

Control of Nonnative Plants in Natural Areas of Florida



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Introduction

Florida's native habitats are protected for historical significance and to protect species, water quality, and water quantity. Setting aside certain lands to be managed for conservation is a method to protect them. According to the Florida Natural Areas Inventory, almost ten million acres of state and federal public lands are currently managed for conservation. Natural areas are conservation lands that have been set aside for the purpose of preserving (or restoring) native plant and animal communities. Natural areas are also maintained by counties and cities in Florida and by private land owners.

Nonnative plants, carried here by humans since European colonization, now threaten the state's remaining natural areas. Of the 4,373 plant species growing on their own without cultivation in Florida, 30% are nonnative (Wunderlin, R.P., and B.F. Hansen. 2003. *Guide to the Vascular Plants of Florida*, Second Edition. Gainesville: University Press of Florida). Many of these nonnative plants were originally introduced as garden ornaments or agricultural crops. Other nonnative plants were accidentally introduced. Regardless of how they arrived, these 1,200 or so nonnative plants grew so well in Florida that they naturalized, meaning that they spread on their own without cultivation into managed or natural areas. While some of these naturalized nonnative plants are not a problem, many became weeds, or undesirable plants, in agricultural and forestry areas, yards, and roadways. When these naturalized nonnative plants spread extensively into natural areas and dominate by displacing native plants and disrupting natural processes such as fire or water flow, they are called invasive. Invasive nonnative plants can be thought of as weeds in natural areas.

The Florida Exotic Pest Plant Council (FLEPPC) is a nonprofit professional organization founded in 1984 to increase public awareness of the significant threat that nonnative invasive plant species pose to native species, communities, and ecosystems, and to develop integrated management and control strategies to halt the spread of exotic species in natural areas. FLEPPC maintains a list of plant species considered by a committee of botanists, ecologists, and land managers to be invasive in Florida. This list is available on the FLEPPC Web site (<http://www.fleppc.org>). The purpose of the FLEPPC list is to alert land managers to plant species that have demonstrated invasiveness in Florida, but the list does not have statutory authority. Plants that are regulated by statute are listed on the Florida Noxious Weed List.

Plant species included in this publication are not limited to either of these lists but are included because they have warranted control measures in at least one natural area in the state and should be viewed as potentially invasive in other natural areas. Some of the plants included here are used in landscaping and are important to the nursery/landscaping industry. Mention of species in this publication does not necessarily mean IFAS recommends limitation of their use. The IFAS Assessment of the Status of Nonnative Plants in Florida is used by IFAS to evaluate the invasiveness of nonnative plants in Florida relative to IFAS recommendations. The results of this assessment can be viewed on the IFAS Center for Aquatic and Invasive Plants Web site (<http://plants.ifas.ufl.edu/assessment/>).

Management of invasive vegetation in natural areas requires control methods that will minimize damage to nontarget vegetation and soil. Often this need for caution necessitates more time and effort than does weed management in agricultural, industrial, or right-of-way settings. Some particular types of vegetation, for example woody or sprawling vegetation, may require removal of standing plant material even after it has been killed if its presence increases fire hazard, reduces aesthetic appeal, or could cause harm as it decays and falls. Control methods include manual removal, mechanical removal, physical controls, herbicides, and biological control alone or in combination with another method.

The purpose of this publication is to provide land managers in Florida with current methods being used to manage nonnative plants in the state. Identification of plant species is not included in this publication. For identification, recognition, and other information about many invasive plant species, readers are referred to *Identification and Biology of Nonnative Plants in Florida's Natural Areas*, 2nd Ed. by K. A. Langeland, H. M. Cherry, C. M. McCormick, and K. A. Craddock Burks (2008), which is available from the IFAS Extension Book Store (800-226-1764 or <http://www.ifasbooks.com>).

Regulatory Agencies

Removal of vegetation in certain areas such as public waters and wetlands is regulated by state and local agencies and a permit may be required. For questions regarding permits to control vegetation in public waters, contact one of the following Florida Wildlife Conservations Commission Regional Biologist Offices:

Northwest, (850) 245-2809
Suwannee River, (386) 758-0464
Southwest, (352) 726-8622
North Central, (321) 228-3364
St. Johns River, (407) 275-4004
South Central, (863) 534-7074
South Gulf, (813) 744-6163
South, (772) 871-5407

For regulatory questions regarding vegetation control in wetlands, contact the Water Management District (WMD) in which you are located:

Northwest Florida WMD, (904) 539-5999
Suwannee River WMD, (386) 362-1001
St. Johns River WMD, (386) 329-4500
Southwest Florida WMD, (352) 796-7211
South Florida WMD, (561) 686-8800

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Control Methods

Education and Prevention

The importation and spread of invasive vegetation can be significantly reduced by public education.

It is the responsibility of those who are aware of the problems caused by invasive nonnative plants to educate others about their identity, impacts, and control so that further ecological degradation of native ecosystems can be reduced.

Biological Control

Classical biological control involved the introduction of reproducing populations of foreign insects or diseases. In Florida, early efforts in invasive nonnative plants in nonagricultural areas focused on aquatic weeds. The first biocontrol agent introduced was the alligatorweed flea beetle (*Agasicles hygrophila*) in 1964 for control of alligatorweed (*Alternanthera philoxeroides*). Subsequently, the alligatorweed thrips (*Aminothrips andersoni*) was released in 1967 and the alligatorweed stem borer (*Vogtia malloi*) in 1971. The flea beetle and stem borer proved to be fairly effective for suppressing growth of alligatorweed, although harsh winters can reduce their populations. Less effective have been introductions of the waterhyacinth weevils (*Neochotina eichhorniae* and *N. bruchi*), released in 1972 and 1974, and the waterhyacinth borer, released in 1977 (*Sameodes albigutalis*) for waterhyacinth (*Eichhornia crassipes*) control. Likewise, effectiveness of a weevil (*Neohydronomous affinis*) and a moth (*Namangama pectinicornis*) released for control of water lettuce (*Pistia stratiotes*) has been unpredictable. Waterhyacinth and water lettuce continue to be problems that require management by other methods. Current biological control research is focused on hydrilla (*Hydrilla verticillata*), waterhyacinth (*Eichhornia crassipes*), melaleuca (*Melaleuca quinquenervia*), and Brazilian pepper (*Schinus terebinthifolius*).

In more recent years, efforts to develop biological controls for natural area weeds have focused on melaleuca (*Melaleuca quinquenervia*), tropical soda apple (*Solanum viarum*), Brazilian pepper (*Schinus terebinthifolius*), and Old World climbing fern (*Lygodium microphyllum*). Current information on the status of these and other biological control programs can be found on the following Web sites: <http://edis.ifas.ufl.edu> and <http://plants.ifas.ufl.edu>.

While classical biological controls are currently under study and will be implemented in the future, their development takes years and they cannot be expected to solve

all invasive plant problems. Biological control programs are typically implemented by state and federal agencies, and the potential role of individual resource managers and the public will depend on the particular action being implemented.

Introduction of animals such as cattle, sheep, goats, or weed-eating fish may also be used to control certain invasive plants. However, environmental impacts of using such nonselective herbivores in natural areas should be carefully considered before implementation.

Manual Removal

Manual removal is very time-consuming but often a major component of effective invasive plant control. Seedlings and small saplings can sometimes be pulled from the ground, but even small seedlings of some plants have tenacious roots that will prevent extraction or cause them to break at the root collar. Plants that break off at the ground will often resprout, and even small root fragments left in the ground may sprout. Therefore, repeated hand pulling or follow-up with herbicide applications is often necessary.

Removal of uprooted plant material is important. Stems and branches of certain species (e.g., ligustrum and melaleuca) that are laid on the ground can sprout roots, and attached seeds can germinate. If material cannot be destroyed by methods such as burning, it should be piled in a secure area that can be monitored and new plants killed as they appear.

Pulling plants from the ground may cause unwanted soil disturbance in some natural areas, especially pine rockland habitat. This soil disturbance may result in further invasion by invasive nonnative plant species, again requiring follow-up control measures.

Mechanical Removal

Mechanical removal involves the use of bulldozers or specialized logging equipment to remove woody plants. Intense follow up with other control methods is essential after the use of heavy equipment because disturbance of the soil creates favorable conditions for regrowth from seeds and root fragments, and recolonization by invasive nonnative plants. Plans for management or replanting of sites with native vegetation following mechanical removal should be carefully developed prior to implementation of mechanical removal. Mechanical removal may not be

appropriate in natural areas because of the disturbance to soils and nontarget vegetation caused by heavy equipment.

Cultural Practices

Prescribed burning and water level manipulation are cultural practices that are used in management of pastures, rangeland, and commercial forests and may be appropriate for vegetation management in natural areas in some situations. One important consideration is the degree of degradation of the area in question. Cultural practices may have impacts to all parts of the habitat—native species included. If the habitat is so badly degraded that the need to reduce invasives strongly outweighs consideration of remaining native species, more aggressive control strategies can be considered. In less degraded areas, more careful use of integrated methods may be appropriate.

The land use history of an area is critical in understanding the effects of fire and flooding on the resulting plant species' composition. Past practices affect soil structure, organic content, seed bank (both native and invasive non-native species), and species composition. While there is evidence that past farming and timber management practices will greatly influence the outcome of cultural management, very little is known about the effects of specific historical practices. Similar management practices conducted in areas with dissimilar histories may achieve very different results. Even less is known about the effects of invasives entering these communities, and the subsequent management effects of fire on the altered communities.

Understanding the reproductive biology of the target and nontarget plant species is critical to effective use of any control methods, but particularly so with methods such as fire management, which often require significant preparation time. Important opportunities exist if management tools can be applied to habitats when nonnative invasive species flower or set seed at different times than the native species.

