections is required for very large stems or difficult-to-control species. The herbicide should remain in the injection cut to avoid wasting herbicide on the bark and to prevent damage of surrounding plants. All injected herbicides can be transferred to untreated plants by root grafts and uptake of root exudates. Herbicides with soil activity can damage nearby plants when washed from incisions into the soil by unexpected rainfall soon after application. Avoid injection treatments if rainfall is predicted within 48 hours.

Tree injection treatments are most effective when applied in late winter and throughout the summer. Heavy spring sap flow in spring can wash herbicide from incision cuts, making this an ineffective period.

### Cut-Treat

Cut-treat involves herbicide concentrates or herbicide-water mixtures applied to the outer circumference of freshly cut stumps or the entire top surface of cut stems, applied with a backpack sprayer, spray bottle, wick, or paint brush. Freshly cut stems and stumps of woody stems, including canes and bamboo, can be treated with herbicide mixtures to prevent resprouting and to kill roots. Cutting is usually by chainsaw or brush saw, but can be accomplished by handsaws or cutting blades. To minimize deactivation of the herbicide, remove sawdust from stumps before treatment. Treat stems and stumps as quickly as possible after cutting with a



Cut-treat the circumference of large stems (A) and the entire top of small stems (B).

backpack sprayer or utility spray bottle for spray applications or a wick applicator, lab wash bottle, or paintbrush for small stems. Add a non-ionic surfactant to the mix to aid in penetration, if permitted by the label.

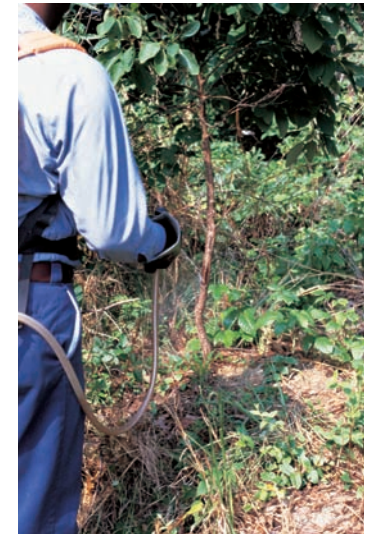
For stumps over 3 inches in diameter, completely wet the outer edge with the herbicide or herbicide mixture. Completely wet the tops of smaller stumps and all cut stems in a clump. Apply a basal spray mixture of herbicide, oil, and penetrant to stumps that have remained untreated for over 2 hours or use Pathfinder II and wet stump sides too.

The most effective time for the stump spray method is late winter and summer. Although winter treatments are slightly less effective than growing season applications, the absence of foliage on cut stems and branches produces some offsetting gains in application efficiency.

### Basal Sprays

Basal sprays are herbicide-oil-penetrant mixtures sprayed or daubed onto the lower portion of woody stems, usually applied with a backpack sprayer or wick applicator. Full basal treatments require that the lower 12 to 20 inches of target woody stems be completely wetted on all sides with an oil-based spray mixture. Application is to smooth juvenile bark. Full basal sprays are usually effective in controlling woody stems less than about 6 inches in diameter or larger diameters of susceptible species, before bark becomes thick, corky, and furrowed. The appropriate equipment for this treatment is a backpack sprayer with a wand or spray gun fitted with a narrow-angle flat fan, cone, or adjustable tip. A wick applicator can also be used. Herbicides that are soluble in oil (mainly Garlon 4) are mixed with a commercially available basal oil, vegetable oil, crop oil, diesel fuel, or kerosene often adding a special penetrant. Some herbicides, such as Pathfinder II and Vine-X, are sold ready-to-use with these ingredients.

A modified method, streamline basal sprays, is effective for many woody species up to 2 inches in diameter, as well as trees and shrubs up to 6 inches in diameter if the species is susceptible. Equipment for this



Basal sprays applied by spray gun and straight-stream nozzle to low stem.



Basal spray mixture applied by a wick applicator to safeguard nearby plants.

treatment is a backpack sprayer with a spray gun and a low-flow straight-stream or narrow-angle spray tip. To prevent waste, maintain pressure below 30 pounds per square inch with a pressure regulator. At this pressure, an effective reach of 9 feet is possible while bark splash is minimized. For treating stems less than 2 inches in diameter, apply the stream of spray up-and-down single stems for about 6 to 8 inches, or apply across multiple stems creating 2- to 3-inch-wide bands. This same multiple-band treatment can be effective on larger stems. Direct the spray stream to smooth juvenile bark at a point about 4 to 18 inches from the ground. Stems that are thick barked or near 3 inches in diameter require treatment on all sides.

Applications are usually in late winter and early spring, when leaves do not hinder spraying the stem. Summer applications are effective but more difficult. Avoid ester herbicide formulations on hot days to prevent vapor drift injury to nontarget plants.

### Soil Spots

Soil spots are Velpar L herbicide applied as metered amounts to the soil surface around target woody stems or in a grid pattern for treating many stems in an area; they are usually applied with a spot gun or with a backpack sprayer equipped with a straight-stream nozzle. Spots of soil-active herbicide (mainly Velpar L) are applied to the soil surface in grid patterns or around target woody stems. This method requires exact amounts and



Soil spots applied as metered herbicide amounts to the soil surface.

prescribed spacings that are specified on the herbicide label or label supplements. It is only effective on specific nonnative plant species and usually only when applied in spring and early summer. Equipment is a special spot gun, utility spray bottle, or a backpack sprayer with a spray gun equipped with a straight-stream spray tip.

## Selecting an Effective Herbicide

Only herbicides registered by the U.S. Environmental Protection Agency for forestry use and noncroplands in the Southern States will be discussed here, although herbicides for other “land use areas,” such as right-of-ways, pastures, and rangelands, may be just as effective or may contain the same active ingredient. The herbicides that will be identified by trade name (and common active-ingredient name) are:

### Foliar active (mostly) herbicides

Glyphosate herbicides (glyphosate) such as: Accord Concentrate, Gly-Flo Herbicide, and etc.  
 Garlon 3A (triclopyr)  
 Garlon 4 (triclopyr)  
 Krenite S (fosamine)  
 Pathfinder II (triclopyr)  
 Milestone VM (aminopyralid)

### Foliar and soil-active herbicides

Arsenal AC (imazapyr)  
 Escort XP (metsulfuron)  
 Pathway (2,4-D + picloram)  
 Plateau (imazapic)  
 Tordon 101 (2,4-D + picloram)  
 Tordon K (picloram)  
 Transline (clopyralid)  
 Vanquish (dicamba)  
 Velpar L (hexazinone)

Because nonnative invasive plants are usually difficult to control, selecting the most effective herbicide(s) is important. Often herbicides that have both soil and foliar activity are most effective with the least number of applications. However, applying herbicides with soil activity can damage desirable plants when their roots are present within the treatment zone or when herbicides move downhill to untreated areas following heavy rainfall. Garlon herbicides are mainly foliar active, but they have some soil activity at high rates or when mixed with oils. Garlon 4 and Vanquish can volatilize at high temperatures and their residues can move by air currents to affect surrounding plants; therefore, avoid application on days when temperatures exceed 80° F. If possible, also avoid applications when rainfall is anticipated within 8 hours, unless soil activation is needed, and during periods of severe drought as effectiveness can be reduced during these times.

When possible, use selective herbicides that target specific nonnative species, such as Transline that controls mainly legumes and composites, and minimize damage to surrounding desirable plants even though they receive herbicide contact. Minimizing damage to desirable cohorts can also be achieved by making applications when the cohorts are dormant. For example, apply basal sprays to the bark of invasives in late winter before most other plants emerge, or foliar spray evergreen or semievergreen invasives after surrounding plants have entered dormancy. Remember that desirable woody plants can be damaged through transfer of herbicides by

root exudates following stem injection and cut-treat treatments or when soil-active herbicides wash off treated stems. Damage to surrounding native plants can be minimized with care and forethought during planning and application.

Read and thoroughly understand the herbicide label and its prohibitions before and during use. Many herbicides require the addition of a non-ionic surfactant to the spray tank. Always use clean water in a herbicide mixture and mix spray solutions thoroughly before applying. Do not mix in the sprayer but in a bucket with a stirring stick—stirring for several minutes or more—before transferring to the sprayer. Water that is highly basic (pH greater than 6) and contains high amounts of calcium and magnesium interferes with glyphosate herbicide effectiveness, requiring the addition of ammonium sulfate or appropriate additives. When changing from a water-based mix to an oil-based mix in a backpack sprayer, thoroughly evacuate the water from the pump and run a small amount of oil through the pumping system before filling with the oil-based mix, otherwise, a white sludge will clog the sprayer. And, always wear personal protective equipment prescribed on the label and in supplementary materials.

## Other Treatments for an Integrated Approach

Overgrazing is a way to reduce the vigor of palatable invasive plants like kudzu, but this rarely yields eradication and may spread seeds (as with tropical soda apple). Mechanical treatments and prescribed burning can assist eradication measures, but are limited in effectiveness. Prescribed burning cannot control rootcrowns or rhizomes of perennial plants and usually only deadens small aboveground shoots, providing only temporary aboveground control. In a similar way, cutting woody plants (by chainsaw and brush saw felling or brush mowing) and mowing vines and herbs without killing roots remove only aboveground plant parts. Mechanical root raking and disking can actually intensify and spread infestations of invasive plants with runners by chopping them into resprouting segments and transporting them on the equipment. Fireplows can also spread invasive plant rhizomes and roots.



*Overgrazing for kudzu control.*

However, root raking, piling, brush mowing, or burning may be the only way to start controlling dense infestations of multiple woody invasive plants. Small infestations may respond to hand pulling, grubbing with a stout hoe, or shrub pulling with newly introduced devices. Hand pulling or grubbing may be the quickest and easiest way to halt invaders when first spotted and stop them from gaining a foothold. String trimmers can reduce infestation densities and injure thick waxy leaves to improve herbicide uptake and effectiveness.



