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UNIVERSITY OF FLORIDA
EXTENSION
Institute of Food and Agricultural Sciences

Circular 868

# Exotic Woody Plant Control[1]

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## INTRODUCTION

Extensive urbanization in Florida has led to the introduction of a great number of exotic (non-native) plants in landscapes. Florida's mild climate and ample rainfall for many months of the year provide a suitable habitat for many of these introduced plants to escape from cultivation and become naturalized. It has been estimated that 27% of Florida's 3448 named plants (excluding ornamental plantings) are exotic, and this suggests that Florida's natural vegetation is becoming displaced (Daniel B. Ward, personal communication). Some of these introduced plants become aggressive invaders of native plant communities because their population is no longer kept in check by factors such as competing species and predators that have coevolved with them.

Large areas of southern and central Florida have been severely altered (probably beyond our present restoration ability) by urbanization and other activities of man. However, certain areas, such as state and national parks, have been relatively protected and attempts are being made by the National Park Service, Florida Department of Natural Resources, and other agencies, to preserve (or restore) the ecology of these areas in as pristine a condition as possible. This endeavor includes management, or elimination where possible, of introduced vegetation. Several very aggressive introduced plants have already replaced native Florida plant communities in some areas, thereby drastically changing the landscape both visually and ecologically. These include Australian pine (*Casuarina* spp.), Brazilian pepper (*Schinus terebinthifolius* Raddi), Asiatic colubrina (*Colubrina asiatica* (L.) Brongn.) and melaleuca (*Melaleuca quinquenervia* (Cav.) Blake).

In recognition of the loss of natural communities caused by these and other aggressive exotic plants, the Exotic Pest Plant Council (EPPC) was formed to coordinate efforts of various agencies into developing management programs and increasing public awareness. This circular is an example of those efforts. It presents current methods for control of Australian pine, Brazilian pepper, Asiatic colubrina and melaleuca that have been tested and compiled by members of the EPPC. Management programs include the use of manual removal, mechanical removal, physical controls and herbicides, alone or in combination. Biological controls are currently under study and should be implemented in the future. Characteristics of the different types of control measures are discussed. All herbicide treatments listed have been found effective under certain circumstances. However, since choice of herbicide

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application will depend upon environmental conditions and personal preference, they are not ranked in this publication.

## TYPES OF CONTROL METHODS

### Prevention

The importation and spread of noxious exotic vegetation can be significantly reduced by public education. *It is the responsibility of those who are aware of the problems caused by noxious exotic plants to educate others as to their identity and control to prevent further ecological damage to native ecosystems.*

### Biological Control

Native plant communities evolve with a complex relationship of natural controls that keep them in balance. These natural controls may include environmental restraints, competing species, herbivores (e.g., insects) and pathogens. When plants are introduced into new areas, they often have a competitive advantage over native plants because natural controls of the introduced plants are not present. This competitive advantage may allow introduced plants to cause problems, such as displacing natural plant communities. Biological control is the purposeful introduction of natural controls such as insects and pathogens, to help provide balance among native and introduced plants.

The type of biological control proposed for exotic woody vegetation in South Florida is called the classical (or introduction) approach. Classical biological control requires a large initial investment of time and money. However, a successful program can have long-term benefit to cost ratios of 100:1 and higher.

Classical biological control involves the following: (1) Surveys are conducted to identify natural controls in a plant's native habitat. (2) Natural controls that are promising biocontrol agents are studied and quarantined to determine their ability to suppress the host (pest) and to insure that they are host-specific (cannot significantly damage or reproduce on nontarget plants such as native plants, ornamental plants or crops). These studies are conducted where the organism is collected and in the region where it is to be released. (3) Biological control agent(s) are released in order to establish self-perpetuating populations that will suppress growth of the pest. (4) If necessary, biological control agents are collected from established populations and moved to new locations.

Classical biological control has been used successfully for many years. Probably the first effort was the use of an insect (*Dactylopius ceylonicus* Green) to control prickly pear cactus (Opuntia *vulgaris* Mill.) in southern India during the 1860's. More recently, alligatorweed flea beetle (*Agasicles hygrophila)* and alligatorweed stem boring moth (*Vogtia malloi*) have successfully suppressed alligatorweed (*Alternanthera philoxeroides* (Mart.) Griseb.) in the southeastern United States.