Prescribed Burning

Fire is a very normal part of most of Florida's many ecosystems, and native species have evolved varying degrees of fire tolerance. Throughout much of Florida, suppression of fire during this century has altered historical plant communities, such as flatwood and oak scrub communities, enhancing fire-intolerant species, and reducing the coverage of species that possess fire adaptations. Within these communities, the fire-tolerant woody species have lingered in smaller numbers, and less fire-tolerant species have replaced ephemeral herbs. Little is known about the amount, frequency, timing, and intensity of fire that

would best enhance the historically fire-tolerant plant species, and less is known about how such a fire management regime could be best used to suppress invasive species. Single fires in areas with many years of fire suppression are unlikely to restore historical species composition. Periodic fires in frequently burned areas do little to alter native species composition.

In a special case, invasion of tree stands by exotic vines and other climbing plants has greatly increased the danger of canopy (crown) fires and the resulting death of mature trees.

Added biomass by invasive plants can result in hotter fires, and can greatly increase the risk of fires spreading to inhabited areas. In these situations, use of fire to reduce standing biomass of invasive species may better protect the remaining plant populations than doing nothing, even though impacts to nontarget native species will occur. Under these conditions, the expense of reducing standing biomass of invasive plant species might be justified by the savings on subsequent fire suppression.

In general, fire can be used to suppress plant growth, and even kill certain plants that are not fire tolerant. Most often, woody species are reduced while effects are less noticeable on herbaceous species. Some information has been published on responses of individual Florida plant species, but very little is known about the vast majority of native plant species, and less about invasive exotic species. Tolerance to fire can sometimes be predicted in species that have thick bark or seeds in the soil or held in the canopy; that are adapted to fire (either tolerant of high temperature; or requiring fire for seed release or germination); and seeds that are disbursed over a wide area.

Effects of a single burn are hard to predict, but under some conditions a single fire effect can persist for several growing seasons. The length of effect is due to the intensity of the fire, the timing (fire during the growing season can be more destructive than during dormant seasons), and the plant species involved. Smoke is now recognized as a germination triggering mechanism for fire-dependent and some non-fire-dependent species, so plant species composition following a burn is due in part to the type of fire and the distribution of the smoke from that fire. A single burn may or may not start a replacement sequence (succession) with its own effects on species composition.

Whether fire can play a logical role in suppression or elimination of invasive exotic plant species depends on many factors. In addition to the principal factors described above, the resource manager must consider potential fire effects on soil loss and water quality, historical and eco-

conomic impacts to buildings, possible harm to human life, and the potential for escape of a fire to nontarget areas.

Fire has been successfully used to manage plant species in grasslands, to maintain open savannahs (scattered trees in herbaceous species dominated habitats), and to promote seral (fire-induced or fire-tolerant) stages of forest succession. However, very little is known about the use of fire to enhance natives while reducing invasive exotic plant species. As a final caution in the use of fire, overly frequent burning has been shown to reduce plant diversity under many conditions, and it appears possible that increased fire frequency could provide opportunities for invasive plants to enter new areas.

Water Level Manipulation

Some success has been achieved regulating water levels to reduce invasive plant species in aquatic and wetland habitats. Dewatering aquatic sites reduces standing biomass, but little else is usually achieved unless the site is rendered less susceptible to repeated invasion when rewatered. Planting native species may reduce the susceptibility of aquatic and wetland sites in some cases.

In most situations, water level manipulation in reservoirs has not provided the level of invasive plant control that was once thought achievable. Ponds and reservoirs can be constructed with steep sides to reduce habitat susceptible to invasion, and levels can be avoided that promote invasive species, but rarely are these management options adaptable to natural areas.

Carefully timed water level increases following mechanical removal or fire management of invasive species can provide effective control of subsequent germination, and with some species, resprouting. Specific methods applicable to natural areas have not been described.

Reestablishment of Native Plant Species

Planting native species can be an effective, though expensive, way to reduce the likelihood of exotic species reinvasion following removal of nonnative species. Commercial plant nurseries currently offer seeds and plants of several wetland and upland species. Because some species cover a wide range of habitats and latitudes, care should be taken to obtain plant material suitable to the habitat under consideration. Seed collected from plants growing in more northern latitudes may do poorly in Florida. Introduction of seeds, plant parts, or whole plants should include thorough screening for any unwanted pests—plant or animal.

It often takes several years for plantings to become thoroughly established, and extra care (water, nutrients) and protection (from fire and pests) may be necessary for a while. Also during this establishment phase, past management practices may have to be altered to avoid injury to the plantings. If periodic burning or flooding, for example, is part of the current management practice, it may be necessary to reduce the intensity or duration until the plantings are able to exhibit their typical resistance to injury, whatever that may be. Unfortunately, little is known about requirements for successful establishment of many native species, and less is known about their tolerances to cultural invasive plant management techniques. Even when tolerances are better known, responses may be affected by historical site effects, traits of particular genetic strains, site-specific nutrition and light conditions, and interactions of soil type, hydroperiod, and microclimate.

Herbicides

Training and Certification

Anyone who applies herbicides in natural areas should have basic training in herbicide application technology. Only topics specifically important to herbicide use in natural areas are emphasized in this publication and the reader is expected to have prior knowledge of basic herbicide application technology.

A pesticide, or some of its uses, is classified as restricted if it could cause harm to humans or to the environment unless it is applied by certified applicators who have the knowledge to use these pesticides safely and effectively. Although none of the herbicides and few uses listed in this publication are classified as restricted use, the basic knowledge of herbicide technology and application techniques needed for safe handling and effective use of any herbicides can be obtained from restricted use pesticide certification training. This training can be obtained through the University of Florida Institute of Food and Agricultural Sciences. Certified applicators can be licensed as either public applicators or commercial applicators. Persons must successfully complete two examinations before they can apply to the Florida Department of Agriculture and Consumer Services (FDACS) for a license. These examinations are a general standards core examination and a category examination. Categories applicable to target species in the publication include the Natural Areas category and/or Aquatics category. The content of the core exam is based upon the manual, *Applying Pesticides Correctly: A Guide for Pesticide Applicators* (IFAS publication SM 1); the Natural Areas exam is based on *Natural Area Weed Management* (IFAS publication SP 295) and *Identification and Biology of Nonnative Plants in Natural Areas of Florida* (IFAS publication SP 257); and the Aquatics exam is based on the *Aquatic Pest Control Manual* (IFAS publication SM 3). Additional information about pesticide applicator licensing can be found on <http://edis.ifas.ufl.edu> and <http://www.flaes.org/complimonitoring/index/html>.

Active Ingredients and Formulations

A herbicide formulation, or product, consists of the herbicide active ingredient dissolved in a solvent (e.g., oil, water, or alcohol), or adsorbed to a solid such as clay. Formulations often include an adjuvant that facilitates spreading, sticking, wetting, and other modifying characteristics of the spray solution. Special ingredients may also improve the safety, handling, measuring, and application of the herbicide. Products mentioned in this publication contain the active ingredients 2,4-D, aminopyralid,

fluzifop, glyphosate, hexazinone, imazamox, imazapyr, metsulfuron, and triclopyr (amine or ester) (table 1).

The active ingredients 2,4-D amine, triclopyr amine, imazamox, imazapyr, and hexazinone are formulated as water-soluble liquids (L). They are not compatible with oil-based diluents and are diluted in water for foliar applications and diluted in water or applied in their concentrated form for cut-stump applications. They are not normally used for basal bark applications.

Triclopyr ester, imazapyr, and fluzifop are formulated as emulsifiable concentrates (EC). Emulsifiable concentrates are compatible with oil-based diluents and also contain emulsifiers that allow the formulation to mix with water. Agitation is used to mix the EC in water. They may be diluted in water for foliar applications or mixed with oil-based diluents for low-volume applications (e.g., basal bark).

Hexazinone is also formulated as an ultra-low-weight soluble granule (ULW) formulation. This formulation is broadcast with specialized ground or aerial equipment.

Where Herbicides Can Be Used

No pesticide may be sold in the United States until the United States Environmental Protection Agency (EPA) has reviewed the manufacturer's application for registration and determined that the use of the product will not present unreasonable risk to humans or the environment. **Pesticide users are required by law to comply with all the instructions and directions for use in pesticide labeling.**

The EPA approves use of pesticides on specific sites, i.e., for use on individual crops, terrestrial non-crop sites or aquatic areas. Only those herbicides registered by the EPA specifically for use in aquatic sites can be applied to plants growing in lakes, rivers, canals, etc. For terrestrial uses, the EPA requires herbicide labels to have the statement: "Do not apply directly to water, to areas where surface water is present, or to intertidal areas below the mean highmark." Several active ingredients in this publication have separate products that are registered for applying directly to water for control of aquatic weeds (table 1). Other products mentioned can be used in non-cropland areas and variously described low-lying areas, including wetlands, but cannot be applied directly to water (table 1).

