

Controlling Invasive Exotic Plants in North Florida Forests¹

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Of the more than 4,000 known plant species growing in Florida, approximately 30% are not native to Florida or the Southeast. Organisms are considered non-native when they occur artificially in locations beyond their known historical native ranges. The term non-native can refer to species brought in from other continents, regions, ecosystems, and habitats. The most important aspect of a non-native (exotic) plant is how it responds to a new environment. An invasive species is one that displays rapid growth and spread, allowing it to establish over large areas. Invasive species are free from the complex array of natural controls, including herbivores, parasites, and diseases, that are present on their native lands. The term noxious is a legal designation used specifically for plant species that have been determined to be major pests of agricultural ecosystems and are subject, by law, to certain restrictions.

Invasive non-native organisms are one of the greatest threats to the natural ecosystems of the United States. According to the U.S. Fish & Wildlife Service, an estimated 42% of the nation's endangered species have declined as a result of encroaching invasive species. Invasive species cause billions of dollars in economic losses and

expenditures each year for agriculture, forestry, range lands, and roadways management (Westbrooks 1998). Known ecological impacts of invasive plants include reduction of biodiversity; loss of and encroachment upon endangered and threatened species; loss of habitat for native insects, birds, and other wildlife; and alterations to the frequency and intensity of fires and disruption of native plant-animal associations such as pollination, seed dispersal, and host-plant relationships. In addition, invasive plants can hybridize with native plants and alter their genetics; they grow rapidly, sometimes girdling native shrubs and trees; they increase the incidence of plant disease and stress in forested areas; and they reduce the amount of space, water, sunlight and nutrients that would otherwise be available for native species.

This publication describes many of the current methods used to manage some of the more common and troublesome invasive exotic plants in north Florida forests. Consult the sources referenced at the end of the paper for additional details about these and several other methods. This publication is intended to assist private forest land-owners in managing their existing forests or establishing

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Use pesticides safely. Read and follow directions on the manufacturer's label.

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new plantations. All of the control methods involve some combination of mechanical and chemical treatments. Biological control agents for some of these plants are currently under investigation. Pictures of each species can be found at the following websites: <http://plants.ifas.ufl.edu/> or in Langeland and Burks's book, "Identification and Biology of Non-Native Plants in Florida's Natural Areas."

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Treatment recommendations involve general herbicide prescriptions that have provided acceptable levels of control in experimental trials and operational experience, and are consistent with product labeling. *Always* follow current herbicide label instructions for determining approved application use sites (i.e., "forests"), herbicide application rates, mixing instructions, personal protective equipment, and use precautions. Additional information about various herbicides used in forestry applications may be found in:

Osiecka, A., and P.J. Minogue. 2011. Forest herbicide characteristics. <http://edis.ifas.ufl.edu/fr345>

Osiecka, A., and P.J. Minogue. 2010. Developing herbicide prescriptions for forest vegetation management. <http://edis.ifas.ufl.edu/fr335>

Osiecka, A., P. Minogue, A. Long, J. Nowak, and M. Mossler. 2009. Herbicides registered for pine plantation management in Florida – 2008. <http://edis.ifas.ufl.edu/fr158>

Trees/Shrubs

Chinese Tallow (*Triadica sebifera*)

Chinese tallow, a.k.a. popcorn tree, was introduced from China in the early 1900s and has since invaded most of the southeastern states. It is a small tree whose seeds are widely dispersed by birds and water runoff. The tree's attractive, light green, heart-shaped leaves that yield bright yellow and orange fall colors have made it a popular ornamental. It is also used by beekeepers for honey production. However, this tree is threatening to become the prominent component of marshes, river margins, and dry uplands within its expanding range. Further planting of this tree is prohibited by the Florida Department of Agriculture and Consumer Services (FDACS), and it is listed as a noxious weed by the

U.S. Department of Agriculture (USDA) and the Exotic Pest Plant Council (EPPC).

CONTROL

Backpack foliar applications are effective on trees less than 8 ft tall to ensure adequate coverage. Cut-stump or basal bark treatments will need to be used on larger trees when using hand-held equipment. Foliar applications are effective from full leaf-out in spring until just prior to the onset of fall colors. Basal bark or cut stump treatments can be performed at any time of the year. See [Table 1](#).