Biological control agents have not yet been introduced for control of Asiatic colubrina, Australian pine, Brazilian pepper or melaleuca. However, a major effort is currently underway to identify natural control of melaleuca and Brazilian pepper. Over 200 insects that feed on melaleuca have been found in Australia and several of these offer promise for introduction into south Florida as biological control agents. It is important that these studies continue. Additional initiatives to identify biological control agents for other major nuisance exotic vegetation, which threaten Florida's natural areas, are equally important.

Research, implementation and results of biological control are very slow. It is not possible to predict how long it will take to have effective biological control of Asiatic colubrina, Australian pine, Brazilian pepper and melaleuca, or how effective these will be. Therefore, other control measures are currently important, and will be necessary even after establishment of successful biological control.

### Mechanical Removal

Mechanical removal involves the use of bulldozers, or specialized logging equipment to remove woody plants. This method is used when an area is to be cleared for a new land-use. Mechanical

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**Figure 1.** The "Kelly Device" can facilitate manual removal of seedlings and small trees that are difficult to remove by hand.

removal is not effective for control of Australian pine, Asiatic colubrina, Brazilian pepper, or melaleuca when used alone because disturbance of the soil creates conditions for regrowth from seeds and root fragments, and further invasion by pioneering exotic plants. Therefore, intense follow up with other control methods is essential. Mechanical removal is usually not appropriate in natural areas because of disturbances to soils and nontarget vegetation caused by the equipment used.

## Physical Control

Woody vegetation can be stressed or sometimes killed by environmental alterations such as water level manipulation or fire. Constraints, such as the need to maintain water levels in water conservation areas, liability involved with burning, and effects on desired vegetation, will often limit the usefulness of these methods. However, research to determine how physical stresses can be incorporated into management programs (e.g., timing of herbicide applications with flooding) is important.

## Herbicides

### Regulations

Herbicides are a commonly used method of managing exotic woody vegetation. Use of herbicides (and other methods of vegetation control in some instances) in certain areas, such as public waters and wetlands, are regulated by state and local agencies. For questions regarding permits to control vegetation in public waters contact one of the following Department of Natural Resources regional offices:

Tampa 813/626-5143
Orlando 407/423-0673
West Palm Beach 407/793-5666

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

Southwest Florida WMD 904/796-7211
St. Johns River WMD 904/328-8321
South Florida WMD 407/686-8800

*A basic knowledge of herbicide technology and application techniques is necessary for safe and effective use of herbicides. For this reason, state agencies and federal agencies require personnel involved in herbicide application to be certified by the Florida Department of Agriculture and Consumer Services (FDACS). It is strongly advised that any individual who practices herbicide application be certified by FDACS. The Universirty of Florida Institute of Food and Agricultural Sciences provides training and testing for certification of pesticide applicators. For information regarding pesticide applicator certification, contact the Cooperative Extension Service in your county.*

## Herbicide Absorption Characteristics

### Contact herbicides

Contact herbicides act quickly and are generally lethal to all plant cells that they contact. Because of this rapid action or other physiological reasons they do not move extensively within the plant and are effective only where they contact plants. They are generally more effective on annual, herbaceous plants, and seedlings. Perennial, woody plants can be defoliated by contact herbicides, but they quickly resprout from unaffected plant parts.

### Systemic herbicides

Systemic herbicides are absorbed into the living portion of the plant and move within the plant. Different systemic herbicides are absorbed to varying degrees by different plant parts. Systemic herbicides that are absorbed by plant roots are referred to as *soil active herbicides* and those that are absorbed by leaves are referred to as *foliar active herbicides.* Some soil active herbicides, tebuthiuron for example, are absorbed only by plant roots. Other systemic herbicides, such as glyphosate and triclopyr, are

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predominantly or only active when applied to and absorbed by the foliage. Others, such as imazapyr, are absorbed by both roots and shoots. When applied correctly, systemic herbicides act slowly compared to contact herbicides. This slow activity allows them to move to their site of action within the plant (e.g., roots, leaves). Systemic herbicides are more effective for controlling mature woody plants than contact herbicides.

## Herbicde Selectivity

### Nonselective or broad spectrum herbicides

Nonselective or broad spectrum herbicides are those that kill all or most plants that they come in contact with. Many herbicides, such as tebuthiuron, hexazinone, glyphosate, and imazapyr that are effective for controlling woody plants are broad spectrum and care must be taken to avoid damage to nontarget, desirable vegetation. However, broad spectrum herbicides can be used for selective weed control if special application techniques, such as fall or girdle treatments (described later), are used. These techniques insure the herbicide only contacts the target plants.