Absorption Characteristics

Herbicides recommended in this publication for invasive plant control are systemic. They move within the plant to the site where they are active after being absorbed by

Table 1 Herbicides commonly used in natural areas of Florida^a

Product	Formulation	Comments
Several	2,4-D various	Some products may be applied directly to water.
Milestone VM	Aminopyralid 21.1% L	Do not apply directly to water.
Fusilade	Fluazifop 24.5% EC	Post emergence, grass specific. Cannot be applied directly to water.
Rodeo	Glyphosate (isopropylamine salt) 53.8% L	May be applied directly to water.
Roundup	Glyphosate (isopropylamine salt) 41.0% L	May be applied to ditch banks, dry ditches, and dry canals. May not be applied directly to water.
Touchdown Pro	Glyphosate 28.3% L (diammonium salt)	May be applied directly to water.
Velpar L	Hexazinone 25% L	May cause groundwater contamination if applied to areas where soils are permeable, especially where the water table is shallow. Nontarget plants can be damaged by root absorption.
Velpar ULW	Hexazinone 75% ULW	Same comments as Velpar L.
Arsenal	Imazapyr 28.7% L	May be applied to nonirrigation ditches and low lying areas when water has drained but may be isolated in pockets due to uneven or unlevel conditions. Otherwise, may not be applied directly to water. May be applied by government agencies or their contractors in Florida, under SLN, by injection, frill and girdle, or cut stump to melaleuca and Brazilian pepper when growing in water. Nontarget plants can be damaged by root absorption.
Stalker	Imazapyr 28.7% L	May be applied to nonirrigation ditch banks. Nontarget plants can be damaged by root absorption.
Clearcast	Imazamox 12.1% L	Can be applied directly to water.
Escort XP	Metsulfuron 60% DF	May not be applied directly to water. SLN for control of Old World climbing fern in/on freshwater marshes, mesic forests, hydric forests, Everglades tree islands, and Everglades prairie scrub.
Brush-B-Gon	Triclopyr amine 8.0% L	Homeowner packaging readily available in retail stores. Lower concentration than Garlon 3A may require follow-up applications.
Brush Killer	Triclopyr amine 8.8% L	Homeowner packaging readily available in retail stores. Lower concentration than Garlon 3A may require follow-up applications.
Garlon 3A	Triclopyr amine 44.4% L	May be applied to nonirrigation ditch banks, seasonally dry wetlands, flood plains, deltas, marshes, swamps, bogs, and transitional areas between upland and lowland sites. May not be applied directly to water.
Garlon 4	Triclopyr ester 61.6% L	Same comments as Garlon 3A.
Pathfinder II	Triclopyr ester 13.6% L	Same comments as Garlon 3A. Ready to use.

^a Alphabetical by active ingredient. All concentrations are active ingredients. Original, branded-product names are used for convenience. Generic products that contain the same active ingredient may be available.

foliage, roots, or bark. The following herbicides can be absorbed by plant leaves and are effective for foliar applications: 2,4-D, aminopyralid, glyphosate, imazamox, imazapyr, metsulfuron, and triclopyr. Addition of an appropriate surfactant, as recommended on the herbicide label, is essential. Triclopyr, 2,4-D and glyphosate are adsorbed by soils or broken down quickly in soil and are not absorbed effectively by plant roots, whereas imazapyr and hexazinone are readily absorbed by plant roots (table 2). Only oil-soluble herbicide formulations (i.e. emulsifiable concentrates) are absorbed readily through tree bark.

Behavior in Soils

Herbicides used for invasive plant control vary in their persistence and sorption to soils (table 2). The most important factor is the ability of various soil types to chemically bind herbicides. Soil-applied herbicides, such as hexazinone, have label recommendations that vary the application rate for different types of soils. In general, soils with more organic matter and/or clay have greater capacities for binding herbicides than coarse, sandy soils and require higher application rates. Because woody plants are a problem on a range of Florida soils, including highly organic muck, sand, and very thin soil layers over limestone, a broad range of herbicide behavior in different soils can be expected.

Selectivity

The ability to selectively control target vegetation with herbicides without harming nontarget plants is related to the relative sensitivities of target and nontarget plants, absorption and chemical characteristics of the herbicides, and placement.

Herbicides vary in their potential to damage nontarget vegetation, and unwanted results can be prevented or minimized by making the best choice of herbicides in conjunction with careful application. Fluazifop, which kills many grasses, can be used to selectively manage invasive grass species among nontarget broadleaf plant species. Formulations that contain the active ingredients 2,4-D, metsulfuron, and triclopyr can often be used selectively because many broadleaf species are more sensitive to them than to perennial grasses.

Because 2,4-D, triclopyr, and glyphosate have little root activity and break down quickly (table 2), they have little potential for causing nontarget damage due to root absorption when carefully applied to target vegetation. In contrast, caution must be used with root-active herbicides (i.e., hexazinone and imazapyr) to minimize damage to nontarget vegetation by root absorption. In shallow, porous soils, extra care should be taken to avoid root absorption of all herbicides by nontarget plants.

Care must be taken to avoid unwanted drift of herbicide spray to nontarget plants when applications are made. Particulate drift can be minimized by avoiding windy conditions when spraying and by using low pressures and large nozzle orifices. Volatile compounds such as ester formulations may cause nontarget damage due to vapor drift when applied on very hot days. This damage, which may be observed as wilting or curling leaves, has been minimal and has not caused permanent harm to woody nontarget plants.

Wildlife Toxicity

Invasive plant management is often conducted in natural areas with the purpose of maintaining or restoring wildlife

Table 2 Soil behavior of herbicides commonly used in natural areas of Florida

	Half-Life (Days)	Mobility in Soil	Absorption by Plant Roots
2,4-D amine	10	Moderate	Slight
Aminopyralid	30	Low	Moderate
Fluazifop	15	Low	Negligible
Glyphosate	47	Negligible	Slight
Imazamox	20-30	Low	Moderate
Imazapyr	25-142	Mobile	Strong
Hexazinone	90	Mobile	Strong
Metsulfuron	30	Moderate	Strong
Triclopyr	10-46	Moderate	Slight

habitat. Therefore, it is essential that the herbicides themselves are not toxic to wildlife. Risk assessment to wildlife is conducted as part of the registration procedure for herbicides and is determined as the product of hazard and exposure. Hazard is measured as the toxicity of the herbicide to test animals and exposure depends on the use and persistence of the compound. Herbicides recommended in this publication have shown very low toxicity to wildlife with the exception of the relatively low LC50 of triclopyr ester (0.87 ppm) and fluzafop (0.53 ppm) for fish, neither of which can be applied directly to water (table 3). Ester formulations are toxic to fish because they irritate gill surfaces. However, because triclopyr ester and fluzafop (1) are not applied directly to water, (2) are absorbed by soil particles, and (3) have low persistence, exposure is low, which results in low risk when properly used.

Herbicide Application Methods

Foliar applications

Herbicide in foliar applications is diluted in water and applied to the leaves with aerial or ground equipment. Dilution is usually about 20 parts water to 1 part herbicide concentrate for aerial applications, and 50 to 400 parts water to 1 part herbicide concentrate when making ground applications for woody plant control. Adjuvants, such as surfactants, drift control agents, or other spray modifiers, are often added to the spray mix, as specified on the herbicide label. Ground equipment ranges from handheld spray bottles for applications to small individual plants, to large high-pressure vehicle- or boat-mounted sprayers for larger areas. Foliar applications can either be directed, to

minimize damage to nontarget vegetation, or broadcast. Broadcast applications are used where damage to nontarget vegetation is not a concern or where a selective herbicide is used.

For directed spray or selective applications, backpack sprayers such as the Solo Model 475 with diaphragm pump or Swissmex SPI are effective and commonly used. A spray tip such as a TP 2503 or TP 2504 produces large spray droplets to reduce spray drift. The 2503 spray tips may be installed in the spray wand that comes with the backpack sprayer, or a Model 30 Gunjet with the 2503 or 2504 spray tip may be attached to any backpack spray unit. If an adjustable tip is used, a Tee-Jet 5500 or equivalent is recommended. All backpack sprayers and spray guns should have chemical-resistant seals for the herbicides being used.

Power-driven ground equipment is commonly used to spray large/tall plants or large areas. Properly adjusted equipment should deliver a uniform spray with nozzle pressures of about 30 to 80 psi and should generate large spray droplets to reduce potential for spray drift. Higher spray pressures produce many small spray particles that may drift onto sensitive desirable plants adjacent to the treated area. Application is made by directing the spray on the target foliage, being sure to spray the growing tips and terminal leader. Techniques must be employed to prevent the spray from contacting foliage of desirable plants.

Commonly used power equipment consists of portable, power-driven spray units mounted on a truck or all-terrain vehicle. A wide variety of pumps, tanks, and accessories

Table 3 Toxicity of herbicides commonly used in natural areas of Florida

	Bobwhite Quail 8-Day Dietary LD50 ^a	Laboratory Rat 96-Hr Oral LD50 ^a	Bluegill Sunfish 96-Hr LC50 ^b
2,4-D amine	>5,620	>1000	524
Aminopyralid	>2250	>5000	>100
Fluzafop	>4659 (5-day)	2721 (Female)	0.53
Glyphosate	> 4,640	>5000	120
Hexazinone	>10,000	1690	420
Imazamox	>5572	>5000	119
Imazapyr	> 5,000	>5000	>100
Metsulfuron	>5620	>5000	>150
Triclopyr amine	>10,000	2574	891
Triclopyr ester	9,026	1581	0.87

^a LD50 is the quantity of herbicide that is lethal to 50% of test animals expressed as mg herbicide per kg body wt.

^b LC50 is the concentration in food (mg/kg) or water (mg/l) required to kill 50% of the population of test animals.

are used. The most common and maintenance-free pump is a diaphragm pump driven by a gasoline engine, or a self-contained, 12-volt pump unit. Routinely used spray guns are Spraying Systems Model 2 and 2A Gunjets. These are adjustable spray guns that produce patterns ranging from a solid stream to a wide cone spray. These spray guns may produce small spray particles at the cone spray setting, resulting in spray drift. Also, a Model 30 Gunjet with a Tee-Jet 5500-X10 adjustable tip is very effective for power sprayers. Dual spray Gunjets that accommodate two flat spray tips with different volumes and patterns are available. The spray gun can immediately be switched from one spray tip to the other by rotating the spray head. The most commonly used spray tips for the spray gun are TP 0512, TP 4010, or TP 4020. These tips produce few fine-spray particles so spray drift potential is reduced.

Basal bark applications

In basal bark applications, herbicide is applied, commonly with a backpack sprayer, directly to the bark around the circumference of each stem/tree up to 15 inches above the ground. The herbicide must be in an oil-soluble formulation (EC) and if not in a ready-to-use form it may be mixed with a specially formulated penetrating oil. The spray tip should be a narrow angle (15-25 degrees), flat, fan-tip nozzle such as a TP 1502, TP 1503, or TP 2502/TP 2503, a solid cone nozzle, or an adjustable conejet such as a Tee-Jet 5500-X4 or 5500-X5 or equivalent. Any of these tips can be installed in the spray wand that comes with the spray unit. A good alternative is a brass tip shut-off wand such as a Spraying Systems Model 31 with brass extension and tip shutoff or a Spraying Systems Model 30 Gunjet. A TP-0001/TP-0002 tip or DE-1/DE-2 disc should be used with the Model 30 Gunjet. The Gunjet can be attached to most backpack spray units that produce pressures between 20 and 50 psi. All backpack sprayers and spray guns should have chemical resistant seals for the herbicides and carriers being used.