*Hand pulling privet.*

Although ineffective by themselves to achieve eradication, both mechanical and burning treatments can give added kill of herbicide-weakened plants and have a place in an integrated pest management program. The stumps and stems of nonnative trees, shrubs, and bamboos can be treated with herbicides immediately after cutting to kill roots. Resprouts of trees, shrubs, and vines that are topkilled by burning or brush mowing can be more easily treated with foliar sprays, often the most cost-effective way to use herbicides. Herbicide applications should be delayed after burning, disking, or mowing to permit adequate resprouting of target plants and, thereby maximizing herbicide uptake and effectiveness. Prescribed burning can also destroy invasive plant seeds (and bulbils of air yams) and often stimulate germination for efficient herbicide



*Prescribed burn.*



*Wildland disk.*

control treatments. Burning can prepare the site for effective herbicide applications by clearing debris and revealing application hazards, such as old wells and pits. Disking and root raking, if applied correctly, can dislodge herbicide-damaged woody roots and large runners, leaving them to dry and rot. With mechanical and burning treatments, take precautions, such as burning in late winter or spring leaf-out, to minimize the period of bare soil. The most effective time for controlling woody invasive plants and their germinants with fire is after plants have initiated growth in spring.

An eradication program for infestations of invasive plants usually requires several years of treatment and many more years of surveillance to check for rhizome sprouts, root sprouts, seed germination, or new invasions. Following these steps in a planned manner and with persistence is the only successful strategy to safeguard land access, productivity, native plants, and suitable habitats for wildlife.



*Sowing native plant seed.*

### The Rehabilitation Phase

Rehabilitation is the most important final phase of an integrated invasive plant eradication and reclamation program. The rehabilitation phase requires establishment and/or release of fast-growing native plants that can outcompete and outlast any surviving nonnative plants while stabilizing and protecting the soil. If the soil seed bank remains intact, native plant communities may naturally reinitiate succession after eradication of nonnative plants. Light-seeded native species are usually present in the seed bank while heavier seeded plants will gradually be deposited on a site by birds and other animals. In recent years, native plant seed and seedlings have become increasingly available for rehabilitation sowing and planting, but a limited number of

species and absence of well-developed establishment procedures often hinder use. Tree nurseries operated by State forestry agencies are a good source of many species of native trees and shrubs. Often it is necessary to establish fast-growing tree species during the later control phase to hinder reestablishment of shade intolerant nonnative invasive plants. Reestablishing native grasses and forbs is equally important. These species are available from commercial nurseries specializing in native plants, utilizing local sources when possible. Native plant seeds will require proper treatments to assure timely germination. Seedling native plants can be also collected and transplanted from suitable field sites. Their establishment will be more challenging than the commonly available nonnative plants so often used for soil stabilization and wildlife food plots. Constant surveillance, maintaining forest vigor with minimal disturbance, treatment of new unwanted arrivals, and finally rehabilitation following eradication are critical to preventing and controlling invasions on a specific site.



*Containerized native plants for rehabilitation plantings.*

## Prescriptions for Specific Nonnative Invasive Plants

The following are herbicide prescription summaries for prevalent invasive plants, detailing mainly selective application treatments. These prescriptions have been assembled from published research results, unpublished trials, State reports, weed council manuals, magazines, and Web sites. In general, very few species-specific experiments have been reported that compare a full array of treatments for nonnative invasive plant species. But until further specific understanding is gained, we must proceed with current knowledge and technology to combat this invasion. Herbicides are mentioned in order by effectiveness when comparative information is available or alphabetically when such information is lacking. Remember to follow the label-specified maximum herbicide amounts that are permissible for an acre of land when using selective application treatments.

### Nonnative Trees

Nonnative tree species hinder reforestation and management of right-of-ways and natural areas as well as dramatically altering habitats. Some occur as scattered trees while others form dense stands. Most spread by prolific seed production and abundant root sprouts. They can be eliminated with herbicides by stem injection, cut-treat, and soil spots, with basal and foliar sprays for seedlings and saplings. Following stem control, total elimination requires surveillance and treatment of root sprouts and plant germinants that originate from the soil seed bank.



#### Tree-of-Heaven, *Ailanthus*

Tree-of-heaven or ailanthus (*Ailanthus altissima*) is a deciduous tree to 80 feet (25 m) tall with long pinnately compound leaves, gray slightly fissured bark, and large terminal clusters of greenish flowers in early summer. Flowers and other parts of the plant have a strong odor.

Viable seed are produced by 2- to 3-year-old plants. Immature appearing seeds are capable of germination. Root sprouts may appear after the main stem is deadened, and root segments left in soil after pulling treatments will sprout. Tree-of-heaven sprouts have been found to have 10 to 14 feet (3 to 4 m) of first year height growth, while seedlings can grow 3 to 6 feet (1 to 2 m) in the first year. This vigorous growth can continue for 4 or more years.

\*Nontarget plants may be killed or injured by root uptake.

† Transline controls a narrow spectrum of plant species.

#### **Recommended control procedures:**

**Large trees.** Make stem injections and then apply Garlon 3A, Pathfinder\*, Pathfinder II, or Arsenal AC\* in dilutions and cut spacings specified on the herbicide label (midsummer best, late winter somewhat less effective). For felled trees, apply these herbicides to stem and stump tops immediately after cutting.

**Saplings.** Apply Garlon 4 as a 20-percent solution in basal oil, vegetable oil, crop oil concentrate, diesel fuel, or kerosene (2.5 quarts per 3-gallon mix) or apply undiluted Pathfinder II to young bark as a basal spray.

**Seedlings and saplings.** Thoroughly wet all leaves with one of the following herbicides in water with a surfactant (July to October): Arsenal AC\* as a 1-percent solution (4 ounces per 3-gallon mix), Krenite S as a 15-percent solution (3 pints per 3-gallon mix), Garlon 4 as a 2-percent solution (8 ounces per 3-gallon mix), or Escort XP\* at 1 ounce per acre.



#### Silktree, *Mimosa*

Silktree or mimosa (*Albizia julibrissin*) is a small legume tree to 10 to 50 feet (3 to 15 m) tall that reproduces by abundant seeds and root sprouts. It has feathery deciduous leaves, smooth light-brown bark, and showy pink blossoms that yield dangling flat pods. Seedpods float and seed remain viable for many years.

#### **Recommended control procedures:**

**Large trees.** Make stem injections using Arsenal AC\* or Garlon 3A in dilutions as specified on the herbicide label (anytime except March and April). For felled trees, apply these herbicides to stem and stump tops immediately after cutting.

**Saplings.** Apply Garlon 4 as a 20-percent solution in basal oil, vegetable oil, crop oil concentrate, diesel fuel, or kerosene (2.5 quarts per 3-gallon mix) or apply undiluted Pathfinder II to young bark as a basal spray.

**Resprouts and seedlings.** Thoroughly wet all leaves with one of the following herbicides in water with a surfactant:

- July to October—Garlon 3A, Garlon 4, or glyphosate herbicide as a 2-percent solution (8 ounces per 3-gallon mix)
- July to September—Transline† as a 0.2- to 0.4-percent solution (1 to 2 ounces per 3-gallon mix)



### Princesstree, Paulownia

Princesstree or paulownia (*Paulownia tomentosa*) is a deciduous tree to 60 feet (18 m) tall with large heart-shaped leaves that are fuzzy hairy on both sides and pecan-like nuts in clusters (containing many tiny winged seeds) following showy pale-violet flowers in early spring. Stump sprouts and root sprouts may eventually emerge after main stems are deadened.

#### **Recommended control procedures:**

**Large trees.** Make stem injections using Arsenal AC\* or a glyphosate herbicide in dilutions and cut spacings specified on the herbicide label (anytime except March and April). For felled trees, apply these herbicides to stem and stump tops immediately after cutting.

**Saplings.** Apply Garlon 4 as a 20-percent solution in basal oil, vegetable oil, crop oil concentrate, diesel fuel, or kerosene (2.5 quarts per 3-gallon mix) or apply undiluted Pathfinder II to young bark as a basal spray.

**Resprouts and seedlings.** Thoroughly wet all leaves with one of the following herbicides in water with a surfactant (July to October): Arsenal AC\* as a 1-percent solution (4 ounces per 3-gallon mix); a glyphosate herbicide, Garlon 3A, or Garlon 4 as a 2-percent solution (8 ounces per 3-gallon mix).



### Chinaberrytree

Chinaberrytree (*Melia azedarach*) is a deciduous tree growing to about 50 feet (15 m) tall. It has lacy, many-divided leaves that are dark green and blue flowers in spring that yield round yellow fruit that persist during winter. Stump sprouts and root sprouts may eventually emerge after main stems are deadened.

#### **Recommended control procedures:**

**Trees.** Make stem injections using Arsenal AC\* , Pathway\* , Pathfinder II, or Garlon 3A in dilutions and cut spacings specified on the herbicide label (anytime except March and April). For felled trees, apply these herbicides to stem and stump tops immediately after cutting.

**Saplings.** Apply Garlon 4 as a 20-percent solution in basal oil, vegetable oil, crop oil concentrate, diesel fuel, or kerosene (2.5 quarts per 3-gallon mix) or apply undiluted Pathfinder II to young bark as a basal spray.

\*Nontarget plants may be killed or injured by root uptake.

**Sprouts and seedlings.** Thoroughly wet all leaves with one of the following herbicides in water with a surfactant (July to October): Garlon 3A or Garlon 4 as a 2-percent solution (8 ounces per 3-gallon mix); Arsenal AC\* as a 1-percent solution (4 ounces per 3-gallon mix).