### Selective herbicides

Selective herbicides are those that control certain plants but not others. Triclopyr and 2,4-D are examples of selective herbicides that are most effective for controlling broad leaf plants (dicotyledons) while grasses and related plants (monocotyledons) are relatively tolerant. Therefore, certain woody plants can be controlled and a grass community preserved. Herbicide selectivity can be affected by the rate of application and growth stage of plants. Factors that affect susceptibility of Australian pine, Brazilian pepper, Asiatic colubrina and melaleuca and nontarget native plants are currently under investigation.

## Environmental Fate of Herbicides

After application, herbicides may break down to nonbiologically active products, adsorb to soil, or move away from the application site unchanged. Breakdown and adsorption may occur at different rates depending upon the herbicide's chemistry, soil characteristics, and other environmental factors. Since some of the herbicides that are used for woody plant control do not break down quickly and may move in Florida soils, damage to nontarget vegetation or contamination of groundwater may occur if proper precautions are not used. To avoid unwanted results, the herbicide applicator must be well informed of the chemical properties of the herbicide to be used and under what particular circumstances it should be applied. Always consult the herbicide label for environmental precautions.

## Environmental Factors Affecting Herbicide Application

### Rainfall

Rainfall can wash foliar applied herbicide off before it is adequately absorbed into the plant. This is a particular problem when using slowly absorbed systemic herbicides such as glyphosate. Heavy rainfall following frill and girdle application of a concentrated herbicide solution can wash the herbicide into the soil and result in damage to nontarget vegetation. Soil active herbicides applied to ditch banks can also be affected if heavy rainfall washes the herbicide away before it can leach in to the root zone. Applying soil active herbicides to moist soil (following rain) is preferable because this promotes quick diffusion of the herbicide into the soil.

Lack of rainfall can also affect herbicide efficacy because drought-stressed plants are less likely to absorb both foliar and soil applied herbicides. Certain herbicide labels such as glyphosate have precautionary statements to this effect. *The applicator should be aware of potential weather conditions and should schedule applications accordingly.*

### Wind

Wind can affect herbicide applications in several ways. Foliar herbicide application during excessive wind may result in poor coverage to the target vegetation and cause drift that results in damage to nontarget vegetation. Wind can also indirectly affect the ability of plant leaves to absorb herbicides, which can result in poor control. *Windy conditions should be avoided when making foliar herbicide applications.*

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### Temperature

Low temperature may affect herbicide efficacy indirectly by affecting plant growth. At less than optimum temperature, plant growth slows down, and this may decrease herbicide absorption and/or activity.

### Soil chemistry

Soil and herbicide interactions are complex. These interactions influence the activity and movement of soil-active herbicides. The most important factor is the ability of different soils to chemically bind herbicides. Soil-applied herbicides usually have label recommendations for use on 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. Since Florida soils, where woody plants are a problem, include highly organic muck, sand, and very thin soil layers over limestone, a broad range of soil-applied herbicide behavior can be expected.

### Water chemistry

Water chemistry can be an important factor in the performance of tank-mixed herbicide applications because some herbicides can be inactivated by suspended particles, dissolved organic materials and water hardness. Always take the following precautions when obtaining water for tank mixes:

- Use the cleanest water available. Avoid sediments.
- When mixing herbicides known to react with hard water, use the softest water available. If possible, use softened or distilled water; lake water is next best choice; avoid using well water.
- Minimize the amount of time that herbicides remain mixed in water.

Some additives have been suggested to alleviate the hard water problem, but these are still under study and results, to date, have been inconsistent.

### Herbicide Formulations

A herbicide formulation usually consists of the herbicide active ingredient dissolved in a solvent (e.g., oil or alcohol), or adsorbed to a solid such as clay. Liquid formulations often include an adjuvant that facilitates spreading, sticking, wetting, and other modifying characteristics of the spray solution. These special ingredients usually improve the safe handling, measuring, and application of the active ingredient.

### Water soluable liquids (WSL or L)

Water soluble liquids have the herbicide (e.g., amines) dissolved in a water soluble solvent such as an alcohol. Since they form true solutions they do not require agitation. They are usually not compatible with oil-based carriers.