Frill or girdle applications

Frill or girdle applications are sometimes called “hack-and-squirt.” With this type of application, cuts into the cambium are made completely around the circumference of the tree with no more than 3-inch intervals between cut edges. Continuous cuts (girdle) are sometimes used for difficult-to-control species and large trees. Do not make multiple cuts directly above or below each other because this will inhibit movement of the herbicide. Incisions should be angled downward to hold herbicide and must be deep enough to penetrate the bark and cambium layer. Herbicide (concentrated or diluted) is applied to each cut until the exposed area is thoroughly wet. Frill or girdle

treatments are slow and labor intensive but sometimes necessary to kill target vegetation and minimize impact to desirable vegetation in mixed communities. To further minimize potential impact to desirable vegetation, cuts can be wrapped with tape to prevent rainfall from washing herbicide to the soil. Water- or oil-soluble formulations can be used for frill or girdle applications.

Backpack sprayers or 1- to 2-gallon pump-up sprayers can be suitable for frill or girdle herbicide mixtures as long as they contain chemically resistant seals such as Viton. Handheld, chemical-resistant spray bottles, such as the 1-quart Delta Industries “Spraymaster” are commonly used for frill or girdle herbicide applications.

Stump treatments

Stump treatments are applied after cutting and removing large trees or brush. The herbicide (concentrated or diluted) is sprayed or painted onto the cut surface of the stump. The cut surface should be as level as possible so that herbicide solution does not run off. Sweep off dirt and sawdust that may prevent the herbicide solution from being taken up by the stump. The herbicide is usually concentrated on the cambium layer on large stumps, especially when using concentrated herbicide solutions. The cambium is next to the bark around the entire circumference of the stump. When using dilute solutions, the entire stump is sometimes flooded (depending on label instructions) with herbicide solution. Water- or oil-soluble formulations can be used. Spray equipment can be used as long as it contains chemical-resistant seals. Best results are obtained if the herbicide is applied immediately after cutting (no more than one hour), especially when using a water-soluble formulation (with less-susceptible species seconds can count). Oil-soluble formulations can be effective when applied after some time has passed and should then be applied to the bark as well. The procedure must ensure that cut stems, branches, or seeds do not take root and produce additional plants.

Soil applications

A soil application of granular herbicide formulations can be applied by hand held spreaders, by specially designed blowers, or by air. Soil-applied water-soluble or water-dispersible formulations can be used with the same type of equipment described for foliar applications or spot-guns that can accurately deliver a measured amount of herbicide.

Marker dyes

Marker dyes are very useful for keeping track of what vegetation has been treated when making applications to

large numbers of individual trees or stumps. Dyes are also a useful indicator of the applicator's efficiency in limiting herbicide contact with nontarget vegetation.

Control Methods for Invasive Nonnative Plants

Control methods being used for invasive nonnative plants by land managers in Florida are listed in this section. All methods listed have been found effective under certain circumstances. However, many factors can affect the performance of a herbicide application and results can vary. Choice of application method, herbicide, and rate for individual species depend on environmental conditions and personal experience. Experience has shown that treatment success may vary from site to site and on the same site.

Pesticide product labeling is the primary method of communication between a herbicide manufacturer and the

herbicide users and provides instructions on how to use the product safely and correctly. Changes in herbicide label directions may occur that are not concurrently updated in this publication. Because pesticide users are required by law to comply with all the instructions and directions for use contained in the pesticide label, no herbicide applications should be made based solely on information presented in this publication. **Pesticide users must review and comply with all conditions set forth in the pesticide label.**

NOTE: All dilutions of Garlon 4 basal bark and cut stump applications are made with oil. Original branded product names are used for convenience. Generic products that contain the same active ingredient may be available. Refer to table 1 for active ingredient.

AGAUACEAE

<i>Sansevieria hyacinthoides</i>	Bowstring hemp, Mother-in-law's tongue
Treatment:	Cut surface, basal stem: 10% Garlon 4 in oil. Addition of 3% Stalker may increase consistency where nontarget vegetation will not be endangered. In sandy soils where a greater potential exists for nontarget damage 15%-25% Roundup can be used but control is less consistent.
Comments:	Plants often take six to twelve months to die and follow-up applications are necessary. Dense populations may require initial physical removal.

ANACARDIACEAE (Cashew Family)

<i>Schinus terebinthifolius</i>	Brazilian pepper; Florida holly
Treatment:	Cut-stump: 50% Garlon 3A or Renovate, 10% Garlon 4, 50%-100% Roundup, Rodeo, or Touchdown Pro. Basal bark: 10%-20% Garlon 4 or undiluted Pathfinder II. Foliar: Garlon 4, Garlon 3A, Renovate, Roundup, Rodeo, Arsenal, or Habitat according label directions. Glyphosate products are less effective when used alone in spring and early summer.
Comments:	Dioecious; female trees produce enormous quantities of bird-dispersed fruit; seed germinate readily; some people experience allergic reactions to the sap; target only female trees if time, funds, or herbicide limitations are a factor.

APOCYNACEAE (Oleander Family)

<i>Alstonia macrophylla</i>	Devil tree
<i>Alstonia scholaris</i>	Scholar tree
Treatment:	Basal bark or cut stump: 50% Garlon 3A or 10% Garlon 4.
Comments:	Both species invade hammocks, pinelands, and disturbed sites; leaves are reportedly toxic to eat; <i>A. macrophylla</i> is becoming widespread in Dade county.
<i>Ochrosia elliptica</i>	<i>Ochrosia; Kopsia</i>
Treatment:	Basal bark or cut-stump: 50% Garlon 3A.
Comments:	Fruits are bright red, paired, and reportedly poisonous to eat; often used in coastal landscaping.

ARACEAE (Arum Family)

<i>Colocasia esculenta</i>	Wild Taro
Treatment:	Foliar: 1.0% Rodeo, 0.5% Renovate, 0.5% Weedar 64, or 0.5% Habitat + silicone surfactant.
Comments:	Usually found in aquatic habitats, so only herbicides labeled for aquatic sites can be used. Large corms (underground storage structures) make control very difficult and repeat applications will be necessary.
<i>Syngonium podophyllum</i>	Nepthytis
Treatment:	Manual: hand pull vegetation and remove from site or destroy (place in plastic bags until decomposed). Foliar: 3% Garlon 4. Basal stem: 10% Garlon 4. Multiple treatments are required.
Comments:	Breaks readily when pulled; roots from nodes; difficult to control; sap is a skin, mouth, and eye irritant; only spreads vegetatively; many populations are the result of discarded landscape material.
<i>Epipremnum pinnatum</i> cv. 'aureum'	Pothos
Treatment:	Same as nepthytis (see above).
Comments:	Roots at nodes; sap is skin, mouth, and eye irritant; may form extensive ground-cover; leaves enlarge considerably when plants climb trees or other support; spreads vegetatively, apparently does not set seed in Florida.

ARALIACEAE (Aralia Family)

<i>Schefflera actinophylla</i>	Queensland umbrella; Umbrella tree
Treatment:	Large individuals (>10 inches diameter) have proven extremely difficult to eradicate. Cut stump (recommended): 50% Garlon 3A or 10% Garlon. Basal bark (if a cut-stump treatment is not possible): wide band of 10% Garlon 4 on smaller individuals and 20% Garlon 4 on larger individuals. It may take up to 9 months to kill large trees.
Comments:	Grows terrestrially or as an epiphyte; invasive in hammocks, particularly wet, rocky sites; bird-dispersed fruits.

ARECACEAE (Palm Family)

<i>Caryota mitis</i>	Fishtail palm (clumping species)
<i>Caryota urens</i>	Fishtail palm (solitary-trunked species)
Treatment:	Cut stump: Cut below growing point and treat with 50% Garlon 3A or 10% Garlon 4. Alternatively, Garlon 4 can be applied to the apical bud.
Comments:	Unlike any other palm genus, the leaves are twice compound; on multiple-trunked (clumping) species, when one trunk is cut the plant will resprout; fruits abundantly and is a common invasive plant in hammocks; fruit and sap are a skin, mouth, and eye irritant.
<i>Chamaedorea seifrizii</i>	Bamboo palm
Treatment:	Treat as fishtail palm, above.
Comments:	Pinnate-leaved, narrow-trunked, clustering species; invades hammocks.
<i>Livistona chinensis</i>	Chinese fan palm
Treatment:	Manual: hand pull seedlings; cut young specimens at ground level or spray Garlon 4 into the apical bud.