Mimosa or Silk Tree (*Albizia julibrissin*)

Mimosa is a small to medium-sized tree with attractive, fern-like leaves and showy pink flowers. It establishes vigorously on disturbed areas, often spreading by seed from nearby ornamentals. It was introduced to the United States as an ornamental in 1745 and continues to be used as such because of its attractive form, foliage, and flowers. It reproduces both vegetatively and by seed. If cut or top-killed, it will re-sprout quickly, growing 3 feet in a single season. Due to its ability to produce large seed crops and re-sprout when damaged, mimosa is a strong competitor to native trees and shrubs in open areas or forest edges. Dense stands of this tree can significantly reduce sunlight and nutrients available for other plants.

CONTROL

Mimosa can be controlled with the use of mechanical (cutting, chopping, mowing) and chemical treatments. Because of suckers and re-sprouts, chemical treatments are necessary for full control. See [Table 2](#).

Chinese Privet (*Ligustrum sinense*), Japanese Privet (*Ligustrum japonicum*), and Glossy Privet (*Ligustrum lucidum*)

These members of the olive family are shade-tolerant, tall, evergreen-leaved shrubs that can grow to about 30 feet in height. They spread by bird-dispersed seeds or underground runners and form dense stands that prevent pine and hardwood regeneration and/or land access. These plants were introduced from Asia.

CONTROL

Adequate control of these shrubs can be achieved through herbicide application. Often dense thickets of privet need to be cut down or mowed and the sprouts treated with herbicides. See [Table 3](#).

Coral Ardisia (*Ardisia crenata*)

Coral ardisia, or spice ardisia, is an evergreen shrub, 2–6 ft tall, with dark green scallop-margined leaves. Flowers and fruit are produced in axillary, not terminal, clusters, usually drooping below the foliage. Fruit are small, bright red, one-seeded drupes. It was introduced into Florida for ornamental purposes in the early 1900s and has spread and become naturalized in hardwood hammocks across the north part of the state. It does not grow well in full sunlight. Seedlings of native plant species are shaded out where it forms dense thickets of more than 100 plants per square meter.

CONTROL

Seedlings can be hand-pulled. Mowing can keep the plants at ground level and inhibit seed production, but most effective control of this plant can be achieved through herbicide application. With the herbicide treatments below, application timing in mid to late fall, when many native desirable plants are dormant, improves selectivity in control. See [Table 4](#).

Vines

Kudzu (*Pueraria montana*)

Kudzu was introduced into the United States at the Philadelphia Centennial Exposition in 1876. By 1900 kudzu was available through mail order as an inexpensive livestock forage, and was later sold by the USDA to be planted for erosion control purposes along rights-of-way and gullies. It now exists in impenetrable patches as large as 100 acres and will overtop and kill trees, even after they are mature. Kudzu is an aggressive leguminous vine capable of growing 1 foot per day. It can easily grow 60 feet in a single growing season. It also establishes roots sporadically as it covers an area, layering vines and foliage on top of each other. One key to this plant's efficiency is its ability to orient each leaf so that the maximum amount of sunlight possible is absorbed. This multidirectional orientation of leaves also poses special problems with sufficiently wetting the top sides of foliage with herbicide.

CONTROL

Special effort is required to control kudzu. The older the patch, the harder it will be to control and the longer it will take to completely eradicate the plant. In severe cases, follow-up spot treatments may be required for 5 to 10 years.

It is best to first evaluate the kudzu problem by determining the age of the patch. Do this by looking at the root crowns (the top of the primary root). If the root crowns are 2 inches

or larger in diameter, the patch is about 10 years of age or older. In some cases, patches of kudzu greater than 10 years old may require higher rates of herbicide for adequate control. For easiest access, it is best to evaluate kudzu problems in winter when vines and foliage are withered.

Where kudzu is draping trees, a foliar application of Transline[®], as shown in the table below, provides effective control. If kudzu is in a drain or around open water, Veteran 720[™] or Vanquish[™], both labeled for ditch banks, is the best choice. Where kudzu invades hardwoods or young pine stands, a broadcast application of Escort[™] may control the kudzu without harming pines and most hardwoods (with the exception of cottonwoods, elms, and legumes such as redbud or locusts). Transline[™] is specifically formulated to control legumes and other plants. All treatments will likely need to be followed by a second treatment 1 year after the initial treatment. Repeat follow-up treatments until acceptable control is achieved. See [Table 5](#).

