

Control of Non-native Plants in Natural Areas of Florida¹

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Introduction

Forty-three percent of Florida's land area is currently in agricultural or urban land uses and over one third of its native habitats have been lost (1987 census). While continued urbanization is an inevitable consequence of increasing population, and food production by agriculture is essential, it is also important to preserve and protect Florida's native habitats 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, 6.3 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.

Non-native plants, carried here by humans since Florida's discovery by Columbus, now threaten the state's remaining natural areas. Of the 4,012 plant species now growing on their own without cultivation in Florida, 29% are non-native (Atlas of Florida Flora, R. P. Wunderlin). Many of these

non-native plants were originally introduced as garden ornamentals or agricultural crops. Other non-native plants were accidentally introduced. Regardless of how they arrived, these 1,200 or so non-native plants grew so well in Florida that they naturalized, that is, spread on their own without cultivation into managed and natural areas. While some of these naturalized non-native plants are not a problem, many became weeds, or undesirable plants, in agricultural, forestry, yards, and roadways. When these naturalized non-native 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 non-native plants can be thought of as weeds in natural areas.

Familiar examples of invasive non-native plants that have already replaced native Florida plant communities and drastically changed the landscape both visually and ecologically include Brazilian pepper (*Schinus terebinthifolius*), and melaleuca (*Melaleuca quinquenervia*) in south Florida, and cogongrass (*Imperata cylindrica*) and Chinese tallow (*Sapium sebiferum*) in north Florida.

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Currently there is no information source that describes all invasive species for each particular part of Florida, and most invasive species are weed problems in some areas, but not in others. Until more information is developed, the best strategy for land managers is to become familiar with the most invasive species, and be watchful for their appearance. Listing of a species in this publication does not necessarily suggest that it should be regulated. It does indicate that it has warranted control measures in at least one natural area in the state and should be viewed as potentially invasive in other natural areas if it appears. Several invasive plants in Florida are regulated by statutory authority of the Florida Department of Agriculture and Consumer Services (DACS) and the Florida Department of Environmental Protection (DEP). The list of plants regulated by DACS, the Florida Noxious Weed List, includes plants that are federally regulated by the Federal Noxious Weed Act of 1974. The Florida Exotic Pest Plant Council (EPPC) maintains a current list of plants that are considered to be invasive or have invasive potential. While the EPPC list contains some plants that are also regulated by DACS and DEP, the list does not have statutory authority. These lists can be obtained from the University of Florida, Institute of Food and Agricultural Sciences Center for Aquatic Plants at 352/392-9613.

Management of invasive vegetation in natural areas requires methods that will minimize damage to nontarget vegetation and soil. Often this need for caution necessitates more time and effort than weed management in agricultural, industrial, or right-of-way settings. Some particular types of vegetation, for instance 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.

The purpose of this publication is to provide land managers in Florida with current methods being used to manage non-native plants by other land managers in the state.

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 Department of Environmental Protection regional offices:

Bartow (941) 534-7143
 Floral City (352) 726-8622
 Lake City (904) 758-0464
 Orlando (407) 275-4004
 Upland Weed Office (904) 487-2600
 Tampa (813) 744-6163
 West Palm Beach (561) 791-4720

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

Northwest Florida WMD (850) 482-9522
 Suwannee River WMD (904) 362-1001
 St. Johns River WMD (904) 329-4500
 Southwest Florida WMD (813) 796-7211
 South Florida WMD (561) 682-6201

Control Methods

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 non-native plants to educate others about their identity, impacts, and control so that further ecological degradation of native ecosystems can be reduced.**

Biological Control

In Florida, classical biological control (introduction of reproducing populations of foreign insects or diseases) of invasive non-native plants in non-agricultural areas has 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, and Brazilian pepper.

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 non-native 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 non-native 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 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 for 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.

Land use history 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 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, that often require significant preparation time. Important opportunities exist when management tools can be applied to habitats when non-native 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 to 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 non-target 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 with thick bark, seeds, either 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 intensity of fire, time of year of fire (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 as well as 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 economic impacts to buildings, possible harm to human life, and the potential for escape of a fire to nontarget areas.

Fire has been very 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. 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 to manage invasive plant species, too 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 invadable habitat, 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.

Re-establishment 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 non-native species. Commercial plant nurseries currently provide seed and plants of several wetland and upland species. Since 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 very 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 circular 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 or uses listed in this publication, or commonly used for invasive plant control in natural areas, are classified as restricted-use, the basic knowledge of herbicide technology and application techniques that is 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. Certification requirements are met by successfully completing testing to ensure that the individual is knowledgeable in the use and supervision of restricted use pesticide application. Once certified, applicators may obtain a license from the Florida Department of Agriculture and Consumer Services as either public applicators or commercial applicators. The fees for a four-year license are \$35 for a public applicator and \$90 for a commercial applicator. Workshops on use of herbicides for invasive plant control in natural areas can also be arranged. For additional information regarding pesticide applicator training contact the Cooperative Extension Service in your county or the IFAS Pesticide Information Office (352) 392-4721. The EPPC can provide information on training opportunities and assist with organization of workshops for natural area managers through its education committee.

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, fluzifop, glyphosate, imazapyr, triclopyr (amine or ester), and hexazinone in varying concentrations (Table 1).

The active ingredients 2,4-D amine, triclopyr amine, 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 U.S. 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.**

EPA approves use of pesticides on specific sites, i.e., for use on individual crops, terrestrial non-crop or aquatic areas. Only those herbicides registered by EPA specifically for use in aquatic sites can be applied to plants growing in lakes, rivers, canals, etc. For terrestrial uses, 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." Rodeo® is the only product mentioned in this publication that is registered for aquatic use and can be applied directly to water (Table 1). Certain but not all products that contain 2,4-D can also be applied directly to water. The state supplemental special local need label for the imazapyr-containing product,

Arsenal® (EPA SLN NO. FL-940004) allows government agencies and their contractors to use it for injection, frill/girdle or cut stump applications to control melaleuca and Brazilian pepper (addition of Chinese tallow to label applied for) growing in water. Other products mentioned can be used in noncropland 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 foliage, roots, or bark. Triclopyr, 2,4-D imazapyr, and glyphosate can be absorbed by plant leaves and are effective for foliar applications. Addition of an appropriate surfactant, as recommended on the herbicide label, is essential. Triclopyr, 2,4-D and glyphosate are absorbed 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 species. Formulations that contain the active ingredients 2,4-D or 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 negligible 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.