### Tallowtree, Popcorn tree

Tallowtree or popcorn tree (*Triadica sebifera*, formerly *Sapium sebiferum*) is a deciduous tree growing to 60 feet (18 m) tall that has heart-shaped leaves turning scarlet in fall, long drooping flowers in spring, and bundles of white waxy "popcorn-like" seeds in fall and winter. Three-year-old plants can produce viable seed and small seedlings can be easily hand pulled. Burning results in abundant seedlings.

#### **Recommended control procedures:**

**Large trees.** Make stem injections using Arsenal AC\* , Garlon 3A, or Pathfinder II in dilutions and cut spacings specified on the herbicide label (anytime except March and April). For felled trees, apply the herbicides to stem and stump tops immediately after cutting (at least a 10-percent solution for Garlon 3A). Ortho Brush-B-Gone (triclopyr) and Enforcer Brush Killer (triclopyr) are effective for treating cut stumps and readily available to homeowners in retail garden stores. For treatment of extensive infestations in forest situations, apply Velpar L\* to the soil surface within 3 feet of the stem (one squirt of spot gun per 1-inch stem diameter) or in a grid pattern at spacings specified on the herbicide label.

**Saplings.** Apply Garlon 4 as a 20-percent solution in basal oil, vegetable oil, crop oil concentrate, diesel fuel, or kerosene (2.5 quarts per 3-gallon mix) or apply undiluted Pathfinder II to young bark as a basal spray.

**Seedlings and saplings.** Thoroughly wet all leaves with one of the following herbicides in water with a surfactant (July to October): Arsenal AC\* as a 1-percent solution (4 ounces per 3-gallon mix), Krenite S as a 20-percent solution (2 quarts per 3-gallon mix), or Garlon 4 as a 2-percent solution (8 ounces per 3-gallon mix).



### Russian Olive

Russian olive (*Elaeagnus angustifolia*) is a small thorny tree to 35 feet (10 m) tall that has microscopic silvery scales covering leaves, twigs, and fruits. Leaves are long and narrow with entire margins. Bark is fissured and reddish brown. Olive-like fruit are yellow and appear in late summer to fall.

### **Recommended control procedures:**

**Trees.** Make stem injections using Arsenal AC\* or Garlon 3A in dilutions and cut spacings specified on the herbicide label (anytime except March and April). For felled trees, apply the herbicides to stem and stump tops immediately after cutting.

**Saplings.** Apply Garlon 4 as a 20-percent solution in basal oil, vegetable oil, crop oil concentrate, diesel fuel, or kerosene (2.5 quarts per 3-gallon mix) or apply undiluted Pathfinder II to young bark as a basal spray.

**Seedlings and saplings.** Thoroughly wet all leaves with one of the following herbicides in water with a surfactant (July to October): Arsenal AC\* as a 1-percent solution in water (4 ounces per 3-gallon mix); a glyphosate herbicide, Garlon 3A, or Garlon 4 as a 2-percent solution in water (8 ounces per 3-gallon mix) for directed spray treatments that have limited or no soil activity.

## **Nonnative Shrubs**

Nonnative shrubs often occur with nonnative tree species and present similar problems. Herbicide control options are similar to trees, with the exception that foliar sprays can be used more often and are more effective. All are shade tolerant with bird-dispersed seeds resulting in scattered plants under existing forest canopies (except nonnative roses), which requires additional surveillance within the interior of forest stands.



### **Silverthorn, Thorny Olive**

Silverthorn or thorny olive (*Elaeagnus pungens*) is an evergreen, densely bushy shrub 3 to 25 feet (1 to 8 m) in height. It has long limber projecting shoots, scattered thorny, dense alternate leaves silver scaly in spring on both top and bottom becoming dark green above and silvery beneath by midsummer. Oblong fruit red and brown scaly appear in spring.

### **Recommended control procedures:**

- Thoroughly wet all leaves with Arsenal AC\* or Vanquish\* as a 1-percent solution in water (4 ounces per 3-gallon mix) with a surfactant; Garlon 3A and Garlon 4 as a 2-percent solution (8 ounces per 3-gallon mix).
- For stems too tall for foliar sprays, apply Garlon 4 as a 20-percent solution in commercially available basal oil, diesel fuel, or kerosene (2.5 quarts

\*Nontarget plants may be killed or injured by root uptake.

per 3-gallon mix) with a penetrant (check with herbicide distributor) to young bark as a basal spray (January to February or May to October). Or, cut large stems and immediately treat the stumps with one of the following herbicides in water with a surfactant: Arsenal AC\* as a 10-percent solution (1 quart per 3-gallon mix) or a glyphosate herbicide as a 20-percent solution (2.5 quarts per 3-gallon mix).



### **Autumn Olive**

Autumn olive (*Elaeagnus umbellata*) is a tardily deciduous bushy leafy shrub, 3 to 20 feet (1 to 6 m) in height, with scattered thorny branches. It has alternate leaves green above and silvery scaly beneath, with many red berries in fall having silvery scales.

### **Recommended control procedures:**

- Thoroughly wet all leaves with Arsenal AC\* or Vanquish\* as a 1-percent solution in water (4 ounces per 3-gallon mix) with a surfactant (April to October).
- For stems too tall for foliar sprays, apply Garlon 4 as a 20-percent solution in basal oil, vegetable oil, crop oil concentrate, diesel fuel, or kerosene (2.5 quarts per 3-gallon mix) or apply undiluted Pathfinder II to young bark as a basal spray (January to February or May to October). Or, cut large stems and immediately treat the stumps with one of the following herbicides in water with a surfactant: Arsenal AC\* as a 10-percent solution (1 quart per 3-gallon mix) or a glyphosate herbicide as a 20-percent solution (2.5 quarts per 3-gallon mix).



### **Winged Burning Bush**

Winged burning bush (*Euonymus alata*) is a deciduous, wing-stemmed, bushy shrub to 12 feet (4 m) in height, multiple stemmed and much branched, canopy broad and leafy. It has small and obovate opposite leaves, green turning bright scarlet to purplish red in fall, along stems with four corky wings. Many orange fruit appear as stemmed pairs in leaf axils and turning purple in fall.

### **Recommended control procedures:**

- Thoroughly wet all leaves with Arsenal AC\* or Vanquish\* as a 1-percent solution in water (4 ounces per 3-gallon mix) with a surfactant (April to October).
- For stems too tall for foliar sprays, apply Garlon 4 as a 20-percent solution in basal oil, vegetable oil, crop oil concentrate, diesel fuel, or kerosene

(2.5 quarts per 3-gallon mix) or apply undiluted Pathfinder II to young bark as a basal spray (January to February or May to October). Or, cut large stems and immediately treat the stumps with one of the following herbicides in water with a surfactant: Arsenal AC\* as a 10-percent solution (1 quart per 3-gallon mix) or a glyphosate herbicide as a 20-percent solution (2.5 quarts per 3-gallon mix).



### Chinese Privet, European Privet

Chinese privet (*Ligustrum sinense*) and European privet (*L. vulgare*) are difficult to distinguish except at flowering, both are evergreen to semievergreen. Both are thicket-forming shrubs to 30 feet (9 m) in height that are soft woody, multiple stemmed with long leafy branches and

opposite leaves less than 2 inches long. Showy clusters of small white flowers in spring yield clusters of small ovoid, dark-purple berries during fall and winter.

#### Recommended control procedures:

■ Thoroughly wet all leaves with one of the following herbicides in water with a surfactant (August to March): a glyphosate herbicide as a 3-percent solution (12 ounces per 3-gallon mix) or Arsenal AC\* as a 1-percent solution (4 ounces per 3-gallon mix).

■ For stems too tall for foliar sprays, apply Garlon 4 as a 20-percent solution in basal oil, vegetable oil, crop oil concentrate, diesel fuel, or kerosene (2.5 quarts per 3-gallon mix) or apply undiluted Pathfinder II to young bark as a basal spray. Or, cut large stems and immediately treat the stumps with Arsenal AC\* or Velpar L\* as a 10-percent solution in water (1 quart per 3-gallon mix) with a surfactant. When safety to surrounding vegetation is desired, immediately treat stumps and cut stems with Garlon 3A or a glyphosate herbicide as a 20-percent solution in water (2.5 quarts per 3-gallon mix) with a surfactant.



### Japanese Privet, Glossy Privet

Japanese privet (*Ligustrum japonicum*) and glossy privet (*L. lucidum*) are evergreen to 35 feet (10 m) in height, with an upward spreading canopies. They have thick leathery opposite leaves 2 to 4 inches (5 to 10 cm) long, and hairless leaves and stems. Clusters of small showy white flowers in spring yield small rounded green to purple fruit.

#### Recommended control procedures:

■ Thoroughly wet all leaves with one of the following herbicides in water with a surfactant (August through March): Arsenal AC\* as a 1-percent solution (4 ounces per 3-gallon mix); Garlon 4 as a 3-percent solution (12 ounces per 3-gallon mix); or a glyphosate herbicide as a 3-percent solution (12 ounces per 3-gallon mix).

■ For stems too tall for foliar sprays, apply Garlon 4 as a 20-percent solution in basal oil, vegetable oil, crop oil concentrate, diesel fuel, or kerosene (2.5 quarts per 3-gallon mix) or apply undiluted Pathfinder II to young bark as a basal spray (January to February or May to October). Or, cut large stems and immediately treat the stumps with Arsenal AC\* or Velpar L\* as a 10-percent solution in water (1 quart per 3-gallon mix) with a surfactant. When safety to surrounding vegetation is desired, immediately treat stumps and cut stems with a glyphosate herbicide or Garlon 3A as a 20-percent solution in water (2.5 quarts per 3-gallon mix) with a surfactant.