Air Potato (*Dioscorea bulbifera*)

This invasive vine from Africa was introduced into Florida in 1905 when a horticulturalist discovered the vine's rapid growth into dense masses. Aside from kudzu, it is the most aggressive invasive vine in Florida. It quickly grows to 60–70 feet in length, high enough to overtop and shade out native trees. The air potato is a member of the yam family and produces many aerial tubers (potato-like growths) called bulbils that are attached to the vines. Bulbils eventually fall off and grow into new plants. It is listed as invasive by EPPC.

CONTROL

Begin by collecting all bulbils, if any, from the ground and removing them from the site. Dispose of the bulbils by putting them in a garbage bag and placing it with yard debris for pick-up. Municipalities dispose of them by incinerating them or incorporating them into hard turf. Bear in mind that many bulbils will be underground: either dig them up or apply herbicide to their emergent vines before they can produce more bulbils.

Once this is done, adequate control can be achieved with the use of herbicides. Guidelines for herbicide control are listed below. Follow-up treatments may be necessary in all cases. See [Table 6](#).

Japanese Climbing Fern (*Lygodium japonicum*) and Old World Climbing Fern (*Lygodium microphyllum*)

Japanese climbing fern is a perennial, delicate looking, climbing vine that forms dense clumps that can cover trees and shrubs. Introduced from Japan as an ornamental, it is scattered throughout the lower portions of Alabama, Georgia, Louisiana, South Carolina, and south into central Florida. Further planting of this vine is prohibited by FDACS.

Japanese and Old World climbing ferns are presently the only non-native invasive ferns in the South. At this time, Old World climbing fern has been a problem for many years in central and south Florida but it is moving north. The northern edge of its advance is now just south of Marion County. Both ferns reproduce readily by wind-blown spores. Animals, equipment, and even people that move through an area with climbing fern are also very likely to pick up spores and move them to other locations on the property or even to other properties.

CONTROL

Adequate control of both climbing ferns has been achieved with multiple applications of glyphosate. Other herbicides have also been used to control Japanese climbing fern. As with most invasive plants, repeated treatments may be necessary. See [Table 7](#).

Grasses

Cogongrass (*Imperata cylindrica*)

Cogongrass is a fast-growing, rhizomatous, perennial grass that has become one of the most troublesome weeds in the world. It was accidentally introduced from Japan as packing material in Mobile, Alabama, in 1911. It was later intentionally introduced from the Philippines into Mississippi as forage. The Mississippi population was shared with the University of Florida, USDA Plant Introduction Station, and Soil Conservation Service in 1937 for forage and soil stabilization. It has proved to be an excellent soil stabilizer, but it is extremely difficult to prevent its escape into unintended areas. It spreads predominantly by transported rhizomes in soil. Cogongrass is listed as a noxious weed by FDACS and USDA, and it is ranked among the 10 most invasive weeds in the world.

CONTROL

Recommendations to control cogongrass are to treat these infestations in the late summer and early fall with

glyphosate and/or imazapyr herbicides (Miller 2003; Faircloth et al. 2005). Fluazifop (Fusilade™) is also an effective option. Because of the extensive rhizomes of cogongrass, repeated applications of herbicide are always necessary to obtain eradication. Remember to thoroughly wet the plants with the herbicide mixture when they are green and growing, not during droughts or time of plant stress. Our demonstration areas indicate that successful treatments have been achieved from late May through October. For all recommendations, retreat as necessary. See [Table 8](#).

Bahiagrass (*Paspalum notatum*), Bermudagrass (*Cynodon dactylon*), Giant Fescue (*Festuca arundinacea*), and Johnsongrass (*Sorghum halepense*)

These grasses have been widely planted and continue to provide forage for livestock, but they can present problems for forest landowners wanting to establish pine stands and/or restore native groundcover on sites they dominate. Introduced as improved pasture grasses from the Mediterranean region of Europe and Africa, they are now distributed worldwide.