	Comments:	Costapalmate leaves; green, curved, sharp spines along petiole; can be mistaken for <i>Sabal</i> and <i>Thrinax</i> species, but neither of the latter have spines on the petioles; differs from <i>Washingtonia</i> by having green, not brown, spines and lacking thread-like fiber on the leaves.
<i>Phoenix reclinata</i>		Senegal date palm
	Treatment:	Cut stems near ground level and treat with 50% Garlon 3A or 10% Garlon 4 or apply 10% Garlon 4 to meristem.
	Comments:	Common nonnative palm in hammocks, especially near coast; pinnate leaves with straight, sharp spines on petiole.
<i>Ptychosperma elegans</i>		Solitaire palm
	Treatment:	Manual; hand pull seedlings; cut mature trees down at ground level; remove fruiting stems from site.
	Comments:	Pinnate leaves, solitary trunk; commonly invades hammocks; high seed germination; fruit dispersed by birds, raccoons, and opossums; very common in the landscape.
<i>Roystonea regia</i>		Royal palm
	Treatment:	Manual: hand pull seedlings; chainsaw mature trees down near the base.
	Comments:	Commonly escapes into hammocks from landscape trees; best controlled in the seedling stage; Florida royal palm, <i>Roystonea elata</i> is similar and some taxonomists lump these two species together as synonyms; royal palms should only be treated as exotics if it is known that they are invading areas outside of their native Florida range; Florida royal palm still occurs as a wild plant in Everglades National park (Royal Palm Hammock), Fakahatchee Strand State Preserve, and Royal Palm Hammock in Collier Seminole State Park in Collier County.
<i>Syagrus romanzoffianum</i> (= <i>Arecastrum romanzoffianum</i>)		Queen palm
	Treatment:	Treat as Royal palm, above.
	Comments:	Pinnate leaves, single trunk; common in the landscape; invasive in hammocks.
<i>Washingtonia robusta</i>		Mexican fan palm, Washingtonia palm
	Treatment:	Manual: hand pull seedlings. Cut young specimens at ground level or spray Garlon 4 into apical bud. Large, mature trees in natural areas will need to be cut down.
	Comments:	Palmate leaves with brown, curved, sharp spines along the petioles; mature trees may retain dead leaves along the trunk; leaves characteristically have brown, threadlike fibers attached; can be mistaken for Chinese fan palm, <i>Livistona chinensis</i> , but the latter has green petiole spines and costapalmate leaves; invades pinelands and disturbed sites.

ASTERACEAE (Aster Family)

<i>Wedelia trilobata</i>		Wedelia; Dune sunflower
	Treatment:	Foliar: 2%-5% (low volume) Roundup or 0.25%-1.0% Garlon 4, with follow-up treatments as needed.
	Comments:	Trailing species, forming dense groundcover; yellow, daisy-like flowers produced all year; invades a variety of open, sunny habitats, including beaches; often becomes established from discarded landscape material.

BERBERIDACEAE (Barberry family)

<i>Nandina domestica</i>	Nandina, Heavenly bamboo
Treatment:	Basal bark: 15% Garlon 4 in mineral oil. Collect and destroy attached fruits.
Comments:	Naturalized in Gadsden, Jackson, Leon, Wakulla, and perhaps other counties.

CACTACEAE (Cactus Family)

<i>Hylocereus undatus</i> (= <i>Cereus undatus</i>)	Night-blooming cereus
Treatment:	Manual: hand pull and remove from site if possible; if removal is not feasible, lay the plants out on a plastic tarp and spray them with 10% Garlon 4; 15% Roundup has been successful but it takes much longer for the plants to die.
Comments:	Vining cactus that climbs and roots to tree trunks; sometimes epiphytic; very showy, fragrant flowers open at night in summertime.

CAPRIFOLIACEAE

<i>Lonicera japonica</i>	Japanese honeysuckle
Treatment:	Foliar: 3%-5% Garlon 3A or 1%-3% Roundup.
Comments:	Twining or trailing woody vine with young stems pubescent. Interrupts succession in once-forested areas by overtopping and smothering young trees, preventing their recruitment to the overstory and can disrupt understory structure in mature forests. May be confused with native honeysuckle, <i>Lonicera sempervirens</i> , leaves and stems of which are not hairy and flowers red with yellow within.

CASUARINACEAE (Beefwood Family)

<i>Casuarina equisetifolia</i>	Australian pine
<i>Casuarina glauca</i>	Beefwood, Brazilian oak
Treatment:	Basal bark: 10%-20% Garlon 4. Cut stump: 50% Garlon 3A or 10%-20% Garlon 4. Remove scaly bark if present. Frill (larger trees): 20% Garlon 4. Addition of 3% Stalker will increase consistency on older trees. Soil: 4-6 pounds Velpar ULW/acre.
Comments:	<i>C. equisetifolia</i> has a single trunk and produces viable seeds which are wind- and bird-dispersed; <i>C. glauca</i> produces suckers at the base of the trunk, rarely sets seed in Florida, and has a weeping growth habit.

CLUSIACEAE (Pitch-apple Family)

<i>Calophyllum antillanum</i> (= <i>C. Calaba</i> ; <i>C. brasiliense</i> var. <i>antillanum</i>)	Brazilian beauty-leaf
Treatment:	Basal bark: 10%-20% Garlon 4. Follow-up herbicide applications may be necessary. Manual: hand pull seedlings.
Comments:	Medium-sized tree with glossy, leathery leaves; has been found principally invading coastal areas, including mangrove fringe.

COMBRETACEAE (Combretum Family)

<i>Terminalia arjuna</i>	Arjun tree
<i>Terminalia catappa</i>	Indian almond
<i>Terminalia muelleri</i>	Mueller's almond
Treatment:	Basal bark: 10% Garlon 4. Cut stump: 50% Garlon 3A.
Comments:	The Indian almond is deciduous and invades coastal habitats, hammocks, and disturbed sites; Arjun tree and Mueller's almond invade hammock interiors and margins.

COMMELINACEAE (Spiderwort Family)

<i>Tradescantia spathacea</i> (= <i>Rhoeo spathacea</i>)	Oyster plant
Treatment:	Manual: hand pull and remove from site. Foliar: 10% Garlon 4 (low volume) applied to bud.
Comments:	Succulent with sword-shaped rosettes of leaves, green on upper surface, bright purple on lower surface; highly invasive, forming extensive colonies.

CONVOLVULACEAE (Morning-glory Family)

<i>Merremia tuberosa</i>	Wood rose
Treatment:	Foliar: 5% Roundup (low volume). Basal bark: 10% Garlon 4. Cut stem: 50% Garlon 3A or 10% Garlon 4.
Comments:	Individual plants can cover extensive areas; rarely roots at nodes; bright yellow morning-glory-like flowers produced in late fall, fruits profusely in early winter; later December and early January die backs occur; seeds germinate readily.

CRASSULACEAE (Orpine Family)

<i>Kalanchoe pinnata</i>	Life plant, Live leaf
Treatment:	Foliar: 5% Roundup. Manual: hand pull. Roundup is an effective treatment because it kills individual leaves that otherwise may produce new plants along leaf margins. Follow-up hand removal of leaves is necessary to prevent leaves from producing new plants.
Comments:	Often found along edges of natural areas, generally as a result of discarded landscape material.

DIOSCOREACEAE (Yam Family)

<i>Dioscorea alata</i>	Water yam
<i>Dioscorea bulbifera</i>	Air-potato; Air yam
<i>Dioscorea sansibarensis</i>	West African yam
Treatment:	Manual: cut vines that are high in trees; cut bulbils and remove from site. Dig up underground tubers if possible. Foliar: 1%-2% Roundup or Touchdown Pro. Cut stem: 10% Garlon 4.
Comments:	Monocot with heart-shaped leaves; dies back to tubers in winter in response to shortened day length, resprouts in spring from tubers; all three species produce aerial bulbils in late summer, early fall.

EBENACEAE (Ebony Family)

<i>Diospyros digyna</i> (= <i>D. ebenaster</i>)	Black sapote
Treatment:	Cut stump: 50% Garlon 3A.
Comments:	Black bark, shiny alternate leaves; scattered throughout a few hammocks in south Florida; fruits large, edible; green when ripe. Large individuals are difficult to kill.

ELAEAGNACEAE (Oleaster family)

<i>Elaeagnus pungens</i>	Silverthorn
Treatment:	Basal bark: 15% Garlon 4 in mineral oil.
Comments:	Naturalized and targeted for removal in Florida Caverns State Park (Jackson County).

EUPHORBIACEAE (Spurge Family)

<i>Aleurites fordii</i>	Tungoil tree
Treatment:	Basal bark: 20% Garlon 4.
Comments:	Found mainly in northern counties to Citrus County.
<i>Bischofia javanica</i>	Bishopwood; toog
Treatment:	Basal bark: 10%-20% Garlon 4. Frill/girdle (larger trees): 20% Garlon 4. Manual: hand pull seedlings.
Comments:	Dioecious; compound leaves with three large leaflets; herbicide treatment may cause adventitious roots to form along trunk; female trees produce massive numbers of bird-dispersed fruits that hang in grape-like clusters; target only female trees if time, funds, or herbicide limitations are a factor.
<i>Ricinus communis</i>	Castor bean
Treatment:	Basal bark or cut stump: 10% Garlon 4. Revisit site several times to pull up seedlings or treat seedlings with 5% Roundup.
Comments:	High seed germination: seeds extremely poisonous to eat.
<i>Sapium sebiferum</i>	Chinese tallow, popcorn tree
Treatment:	Cut stump: 20%-30% Garlon 4, Garlon 3A, or Renovate, 10% Habitat. Basal bark: 15%-20% Garlon 4 or undiluted Pathfinder II. Addition of 3% Stalker will reduce resprouting on older trees. Foliar: 0.5%-0.75% Arsenal or Habitat. Follow-up treatment may be necessary for root sprouts.
Comments:	Seedlings up to 10 inches tall can be hand pulled.

FABACEAE (Pea Family)

<i>Abrus precatorius</i>	Rosary pea
Treatment:	Basal stem: 10% Garlon 4. Foliar: 5% Roundup (low volume). Remove seed pods if possible. Site must be revisited several times to pull seedlings.
Comments:	Seeds black and red, highly poisonous.
<i>Acacia auriculiformis</i>	Earleaf acacia
Treatment:	Basal bark: 10% Garlon 4. Cut stump: 50% Garlon 3A. Addition of 3% Stalker will increase consistency.
Comments:	A frequent invader of pinelands and disturbed sites.
<i>Adenanthera pavonina</i>	Red sandalwood
Treatment:	Basal bark: 10% Garlon 4. Cut stump: 50% Garlon 3A or 10% Garlon 4. Manual: small seedlings can be hand pulled.
Comments:	Can be confused with <i>Albizia lebeck</i> , which has larger leaflets; bark of red sandalwood is typically reddish; produces hard red seeds which seem to persist in soil for up to 5 years.
<i>Albizia lebeck</i>	Woman's tongue; Rattle pod
Treatment:	Basal bark: 20% Garlon 4 or undiluted Pathfinder II. Cut stump: 50% Garlon 3A or 10% Garlon 4, follow-up treatments necessary for root sprouts with 10% Garlon 4.
Comments:	Large, dry, brown pods with few large seeds, mature principally in winter; common in pinelands and hammocks.
<i>Albizia julibrissin</i>	Mimosa
Treatment:	Basal bark: 15% Garlon 4 or undiluted Pathfinder II.