### Emulsifiable concentrate (EC)

Emulsifiable concontain a mixture of petroleum solvents and emulsifiers that allow an insoluble or low solubility herbicide to mix with water. EC's require little agitation. They cause minimum equipment wear because they are nonabrasive. EC's may also be mixed with oil based carriers for low volume applications (e.g., basal bark).

### Flowable (F)

A flowable formulation consists of an insoluble solid phase suspended in a liquid. The active ingredients in flowables are insoluble in water and form suspensions when mixed with water. Therefore, constant tank agitation is important when using flowables. Flowables share the handling advantages of an EC.

### Dry flowable (DF)

Dry flowables are formulations that are insoluble in water but are formulated in such a way that they can be easily poured and measured. As with flowables, tank agitation is important to keep them in suspension. They are much easier to handle than wettable powders but usually are more expensive.

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### Granule (G) and pellet (P)

Granules and pellets range from 1%-40% active ingredient. Granules are convenient for spot treatments, are ready to use, reduce drift hazards, and can be easily applied. The disadvantage of granules is the sometimes high expense per pound of active ingredient.

### Wettable powder (WP)

Another common dry formulation is the wettable powder. WP formulations resemble a fine dust and generally contain greater than 50% active ingredient. When mixed with water, agitation is required to keep the insoluble particles of a wettable powder in suspension. The advantages of WPs are the lower cost, ease of handling, and ease of measuring. Some disadvantages of WPs are the abrasion of suspended particles on spray equipment and the requirement for constant tank agitation.

## The Herbicide Label

All herbicide containers must have attached to them a label that provides instructions for storage and disuse of the product, and precautions for the user and the environment. *The label is the law. It is unlawful to use a pesticide* in a manner *that is inconsistent with or not specified on the label. It is unlawful to alter, detach, or destroy the label. It is unlawful to transfer herbicide to an improperly labeled container.* Misuse of a herbicide is not only a violation of federal and state law, but also may cause unwanted results such as damage to nontarget vegetation. *Make sure to have all appropriate labels at the application site including supplemental labels, special local need labels and emergency use labels.*

*The herbicide label contains a great deal of informaabout the product and should be read thoroughly and carefully before each use. Before applying a herbiread the label to determine the following:*

- Can the weed be controlled with the product?
- Can the herbicide be used safely under particular application conditions?
- How much herbicide is needed?
- Is the product labeled for the site, i.e., ditch banks only, canal banks, wetlands, etc.?
- What is the behavior of the herbicide on different types of soils?
- What is the toxicity of the herbicide to fish and nontarget vegetation?
- When should the herbicide be applied (time of year, stage of plant growth, etc.)?
- Is the herbicide classified restricted or general use?•
- What is the signal word (DANGER, WARNING, CAUTION) and safety equipment that should be worn during mixing and application?

*Read labels often even if you use the herbicide routinely. You may have missed something or it may have changed. Labels are updated often by industry.*

## Herbicide Application Methods

### Basal bark applications

Basal bark applications are made by applying herbicide directly to the bark around the circumference of each stem/tree up to 15 inches above the ground (Figure 2). Hand-held equipment or backpack sprayers are usually used. The herbicide is sometimes in a ready-to-use form, but is usually diluted in some carrier, such as diesel fuel, kerosene, or mineral oil.

### Foliar applications

Foliar applications are usumade by diluting herbicide in water and applying to the leaves with aerial or ground equipment (Figure 3). Dilution is usually about 20:1 for aerial applications and 50-400:1 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. Ground equipment ranges from hand-held sprayers for applications to small individual plants to large high pressure vehicle or boat-mounted sprayers for larger vegetation. Foliar

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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.

## 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. Overlapping and continuous cuts (girdle) are sometimes used for difficult-to-control species and large trees (Figure 4). 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 herbicides, 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 noxious vegetation and minimize impact to desirable vegetation. To further minimize potential impact to desirable vegetation cuts can be wrapped with masking tape to prevent rainfall from washing herbicide to the soil.

## Injection

Special equipment (available from agricultural or forestry equipment suppliers) is used that delivers a measured amount of herbicide into the tree trunk. Injections should surround the tree at intervals of 2-3 inches between edges. They may be made at any convenient height, usually 2-4 feet aboveground.