CONTROL

Adequate control of these grasses can be achieved with a summer application of Accord® followed by a spring application of an Arsenal AC™ and Oust™ tank mix. See [Table 9](#).

Conclusion

The invasive exotic species described in this publication represent those most likely to be found in forestlands in north Florida. More complete information on these and other non-native plants can be found in Langeland and Burks's "Identification and Biology of Non-native Plants in Florida's Natural Areas" (1998) and Langeland and Stocker's "Control of Non-native plants in Natural Areas of Florida" (1997). Another good source of information on invasive plants can be found in Miller's "Non-native Invasive Plants of Southern Forests" (2003). Other resources, including several on the web are listed below.

Learn to identify these invasive plants, and if they show up on your property treat them quickly before they can spread and increase the difficulty of controlling them. Treated areas should be periodically examined to determine if retreatment is necessary. It is normal for areas infested with invasive plants to receive multiple treatments to effectively reduce the impact and presence of these plants.

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Web Resources

- Cogongrass.org, <http://www.cogongrass.org/>
- Invasive and Exotic Species of North America. <http://www.invasive.org/>
- The Plant Conservation Alliance's Alien Plant Working Group. Weeds Gone Wild: Alien Plant Invaders of Natural Areas, <http://www.nps.gov/plants/alien/index.htm>
- UF/IFAS Center for Aquatic and Invasive Plants, <http://plants.ifas.ufl.edu/>

Table 1. Control of Chinese Tallow

Herbicide	Treatment
Garlon® 4 Ultra	Basal Bark: Treat the trunk to a height of 12 to 15 inches from the ground, thoroughly wetting with 1 to 5% Garlon 4 in oil or oil-water mixtures (see label). ¹ Basal bark treatments are only effective on saplings and seedlings less than 6 inches in stem diameter. (<i>Caution: Garlon 4 can volatilize in hot weather, potentially injuring nearby plants through foliar contact of vapors, so spray early in the day or on cooler days</i>)
Garlon® 3A	Cut Stump: Cut down the tree and spray or paint the cambium layer (the thin band of growing wood, usually light green or light brown, just inside the bark) of the freshly cut stump with 20–50% Garlon 3A in water ^{2,3} . Using a paint brush, or by applying a straight stream from a squirt bottle, place the herbicide on the cambium, where it does the most good. Hack-'n'-squirt: Using a sharp hatchet, make cuts through the bark and cambium at a downward angle with overlapping cuts completely around the tree and spray 1 milliliter (usually one pull on a typical squirt bottle) of a 50% solution of Garlon 3A in water into each cut. (<i>Effective on large trees</i>) Directed Foliar Application: Treat foliage with 1–5% Garlon 3A in water between July and October. Add 0.25 to 1% nonionic surfactant to improve coverage and foliar uptake.
Arsenal® AC or Chopper Gen2	Foliar: Treat foliage of seedlings and saplings with 0.75 to 1% Arsenal AC or 1.5 to 2% Chopper herbicide in water plus 0.25 to 1% non-ionic surfactant ^{3,4} . (<i>Caution: Arsenal is very soil active and has a high potential for non-target damage, especially to hardwood trees and shrubs through root uptake</i>)
¹ Kline and Duquesnel 1996 ² Langeland and Stocker 1997 ³ Langeland 2003 ⁴ Miller et al. 2010.	