Care must be taken to avoid unwanted contact of herbicide spray (drift) to foliage of nontarget plants when broadcast applications of the foliar active herbicides, 2,4-D, triclopyr, glyphosate, or imazapyr are made. Particulate drift can be minimized by avoiding windy conditions when spraying and 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 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 that they have been tested on, with the exception of the relatively low LC_{50} (0.87 ppm) of triclopyr ester and fluzifop (0.57 ppm) for fish, neither of which can be applied directly to water (Table 3). Ester formulations are toxic to fish because of irritation to fishes' gill surfaces. However, because triclopyr ester and fluzifop are not applied directly to water, are absorbed by soil particles, and have low persistence, exposure is low, which results in low risk when properly used.

Herbicide Application Methods

Foliar applications. Herbicide 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 handspray 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, 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-X8 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, which 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 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 which 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 two 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. 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 or 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 may 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 shut-off 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 may 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 (sometimes called hack-and-squirt) applications. 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 in mixed communities to kill target vegetation and minimize impact to desirable vegetation. 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 such as described above 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. Hand-held, chemical resistant spray bottles, such as the 1-quart Delta Industries "Spraymaster" are commonly used for applying herbicide for frill and girdle applications.

Stump treatments. After cutting and removing large trees or brush, herbicide (concentrated or diluted) is sprayed or painted on to the cut surface. 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 previously described can be used as long as they contain chemical resistant seals for the herbicides and carriers being used. Best results are obtained if the herbicide is applied immediately after cutting and with no more than one hour between cutting and applying herbicide, especially when using a water-soluble formulation (seconds can count with less susceptible species). 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. Granular herbicide formulations can be applied by hand held spreaders, by specially designed blowers, or aerially. Soil-applied water-soluble or water-dispersible formulations can be applied with the same type of application equipment described for foliar applications or spotguns 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 of limiting herbicide contact with nontarget vegetation and personal contact.

Methods Currently Used by Land Managers in Florida

Control methods being used for invasive non-native plants by land managers in Florida are listed in Table 4. 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.**

Table 1. Herbicides commonly used in natural areas of Florida. (Alphabetical by active ingredient. All concentrations are a.i.)

| PRODUCT | FORMULATION | COMMENTS |
|--|----------------------------|--|
| Several | 2,4-D various | Some products can be applied directly to water. |
| Fusilade | Fluazifop 24.5% EC | Post emergence, grass specific. Cannot be applied directly to water. |
| Rodeo, Aquamaster, Aquaneat, Eagre, AquaPro, GlyPro, Accord | Glyphosate 53.8% L | Can be applied directly to water. |
| Roundup Pro, Roundup Super Concentrate, Credit, Glyphos, GloPro Plus, Rattler, Honcho, Touchdown Pro, Dupont Glyphosate, Roundup Pro Dry, Gly Gran | Glyphosate 41.0% L | May be applied to ditch banks, dry ditches, dry canals. May not be applied directly to water. |
| Velpar L | Hexazinone 25% L | May cause ground-water 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 non-irrigation 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 | Can be applied to non-irrigation ditch banks. Nontarget plants can be damaged by root absorption. |
| 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 non-irrigation 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. |

Table 1. Herbicides commonly used in natural areas of Florida. (Alphabetical by active ingredient. All concentrations are a.i.)

| PRODUCT | FORMULATION | COMMENTS |
|---------------|----------------------------|---|
| 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. |

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

| | HALF-LIFE (DAYS) | MOBILITY IN SOIL | ABSORPTION BY PLANT ROOTS |
|-------------|---------------------|------------------|------------------------------|
| Glyphosate | ~47 | Little | Negligible |
| Fluazifop | 15 | Little | Negligible |
| Triclopyr | 10-46 | Moderate | Slight |
| 2,4-D amine | 10 | Moderate | Slight |
| Imazapyr | 25-142 | Mobile | Strong |
| Hexazinone | ~90 | Mobile | Strong |

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

| | BOBWHITE QUAIL 8-DAY DIETARY LC ₅₀ * | LABORATORY RAT 96-HR ORAL LD ₅₀ ** | BLUEGILL SUNFISH 96-HR LC ₅₀ * |
|-----------------|--|--|--|
| 2,4-D amine | >5,620 | >1000 | 524 |
| Fluazifop | >4659 (5-day) | 2721 (Female) | 0.53 |
| Triclopyr amine | >10,000 | 2574 | 891 |
| Triclopyr ester | 9,026 | 1581 | 0.87 |
| Imazapyr | > 5,000 | >5000 | >100 |
| Glyphosate | > 4,640 | >5000 | 120 |
| Hexazinone | >10,000 | 1690 | 420 |

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

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

Table 4. Control methods for non-native plants in use by land managers in Florida.