### Bush Honeysuckles

Amur honeysuckle (*Lonicera maackii*), Morrow's honeysuckle (*L. morrowii*), Tatarian honeysuckle (*L. tatarica*), and sweet-breath-of-spring (*L. fragrantissima*) are all tardily deciduous, upright, arching-branched shrubs. Amur is to 30 feet (9 m) in height and spindly in forests, Morrow's is to 6.5 feet (2 m) in height, and Tatarian and sweet-breath-of-spring are to 10 feet (3 m) in height. All are much branched

and arching in openings, multiple stemmed, with dark-green oval-to-oblong distinctly opposite leaves 0.8 to 2.4 inches (2 to 6 cm) long. Fragrant showy tubular white-to-pink or yellow paired flowers appear from May to June. Abundant paired berries are red to orange during winter. Seeds are long-lived in the soil.

#### Recommended control procedures:

■ Thoroughly wet all leaves with glyphosate herbicide as a 2-percent solution in water (8 ounces per 3-gallon mix) with a surfactant (August to October). Or, apply Garlon 4 as a 20-percent solution in basal oil, vegetable oil, crop oil concentrate, diesel fuel, or kerosene (2.5 quarts per 3-gallon mix) or apply undiluted Pathfinder II to young bark as a basal spray.

■ For stems too tall for foliar sprays, cut large stems and immediately treat the stumps with one of the following herbicides in water with a surfactant: Arsenal AC\* as a 10-percent solution (1 quart per 3-gallon mix) or a glyphosate herbicide as a 20-percent solution (2.5 quarts per 3-gallon mix).

\*Nontarget plants may be killed or injured by root uptake.



### Sacred Bamboo, *Nandina*

Sacred bamboo or nandina (*Nandina domestica*) is an evergreen erect shrub to 8 feet (2.5 m) in height, with multiple bushy stems resembling bamboo, glossy pinnately to bipinnately compound green or reddish leaves. Early summer terminal clusters of tiny white-to-pinkish flowers yield dangling clusters of red berries in fall and winter.

#### Recommended control procedures:

- Thoroughly wet all leaves with glyphosate herbicide as a 1-percent solution in water (4 ounces per 3-gallon mix) with a surfactant (August to October). Or, apply Garlon 4 as a 20-percent solution in basal oil, vegetable oil, crop oil concentrate, diesel fuel, or kerosene (2.5 quarts per 3-gallon mix) or apply undiluted Pathfinder II to young bark as a basal spray.
- For stems too tall for foliar sprays, cut large stems and immediately treat the stumps with one of the following herbicides in water with a surfactant: Arsenal AC\* as a 10-percent solution (1 quart per 3-gallon mix) or a glyphosate herbicide as a 20-percent solution (2.5 quarts per 3-gallon mix).
- Collect and destroy fruit.



### Nonnative Roses

Multiflora rose (*Rosa multiflora*), Macartney rose (*R. bracteata*), Cherokee rose (*R. laevigata*), and other nonnative roses are all evergreen except multiflora and are all erect, arching, or trailing shrubs to 10 feet (3 m) in height or long, clump forming. They have pinnately compound leaves with three to nine leaflets, frequent recurved or straight thorns. Clustered or single white-to-pink flowers in early summer yield red rose hips in fall to winter.

#### Recommended control procedures:

- Thoroughly wet all leaves with one of the following herbicides in water with a surfactant: April to June (at or near the time of flowering)—Escort\* at 1 ounce per acre in water (0.2 dry ounces per 3-gallon mix); August to October—Arsenal AC\* as a 1-percent solution (4 ounces per 3-gallon mix) or Escort\* XP at 1 ounce per acre in water (0.2 dry ounces per 3-gallon mix); May to October—repeated applications of a glyphosate herbicide as a 4-percent solution in water (1 pint per 3-gallon mix), a less effective treatment that has no soil activity to damage surrounding plants.

\*Nontarget plants may be killed or injured by root uptake.

- For stems too tall for foliar sprays, apply Garlon 4 as a 20-percent solution in basal oil, vegetable oil, crop oil concentrate, diesel fuel, or kerosene (2.5 quarts per 3-gallon mix) or apply undiluted Pathfinder II to young bark as a basal spray (January to February or May to October). Or, cut large stems and immediately treat the stumps with one of the following herbicides in water with a surfactant: Arsenal AC\* as a 10-percent solution (1 quart per 3-gallon mix) or a glyphosate herbicide as a 20-percent solution (2.5 quarts per 3-gallon mix).

### Nonnative Vines

Nonnative vines are some of the most troublesome invaders because they often form the densest infestations, making herbicide applications difficult. Many of these vines overtop even mature forests and often form mixed-species infestations with nonnative trees and shrubs. Specific herbicides can be effective on certain vines while not controlling, but actually releasing any underlying nonnative trees and shrubs. In these situations, select the best herbicide or herbicide mixture for controlling all the nonnative species in a mixed-species infestation. Vine control is always difficult because foliar active herbicides must move through lengthy vines to kill large unseen woody roots and tubers. Thus, herbicides that have both soil and foliar activity are often the most effective. Only the lower foliage within sprayer reach needs to be treated with a herbicide having both foliar and soil activity. With all herbicides, spray foliage of climbing stems as high as possible and if not controlled, then cut vines before retreatment.



### Oriental Bittersweet

Oriental bittersweet (*Celastrus orbiculatus*) is an attractive but very invasive deciduous, twining, and climbing woody vine to 60 feet (20 m) with drooping branches in tree crowns, forming thicket and arbor infestations. It has alternate elliptic-to-rounded leaves 1.2 to 5 inches (3 to 12 cm) long. Its axillary dangling clusters of inconspicuous yellowish flowers yield green spherical fruit that split to reveal three-parted showy scarlet fleshy covered seeds, which remain through winter at most leaf axils.

#### Recommended control procedures:

- Thoroughly wet all leaves with one of the following herbicides in water with a surfactant (July to October): Garlon 4, Garlon 3A, or a glyphosate herbicide as a 3-percent solution (12 ounces per 3-gallon mix).
- For stems too tall for foliar sprays, apply Garlon 4 as a 20-percent solution in basal oil, vegetable oil, crop oil concentrate, diesel fuel, or kerosene

(2.5 quarts per 3-gallon mix) or apply undiluted Pathfinder II as a basal spray to the lower 16 inches of stems. Or, cut large stems and immediately treat the cut surfaces with one of the following herbicides in water with a surfactant: Garlon 4 or a glyphosate herbicide as a 25-percent solution (32 ounces per 1-gallon mix).



### Climbing Yams

Air yam (*Dioscorea bulbifera*), Chinese yam or cinnamon vine (*D. oppositifolia*, formerly *D. batatas*), and water yam (*D. alata*) are herbaceous, high climbing vines to 65 feet (20 m) that cover shrubs and trees in infestations. They have twining and sprawling stems with long-petioled smooth heart-shaped leaves and dangling potato-like tubers (bulbils) that appear at leaf axils and drop to form new plants. Aerial tubers spread down slope by gravity and by water. All species also have large underground tubers that make control difficult.

#### Recommended control procedures:

- Thoroughly wet all leaves with one of the following herbicides in water with a surfactant (July to October): Garlon 3A or Garlon 4 as a 2-percent solution (8 ounces per 3-gallon mix). Sometimes the air yams take up the herbicide; otherwise, they must be collected and destroyed (not composted).
- Cut climbing plants just above the soil surface and immediately treat the freshly cut stem with undiluted Garlon 3A (safe to surrounding plants).



### Winter Creeper, Climbing Euonymus

Winter creeper or climbing euonymus (*Euonymus fortunei*) is an evergreen shrub to 3 feet (1 m) in height and woody trailing vine to 40 to 70 feet (12 to 22 m) that forms a dense ground cover and climbs by clinging aerial roots along the stem. It has leaves that are opposite, thick, and dark green or green-white variegated on green stems. Pinkish-to-red capsules split open in fall to expose orange fleshy covered seeds.

#### Recommended control procedures:

- Thoroughly wet all leaves (until runoff) with one of the following herbicides in water with a surfactant (July to October for successive years): Tordon 101\*<sup>‡</sup> as a 3-percent solution (12 ounces per 3-gallon mix) or Tordon K\*<sup>‡</sup> as a 2-percent solution (8 ounces per 3-gallon mix).

\* Nontarget plants may be killed or injured by root uptake.

<sup>‡</sup> When using Tordon herbicides, rainfall must occur within 6 days after application for needed soil activation. Tordon herbicides are Restricted Use Pesticides.

- Or, repeatedly apply Garlon 4 or a glyphosate herbicide as a 4-percent solution (1 pint per 3-gallon mix) in water with a surfactant, a less effective treatment that has no soil activity to damage surrounding plants.

- Cut all vertical climbing stems to prevent fruiting and spread by birds.



### English Ivy

English ivy (*Hedera helix*) is an evergreen vine climbing to 90 feet (28 m) that forms dense ground cover and climbs by aerial roots. It has thick dark-green leaves with whitish veins when juvenile that are heart-shaped with three to five pointed lobes, later becoming broadly lanceolate, and terminal flower clusters in summer that yield dark-purple berries in winter and spring.

#### Recommended control procedures:

- Thoroughly wet all leaves (until runoff) with one of the following herbicides in water with a surfactant (July to October for successive years): Garlon 3A or Garlon 4 as a 3- to 5-percent solution (12 to 20 ounces per 3-gallon mix) or a glyphosate herbicide as a 4-percent solution (1 pint per 3-gallon mix). Use a string trimmer to reduce growth layers and injure leaves for improved herbicide uptake. Cut large vines and apply these herbicides to cut surfaces.
- Or, apply Garlon 4 as a 20-percent solution in basal oil, vegetable oil, crop oil concentrate, diesel fuel, or kerosene (2.5 quarts per 3-gallon mix) or apply undiluted Pathfinder II as a basal spray to large vines being careful to avoid the bark of the host tree.