Table 2. Control of Mimosa

Herbicide	Treatment
Garlon® 4 Ultra	Basal Bark: Treat the trunk to a height of 12 to 15 inches from the ground, thoroughly wetting with 1 to 5% Garlon 4 in oil or oil-water mixtures (see label). ¹ Basal bark treatments are only effective on saplings and seedlings less than 6 inches in stem diameter. Cut stump: Apply 10% Garlon 4 in oil covering the outer 20% of the stump (the root collar area, sides of the stump, and the outer portions of the cut surface, including the cambium) until wet, but not to the point of runoff ¹ . May be applied year-round. Foliar: Treat all foliage until wet with 2% Garlon 4 in water plus 0.25 to 1% non-ionic surfactant ² . (<i>Caution: Garlon 4 can volatilize in hot weather, potentially injuring nearby plants through foliar contact of vapors, so spray early in the day or on cooler days</i>)
Garlon® 3A	Cut stump: Apply 25–50% solution covering the outer 20% of stump (the root collar area, sides of the stump, and the outer portions of the cut surface, including the cambium) until wet but not to the point of runoff. ^{1,3} May be applied year-round. Foliar: Treat all foliage until wet with 2% Garlon 3A in water plus 0.25 to 1% non-ionic surfactant. ² Hack-'n'-squirt: Using a sharp hatchet, make cuts through the bark and cambium at a downward angle with overlapping cuts completely around the tree and spray 1 milliliter (usually one pull on a typical squirt bottle) of a 50% solution of Garlon 3A in water into each cut.
Accord® XRT II	Cut stump: Apply 50–100% Accord in water covering the freshly cut surface. Foliar: Apply 2% Accord in water plus 0.25–1.0% non-ionic surfactant. ²
Transline®	Foliar: Apply 0.25% Transline plus 4% Garlon 3A in water from July to September ³ . Transline shows selectivity, such that grasses and many native plants are tolerant
¹ Langeland and Stocker 1997 ² Miller 1999 ³ Miller et al. 2010	

Table 3. Control of Privets

Herbicide	Treatment
Accord® XRT II	<u>Foliar</u> : In the fall, spray the foliage of Chinese privet thoroughly with a mixture of 3% Accord in water. ⁴
Garlon® 3A	<u>Cut stump</u> : Apply 25% Garlon 3A in water to cover the entire cut surface immediately after cutting the stem at ground level. ³
Garlon® 4Ultra	<u>Thinline Basal-bark</u> : Apply 15–20% Garlon 4 in oil or oil-water mixture to a narrow band on stems 16 inches from the ground. ^{1, 2} (Basal bark mixtures are herbicides combined with mineral oils [such as diesel], vegetable oils [such as methylated seed oil], or oil-water emulsions as herbicide carriers to penetrate the bark.)
Arsenal® AC	<u>Foliar</u> : Spray all foliage until wet with 1% Arsenal in water plus 0.25 to 1.0% non-ionic surfactant from August to September. ^{2, 4} (Caution: Arsenal is very soil active and has a high potential for non-target damage, especially to hardwood trees and shrubs through root uptake.)
¹ Langeland and Stocker 1997 ² Miller 1999 ³ UF/IFAS Center for Aquatic and Invasive Plants ⁴ Miller et al. 2010	

Table 4. Control of Coral Ardisia

Herbicide	Treatment
Garlon® 4 Ultra	<u>Basal-bark</u> : In fall, apply a basal spray using 10% Garlon 4 in a labeled basal oil to the bottom 12 inches of stems. <u>Foliar</u> : Treat all leaves thoroughly with a 3–5% solution of Garlon 4 in water.
Garlon® 3A	Cut stem treatment with 50% concentration.
Langeland and Stocker 1997	

Table 5. Control of Kudzu

Herbicide	Treatment
Escort® XP + Accord® XRT	<u>Broadcast non-selective</u> : Apply 4 oz Escort plus 3 quarts Accord in 50 to 100 gallons water per acre as a broadcast foliar spray from June through September. Spot treat emerging crowns in June or July annually for eradication.
Garlon 4 Ultra or Accord XRT	<u>For partial control and no soil activity</u> : Broadcast 4% Garlon 4 or 4% Accord using at least 50 gallons water per acre. Repeated applications are needed for control. ⁴
Garlon® 4 Ultra	<u>Cut stem</u> : Cut the stem 5 cm (2 in.) above ground level. Immediately apply a 25% solution to the cross section of the stem. A subsequent foliar application (2% Garlon 4 in water) may be necessary to control new seedlings. ²
Accord® XRT	<u>Cut stem</u> : Cut the stem 5 cm (2 in.) above ground level. Immediately apply a 25% solution to the cross section of the stem. This may require a subsequent foliar application (2–5% Accord in water) during the late growing season. ²
Escort® XP	Broadcast 4 oz. per acre in mid-summer as a foliar spray. ¹ May be used with some selectivity for kudzu control in hardwood stands; however, red maple, cherry, locust, and wax myrtle may be injured by root uptake. <u>In young pine stands</u> : Broadcast 1–2 oz. per acre in mid-summer as a foliar spray. ³ Severe stunting to pines, especially slash, will occur. Use a handgun to direct the spray away from pines when possible.
Transline®	<u>When safety to surrounding vegetation is desired</u> : Broadcast 0.5% solution (2 oz. in 3-gal. sprayer) in July to September as a foliar spray for partial control. ^{3, 4} <u>In young pine stands</u> : Broadcast 22 oz. per acre. ¹
¹ Ezell 1998 ² Johnson 1998 ³ Miller 1999 ⁴ Miller et al. 2010	