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| <p>The development and testing of many of these techniques was made possible through the Post-Hurricane Natural Areas Recovery Program supported by the Knight Foundation and a Florida state legislative appropriation to the Metro-Dade Park and Recreation Department. The following individuals contributed to recommendations listed in this table: Rodell Collins, Laura Flynn, Roger Hammer, Dallas Hazelton, Linda McDonald, Laurie McHargue, Jose Prieto, Robert Stewart, Sandra Vardaman Wells - Metro-Dade Park and Recreation Department; Jim Duquesnel, Mark Ludlow, Greg Jubinsky - Florida Department of Environmental Protection; Doria Gordon - The Nature Conservancy; Brian Nelson - Southwest Florida Water Management District; Wayne Corbin, Johnny Drew, Shawn Moore, Jerry Glance - St. Johns River Water Management District; Ross Hakes, Monsanto; Joe Visaggio, American Cyanamid; Bill Kline, DowElanco; Doug DeVries - National Park Service; Alison Fox, Ken Langeland, Jeff Mullahey, Donn Shilling, Brian Smith - University of Florida Institute of Food and Agricultural Sciences. Deborah Shelley, Jim Burney</p> <p>NOTE! All dilutions of Garlon 4 applications (except foliar) are made with oil. All dilutions of Arsenal, Garlon 3A, Rodeo, Roundup Pro, or Roundup Super Concentrate are made with water.</p> | |
| AGAVACEAE | |
| <i>Sansevieria hyacinthoides</i> | Bowstring hemp, Mother-in-law's tongue |
| | Treatment: Foliar apply 5%-10% Garlon 4 in oil or water. Addition of 3% stalker may increase consistency where non-target vegetation will not be endangered. In sandy soils where a greater potential exists for non-target damage plants can be cut and 15%-25% Roundup applied to the cut surfaces. |
| | Comments: Plants often take six to twelve months to die and follow-up applications are necessary. |
| ANACARDIACEAE (Cashew Family) | |
| <i>Schinus terebinthifolius</i> | Brazilian pepper; Florida holly |
| | Treatment: Cut-stump treatment with 50% Garlon 3A, 10% Garlon 4 or a basal bark application of 10% Garlon 4. Foliar application of Garlon 4, Garlon 3A, Roundup Pro, Roundup Super Concentrate, or Rodeo, according label directions may be used where appropriate. Glyphosate products are less effective when used alone in spring and early summer. Use Rodeo or cut stump application of 50% Arsenal where plants are growing in aquatic sites. |
| | 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 application of 10% Garlon 4 or cut stump application of 50% Garlon 3A. |
| | 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> | Ochrosia; Kopsia |
| | Treatment: Cut-stump treatment with 50% Garlon 3A. |
| | Comments: Fruits are bright red, paired and reportedly poisonous to eat; often used in coastal landscaping. |

Table 4. Control methods for non-native plants in use by land managers in Florida.

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| ARACEAE (Arum Family) | |
| <i>Colocasia esculenta</i> | Wild Taro |
| | Treatment: Foliar application of 1% Weedar 64 (3lb a.e./gal 2,4-D amine) + 1% Rodeo + 0.5% 1% Kammo (D-limonene) + silicone surfactant. |
| | Comments: Usually found in aquatic habitats so only herbicides labeled for aquatic sites can be used. Large corms make control very difficult and repeat applications will be necessary. |
| <i>Syngonium podophyllum</i> | Nepthytis |
| | Treatment: Hand pull vegetation, remove from site, spray resprouts with 3% Roundup or apply 10% Garlon 4 to stems. Foliar application of 3% Garlon 4 in water with surfactant has also achieved reasonable success. 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' | |
| | Treatment: Hand pull vegetation, remove from site or place in plastic in plastic bags and leave on-site until decomposed. After it has resprouted from broken stems, treat with 3% Roundup and surfactant. If non-target damage is not a concern, 3% roundup is very effective on large intact patches. Repeated cuttings of climbing vines 4-6' above ground and removal of the lower portion. |
| | Comment: Roots at nodes; sap is skin, mouth, and eye irritant; may form extensive groundcover; 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 dbh) have proven extremely difficult to eradicate. A cut-stump treatment with 50% Garlon 3A or 10% Garlon 4 is recommended. If a cut-stump treatment is not possible, application of a wide band of 10% Garlon 4 may be used on smaller individuals and 20% Garlon 4 may be used 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 palm 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. |

Table 4. Control methods for non-native plants in use by land managers in Florida.

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| <i>Livistona chinensis</i> | Chinese fan palm |
| | Treatment: 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 threadlike 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 non-native palm in hammocks, especially near coast; pinnate leaves with straight, sharp spines on petiole. |
| <i>Ptychosperma elegans</i> | Solitaire palm |
| | Treatment: 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: 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 the same 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: 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: Treat small patches with 2% Roundup; large, dense populations may be treated by broadcast-spraying 5% Roundup (with follow-up treatments as needed). Or 1/4-1.0% Garlon 4 in water. |

Table 4. Control methods for non-native plants in use by land managers in Florida.

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| <p>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.</p> | |
| BERBERIDACEAE (Barberry family) | |
| <i>Nandina domestica</i> | Nandina, Heavenly bamboo |
| <p>Treatment: Basal bark application of 15% Garlon 4 in mineral oil. Collect and destroy attached fruits.</p> | |
| <p>Comments: Naturalized in Gadsden, Jackson, Leon, Wakulla, and perhaps other Counties.</p> | |
| CACTACEAE (Cactus Family) | |
| <i>Hylocereus undatus</i> (=Cereus undatus) | Night-blooming cereus |
| <p>Treatment: 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.</p> | |
| <p>Comments: Vining cactus that climbs and roots to tree trunks; sometimes epiphytic; very showy, fragrant flowers open at night in summertime.</p> | |
| CAPRIFOLIACEAE | |
| <i>Lonicera japonica</i> | Japanese honeysuckle |
| <p>Treatment: Foliar application of 3%-5% Garlon 3A or 1%-3% Roundup Pro or equivalent concentration of other glyphosate containing product.</p> | |
| <p>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.</p> | |
| CASUARINACEAE (Beefwood Family) | |
| <i>Casuarina equisetifolia</i> | Australian pine |
| <i>Casuarina glauca</i> | Beefwood, Brazilian oak |
| <p>Treatment: Basal bark treatment with 10% Garlon 4 is very effective, as is a cut-stump treatment with 50% Garlon 3A or 10% Garlon 4. When basal bark treatment is used on trees greater than 1 foot in diameter it may be necessary to slough off loose bark in the application area to prevent the bark from trapping the herbicide. Addition of 3% Stalker will increase consistency on older trees. Broadcut of 4-6 lb Velpar ULW may be used when appropriate.</p> | |
| <p>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.</p> | |
| CLUSIACEAE (Pitch-apple Family) | |
| <i>Calophyllum antillanum</i> (= <i>C. Calaba</i> ; <i>C. brasiliense</i> var. <i>antillanum</i>) | Brazilian beauty-leaf |
| <p>Treatment: Basal bark treatment with 10% Garlon 4. Follow-up herbicide applications may be necessary.</p> | |
| <p>Comments: Medium-sized tree with glossy, leathery leaves; has been found principally invading coastal areas, including mangrove fringe.</p> | |

Table 4. Control methods for non-native plants in use by land managers in Florida.