### Japanese Honeysuckle

Japanese honeysuckle (*Lonicera japonica*) is a semievergreen to evergreen woody vine, high climbing and trailing to 80 feet (24 m), branching and often forming arbors in forest canopies and/or ground cover under canopies. It has opposite leaves and long woody rhizomes that sprout frequently and make control difficult.

#### Recommended control procedures:

- Apply Escort\* XP with a surfactant to foliage June to August—either by broadcast spraying 2 ounces per acre in water (0.6 dry ounces per 3-gallon mix) or by spot spraying 2 to 4 ounces per acre in water (0.6 to 1.2 dry ounces per 3-gallon mix).
- Or, treat foliage with one of the following herbicides in water with a surfactant (July to October or during warm days in early winter) keeping

spray away from desirable plants: a glyphosate herbicide as a 2-percent solution (8 ounces per 3-gallon mix) or Garlon 3A or Garlon 4 as a 3- to 5-percent solution (12 to 20 ounces per 3-gallon mix).

- Or, cut large vines just above the soil surface and immediately treat the freshly cut stem with a glyphosate herbicide or Garlon 3A as a 20-percent solution (2.5 quarts per 3-gallon sprayer) in water with a surfactant July to October (safe to surrounding plants).
- Prescribed burning in spring will reduce dense ground mats and sever climbing vines for more effective herbicide treatments to resprouting vines.



### Kudzu

Kudzu (*Pueraria montana*) is a deciduous twining, trailing, mat-forming, woody leguminous vine 35 to 100 feet (10 to 30 m) with lobed three-leaflet leaves. Large root crowns that increase in size with age are difficult to control. Prescribed burning in spring can clear debris, sever climbing vines, and reveal hazards before summer applications.

#### **Recommended control procedures:**

- Thoroughly wet all leaves (until runoff) with one of the following herbicides in water with a surfactant: July to October for successive years when regrowth appears—Tordon 101<sup>\*†</sup> as a 3-percent solution (12 ounces per 3-gallon mix) or Tordon K<sup>\*‡</sup> as a 2-percent solution (8 ounces per 3-gallon mix), either by broadcast or spot spray—spraying climbing vines as high as possible. July to September for successive years—Escort<sup>\*</sup> XP at 3 to 4 ounces per acre in water (0.8 to 1.2 dry ounces per 3-gallon mix)—or when safety to surrounding vegetation is desired, Transline<sup>†</sup> as a 0.5-percent solution in water (2 ounces per 3-gallon mix); spray climbing vines as high as possible or cut vines that are not controlled after herbicide treatment.
- For partial control, repeatedly apply Garlon 4 or a glyphosate herbicide as a 4-percent solution in water (1 pint per 3-gallon mix) with a surfactant during the growing season. Cut large vines and immediately apply these herbicides to the cut surfaces. Or, apply Garlon 4 as a 20-percent solution in basal oil, vegetable oil, crop oil concentrate, diesel fuel, or kerosene (2.5 quarts per 3-gallon mix) or apply undiluted Pathfinder II as a basal spray to large vines as a basal spray (January to April), which controls vines less than 2 inches in diameter.

<sup>\*</sup>Nontarget plants may be killed or injured by root uptake.

<sup>†</sup>Transline controls a narrow spectrum of plant species.

<sup>‡</sup>When using Tordon herbicides, rainfall must occur within 6 days after application for needed soil activation. Tordon herbicides are Restricted Use Pesticides.



### Vincas, Periwinkles

Common periwinkle (*Vinca minor*) and bigleaf periwinkle (*V. major*) are evergreen to semievergreen (leaves always present) somewhat-woody, trailing or scrambling vines to 3 feet (1 m) long and upright to 1 foot (30 cm) that form dense ground cover. They have opposite lanceolate-to-heart-shaped leaves and five-petaled pinwheel-shaped violet single flowers. Viable seed appear to be produced only rarely.

#### **Recommended control procedures:**

- Thoroughly wet all leaves (until runoff) with one of the following herbicides in water with a surfactant (July to October for successive years): Tordon 101<sup>\*†</sup> as a 3-percent solution (12 ounces per 3-gallon mix), Tordon K<sup>\*‡</sup> as a 2-percent solution (8 ounces per 3-gallon mix), or Garlon 4 as a 4-percent solution (15 ounces per 3-gallon mix).
- Or, during the growing season, repeatedly apply Garlon 4 or a glyphosate herbicide as a 2-percent solution in water (8 ounces per 3-gallon mix) with a surfactant. In winter, herbicide treatments should be limited to warm days.



### Chinese Wisteria, Japanese Wisteria

Chinese wisteria (*Wisteria sinensis*) and Japanese wisteria (*W. floribunda*) are deciduous high climbing, twining, or trailing leguminous woody vines to 70 feet (20 m) with long pinnately compound leaves and showy spring flowers. Chinese and Japanese wisterias are difficult to distinguish due to possible hybridization.

#### **Recommended control procedures:**

- Thoroughly wet all leaves (until runoff) with one of the following herbicides in water with a surfactant:
- July to October for successive years when regrowth appears—Tordon 101<sup>\*†</sup> as a 3-percent solution (12 ounces per 3-gallon mix), Tordon K<sup>\*‡</sup> as a 2-percent solution (8 ounces per 3-gallon mix), or Garlon 4 as a 4-percent solution (15 ounces per 3-gallon mix)
  - July to September for successive years when regrowth appears—Transline<sup>\*†</sup> as a 0.5-percent solution in water (2 ounces per 3-gallon mix) when safety to surrounding vegetation is desired
  - September to October with repeated applications—a glyphosate herbicide as a 4-percent solution (1 pint per 3-gallon mix)

## Nonnative Grasses

Nonnative grasses continue to spread and increasingly reside along highway right-of-ways and thus gain access to adjoining lands. Most nonnative invasive grasses are highly flammable, increasing fire intensities, subjecting firefighters to increased risk, and spreading even faster after wildfire or a prescribed burn. Nonnative grasses have become one of the most insidious problems in the field of wildlife management on pasture and prairie lands, because they have little wildlife value and leave no room for native plants. Repeated applications of herbicides are required for control.



### Giant Reed

Giant reed (*Arundo donax*) is a giant leafy reed grass to 20 feet (6 m) in height that forms thickets in distinct clumps. It has cornlike gray-green and hairless leaves jutting from stems and drooping at the ends. Erect plumelike terminal panicles of flowers and seed heads appear in late summer and persist through winter. Seed are not viable.

#### Recommended control procedures:

Thoroughly wet all leaves with one of the following herbicides in water with a surfactant (September or October with multiple applications to regrowth):

- A glyphosate herbicide as a 4-percent solution (1 pint per 3-gallon mix)
- Arsenal AC\* as a 1-percent solution (4 ounces per 3-gallon mix)
- A combination of the two herbicides



### Tall Fescue

Tall fescue (*Lolium arundinaceum*, formerly *Festuca arundinacea* and *F. elatior*) is an erect, tufted cool-season perennial grass, 2 to 4 feet (60 to 120 cm) in height. It has whitish-eared areas where leaf blades connect to the stem, and the stem has swollen nodes. Dark-green seedstalks and leaves appear in late winter, usually flowering in spring (infrequently in late summer). This grass is dormant in midsummer. Most tall fescue is infected with a fungus that can reduce weight gains and lower reproductive rates in livestock, while adversely affecting the nutrition of songbirds and Canada geese. Tall fescue monocultures are generally poor habitat for wildlife.

\*Nontarget plants may be killed or injured by root uptake.

#### Recommended control procedures:

- On forest lands, apply a glyphosate herbicide as a 0.5-percent solution in water (2 quarts per 10 gallons mix per acre), or Arsenal AC\* as a 1-percent solution (25 ounces per 20 gallons mix per acre) in spring.
- On noncroplands, apply 10 to 12 ounces of Plateau or 20 to 24 ounces of Journey per 20 gallons mix per acre (consult the label for additives) in spring. Mixing Plateau or Journey with a glyphosate herbicide will improve control but may damage associated native plants. Vantage (sethoxydim), Poast (sethoxydim), Assure (quizalofop), and Select (clethodim) may be useful on pastures, but they are usually more costly than a glyphosate mix with Plateau or Journey.
- Early spring burning—if repeated—inhibits fescue and encourages native warm-season grasses.



### Cogongrass

Cogongrass (*Imperata cylindrica*) is an aggressive, colony-forming dense erect perennial grass 1 to 5 feet (30 to 150 cm) in height. It has tufts of long leaves, yellow-green blades (each with an off-center midvein and finely saw-toothed margins), and silver-plumed flowers and seeds in spring, arising from sharp-tipped branching rhizomes. Older infestations will be more difficult to control.

#### Recommended control procedures:

- Thoroughly wet all leaves with one of the following herbicides in water with a surfactant (September or October with multiple applications to regrowth): Arsenal AC\* as a 1-percent solution (4 ounces per 3-gallon mix), a glyphosate herbicide as a 4-percent solution (1 pint per 3-gallon mix), or combination of the two herbicides.
- Repeat before flowering in spring to suppress seed production and again in successive years for eradication.



### Nepalese Browntop

Nepalese browntop (*Microstegium vimineum*) is a sprawling, dense, mat-forming annual grass, 0.5 to 3 feet (15 to 90 cm) long with stems growing to 1 to 3 feet (30 to 89 cm) in height, often bending over and rooting at nodes to form extensive infestations. It has alternate, lanceolate leaf blades to 4 inches (10 cm) long with off-center veins and thin seed heads in summer and fall. Apply treatment to stop seed production.