## Stump treatments

After cutting and removing large trees or brush, herbicide (concentrated or diluted) is sprayed or painted on to the exposed cambium layer next to the bark around the entire circumference of the stump (Figure 5). Do not allow more than 1 hour to elapse between cutting and applying herbicide.

## Soil applications

Granular and pellet herbicide formulations can be applied by hand, hand-held spreadspecially designed blowers, or aerially. Soil-applied, liquid, flowable or wettable powder herbicide formulacan be applied with the same type of application 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 keeptrack 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.

**Figure 2.** Basal bark applications are made by applying herbicide directly to the bark around the circumference of each stem/tree up to 1 inch above the ground. In this appliation, waterproof boots and eye protection are being worn. Additional protective clothing is often required or advised, especially when handling herbicide concentrate.

**Figure 3.** Foliar applications are made by diluting herbicide (usually in water) and applying to the leaves with aerial or ground equipment. In this application, waterproof boots and eye protection are being worn. Additional protective clothing is often required or advised, especially when handling herbicide concentrate.

**Figure 4.** Girdle applications are sometimes used for difficult-to-control species such as melaleuca and large trees. To further minimize potential impact to desireable vegetation, cuts can be wrapped with masking tape to prevent rainfall from washing herbicide to the soil.

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**Figure 5.** After cutting and removing large trees or brush, herbicide is sprayed or painted on to the exposed cambium layer, next to the bark around the entire circumference of the stump.

## Botanical Descriptions and Control Recommendations for Austrailian Pine, Brazilian Pepper, Asiatic Columrina, and Maleluca

### Austrailian Pine

**Other Common Names:** Ironwood, beefwood, she oak, horsetail tree.

**Native Country:** Australia.

**Habitat:** Occurs throughout South Florida (from Orlando, south) on sandy shores, pinelands, and in the Everglades, above the water table or mean high water line. Frequently colonizes disturbed sites, such as filled wetlands, road shoulders, cleared land, and vacant lots. Austrailian pine is capable of colonizing nutrient-poor soils by nitrogen fixing microbial associations.

**General Description:** Evergreen tree, up to 150 ft. high, with long, slender branches which resemble a conifer.

**Leaves:** Dark green, reduced to scalelike sheaths, surrounding jointed cylindrical branches in whorls, 6-8 scales per whorl.

**Bark:** Reddish brown to grey; rough, brittle and peeling; smooth in young growth.

**Flowers:** Staminate spikes 1/2-2 in. long, pistilate spikes globular.

**Seed Capsule:** Cone-like and woody, 1/2 - 3/4 in. wide.

**Seed Dispersal:** Throughout the year, primarily by wind, but capsules will float.

**Problem:** Australian pine was introduced into Florida in the late 1800's for use as windbreaks and to provide shade and lumber. It is a hardy, salt-tolerant species, which has become one of the three worst pest plants in south Florida. Because of its fast growth, it forms dense stands, which crowd out native vegetation. Litter produced under a stand of Australian pines inhibits growth of other plants, and nitrogen fixing capability may give it an additional competitive advantage. Sensitivity to cold temperatures limits it to areas south of Orlando.

**Biological Control:** No biological control research has been conducted.

**Manual Removal:** Seedlings, saplings and small trees can be removed manually. Kelly device facilitates manual removal.

**Mechanical Removal:** If trees are cut they will regrow from stumps if not removed or treated with herbicide. Follow cutting with herbicide and/or manual removal to control seedlings and root sprouts.

**Physical Removal:** Fire is sometimes effective in dense stands with sufficient fuel on the ground. Large trees usually resprout from bases. Follow-up treatment may be necessary.

**Herbicides:** Guidelines for initial development of a herbicide control program for Australian pine are listed below. *Always follow current herbicide label instructions for deterrates of application, approved application sites, safety clothing, and use precautions.* (Figure 6)

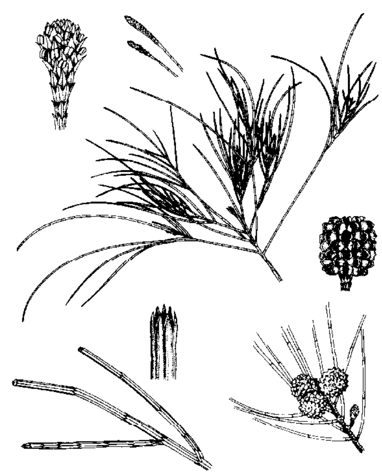

**Figure 6.**

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## Brazilian Pepper

**Other Common Names:** Florida holly, Christmas berry.

**Native Country:** Brazil.

**Habitat:** Native of Brazil's tropical coast; now found in most tropical and subtropical regions of the world. Brazilian pepper grows in moist to moderately well drained soil of good-to-poor fertility. Aggressive pioneering species on disturbed sites.