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| 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 application of 10% Garlon 4 or cut-stump treatment with 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: Hand pull and remove from site. |
| | 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: Cut stem at ground level and treat with 50% Garlon 3A or 10% Garlon 4. A basal bark treatment with 10% Garlon 4 also works. The cut-stem treatment is preferred because it is evident within one week which stems were treated and which were missed. |
| | 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: Hand pull or treat with direct application of 3% Roundup and surfactant. 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. Basal stem treatments with 10% Garlon 4 is NOT recommended. This causes the leaves to drop, resulting in hundreds of new plantlets. |
| | 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: Cut and remove as much of the vines as possible and collect bulbils and remove from site. Apply foliar application of 1.25%-2.0% Garlon 3A or 0.5%-2.0% Garlon 4 to remaining vegetation. Several follow-up applications will be necessary through the growing season and perhaps successive years to control growth. |

Table 4. Control methods for non-native plants in use by land managers in Florida.

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| 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: Large individuals are difficult to kill. Applying 50% Garlon 3A to a freshly cut stump is recommended. Basal bark treatments with Garlon 4 does not work. | |
| Comments: Black bark, shiny alternate leaves; scattered throughout a few hammocks in South Florida; fruits large, edible; green when ripe. | |
| ELAEAGNACEAE (Oleaster family) | |
| <i>Elaeagnus pungens</i> | Silverthorn |
| Treatment: Basal bark application of 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 applications with 20% Garlon 4. | |
| Comments: Found mainly in northern counties to Citrus County. | |
| <i>Bischofia javanica</i> | Bishopwood; toog |
| Treatment: Basal bark treatment with 10% Garlon 4 is effective. Large trees require applying a wider band of herbicide on the trunk, or increasing the concentration of Garlon 4 to 20%. | |
| 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 treatment with 10% Garlon 4. Site must be revisited several times to pull up seedlings. | |
| Comments: High seed germination: seeds extremely poisonous to eat. | |
| <i>Sapium sebiferum</i> | Chinese tallow, popcorn tree |
| Treatment: Cut stump treatment of 20% Garlon 4; or basal bark application of 15% Garlon 4 to trees <10 in dbh or 20% Garlon 4 to trees >10 in dbh (non-aquatic sites only). Addition of 3% Stalker will reduce resprouting on older trees. Experimental cut stump and frill applications of 2-3% Arsenal have proven effective in aquatic sites and an application has been made to add to the label. Low volume foliar application with 0.5%-0.75% Arsenal can be used where appropriate. | |
| Comments: Use basal bark method when seeds are present on tree to reduce seed spread, apply to run-off. Seedlings up to 10 in tall can be hand pulled. | |
| FABACEAE (Pea Family) | |
| <i>Abrus precatorius</i> | Rosary pea |
| Treatment: Treat base of vine with 10% Garlon 4. Site must be revisited several times to pull seedlings. | |

Table 4. Control methods for non-native plants in use by land managers in Florida.

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| | Comments: Seeds black and red, highly poisonous. |
| <i>Acacia auriculiformis</i> | Earleaf acacia Treatment: Basal bark application of 10% Garlon 4 or cut-stump treatment with 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 treatment with 10% Garlon 4. Cut-stump treatments are also effective with 50% Garlon 3A or 10% Garlon 4. Small seedlings can be hand-pulled. |
| | Comments: Can be easily confused with <i>Albizia lebbbeck</i> , which has larger leaflets; bark of red sandalwood is typically reddish; produces hard red seeds which seem to persist in soil. |
| <i>Albizia lebbbeck</i> | Woman's tongue; Rattle pod Treatment: Basal bark treatment with 10% Garlon 4. Cut stump treatments are also effective with 50% Garlon 3A or 10% Garlon 4. Small seedlings can be hand-pulled. |
| | 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 application of 15% Garlon 4. Comments: Apply to 1-2 ft of trunk on larger trees. Trees >3 in dbh 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 application of 10% Garlon 4 or application of 50% Garlon 3A to cut stump. 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 treatment with 10% Garlon 4. Comments: Medium to large tree with compound leaves bearing 3 to 5 leaflets; papery seed pods wind-dispersed; invasive along hammock margin, canopy gaps and disturbed sites. |
| <i>Delonix regia</i> | Royal poinciana Treatment: Cut stump application of 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 treatment with 10%-20% Garlon 4 has been reported to be effective while others report only partial success with 40% Garlon 4. 25% has been effective on trees <3" DBH, while larger trees were not killed. Large trees must be completely girdled for frill/girdle applications. |

Table 4. Control methods for non-native plants in use by land managers in Florida.

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| <i>Mimosa pigra</i> (= <i>M. pelita</i>) | <p>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.</p> <p>Catclaw mimosa</p> |
| | <p>Treatment: Basal bark or cut stump application of Pathfinder or 30%-50% Garlon 4 and oil. Repeat foliar applications of 1.5% Rodeo or 2%-3% Garlon 3A.</p> <p>Comments: Repeated site visits are necessary to control seedlings and prevent further seed production. An estimated ten years are estimated to be needed for seed bank eradication.</p> |
| <i>Mucuna pruriens</i> | <p>Cow itch</p> <p>Treatment: Basal bark application of 10% Garlon 4, or hand pull mature vines and seedlings; does not resprout from roots. It is important to continue pulling seedlings until seed bank is exhausted.</p> <p>Comments: Hairs on seed pods cause intense itching.</p> |
| <i>Pueraria montana</i> (= <i>P. lobata</i>) | <p>Kudzu</p> <p>When actively growing at or beyond bloom stage of growth apply 2% Roundup Pro (or equivalent) diluted in water with hand held equipment. During early to mid growing season apply 2% Garlon 3A. Use sufficient spray volume to thoroughly wet foliage.</p> <p>Comments: Follow up treatments are necessary as resprouting occurs from root crowns and tubers.</p> |
| <i>Wisteria sinensis</i> | <p>Chinese wisteria</p> <p>Treatment: Cut vine and treat stump with 20%-30% Garlon 4 or 100% Garlon 3A.</p> <p>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.</p> |
| GOODENIACEAE (Goodenia Family) | |
| <i>Scaevola sericea</i> (= <i>S. frutescens</i> ; <i>S. taccada</i>) | <p>Beach naupaka; Half-flower; Scaevola</p> <p>Treatment: Hand pull and remove, at least fruit, from site whenever possible; basal treatment with 10% Garlon 4 or treat cut stump with 50% Garlon 3A or 10% garlon 4 if removal is not feasible. Monocultures can be treated foliarly with 4% Garlon 4 in water, using care not to allow drift to non-target vegetation.</p> <p>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.</p> |
| LYGODIACEAE (Climbing fern family) | |
| <i>Lygodium microphyllum</i> | <p>Old World climbing fern</p> <p>Treatment: Thoroughly spray foliage to wet with 1.25% Garlon 4 (4 pt per acre), 0.6% Roundup Pro (maximum 5 pt/acre), 1.0%-3.0% Rodeo (maximum 7 pt per acre). Only Rodeo can be used if plants are growing in aquatic site. Plants growing high into trees cut vines and treat lower portions. Do not apply when plants are under environmental stress.</p> |

Table 4. Control methods for non-native plants in use by land managers in Florida.