	Comments:	Apply to 1-2 feet of trunk on larger trees. Trees >3 inches diameter may require retreatment.
<i>Bauhinia forficata</i>		Spiny orchid tree
<i>Bauhinia purpurea</i>		Orchid tree
<i>Bauhinia variegata</i>		Orchid tree
	Treatment:	Basal bark: 10% Garlon 4. Cut stump: 50% Garlon 3A.
	Comments:	All three species invade disturbed sites and the edges of natural areas in Dade County.
<i>Dalbergia sissoo</i>		Indian rosewood
	Treatment:	Basal bark: 10% Garlon 4. Cut stump: 50% Garlon 3A.
	Comments:	Medium to large tree with compound leaves bearing 3 to 5 leaflets; papery seed pods are wind-dispersed; invasive along hammock margin, canopy gaps, and disturbed sites.
<i>Delonix regia</i>		Royal poinciana
	Treatment:	Basal bark: 20% Garlon 4 or undiluted Pathfinder II. Cut stump: 50% Garlon 3A.
	Comments:	Large spreading tree with bi-pinnately compound leaves; very popular flowering tree in the landscape; invades hammock margin, canopy gaps and disturbed sites; seeds commonly sprout beneath parent trees.
<i>Leucaena leucocephala</i>		Lead tree, jumble bean
	Treatment:	Difficult to control and variable results have been reported. Basal bark or cut stem: 10%-20% Garlon 4 has been reported to be effective while others report only partial success with higher rates. 25% has been effective on trees <3 inches diameter, while larger trees were not killed. Large trees must be completely girdled for frill/girdle applications. Experimental application of Milestone indicates that basal bark, cut stump, and foliar applications can be effective. Rates have not been refined.
	Comments:	Usually found on edges of natural areas; can be mistaken for native wild tamarind, <i>Lysiloma latisiliquum</i> . A larger band of Garlon 4 is applied to larger trees or those growing in sandy soils.
<i>Mimosa pigra</i> (= <i>M. pelita</i>)		Catclaw mimosa
	Treatment:	Basal bark or cut stump: 30%-50% Garlon 4. Foliar: Repeat applications of 1.5% Roundup or Rodeo or 2%-3% Garlon 3A or Renovate.
	Comments:	Repeated site visits are necessary to control seedlings and prevent further seed production. An estimated ten years are needed for seed bank eradication.
<i>Mucuna pruriens</i>		Cow itch
	Treatment:	Basal bark: 10% Garlon 4, Foliar: 5% Roundup. Manual: hand pull mature vines and seedlings; does not resprout from roots. It is important to continue pulling seedlings until seed bank is exhausted.
	Comments:	Hairs on seed pods cause intense itching.
<i>Pueraria montana</i> (= <i>P. lobata</i>)		Kudzu
	Treatment:	Foliar: When actively growing, at or post bloom, apply 2% Roundup, during early to mid growing season, 2% Garlon 3A.

	Comments:	Follow up treatments are necessary as resprouting occurs from root crowns and tubers.
<i>Wisteria sinensis</i>		Chinese wisteria
	Treatment:	Cut stump: 20%-30% Garlon 4 or 100% Garlon 3A.
	Comments:	High-climbing woody vine with showy lavender flowers in spring. Can top and kill mature trees. Legume densely, velvety pubescent compared to the native <i>Wisteria frutescens</i> , with glabrous fruits.

GOODENIACEAE (Goodenia Family)

<i>Scaevola sericea</i> (= <i>S. frutescens</i> ; <i>S. taccada</i>)		Beach naupaka; Half-flower; Scaevola
	Treatment:	Manual: hand pull, at least fruit, from site whenever possible. Basal bark: 10% Garlon 4. Cut stump: 50% Garlon 3A or 10% Garlon 4. Foliar: (monocultures) 4% Garlon 4.
	Comments:	Semi-woody shrub with either glabrous or pubescent, somewhat succulent leaves; flowers fan shaped, white or blushed with purple; fruit are white, which helps distinguish it from the black-fruited, native Inkberry, <i>Scaevola plumieri</i> ; seeds of the exotic scaevola are carried by ocean currents where they sprout and colonize beaches and other shoreline habitats. Branches in contact with ground may root. Seed bank lasts one year.

LYGODIACEAE (Climbing fern family)

<i>Lygodium microphyllum</i>		Old World climbing fern
	Treatment:	Foliar: For ground applications, cut plants that grow high into trees; thoroughly spray foliage to wet with 1%-2% Roundup or Rodeo, 2% Garlon 3A, 1% Plateau, or equivalent of 1-2 ounces Escort XP/100 gallon diluent; light infestations use 2%-4% Roundup or Rodeo (low volume). For aerial application, 7.5 pints Rodeo or 2 ounces Escort XP in sufficient volume and using spray pattern to maximize coverage.
	Comments:	Fern with twining, climbing fronds, leaflets unlobed. The most serious natural area weed in Florida. Land managers should be on constant lookout for it and take immediate steps to control it when encountered.
<i>Lygodium japonicum</i>		Japanese climbing fern
	Treatment:	Foliar: 2% Roundup + 5 ounces Escort XP per 100 gallons Do not exceed 40 gallons spray solution per acre.
	Comments:	Fern with twining, climbing fronds, leaflets lobed. Occurs throughout west and north Florida into central Florida. Smothers seedlings of overstory tree species.

MALVACEAE (Mallow Family)

<i>Hibiscus tiliaceus</i>		Sea hibiscus; Mahoe
	Treatment:	Manual: hand pull seedlings. Basal bark: 10%-20% Garlon 4. Cut stump: 50% Garlon 3A.
	Comments:	Multi-trunked, large, spreading tree with long-petioled, rounded cordate leaves, hibiscus-like yellow flowers turn pink or red with age; seeds float and drift to new coastal habitats; erroneously considered native by some people.
<i>Thespesia populnea</i>		Seaside mahoe; Portia tree
	Treatment:	Manual: seedlings can be hand pulled. Basal bark: 10%-25% Garlon 4. Cut stump: 50% Garlon 3A for cut stump applications.

	Comments:	Multi-trunked, large, spreading tree; heart-shaped leaves with a pronounced drip-tip; hibiscus-like yellow flowers turn pink or red with age; seeds float and drift to new coastal habitats; erroneously considered native by some people.
MELIACEAE (Mahogany family)		
<i>Melia azedarach</i>		Chinaberry, Pride of India
	Treatment:	Basal bark: 15%-30% Garlon 4. Addition of 3% Stalker may increase consistency. Trees > 3 inches diameter may require retreatment. Cut stump: 30% Garlon 4. Foliar: low volume 1% Arsenal covering 50% of the foliage.
	Comments:	Often shrubby and root-suckering, forming thickets. Fruits poisonous to humans and some other mammals. Most abundantly found in north and west Florida but often escaping cultivation in peninsular counties, south to the Keys.
MORACEAE (Mulberry Family)		
<i>Broussonetia papyrifera</i>		Paper mulberry
	Treatment:	Basal bark: 10%-30% Garlon 4. Addition of 3% Stalker will increase consistency.
	Comments:	Large tree with scabrous leaves and reddish-orange balls of flowers. Invades hammocks and disturbed sites; young trees can be mistaken for the native red mulberry, <i>Morus rubra</i> .
<i>Ficus altissima</i>		Lofty fig
<i>Ficus benghalensis</i>		Banyan fig
<i>Ficus microcarpa</i>		Laurel fig
	Treatment:	Basal bark: 10% Garlon 4.
	Comments:	All three species invade the interior and edges of hammocks; often found growing as epiphytes (on trees) or epiliths (on rocks or stone structures); exercise care when treating epiphytic figs to ensure that herbicide does not come in contact with the host tree; members of this genus are very sensitive to Garlon 4; extreme care must be taken when treating any vegetation near the native strangler fig and shortleaf fig; spray that contacts surface roots can kill a large tree.
MYRSINACEAE (Myrsine Family)		
<i>Ardisia elliptica</i> (= <i>Ardisia solanacea</i>)		Shoe-button Ardisia
	Treatment:	Basal bark: 10% Garlon. Cut stump: 50% Garlon 3A. Manual: hand pull seedlings.
	Comments:	Often found in wetter areas; prolific reproduction; closely resembles the native <i>Ardisia escallonioides</i> (Marlberry) but differs in that new growth, petioles, and stem tips are pink to red, and fruit are produced in axillary, not terminal, clusters.
<i>Ardisia crenata</i>		Coral ardisia
	Treatment:	Foliar: 3% Garlon 3A + 1% Plateau, 5% Garlon 4 (low volume). Basal bark: 10% Garlon 4.
	Comments:	Small shrub, easily recognized by bright shiny leaves, with crenate (scalloped) margins and calluses in the margin notches and persistent bright red (sometimes white) fruits.
MYRTACEAE (Myrtle Family)		
<i>Eugenia uniform</i>		Surinam cherry
	Treatment:	Basal bark: For plants up to ½ inch diameter, 10% Garlon 4. Cut-stump: 50% Garlon 3A or 10% Garlon 4. Seedlings should be hand pulled.
	Comments:	Looks quite similar to native species of <i>Eugenia</i> ; leaves have a distinct odor when crushed.