Table 6. Control of Air Potato

Herbicide	Treatment
Glyphosate product (Accord®, Roundup®)	<u>Foliar</u> : Spray with a 2–3% solution using a glyphosate product that contains 4 lb active ingredient per gallon. ⁴ Apply late in the growing season for best results. ⁵
Garlon® 4 Ultra	<u>Frill/girdle</u> : Treat girdle cuts with 10% Garlon 4 in water. ¹ <u>Stems</u> : Treat stems emerging from bulbils with 10% Garlon 4 in water. ² <u>Foliar</u> : Thoroughly wet all leaves with 2% Garlon 4 in water from July to October. ³
Garlon® 3A	Treat girdle cuts with 50% Garlon 3A in water. ¹ <u>Foliar</u> : Thoroughly wet all leaves with 2% Garlon 3A in water from July to October. ³
¹ Kline and Duquesnel 1996 ² Langeland and Stocker 1997 ³ Miller 2003 ⁴ UF/IFAS Center for Aquatic and Invasive Plants ⁵ Langeland and Meisenburg 2011	

Table 7. Control of Japanese Climbing Fern

Herbicide	Treatment
Glyphosate product (Accord®, Roundup®)	<u>Foliar</u> : Spray the leaves with a 2–3% solution using a product that has 4 lb active ingredient/gal from July to October. Follow up with annual applications until controlled. ¹
Arsenal® AC	<u>Foliar</u> : Spray the leaves with 2% Arsenal in water plus 0.25% non-ionic surfactant. Follow up with annual applications until controlled. ²
Escort® XP	<u>Foliar</u> : Spray 1 to 2 ounces product per acre. Mix 0.3 to 0.6 dry ounces Escort per 3 gallons water. Add 0.25% non-ionic surfactant. ³
¹ Miller 1999 ² Miller 2003 ³ UF/IFAS Center for Aquatic and Invasive Plants	

Table 8. Control of Cogongrass

Herbicide	Treatment
Arsenal® AC or Chopper®	<u>Foliar</u> : Treat with 1% Arsenal or 2% Chopper solution with 0.25 to 1% non-ionic surfactant or 1% methylated seed oil (MSO) in September or October. Mowing, burning, and/or disking in the spring prior to treatment can enhance the effectiveness of herbicide treatments. ^{2,3,4} Imazapyr, the active ingredient in both Chopper and Arsenal, is a persistent soil active herbicide that will kill or severely damage hardwood trees or shrubs, although pines are tolerant. In hardwood stands, the use of Fusilade or Accord is preferred.
Fusilade®	<u>Foliar</u> : Treat with 0.5 qt. per acre herbicide plus label recommended surfactant. ¹
Glyphosate (Accord® or Roundup®)	<u>Foliar</u> : Treat with a 2–3% solution using a product containing 4 lb active ingredient per gallon when the plants are green and growing. Glyphosate products can be enhanced with addition of 1% methylated seed oil.
¹ Langeland and Stocker 1997 ² Miller 1999 ³ Jose et. al. 2002 ⁴ Miller 2003	

Table 9. Control of Bahiagrass

Herbicide	Treatment
Accord® XRT (or comparable generic product)	Treat with 2% Accord in water in late summer before planting. Then follow up after planting pines with a tank mixture of Arsenal® AC + Oust® XP (see below).
Follow-up tank mix	Using a calibrated sprayer, apply 4 oz Arsenal® AC plus 2 oz Oust® XP over pines in early spring (late March–April) but at least one month after planting to ensure pine vigor and better herbicide tolerance. Do not add surfactants. Where planted rows are present, herbicides may be applied in a 6-ft-wide band centered on the row.
Miller 1999	