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| | <p>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.</p> |
| <i>Lygodium japonicum</i> | <p>Japanese climbing fern</p> <p>Treatment: Foliar application of 1.5% Rodeo or equivalent glyphosate containing product at proportional glyphosate concentration.</p> <p>Comments: Fern with twining, climbing fronds, leaflets lobed. Occurs throughout west and north Florida into central Florida. Smothers seedlings of overstory tree species.</p> |
| MALVACEAE (Mallow Family) | |
| <i>Hibiscus tiliaceus</i> | <p>Sea hibiscus; Mahoe</p> <p>Treatment: Hand pull seedlings; basal bark treatment with 10% Garlon 4 or cut stump treatment with 50% Garlon 3A.</p> <p>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.</p> |
| <i>Thespesia populnea</i> | <p>Seaside mahoe; Portia tree</p> <p>Treatment: Seedlings can be hand pulled. 50% Garlon 3A for cut stump applicaitons. Basal bark applications of 10% Garlon 4 have killed trees <2" DBH after 8 weeks. Larger trees with thick corky bark require up to 25% Garlon 4.</p> <p>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.</p> |
| MELIACEAE (Mahogany family) | |
| <i>Melia azedarach</i> | <p>Chinaberry, Pride of India</p> <p>Treatment: Basal bark application of 15% to 30% Garlon 4. Treat 1-2 ft of trunk for larger trees. Trees > 3" dbh may require retreatment. Fell trees over 6" DBH and treaat stumps with up to 30% Garlon 4. Addition of 3% Stalker may increase consistency. Apply low volume foliar application of 1% Arsenal covering 50% of the foliage.</p> <p>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.</p> |
| MORACEAE (Mulberry Family) | |
| <i>Broussonetia papyrifera</i> | <p>Paper mulberry</p> <p>Treatment: Basal bark application of 10%-30% Garlon 4. Addition of 3% Stalker will increase consistency.</p> <p>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>.</p> |
| <i>Ficus altissima</i> | Lofty fig |
| <i>Ficus benghalensis</i> | Banyan fig |
| <i>Ficus microcarpa</i> | Laurel fig |

Table 4. Control methods for non-native plants in use by land managers in Florida.

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| | <p>Treatment: Basal bark application of 10% Garlon 4 is effective.</p> <p>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.</p> |
| MYRSINACEAE (Myrsine Family) | |
| <i>Ardisia elliptica</i> (= <i>Ardisia solanacea</i>) | <p>Shoe-button Ardisia</p> <p>Treatment: Basal bark treatment with 10% Garlon 4 or cut stump application of 50% Garlon 3A. Hand pull seedlings.</p> <p>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.</p> |
| <i>Ardisia crenata</i> | <p>Coral ardisia</p> <p>Treatment: Foliar application of 5% Garlon 4 or basal bark application of 10% Garlon 4. Thorough coverage is essential for foliar application.</p> <p>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.</p> |
| MYRTACEAE (Myrtle Family) | |
| <i>Eugenia uniflora</i> | <p>Surinam cherry</p> <p>Treatment: For seedlings and small plants up to 1/2 inch diameter, use a basal bark treatment with 10% Garlon 4. This species takes a long time to die, and may require a subsequent herbicide application. For larger stems, use a cut-stump treatment with either 50% Garlon 3A or 10% Garlon 4. Seedlings should be hand pulled.</p> <p>Comments: Looks quite similar to native species of <i>Eugenia</i>; leaves have a distinct odor when crushed.</p> |
| <i>Melaleuca quinquenervia</i> | <p>Cajeput; Punk tree; Melaleuca</p> <p>Treatment: For seedlings and saplings: (1) hand pull, being sure not to break plant off of root system and remove or place in piles to help reduce the chance that they will reroot or; (2) Treat with foliar, low volume spot application of 5% Rodeo. For mature trees: (1) Fell large trees with chain saw leaving a level surface, or fell small trees with machete and treat with 20% to 40% Arsenal according to directions on SLN; (2) if trees are to be left standing, make girdle application of 20% to 50% Arsenal or mixture of 25% Arsenal and 25% Rodeo according to frill and girdle directions on Arsenal SLN. Monitor for resprouting and retreat as necessary. (3) Mature trees are very difficult to control with foliar applications. Experimental aerial applications of 3 qt Rodeo + 3 qt Arsenal + 4 qt methylated seed oil surfactant have been somewhat successful. Contact manufacturer representatives when planning such large-scale treatments.</p> <p>Comments: Tall, highly invasive tree in freshwater wetlands; thick, papery bark; extremely high seed production; seeds dispersed by wind following natural or mechanical disturbance.</p> |

Table 4. Control methods for non-native plants in use by land managers in Florida.