**Recommended control procedures:**

- Apply a glyphosate herbicide as a 2-percent solution in water (8 ounces per 3-gallon mix) with a surfactant in summer. Or, apply Vantage (see label) for situations that require more selective control and less impact on associated plants.
- Repeat treatments for several years to control abundant germinating seeds. Mowing or pulling just before seed set will also prevent seed buildup in the soil seed bank.

**Chinese Silvergrass**

Chinese silvergrass (*Miscanthus sinensis*) is a tall, densely tufted, perennial grass, upright to arching, 5 to 10 feet (1.5 to 3 m) in height. It has long, slender, and upright-to-arching leaves with whitish upper midveins and many loosely plumed panicles turning silvery to pinkish in fall.

**Recommended control procedures:**

Thoroughly wet all leaves with one of the following herbicides in water with a surfactant (September or October with multiple applications to regrowth):

- Arsenal AC\* as a 1-percent solution (4 ounces per 3-gallon mix)
- A glyphosate herbicide as a 4-percent solution (1 pint per 3-gallon mix)
- A combination of the two herbicides

**Bamboos**

Golden bamboo (*Phyllostachys aurea*) and other nonnative bamboos (*Phyllostachys* spp. and *Bambusa* spp.) are perennial infestation-forming grasslike plants 16 to 40 feet (5 to 12 m) in height. They have jointed cane stems and bushy tops of lanceolate leaves in fan clusters on grasslike stems, often golden green.

**Recommended control procedures:**

- Thoroughly wet all leaves with one of the following herbicides in water with a surfactant (September or October with multiple applications to regrowth): Arsenal AC\* as a 1-percent solution (4 ounces per 3-gallon mix), a glyphosate herbicide as a 4-percent solution (1 pint per 3-gallon mix), or combination of the two herbicides.

- Cut just above ground level and treat stems immediately with a double-strength batch of the same herbicides or herbicide mixture.

**Nonnative Ferns**

Japanese climbing fern is presently the only nonnative invasive fern in the temperate parts of the South.

**Japanese Climbing Fern**

Japanese climbing fern (*Lygodium japonicum*) is a climbing and twining, perennial viney fern to 90 feet (30 m), often forming mats of shrub- and tree-covering infestations. It has lacy finely divided leaves along green-to-orange-to-black wiry vines.

**Recommended control procedures:**

Thoroughly wet all leaves with one of the following herbicides in water with a surfactant (July to October):

- Escort\* XP at 1 to 2 ounces per acre in water (0.3 to 0.6 dry ounces per 3-gallon mix) and as a mixture with a glyphosate herbicide
- Arsenal AC\* as a 1-percent solution (4 ounces per 3-gallon mix)
- Glyphosate herbicide, Garlon 3A, or Garlon 4 as a 4-percent solution (1 pint per 3-gallon mix), or a combination of these herbicides

**Nonnative Forbs and Subshrubs**

Forbs are broadleaf herbaceous plants and subshrubs are short semi-woody plants. Control treatments are usually by foliar sprays of herbicides.

**Garlic Mustard**

Garlic mustard (*Alliaria petiolata*) is an upright biennial forb in small-to-extensive colonies under forest canopies, characterized by a faint-to-strong garlic odor from all parts of the plant when crushed (odor fading as fall approaches). It has basal rosettes of broadly arrow-point shaped leaves with wavy margins in the first year (remaining green during winter), a 2- to 4-foot (60- to 120-cm) flower stalk and terminal clusters of flowers with four white petals in the second year, and eventually dead plants with long slender seed pods after June of the second year. Stand density varies yearly depending on germination requirements of

\*Nontarget plants may be killed or injured by root uptake.

seeds in the soil seed bank, with a single crop germinating over a 2- to 4-year period.

**Recommended control procedures:**

- To control two generations, thoroughly wet all leaves with a glyphosate herbicide as a 2-percent solution in water (8 ounces per 3-gallon mix) during flowering (April through June). Include a surfactant unless plants are near surface waters.
- In locations where herbicides cannot be used, pull plants before seed formation. Repeated annual prescribed burns in fall or early spring will control this plant, while “flaming” individual plants with propane torches has also shown preliminary success.



**Shrubby Lespedeza, Chinese Lespedeza**

Shrubby lespedeza (*Lespedeza bicolor*) and Chinese lespedeza (*L. cuneata*) are perennials, with three-leaflet leaves, that remain standing dormant most of the winter and form dense stands that prevent forest regeneration and land access. Shrubby lespedeza is a much-branched legume up to 10 feet (3 m) in height with small purple-pink pealike flowers, and single-seeded pods. Chinese lespedeza is not really a shrub, but a semiwoody ascending-to-upright leguminous forb to 6 feet (2 m) in height with many leaves feathered along erect slender whitish stems that often branch in the upper half and tiny cream-colored

flowers in leaf axils during summer. Seed of both are long lived in the soil seed bank and require long-term monitoring after control treatments. Prescribed burning can promote spread of the infestation margins.

**Recommended control procedures:**

- Thoroughly wet all leaves with one of the following herbicides in water with a surfactant (July to September): Garlon 4 as a 2-percent solution (8 ounces per 3-gallon mix), Escort\* XP at three-fourths of an ounce per acre (0.2 dry ounces per 3-gallon mix), Transline† as a 0.2-percent solution (1 ounce per 3-gallon mix), a glyphosate herbicide as a 2-percent solution (8 ounces per 3-gallon mix), or Velpar L\* as a 2-percent solution (8 ounces per 3-gallon mix).
- Mowing 1 to 3 months before herbicide applications can assist control.

\*Nontarget plants may be killed or injured by root uptake.

† Transline controls a narrow spectrum of plant species.



**Tropical Soda Apple**

Tropical soda apple (*Solanum viarum*) is an upright, thorny perennial sub-shrub or shrub, 3 to 6 feet (1 to 2 m) in height, characterized by remaining green year-round in most southern locations. It has oak-shaped leaves, clusters of tiny white flowers, and golf-ball size fruit that are mottled green white turning to yellow in late summer to fall, which have a sweet smell attractive to livestock and wildlife. Even green fruit contain viable seeds. Report infestations to county agents for treatment under a federally sponsored eradication program.

**Recommended control procedures for isolated sightings:**

- Thoroughly wet leaves and stems with one of the following herbicides in water with a surfactant at times of flowering before fruit appear: Garlon 4 (or Remedy in pastures) or Arsenal AC\* as a 2-percent solution (8 ounces per 3-gallon mix); Mileston VM as a 0.5-percent solution (2 ounces per 3-gallon mix) applied as 10 gallons per acre; a glyphosate herbicide as a 3-percent solution in water (12 ounces per 3-gallon mix).
- Collect and destroy fruit to prevent reestablishment.
- If mowing is used to stop fruit production, delay herbicide applications until 50 to 60 days to ensure adequate regrowth.

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- California Exotic Plant Pest Council: [www.caleppc.org](http://www.caleppc.org)
- Florida Exotic Plant Pest Council: [www.fleppc.org](http://www.fleppc.org)
- Southeast Exotic Plant Pest Council: [www.se-eppc.org](http://www.se-eppc.org)
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- USDA Animal and Plant Health Inspection Service's Federal Noxious Weed Program: [www.aphis.usda.gov/ppq/weeds](http://www.aphis.usda.gov/ppq/weeds)
- USDA, Forest Service, Southern Research Station: [www.srs.fs.fed.us](http://www.srs.fs.fed.us) or [www.srs.fs.usda.gov](http://www.srs.fs.usda.gov)
- USDA Natural Resources Conservation Service's National Noxious Weed Program: <http://dogwood.itc.nrcs.usda.gov:90/Weeds>

## Sources of Native Plants

USDA Natural Resources Conservation Service's Plant Materials Program: <http://plant-materials.nrcs.usda.gov/>

## Glossary of Important Terms

**acute tip:** terminating in a sharp or well-defined point, with more or less straight sides.

**allelopathic:** referring to a plant known to emit chemicals that retard the growth or seed germination of associated plants.

**alternate leaves:** one leaf at each node and alternating on sides of the stem.

**alternately whorled leaves:** one leaf at each node and their points of attachment forming a spiral up the stem.

**annual:** a plant that germinates, flowers, produces seed, and dies within one growing season.

**anthers:** the pollen-producing portion of the stamen or male reproductive part of a flower.

**appressed:** lying close to or flattened against.

**arbor:** vine entanglement within the crowns of shrubs or trees.

**ascending:** tending to grow upward, slightly leaning to somewhat erect.

**asymmetric:** not identical on both sides of a central line.

**axil:** the angle formed between two structures, such as between a leaf and the stem.

**axillary:** located in an axil or angle.

**berry:** a fleshy or pulpy fruit from a single ovary with one to many embedded seeds, such as tomato and grape.

**biennial:** a plant that lives for about 2 years, typically forming a basal rosette in the first year, flowering and fruiting in the second year, and then dying.

**bipinnately compound:** twice pinnately compound; a pinnately compound leaf being again divided.

**blade:** the expanded part of a leaf.

**bract:** a small leaf or leaflike structure at the base of a flower, inflorescence, or fruit.

**branch scar:** a characteristic marking on a stem where there was once a branch.

**bud:** an undeveloped flower, flower cluster, stem, or branch, often enclosed by reduced or specialized leaves termed bud-scales.

**bulbil:** an aerial tuber.

**bunch grass:** a grass species with a cluster-forming growth habit; a grass growing in an upright large tuft.

**bundle scar:** tiny raised area(s) within a leaf scar, from the broken ends of the vascular bundles, found along a twig.

**calyx:** the collective term for all of the sepals of a flower, commonly green, but occasionally colored and petal-like or reduced to absent.