<i>Melaleuca quinquenervia</i>	Cajeput; Punk tree; Melaleuca
Treatment:	Manual: seedlings and saplings can be hand pulled, being sure not to break plant off of root system, and removed or placed in piles to help reduce the chance that they will re-root. Foliar: Low volume spot application of 5% Rodeo (seedlings and saplings only). Aerial application of 3 quarts Rodeo + 3 quarts Arsenal + 4 quarts methylated seed oil per acre. Follow-up ground or aerial application may be necessary. Cut stump: 10%-20% Arsenal or Habitat, 50%-100% Roundup or Rodeo, or 40% Roundup or Rodeo + 10% Arsenal or Habitat. Use of imazapyr product provides more consistent results. Frill and girdle: 20%-50% Arsenal or Habitat or 10% Arsenal or Habitat and 40% Roundup or Rodeo. Lower amounts of imazapyr may be effective.
Comments:	Tall, highly invasive tree in freshwater wetlands; thick, papery bark; extremely high seed production; seeds dispersed by wind following natural or mechanical disturbance.
<i>Psidium guajava</i> <i>Psidium cattleianum</i>	Common guava Strawberry guava
Treatment:	Basal bark or cut stump: 10% Garlon 4.
Comments:	Yellow, edible fruits; common invader in disturbed areas, hammock margins and wetlands.
<i>Rhodomyrtus tomentosa</i>	Downy rosemyrtle
Treatment:	Basal bark or cut stump (individual plants): 10%-20% Garlon 4. Re-treatment may be necessary. Foliar: 1% Arsenal + 2% Roundup or 2 quarts Vanquish/acre in 50 gallons spray volume.
Comments:	A very aggressive evergreen shrub to 6 feet tall found as far north as Pasco County on the west coast. Action should be taken immediately to remove it when found in natural areas. Identified by opposite, simple entire leaves, which are glossy green above, densely soft-hairy below, with three main veins form blade base; round, dark purple fruit with sweet aromatic flesh.
<i>Syzygium cumini</i> <i>Syzygium jambos</i>	Jambolan plum; Java plum Rose apple
Treatment:	Cut stump: 50% Garlon 3A or 10% Garlon 4. Basal bark: 10%-20% Garlon 4 or Pathfinder II.
Comments:	Large trees, bird- and mammal-dispersed fruits. Mature trees may take up to 9 months to die.
OLEACEAE (Olive Family)	
<i>Jasminum dichotomum</i> <i>Jasminum fluminense</i>	Gold coast jasmine Brazilian jasmine
Treatment:	Cut-stump: 50% Garlon 3A or 10% Garlon 4. Basal bark: 10% Garlon 4. It is helpful to pull runners back to the main stem, cut, and apply Garlon 3A or Garlon 4 to the cut stem. Retreatment of areas is usually necessary. Foliar: 5% Roundup. Manual: newly emerged seedlings can be hand pulled.
Comments:	Jasmines produce a large number of bird- and mammal-dispersed seeds with very high germination; highly invasive.
<i>Ligustrum lucidum</i> <i>Ligustrum sinense</i>	Glossy privet Chinese privet
Treatment:	Basal Bark or cut stump: 15%-20% Garlon 4 or undiluted Pathfinder II.
Comments:	<i>L. sinense</i> widespread in northern Florida mesic woods, road shoulders, and farm-lands. Invades logged areas, dispersed by mammals, birds, and floodwaters.

PASSIFLORACEAE (Passion-flower Family)

<i>Passiflora edulis</i>	Passion-flower
Treatment:	Basal bark or cut stem: 10% Garlon 4.
Comments:	Large attractive flower; fruit purple, edible; invasive in hammocks.

PIPERACEAE (Pepper Family)

<i>Lepianthes peltata</i>	Lepianthes
<i>Piper aduncum</i>	Bamboo piper
<i>Piper auritum</i>	Makulan
Treatment:	Manual: hand pull when possible (broken roots may resprout); remove entire plant from site. Basal bark: 20% Garlon 4 or undiluted Pathfinder II. Cut stump: 50% Garlon 3A; remove cut stems from the site to avoid resprouting from nodes.
Comments:	All three of the above species invade hardwood hammocks, especially margins and canopy gaps.

POACEAE (Grass Family)

<i>Imperata cylindrica</i>	Cogongrass
Treatment:	Foliar: 3-4 quarts. Roundup Pro, 2-3 quarts. Arsenal, or 0.5 quarts Fusilade per acre. For high volume, spot treatment use 3%-5% Roundup Pro or 0.25%-0.5% Arsenal. Herbicides should be used in combination with burning or tillage for optimum control. See IFAS Publication SS-AGR-52 for additional information.
Comments:	If not controlled, cogongrass will spread along roadways and into pastures, mining areas, forest land, parks, and other recreation areas. Extensive rhizomes must be eliminated for long term control.

<i>Neyraudia reynaudiana</i>	Burma reed
Treatment:	Foliar: 1%-3% Roundup. Cut stem: 10% Garlon 4. In areas with surrounding desirable vegetation, the culms can be cut to ground level and sprayed with 5% Roundup when the plant reaches a height of approximately 12 to 18 inches (cut stems should be removed from the site). Removing seedheads before treatment will reduce need for follow-up. Responds quickly after fire and should be targeted as soon as new growth reaches 12 to 18 inches. Most native plants will not have resprouted from the fire by the time Burma reed has reached this height, and it can be easily treated with little concern about nontarget damage.
Comments:	Tall cane grass; extremely invasive in pine rockland habitat and open dry habitats, as well as roadsides, vacant lots, and other disturbed sites; fire tolerant.

<i>Panicum repens</i>	Torpedograss
Treatment:	Foliar: 0.75% - 1.5% Rodeo and/or 0.5% Habitat, 4 pints Habitat per acre, or 5% Rodeo low volume spot treatment.
Comments:	Numerous dormant buds associated with extensive rhizomes make this plant extremely difficult to control. Several years of reapplication may be necessary to completely eliminate a population.

<i>Pennisetum purpureum</i>	Napier grass
Treatment:	Foliar: 1%-3% Roundup. If nontarget damage is a concern, cut stems to ground level and allow sprouts to reach 8-12 inches and treat the same as <i>Neyraudia</i> . Broadcast 3-5 quart/acre Roundup Pro, 2 quart/acre Arsenal, or 1 quart Arsenal and 2 quart Roundup Pro.
Comments:	Tall cane grass with white stripe down the center of the leaf blade and a foxtail-like inflorescence; prefers wetter substrates.

<i>Phyllostachys aurea</i>	Golden Bamboo
Treatment:	Foliar: Cut mature plants and apply 5% Roundup.
Comments:	Not a common problem, but once established can spread extensively. Populations should be controlled immediately. Can become established by dumping of yard waste.
RHAMNACEAE (Buckthorn Family)	
<i>Colubrina asiatica</i>	Latherleaf; Asian colubrina
Treatment:	Basal bark: 10%-20% Garlon 4 or undiluted Pathfinder II. Cut-stump: 50% Garlon 3A. Foliar: 3% Garlon 3A or Garlon 4. Follow up for 3 to 4 weeks. Manual: hand pull seedlings.
Comments:	Sprawling shrub commonly invading coastal habitats; has become a serious pest plant in mangrove/buttonwood habitat and in coastal hardwood forests. Capsules spread by tides and currents. Seeds resemble small pebbles and may be used as crop stones by seed-eating birds, such as doves, and dispersed.
ROSACEAE (Rose Family)	
<i>Rubus albescens</i>	Mysore raspberry
Treatment:	Cut stem: 50% Garlon 3A or 10% Garlon 4.
Comments:	Sharp thorns on stems and leaves; arching stems and branches of intact plants root where they touch the ground; seeds bird- and mammal-dispersed.
<i>Eriobotrya japonica</i>	Loquat
Treatment:	Basal bark: 10% Garlon 4. Cut-stump: 50% Garlon 3A or Garlon 4.
Comments:	Invasive in hammocks; commonly cultivated for its yellow, fuzzy, edible fruit; seeds spread into natural areas by mammals; exotic, free-flying parrots are known to feed on the fruit as well, and may also be vectors of seeds.
RUBIACEAE (Madder Family)	
<i>Paederia cruddasiana</i>	Sewer vine; skunk vine; Chinese fever vine
Treatment:	Foliar: 3%-5% Roundup. Basal bark: 10% Garlon 4. Within 2-4 weeks re-treat the area with basal applications of 10% Garlon 4. This second treatment can be time-consuming because many underground runners sprout. The area should continue to be monitored for follow-up treatments.
Comments:	Climbing vine; related to <i>Paederia foetida</i> , which is established in central Florida; flowers profusely; produces viable seeds.
<i>Paederia foetida</i>	Skunk vine
Treatment:	Foliar: 1%-3% Garlon 3A, Garlon 4, or 1%-1.5% Plateau to thoroughly wet foliage. Homeowners can use Brush-B-Gon or Brushkiller at maximum label rates. Cut stem: 10% Garlon 4.
Comments:	Perennial twining vine from woody rootstock having leaves and stems with disagreeable odor, especially when crushed. Most common in west central Florida, documented northward to Gadsen County and southward to Broward County.
RUTACEAE (Rue Family)	
<i>Murraya paniculata</i>	Orange jessamine
Treatment:	Manual: hand pull seedlings. Basal bark or cut stump: 10% Garlon 4.
Comments:	Shrub or small tree with small, glossy, compound leaves that are fragrant when crushed; white, citrus-like, heavily perfumed flowers produced in summertime; small orange fruit are bird dispersed; invasive in hammocks, especially when bordered by residential areas that use this plant in the landscape.

SAPINDACEAE (Soapberry Family)

<i>Cupaniopsis anacardioides</i>	Carrotwood
Treatment:	Basal bark: 10%-20% Garlon 4 or undiluted Pathfinder II. Cut stump: 10%-50% Garlon 3A or undiluted Roundup. Frill and girdle: 10%-20% Garlon 4.
Comments:	Invades interior of hammocks; becoming a popular landscape tree; bird dispersed. Note label restrictions with respect to high-tide mark and use extra caution near mangroves.