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|---|--|
| <i>Psidium guajava</i> | Guava |
| | Treatment: Basal bark application of 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 application of 10%-20% Garlon 4. |
| | Comments: A very aggressive evergreen shrub to 6 ft 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> | Jambolan plum; Java plum |
| <i>Syzygium jambos</i> | Rose apple |
| | Treatment: Cut-stump treatment with 50% Garlon 3A or 10% Garlon 4, or use a basal bark treatment with 10% Garlon 4. |
| | 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> | Gold coast jasmine |
| <i>Jasminum fluminense</i> | Brazilian jasmine |
| | Treatment: Individual vines of any size can receive a cut-stump treatment with 50% Garlon 3A or 10% Garlon 4, or a basal bark application of 10% Garlon 4. Because basally-applied Garlon 4 does not translocate beyond a few rooted nodes it is often necessary to pull runners back to the main stem, cut and apply Garlon 3A or Garlon 4 to the cut stem. Re-treatment of areas is usually necessary. 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> | Glossy privet |
| <i>Ligustrum sinense</i> | Chinese privet |
| | Treatment: Basal Bark application of 15% Garlon 4. Apply to 1-2 ft of trunk on larger trees. |
| | <i>L. sinense</i> widespread in northern Florida mesic woods, road shoulders, and farmlands. Invades logged areas, dispersed by mammals, birds, and floodwaters. |
| PASSIFLORACEAE (Passion-flower Family) | |
| <i>Passiflora edulis</i> | Passion-flower |
| | Treatment: Treat stems with a basal application of 10% Garlon 4 or use 10% Garlon 4 in a cut-stem application. |
| | 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 |

Table 4. Control methods for non-native plants in use by land managers in Florida.

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| | <p>Treatment: Hand pull when possible (broken roots may resprout); remove entire plant from site; if hand pulling is not possible or feasible, use basal bark application of 20% Garlon 4, or cut stems off at ground level and treat stumps with 50% Garlon 3A; remove cut stems from the site to avoid resprouting from nodes.</p> <p>Comments: All three of the above species invade hardwood hammocks, especially margins and canopy gaps.</p> |
| POACEAE (Grass Family) | |
| <i>Imperata cylindrica</i> | <p>Cogongrass</p> <p>Treatment: 3-4 qt. Roundup Pro, 2-3 qt. Arsenal, or 0.5 qt Fusulade 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.</p> <p>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.</p> |
| <i>Neyraudia reynaudiana</i> | <p>Burma reed</p> <p>Treatment: Where non-target damage is not a concern, the entire culm can be sprayed with 1-3% Roundup Pro. In areas with surrounding desirable vegetation, the culms can be cut to ground level and sprayed with 5% Roundup Pro 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 non-target damage.</p> <p>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.</p> |
| <i>Panicum repens</i> | <p>Torpedograss</p> <p>Treatment: Foliar application of 0.75 - 1.5% Rodeo and surfactant solution. Re-apply as necessary when plants regrow to with 4 - 6 inches in height; or foliar application of 0.5% spot treatment or 4 pints per acre broadcast treatment of Arsenal.</p> <p>Comments: Numerous dormant buds associated with extensive rhizomes make this plant extremely difficult to control. Several years of re-application may be necessary to completely eliminate a population.</p> |
| <i>Pennisetum purpureum</i> | <p>Napier grass</p> <p>Treatment: Foliar application of 1%-3% Roundup Pro. If non-target 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> above. Broadcast 3-5 quart/acre Roundup Pro, 2 quart/acre Arsenal, or 1 quart Arsenal and 2 quart Roundup Pro.</p> <p>Comments: Tall cane grass with white stripe down the center of the leaf blade and a foxtail-like inflorescence; prefers wetter substrates.</p> |
| <i>Phyllostachys aurea</i> | <p>Golden Bamboo</p> |

Table 4. Control methods for non-native plants in use by land managers in Florida.

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| | <p>Treatment: Foliar application of 3% Roundup Pro (equivalent formulations should be effective). Application of 5% Roundup Pro to cut culms will reduce resprouting but results are inconsistent.</p> <p>Comments: Not a common problem but once established can spread extensively. Populations should be controlled immediately. Can become established by dumping of yard waste.</p> |
| RHAMNACEAE (Buckthorn Family) | |
| <i>Colubrina asiatica</i> | Latherleaf; Asian colubrina |
| | <p>Treatment: Basal bark application of 20% Garlon 4, cut-stump treatment with 50% Garlon 3A, or foliar application with 3% Garlon 3A or Garlon 4 in water with surfactant. Follow up for 3 to 4 weeks Hand pull seedlings.</p> <p>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.</p> |
| ROSACEAE (Rose Family) | |
| <i>Rubus albescens</i> | Mysore raspberry |
| | <p>Treatment: Cut stem near ground and spray with 50% Garlon 3A or 10% Garlon 4. This species has not been observed resprouting from cut stem segments lying on the ground.</p> <p>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.</p> |
| <i>Eriobotrya japonica</i> | Loquat |
| | <p>Treatment: Tree can be cut-stump treated with 50% Garlon 3A or Garlon 4 or with a basal bark application of 10% Garlon 4.</p> <p>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.</p> |
| RUBIACEAE (Madder Family) | |
| <i>Paederia cruddasiana</i> | Sewer vine; skunk vine; Chinese fever vine |
| | <p>Treatment: Low volume foliar applications of 3% RoundupPro where non-target damage is not a concern. Where there are desirable plants, basal bark applications of 10% Garlon 4. Within 2-4 weeks retreat 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.</p> <p>Comments: Climbing vine; related to <i>Paederia foetida</i>, which is established in central Florida; flowers profusely; produces viable seeds.</p> |
| <i>Paederia foetida</i> | Skunk vine |
| | <p>Treatment: Apply 0.5% Garlon 3A to thoroughly wet foliage (4-8 pt.acre) or 10% to 6-inch band chest high to foliage of vertically climbing vines. Or apply 0.2%-0.6% Garlon 4 to thoroughly wet foliage or 1.0%-10% to 6 to 20-inch band chest high. Or thoroughly wet foliage with 1.0%-1.5% Plateau. Homeowners can use Brush-B-Gon at maximum label rates.</p> |

Table 4. Control methods for non-native plants in use by land managers in Florida.