**calyx tube:** a tubelike structure formed by wholly or partially fused sepals.

**cane:** very tall grasses, for example, switchcane and bamboo; tall, stiff stem.

**capsule:** a dry fruit that splits into two or more parts at maturity, for example, the fruit of tallowtree.

**clasping:** base that partly or wholly surrounds another structure, such as a leaf base surrounding a stem.

**collar:** the area of a grass leaf blade where it attaches to the sheath.

**colony:** a stand or group of one species of plant, from seed origin or those connected by underground structures such as rhizomes.

**cordate:** heart-shaped.

**cordate base:** a leaf base resembling the double-curved top of a heart shape.

**corolla:** the collective name of all of the petals of a flower.

**cotyledon:** the initial leaves on a plant germinant.

**crenate:** margin with shallow, rounded teeth; scalloped.

**cultivar:** a form or variety of plant originating under cultivation.

**deciduous:** falling off or shedding; not persistent; refers to leaves, bracts, stipules, and stipels.

**dioecous:** plants with unisexual flowers and having male and female flowers on separate plants.

**drupe:** a fleshy fruit, surrounding a stone (endocarp) that contains a single seed.

**ellipsoid:** a three-dimensional ellipse; narrow or narrowly rounded at ends and widest in the middle.

**elliptic:** oval-shaped; broadest at the middle and rounded and narrower at the two equal ends.

**entire:** margins without teeth, notches, or lobes.

**even pinnately compound:** a leaf with two or more leaflets arranged opposite along a leafstalk or rachis.

**evergreen:** green leaves remaining present through winter.

**exotic:** foreign; originating on a continent other than North America.

**fern:** a broadleaf pteridophyte of the order Filicales, typically with much-divided leaves and spore reproduction.

**filament:** the long, slender stalk of a stamen that supports the anther.

**forb:** a broad-leaved herbaceous (nonwoody) plant.

**frond:** a large, once- or twice-divided leaf, here referring to fern leaves.

**gland:** a structure which contains or secretes a sticky, shiny, or oily substance.

**grain:** a grass seed.

**grass:** plants of the family Poaceae, typically with narrow leaves and jointed stems.

**hairy:** surface features of plants, many protruding filaments or glands that give texture; pubescent.

**herb or herbaceous:** a plant with no persistent aboveground woody stem, dying back to ground level at the end of the growing season.

**hip fruit:** the fruit of the genus *Rosa* that is ovoid, fleshy, and usually red when ripe.

**husk:** the outer scalelike coverings of a grass seed.

**inflorescence:** the flowering portion of a plant; the flower cluster; the arrangement of flowers on the stem.

**internode:** the space on an herb or grass stem between points of leaf attachment.

**lanceolate:** lance-shaped; widest at or near the base and tapering to the apex.

**lateral:** on or at the sides, as opposed to terminal or basal.

**leaflet:** an individual or single division of a compound leaf.

**leaf scar:** the scar or marking left on a twig after leaf fall.

**leafstalk:** the main stem of a compound leaf, rachis.

**legume:** a plant in the family Fabaceae; a dry, splitting fruit, one-to-many seeded, derived from a single carpel and usually opening along two sutures, confined to the Fabaceae.

**legume pod:** the fruit of a legume.

**lenticel:** a raised dot or short line, usually corky to white in color, on twigs and stems.

**ligule:** a tiny membranous projection, often fringed with hairs, from the summit of the sheath (top of the throat), where the leaf attaches, in many grasses and some sedges.

**linear:** long and narrow shaped with roughly parallel sides.

**lobed leaf:** margins having deep indentations resulting in rounded-to-pointed portions.

**margin:** the edge of a leaf blade or flower petal; the edge of a forest.

**marsh:** a poorly drained portion of the landscape with shallow standing water most of the year, most extensive around intertidal zones.

**membranous:** thin, filmy, and semitransparent.

**midvein:** the central vein of a leaf or leaflet.

**milky sap:** sap being opaque white and often of a thick consistency.

**monocot:** the class of plants having one cotyledon (or monocotyledonous) and parallel leaf veins, including grasses, sedges, lilies, and orchids.

**mottled:** spotted or blotched in color.

**node:** the point of leaf or stem attachment, sometimes swollen on grass stems where the sheath is attached.

**nutlet:** a small, dry, nonsplitting fruit with a woody cover, usually containing a single seed.

**oblanceolate:** lance-shaped with the widest portion terminal; inversely lanceolate.

**oblong:** a shape two-to-four times longer than wide with nearly parallel sides.

**obovate:** two-dimensional egg-shaped, with the attachment at the narrow end; inverted ovate.

**odd pinnately compound:** pinnately compound leaves with a terminal leaflet rather than a terminal pair of leaflets or a terminal tendril.

**opposite:** leaves born in pairs at each node on opposite sides of the stem.

**ornamental:** a plant cultivated for aesthetic purposes.

**oval:** broadly elliptic in shape, with the width greater than half of the length.

**ovate:** two-dimensional egg-shaped, with the attachment at the wider end.

**ovoid:** three-dimensional egg-shaped, with the attachment at the wider end.

**panicle:** an irregularly branched inflorescence with the flowers maturing from the bottom upward.

**pealike flower:** irregular flower characteristic of sweet peas and beans in the family Fabaceae.

**perennial:** any plant that persists for three or more growing seasons, even though it may die back to rhizomes or rootstock during the dormant period.

**petiole:** a stalk that attaches the leaf blade to the stem.

**pinnately compound:** a compound leaf with leaflets arising at intervals along each side of an axis or rachis (leafstalk).

**pistil:** the female reproductive portion of a flower, usually consisting of an ovary, style, and stigma.

**pith:** the soft or spongy central tissue in some twigs and stems, sometimes absent making the stem hollow.

**plume:** a tuft of simple or branched bristles.

**pod:** an elongated dry fruit that usually splits open upon maturity, such as a legume.

**raceme:** an elongated, unbranched inflorescence with stalked flowers generally maturing from the bottom upward.

**rachis:** the main axis of an inflorescence or compound leaf.

**recurved:** gradually curved backward or downward.

**rhizome:** an underground stem, usually horizontal and rooting at nodes.

**right-of-way:** a narrow corridor of land in straight sections across the landscape, repeatedly cleared and kept in low vegetation, to accommodate roadway structures, poles and wire for electrical and telephone transmissions, and pipelines.

**riparian:** situated or dwelling on the bank or floodplain of a river, stream, or other body of water.

**root collar:** the surface area of a perennial where the stem and roots join.

**rootcrown:** the part of a perennial plant where the stem and roots join, often swollen.

**root sprout:** a plant originating from a root or rhizome that takes root at nodes.

**rootstock:** the part of a perennial plant near the soil surface where roots and shoots originate.

**rosette (basal rosette):** a circular cluster of leaves on or near the soil surface radiating from a rootcrown, as in dandelions.

**scaly:** covered with minute flattened, platelike structures.

**semievergreen:** tardily deciduous or maintaining green foliage during winter only in sheltered locations.

**semiwoody plants:** species that have mostly woody stems and deciduous leaves, usually shorter than shrubs.

**sepal:** a single unit of the calyx; the lowermost whorl of flower parts.

**serrate:** margin with sharp forward-pointing teeth.

**sessile:** attached without a stalk, such as a leaf attached without a petiole.

**shade intolerant:** a plant that cannot grow and reproduce under the canopy of other plants but needs direct sunlight.

**shade tolerant:** a plant that can grow and reproduce under the canopy of other plants.

**sheath:** a more or less tubular portion of a structure surrounding another structure, such as the tubular portion of leaf bases of grasses that surround the stem.

**shrub:** a wood plant, typically multistemmed and shorter than a tree.

**simple:** not compound; single; undivided; unbranched.

**smooth:** not rough to the touch, usually hairless (or only finely hairy) and scaleless.

**spherical:** round in three dimensions, like a ball; synonymous with globose.

**spike:** an elongated, unbranched inflorescence with sessile or unstalked flowers along its length, the flowers generally maturing from the bottom upward.

**sporangia:** the case bearing spores on ferns.

**spore:** a minute (almost not visible), one-celled reproductive body of ferns, asexual.

**stamen:** the male reproductive portion of a flower, usually consisting of an anther and filament.

**stipules:** the pair of leaflike structures at the base of a leaf petiole in some species.

**stone:** a hard woody structure enclosing the seed of a drupe.

**subshrub:** a very short woody plant.

**subtend:** a structure just below another, such as flowers subtended by bracts.

**succulent:** fleshy or soft tissue.

**swamp:** a wooded or brushy area usually having surface water.

**synonym:** a discarded scientific name for a plant; another common name.

**taproot:** the main root axis; a long vertical, central root.

**tardily deciduous:** maintaining at least some green leaves into winter or early spring.

**terminal:** at the end.

**thorn:** a stiff, curved, sharply pointed modified stem, sometimes branched.

**throat:** the area inside a flower tube formed from fused petals; the upper side of a grass collar where the blade meets the sheath.

**toothed:** margin with outward pointed lobes; coarsely dentate.

**trailing:** running along the soil or leaf litter surface.

**tuber:** a thickened portion of a root or rhizome modified for food storage and vegetative propagation, such as a sweet potato.

**tubular:** a cylindrical structure, such as formed from fused petals or sepals.

**twig:** short leaf branch.

**umbel:** a compound flower with stems arising and radiating from one point of attachment.

**variegated:** marked with stripes or patches of different colors.

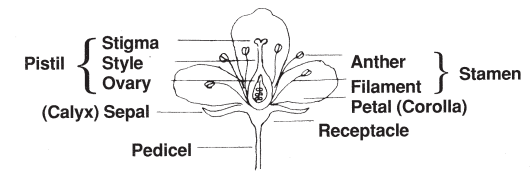
**vine:** a long trailing or climbing plant.