SAPOTACEAE (Sapodilla Family)

<i>Manilkara zapota</i>	Sapodilla
Treatment:	Hand pull seedlings. Basal bark: 10%-20% Garlon 4, larger trees may require several applications. Cut stump: 50% Garlon 3A.
Comments:	Large, spreading tree; edible fruit; seeds dispersed by raccoons and opossums; invades hammock interiors.
<i>Pouteria campechiana</i>	Egg fruit; Canistel
Treatment:	Hand pull seedlings. Basal bark: 10% Garlon 4.
Comments:	Small to medium tree; yellow, edible fruit; prolific invader of hammocks but local in distribution; fruit eaten by raccoons and opossums.

SOLANACEAE (Nightshade Family)

<i>Cestrum diurnum</i>	Day jessamine
Treatment:	Manual: hand pull when possible (if soil disturbance is not an issue). Basal bark: 10% Garlon 4. Cut stump: 50% Garlon 3A.
Comments:	Shrub or small tree with small, tubular, very fragrant flowers (in daytime) small purple fruit dispersed by birds.
<i>Solanum tampicense</i>	Wetland nightshade, misleadingly called aquatic soda apple
Treatment:	Foliar: 1.5% Garlon 3A. Aggressive follow-up treatments are necessary.
Comments:	An aggressive invader of wetlands and floodplains. Should be eliminated whenever located.
<i>Solanum viarum</i>	Tropical soda apple
Treatment:	Hand pull and destroy individual plants when practical. Foliar: 1% Garlon 4, 3% Roundup, 0.5% Arsenal, or 5-7 ounces Milestone/acre. Milestone (7 ounces/acre) provides residual control of seedlings.
Comments:	Destroy fruit and treat plants immediately after detection. Spreads extremely fast. Livestock and wild animals eat fruits and readily disperse seed. For additional information see IFAS publication SS-AGR-58.

VERBENACEAE (Verbena Family)

<i>Lantana camara</i>	Shrub verbena; Lantana
Treatment:	Basal bark: 10% Garlon 4. Cut stump: 50% Garlon 3A or 10% Garlon 4.
Comments:	Shrub with prickly stems and branches; multi-colored flower heads; ripe fruit blue; green unripe fruit highly toxic if eaten; this exotic species should be controlled to help avoid hybridization with the endemic <i>Lantana depressa</i> ; typically a plant of roadsides and other disturbed sites but also invades pineland as well as hammock margins; numerous cultivars exist in the nursery trade.

Appendix A: Common Names and Botanical Family Names

Common Name	Botanical Family Name	Common Name	Botanical Family Name
Air-potato	Dioscoreaceae	Ficus	Moraceae
Air yam	Dioscoreaceae	Fishtail palm	Arecaceae
Ardisia	Myrsinaceae	Florida holly	Anacardiaceae
Arjun tree	Combretaceae	Glossy privet	Oleaceae
Asian colubrina	Rhamnaceae	Gold Coast jasmine	Oleaceae
Australian pine	Casuarinaceae	Golden bamboo	Poaceae
Bamboo palm	Arecaceae	Guava	Myrtaceae
Bamboo piper	Piperaceae	Half-flower	Goodeniaceae
Banyan fig	Moraceae	Heavenly bamboo	Berberidaceae
Beach naupaka	Goodeniaceae	Hunter's robe	Araceae
Beefwood	Casuarinaceae	Indian almond	Combretaceae
Bishopwood	Euphorbiaceae	Indian rosewood	Fabaceae
Black sapote	Ebenaceae	Jambolan plum	Myrtaceae
Bowstring hemp	Agauaceae	Japanese climbing fern	Lygodiaceae
Brazilian beauty-leaf	Clusiaceae	Japanese honeysuckle	Caprifoliaceae
Brazilian jasmine	Oleaceae	Jasmine	Oleaceae
Brazilian oak	Casuarinaceae	Java plum	Myrtaceae
Brazilian pepper	Anacardiaceae	Kopsia	Apocynaceae
Burma reed	Poaceae	Lantana	Verbenaceae
Cajeput	Myrtaceae	Latherleaf	Rhamnaceae
Canistel	Sapotaceae	Laurel fig	Moraceae
Carrotwood	Sapindaceae	Lead tree	Fabaceae
Castor bean	Euphorbiaceae	Lepianthes	Piperaceae
Catclaw mimosa	Fabaceae	Life plant	Crassulaceae
Chinaberry	Meliaceae	Live leaf	Crassulaceae
Chinese fan palm	Arecaceae	Lofty fig	Moraceae
Chinese privet	Oleaceae	Loquat	Rosaceae
Chinese tallow	Euphorbiaceae	Mahoe	Malvaceae
Chinese wisteria	Fabaceae	Makulan	Piperaceae
Cogongrass	Poaceae	Melaleuca	Myrtaceae
Coral ardisia	Myrsinaceae	Mexican fan palm	Arecaceae
Cow itch	Fabaceae	Mimosa	Fabaceae
Day jessamine	Solanaceae	Mother-in-law's tongue	Agauaceae
Devil tree	Apocynaceae	Mueller's almond	Combretaceae
Downy rose myrtle	Myrtaceae	Mysore raspberry	Rosaceae
Dune sunflower	Asteraceae	Nandina	Berberidaceae
Earleaf acacia	Fabaceae	Napier grass	Poaceae
Egg fruit	Sapotaceae	Nephtytis	Araceae

Appendix A: Common Names and Botanical Family Names

Common Name	Botanical Family Name	Common Name	Botanical Family Name
Night-blooming cereus	Cactaceae	Scaevola	Goodeniaceae
Ochrosia	Apocynaceae	Schefflera	Araliaceae
Old World climbing fern	Lygodiaceae	Scholar tree	Apocynaceae
Orange jessamine	Rutaceae	Sea hibiscus	Malvaceae
Orchid tree	Fabaceae	Seaside mahoe	Malvaceae
Oyster plant	Commelinaceae	Senegal date palm	Arecaceae
Palms	Arecaceae	Sewer vine	Rubiaceae
Paper mulberry	Moraceae	Shoebuttan ardisia	Myrsinaceae
Passion-flower	Passifloraceae	Silverthorn	Elaeagnaceae
Piper	Piperaceae	Skunk vine	Rubiaceae
Popcorn tree	Euphorbiaceae	Solitaire palm	Arecaceae
Portia tree	Malvaceae	Surinam cherry	Myrtaceae
Possum grape	Vitaceae	Toog	Euphorbiaceae
Pothos	Araceae	Torpedograss	Poaceae
Punk tree	Myrtaceae	Tropical soda apple	Solanaceae
Queen palm	Arecaceae	Tung oil tree	Euphorbiaceae
Queensland umbrella	Araliaceae	Umbrella tree	Araliaceae
Raspberry	Rosaceae	Washingtonia palm	Arecaceae
Red sandalwood	Fabaceae	Water yam	Dioscoreaceae
Rosary pea	Fabaceae	Wedelia	Asteraceae
Rose apple	Myrtaceae	West African yam	Dioscoreaceae
Rosewood	Fabaceae	Wild taro	Araceae
Royal poinciana	Fabaceae	Woman's tongue	Fabaceae
Royal palm	Arecaceae	Wood rose	Convolvulaceae
Sapodilla	Sapotaceae		

Appendix B: Genus Names and Botanical Family Names

Genus Name	Refer to Plant Family	Genus Name	Refer to Plant Family
Abrus	Fabaceae	Ligustrum	Oleaceae
Acacia	Fabaceae	Livistona	Arecaceae
Adenantha	Fabaceae	Lonicera	Caprifoliaceae
Albizia	Fabaceae	Lygodium	Lygodiaceae
Aleurites	Euphorbiaceae	Manilkara	Sapotaceae
Alstonia	Apocynaceae	Melaleuca	Myrtaceae
Ardisia	Mysinaceae	Melia	Meliaceae
Bauhinia	Fabaceae	Merremia	Convolvulaceae
Bischofia	Euphorbiaceae	Mimosa	Fabaceae
Broussonetia	Moraceae	Mucuna	Fabaceae
Calophyllum	Clusiaceae	Murraya	Rutaceae
Caryota	Arecaceae	Nandina	Berberidaceae
Casuarina	Casuarinaceae	Ochosia	Apocynaceae
Cereus	Cactaceae	Neyraudia	Poaceae
Cestrum	Solanaceae	Paederia	Rubiaceae
Chamaedorea	Arecaceae	Panicum	Poaceae
Colocasia	Araceae	Passiflora	Passifloraceae
Colubrina	Rhamnaceae	Pennisetum	Poaceae
Cupaniopsis	Sapindaceae	Phoenix	Arecaceae
Dalbergia	Fabaceae	Phylostachis	Poaceae
Delonix	Fabaceae	Piper	Piperaceae
Dioscorea	Dioscoreaceae	Pouteria	Sapotaceae
Diospyros	Ebenaceae	Ptychosperma	Arecaceae
Elaeagnus	Elaeagnaceae	Psidium	Myrtaceae
Epipremnum	Araceae	Rhaphidophora	Araceae
Eriobotrya	Rosaceae	Rhodomyrtus	Myrtaceae
Eugenia	Myrtaceae	Rhoeo	Commelinaceae
Ficus	Moraceae	Ricinus	Euphorbiaceae
Hibiscus	Malvaceae	Roystonea	Arecaceae
Hylocereus	Cactaceae	Rubus	Rosaceae
Imperata	Poaceae	Sansevieria	Agauaceae
Jasminum	Oleaceae	Sapium	Euphorbiaceae
Kalanchoe	Crassulaceae	Scaevola	Goodeniaceae
Lantana	Verbenaceae	Schefflera	Araliaceae
Lepianthes	Piperaceae	Schinus	Anacardiaceae
Leucaena	Fabaceae	Solanum	Solanaceae

Appendix B: Genus Names and Botanical Family Names

Genus Name	Refer to Plant Family
Sphagneticola	Asteraceae
Syagrus	Arecaceae
Syngonium	Araceae
Syzygium	Myrtaceae
Terminalia	Combretaceae
Thespesia	Malvaceae
Tradescantia	Commelinaceae
Washingtonia	Arecaceae
Wedelia	Asteraceae
Wisteria	Fabaceae



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