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| | <p>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.</p> |
| <i>Paederia foetida</i> | <p>Skunk vine</p> <p>Treatment: Limited information available. Foliar application of 3% (4 oz/gal) Brush-B-Gone or 1-2% Roundup has been effective. Preliminary data suggests successful control with fire when invading a pyric community.</p> <p>Comments: Extremely aggressive, draping, foul smelling vine. Common in West Central Florida and expanding its range.</p> |
| RUTACEAE (Rue Family) | |
| <i>Murraya paniculata</i> | <p>Orange jessamine</p> <p>Treatment: Hand pull seedlings; basal bark treatment with 10% Garlon 4.</p> <p>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.</p> |
| SAPINDACEAE (Soapberry Family) | |
| <i>Cupaniopsis anacardioides</i> | <p>Carrotwood</p> <p>Treatment: Basal bark application of 100% Pathfinder II, or 10%-20% Garlon 4 diluted with oil; or cut stump application of 10% Garlon 3A, 100% Brush-B-Gon, 100% Roundup Pro, 100% Rodeo, or equivalent glyphosate containing product, or 100% Pathfinder II.</p> <p>Comments: Invades interior of hammocks; added to Florida Noxious List in 1999; bird dispersed. Note label restrictions with respect to high tide mark and use extra caution near mangroves.</p> |
| SAPOTACEAE (Sapodilla Family) | |
| <i>Manilkara zapota</i> | <p>Sapodilla</p> <p>Treatment: Hand pull seedlings; basal bark application of 10% Garlon 4, larger trees may require several applications or increasing the Garlon 4 to 20%; or cut stump application with 50% Garlon 3A.</p> <p>Comments: Large, spreading tree; edible fruit; seeds dispersed by raccoons and opossums; invades hammock interiors.</p> |
| <i>Pouteria campechiana</i> | <p>Egg fruit; Canistel</p> <p>Treatment: Hand pull seedlings; basal bark application of 10% Garlon 4.</p> <p>Comments: Small to medium tree; yellow, edible fruit; prolific invader of hammocks but local in distribution; fruit eaten by raccoons and opossums.</p> |
| SOLANACEAE (Nightshade Family) | |
| <i>Cestrum diurnum</i> | <p>Day jessamine</p> <p>Treatment: Hand pull when possible (if soil disturbance is not an issue); cut stump treatment with 50% Garlon 3A is effective.</p> <p>Comments: Shrub or small tree with small, tubular, very fragrant flowers (in daytime) small purple fruit dispersed by birds.</p> |
| <i>Solanum tampicense</i> | <p>Wetland nightshade, misleadingly called aquatic soda apple</p> |

Table 4. Control methods for non-native plants in use by land managers in Florida.

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| | <p>Treatment: Preliminary research results suggest foliar applications of 1.5% Garlon 3A is most effective while similar application rates of Rodeo or Weedar 64 may be somewhat less effective. Aggressive follow-up treatments will probably be necessary to control seedlings.</p> <p>Comments: An aggressive invader of wetlands and floodplains. Should be eliminated whenever located.</p> |
| <i>Solanum viarum</i> | <p>Tropical soda apple</p> <p>Treatment: Foliar application of 1% Garlon 4, 3% Roundup or 0.5% Arsenal solution in water with surfactant.</p> <p>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.</p> |
| VERBENACEAE (Verbena Family) | |
| <i>Lantana camara</i> | <p>Shrub verbena; Lantana</p> <p>Treatment: Basal application with 10% Garlon 4 or cut stump treatment with 50% Garlon 3A or 10% Garlon 4.</p> <p>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.</p> |

Index of Common Names.

| COMMON NAME | REFER TO PLANT FAMILY |
|--------------------|------------------------------|
| Air-potato | Dioscoreaceae |
| Air yam | Dioscoreaceae |
| Ardisia | Myrsinaceae |
| Arjun tree | Combretaceae |
| Asian colubrina | Rhamnaceae |
| Australian pine | Casuarinaceae |
| Bamboo palm | Arecaceae |
| Bamboo piper | Piperaceae |
| Banyan fig | Moraceae |
| Beach naupaka | Goodeniaceae |
| Beefwood | Casuarinaceae |
| Bishopwood | Euphorbiaceae |
| Black sapote | Ebenaceae |

Index of Common Names.

| COMMON NAME | REFER TO PLANT FAMILY |
|-----------------------|------------------------------|
| Bowstring hemp | Agavaceae |
| Brazilian beauty-leaf | Clusiaceae |
| Brazilian jasmine | Oleaceae |
| Brazilian oak | Casuarinaceae |
| Brazilian pepper | Anacardiaceae |
| Burma reed | Poaceae |
| Cajeput | Myrtaceae |
| Canistel | Sapotaceae |
| Carrotwood | Sapindaceae |
| Castor bean | Euphorbiaceae |
| Catclaw mimosa | Fabaceae |
| Chinaberry | Meliaceae |
| Chinese fan palm | Arecaceae |
| Chinese privet | Oleaceae |
| Chinese tallow | Euphorbiaceae |
| Chinese wisteria | Fabaceae |
| Cogongrass | Poaceae |
| Coral ardisia | Myrsinaceae |
| Cow itch | Fabaceae |
| Day jessamine | Solanaceae |
| Devil tree | Apocynaceae |
| Downy rosemyrtle | Myrtaceae |
| Dune sunflower | Asteraceae |
| Earleaf acacia | Fabaceae |
| Egg fruit | Sapotaceae |
| Ficus | Moraceae |
| Fishtail palm | Arecaceae |
| Florida holly | Anacardiaceae |
| Glossy privet | Oleaceae |

Index of Common Names.

| COMMON NAME | REFER TO PLANT FAMILY |
|------------------------|------------------------------|
| Gold coast jasmine | Oleaceae |
| Golden bamboo | Poaceae |
| Guava | Myrtaceae |
| Half-flower | Goodeniaceae |
| Heavenly bamboo | Berberidaceae |
| Hunter's robe | Araceae |
| Indian almond | Combretaceae |
| Indian rosewood | Fabaceae |
| Jambolan plum | Myrtaceae |
| Japanese climbing fern | Lygodiaceae |
| Japanese honeysuckle | Caprifoliaceae |
| Jasmine | Oleaceae |
| Java plum | Myrtaceae |
| Kopsia | Apocynaceae |
| Lantana | Verbenaceae |
| Latherleaf | Rhamnaceae |
| Laurel fig | Moraceae |
| Lead-tree | Fabaceae |
| Lepianthes | Piperaceae |
| Life plant | Crassulaceae |
| Live leaf | Crassulaceae |
| Lofty fig | Moraceae |
| Loquat | Rosaceae |
| Mahoe | Malvaceae |
| Makulan | Piperaceae |
| Melaleuca | Myrtaceae |
| Mexican fan palm | Arecaceae |
| Mimosa | Fabaceae |
| Mother-in-law's tongue | Agavaceae |