**whorled:** three or more leaves in a circular arrangement arising from a single node or radiating at different angles to the main stem.

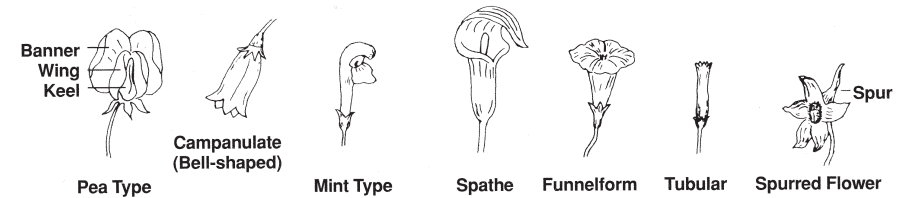
**wiry:** thin, flexible, and tough.

**yam:** a tuber or potato-like organ

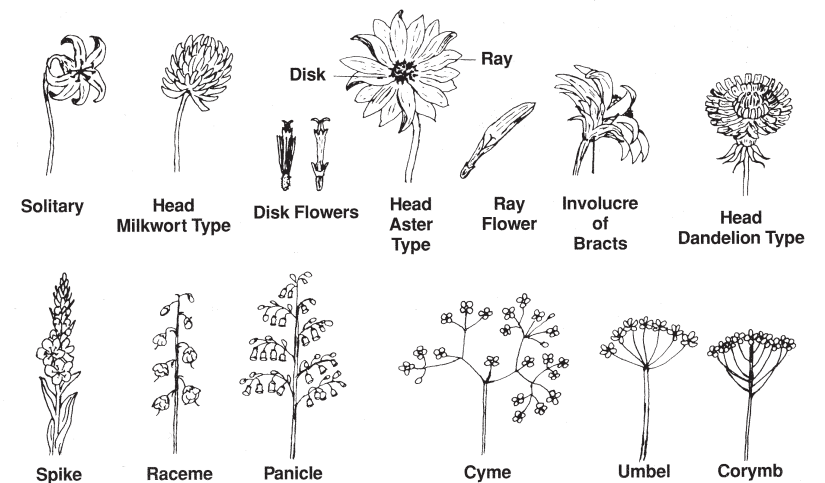
## FLOWER PARTS



## FLOWER TYPES

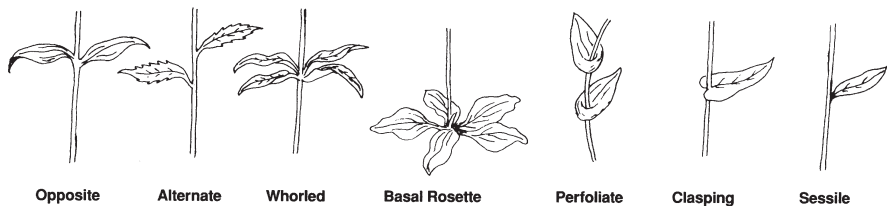


## INFLORESCENCES

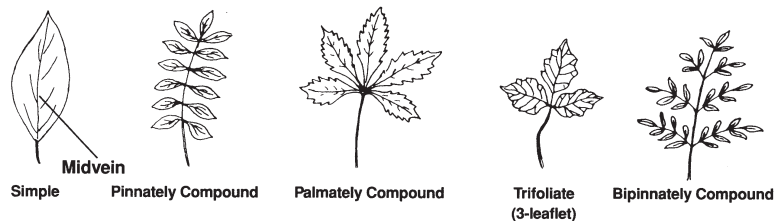


Flower parts, flower types, and inflorescences.

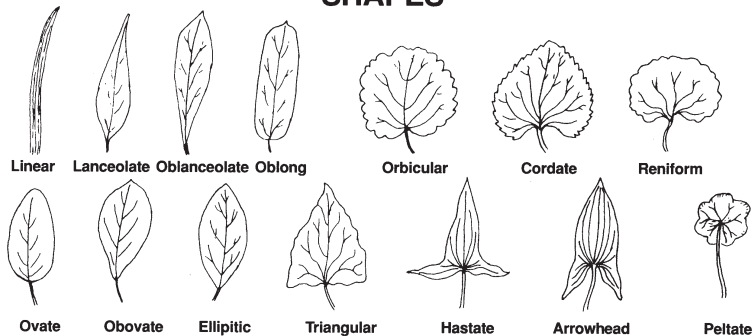
### LEAF ARRANGEMENTS



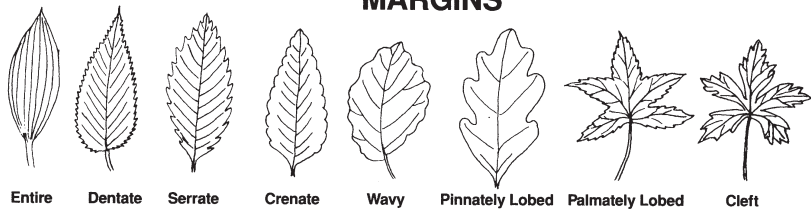
### LEAF DIVISIONS



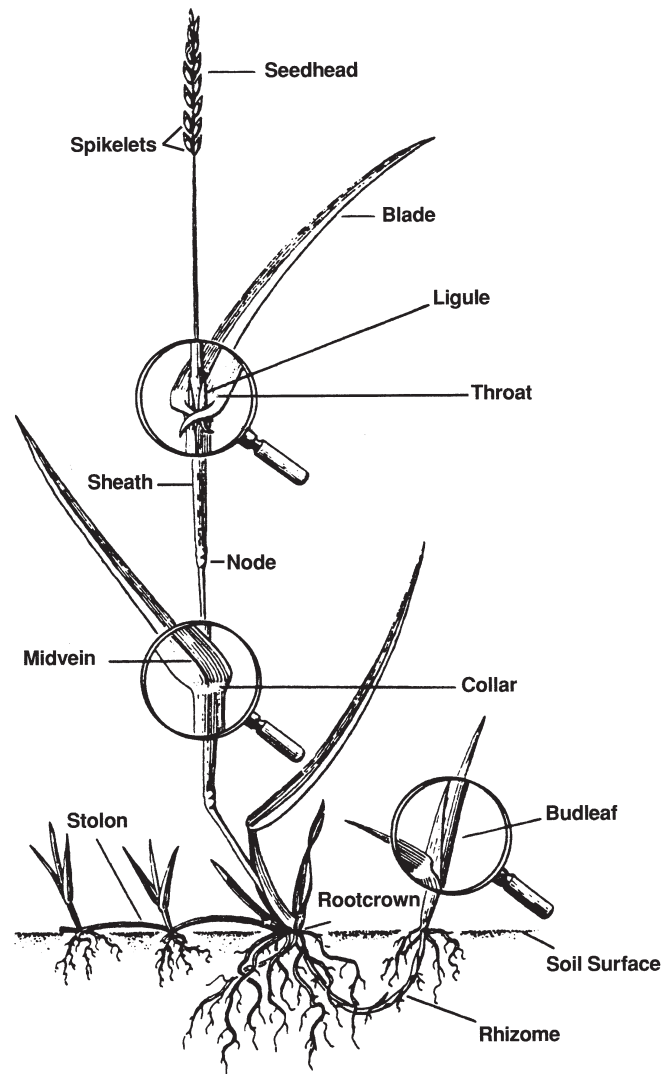
### SHAPES



### MARGINS



Leaf arrangements, leaf divisions, shapes, and margins.



Parts of a grass plant.

### **Pesticide Precautionary Statement**

Pesticides used improperly can be injurious to humans, animals, and plants. Follow the directions and heed all precautions on the labels

Store pesticides in the original containers under lock and key—out of reach of children and animals—and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish and wildlife. Do not apply pesticides when there is danger of drift, when honeybees or other pollinating insects are visiting plants, or in ways that may contaminate or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dust; wear protective clothing and equipment if specified on the container.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed them. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash thoroughly.

Do not clean spray equipment or dump excess spray material near ponds, streams, or wells. Because it is difficult to remove all traces of herbicides from equipment, do not use the same equipment for insecticides or fungicides that you use for herbicides.

**Dispose of empty pesticide containers promptly and in accordance with all applicable Federal, State, and local laws.**

NOTE: Some States have restrictions on the use of certain pesticides. Check your State and local regulations. Also, because registrations of pesticides are under constant review by the U.S. Environmental Protection Agency, consult your State forestry agency, county agricultural agent or State extension specialist to be sure the intended use is still registered.

Use of trade names is for reader's information and does not constitute official endorsement or approval by the U.S. Department of Agriculture to the exclusion of any suitable product or process.

**Miller, James H.** 2003. Nonnative invasive plants of southern forests: a field guide for identification and control. Revised. Gen. Tech. Rep. SRS-62. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 93 p.

Invasions of nonnative plants into forests of the Southern United States continue to go unchecked and unmonitored. Invasive nonnative plants infest under and beside forest canopies and dominate small forest openings, increasingly eroding forest productivity, hindering forest use and management activities, and degrading diversity and wildlife habitat. Often called nonnative, exotic, nonindigenous, alien, or noxious weeds, they occur as trees, shrubs, vines, grasses, ferns, and forbs. This book provides information on accurate identification and effective control of the 33 nonnative plants and groups that are currently invading the forests of the 13 Southern States, showing both growing and dormant season traits. It lists other nonnative plants of growing concern, control strategies, and selective herbicide application procedures. Recommendations for preventing and managing invasions on a specific site include maintaining forest vigor with minimal disturbance, constant surveillance and treatment of new unwanted arrivals, and finally rehabilitation following eradication.

**Keywords:** Alien plants, exotic plant control, exotic weeds, herbicide weed control, integrated vegetation management, invasive exotic plants, invasive nonindigenous plants, noxious plant control.



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