Index of Common Names.

| COMMON NAME | REFER TO PLANT FAMILY |
|-------------------------|------------------------------|
| Mueller's almond | Combretaceae |
| Mysore raspberry | Rosaceae |
| Nandina | Berberidaceae |
| Napier grass | Poaceae |
| Nephtytis | Araceae |
| Night-blooming cereus | Cactaceae |
| Ochrosia | Apocynaceae |
| Old World climbing fern | Lygodiaceae |
| Orange jessamine | Rutaceae |
| Orchid tree | Fabaceae |
| Oyster plant | Commelinaceae |
| Palms | Arecaceae |
| Paper mulberry | Moraceae |
| Passion-flower | Passifloraceae |
| Piper | Piperaceae |
| Popcorn tree | Euphorbiaceae |
| Portia tree | Malvaceae |
| Possum grape | Vitaceae |
| Pothos | Araceae |
| Punk tree | Myrtaceae |
| Queen palm | Arecaceae |
| Queensland umbrella | Araliaceae |
| Raspberry | Rosaceae |
| Red sandalwood | Fabaceae |
| Rosary pea | Fabaceae |
| Rose apple | Myrtaceae |
| Rosewood | Fabaceae |
| Royal poinciana | Fabaceae |
| Royal palm | Arecaceae |

Index of Common Names.

| COMMON NAME | REFER TO PLANT FAMILY |
|---------------------|------------------------------|
| Sapodilla | Sapotaceae |
| Scaevola | Goodeniaceae |
| Schefflera | Araliaceae |
| Scholar tree | Apocynaceae |
| Sea hibiscus | Malvaceae |
| Seaside mahoe | Malvaceae |
| Senegal date palm | Arecaceae |
| Sewer vine | Rubiaceae |
| Shoebuttton ardisia | Myrsinaceae |
| Silverthorn | Elaeagnaceae |
| Skunk vine | Rubiaceae |
| Solitaire palm | Arecaceae |
| Surinam cherry | Myrtaceae |
| Toog | Euphorbiaceae |
| Torpedoglass | Poaceae |
| Tropical soda apple | Solanaceae |
| Tungoil tree | Euphorbiaceae |
| Umbrella tree | Araliaceae |
| Washingtonia palm | Arecaceae |
| Water yam | Dioscoreaceae |
| Wedelia | Asteraceae |
| West African yam | Dioscoreaceae |
| Wild taro | Araceae |
| Woman's tongue | Fabaceae |
| Wood rose | Convolvulaceae |

Index of Botanical Names.

| GENUS NAME | REFER TO PLANT FAMILY |
|-------------------|------------------------------|
| Abrus | Fabaceae |

Index of Botanical Names.

| GENUS NAME | REFER TO PLANT FAMILY |
|-------------------|------------------------------|
| Acacia | Fabaceae |
| Adenanthera | Fabaceae |
| Albizia | Fabaceae |
| Aleurites | Euphorbiaceae |
| Alstonia | Apocynaceae |
| Ardisia | Mysinaceae |
| Bauhinia | Fabaceae |
| Bischofia | Euphorbiaceae |
| Broussonetia | Moraceae |
| Calophyllum | Clusiaceae |
| Caryota | Arecaceae |
| Casuarina | Casuarinaceae |
| Cereus | Cactaceae |
| Cestrum | Solanaceae |
| Chamaedorea | Arecaceae |
| Colocasia | Araceae |
| Colubrina | Rhamnaceae |
| Cupaniopsis | Sapindaceae |
| Dalbergia | Fabaceae |
| Delonix | Fabaceae |
| Dioscorea | Dioscoreaceae |
| Diospyros | Ebenaceae |
| Elaeagnus | Elaeagnaceae |
| Epipremnum | Araceae |
| Eriobotrya | Rosaceae |
| Eugenia | Myrtaceae |
| Ficus | Moraceae |
| Hibiscus | Malvaceae |
| Hylocereus | Cactaceae |

Index of Botanical Names.

| GENUS NAME | REFER TO PLANT FAMILY |
|-------------------|------------------------------|
| Imperata | Poaceae |
| Jasminum | Oleaceae |
| Kalanchoe | Crassulaceae |
| Lantana | Verbenaceae |
| Lepianthes | Piperaceae |
| Leucaena | Fabaceae |
| Ligustrum | Oleaceae |
| Livistona | Arecaceae |
| Lonicera | Caprifoliaceae |
| Lygodium | Lygodiaceae |
| Manilkara | Sapotaceae |
| Melaleuca | Myrtaceae |
| Melia | Meliaceae |
| Merremia | Convolvulaceae |
| Mimosa | Fabaceae |
| Mucuna | Fabaceae |
| Murraya | Rutaceae |
| Nandina | Berberidaceae |
| Ochosia | Apocynaceae |
| Neyraudia | Poaceae |
| Paederia | Rubiaceae |
| Panicum | Poaceae |
| Passiflora | Passifloraceae |
| Pennisetum | Poaceae |
| Phoenix | Arecaceae |
| Phylostachis | Poaceae |
| Piper | Piperaceae |
| Pouteria | Sapotaceae |
| Ptychosperma | Arecaceae |

Index of Botanical Names.

| GENUS NAME | REFER TO PLANT FAMILY |
|-------------------|------------------------------|
| Psidium | Myrtaceae |
| Rhaphidophora | Araceae |
| Rhodomyrtus | Myrtaceae |
| Rhoeo | Commelinaceae |
| Ricinus | Euphorbiaceae |
| Roystonea | Arecaceae |
| Rubus | Rosaceae |
| Sansevieria | Agavaceae |
| Sapium | Euphorbiaceae |
| Scaevola | Goodeniaceae |
| Schefflera | Araliaceae |
| Schinus | Anacardiaceae |
| Solanum | Solanaceae |
| Sphagneticola | Asteraceae |
| Syagrus | Arecaceae |
| Syngonium | Araceae |
| Syzygium | Myrtaceae |
| Terminalia | Combretaceae |
| Thespesia | Malvaceae |
| Tradescantia | Commelinaceae |
| Washingtonia | Arecaceae |
| Wedelia | Asteraceae |
| Wisteria | Fabaceae |