**General Description:** Dioecious, evergreen tree or shrub to 36 ft. high with stiffly upright, thick, dense branches.

**Leaves:** Odd pinnate, leaflets obovate 1-2 in. long; smell of turpentine when crushed.

**Bark:** Tan, gray; fairly smooth when young. Rough, furrowed on older trees.

**Flowers:** White, inconspicuous, unisexual in dense terminal panicles, sepals 1/25 in. long, petals 1/16 in. long.

**Fruit:** Clusters of red berries 1/5 in. wide on female trees.

**Seed Dispersal:** Birds, raccoons, opossums, cattle, deer.

**Vegetative Reproduction:** Root sprouting after fire or frost defoliation and by layering.

**Problem:** Brazilian pepper was introduced into Florida in the late 1800's for ornamental purposes. This small tree is fast-growing and is a prolific seed-producer. It is widely adaptable and quickly invades disturbed land such as roadsides, canal embankments and abandoned farm It has taken over thousands of acres of wetlands, hammocks, pinelands and pastures. Once established, it successfully competes for light and space with other plants. It has been suggested that Brazilian pepper produces a chemical in its leaves that gives it the ability to suppress the growth of other plants.

**Biological Control:** Several insects are currently being evaluated.

**Manual Removal:** Seedlings and saplings can be hand pulled. If the entire root system is not removed resprouting usually occurs.

**Mechanical Removal:** Heavy equipment is often used to clear land of Brazilian pepper. Regrowth rapidly occurs from the seed pool and vegetative fragments. Therefore, follow up control methods are necessary.

**Physical Control:** Fire will control seedlings but mature trees (more than 1 m high or 5 yrs. old) usually resprout.

**Herbicides:** Guidelines for initial development of a herbicide control program for Brazilian pepper are listed below. *Always follow current herbicide label instructions for determining rates of application, approved application sites, safety clothing, and use precautions*. (Figure 7)


**Figure 7.**

## Asiatic Colubrina

**Other Common Names:** Common colubrina, latherleaf.

**Native Country:** Native to Old World beaches from east Africa to India, Malaysia, and Pacific islands.

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**Table 1.** AUSTRALIAN PINE (Casuarina spp.)

| Herbicide | Application Method | Comments |
|---|---|---|
| Garlon 4 | Basal bark | Use undiluted or as 2% - 25% solution in diesel. Refer to herbicide label for additional application instructions. Follow-up treatment may be necessary on large trees. |
| Garlon 3A | Injection | Inject undiluted herbicide using special injection equipment. |
| | Cut stump | Use undiluted herbicide or dilute 1:1 with water. Apply to cambium. |
| | Frill/Girdle | Use undiluted herbcide or dilute 1:1 with water. |
| | Foliar | Dilute in 50-400 gal. of water and include an approved nonionic surfactant in spray mixture. Thorough coverage of foliage is important. |
| 2,4-D | Cut stump | Use a formulation labeled for this purpose and apply to cambium. |
| | Foliar | Dilute and include surfactant as instructed on herbicide label. |
| Velpar L | Soil applied | Apply .4 tsp. (24 drops) of undiluted herbicide per inch of tree diameter within 6 inches of base with spot gun. Do not exceed 3 gal./acre. *Will kill desirable vegetation where roots come in contact with the herbicide.* |
| | Frill/Girdle | Apply .4 tsp. (24 drops) of undiluted herbicide per inch of tree diameter to frill. Do not exceed 3 gal./acre. |
| | Injection | Apply .4 tsp. (24 drops) of undiluted herbicide per inch of tree diameter using special injection equipment. |
| Spike 40P | Soil applied | Can be applied by aerial application, backpack blower or by hand. Do not exceed 15 lbs./acre. Will kill desirable vegetation where roots come in contact with the herbicide. For spot treatments use the following application rates:<br><br>Stem Diameter (inches) — Ounces<br>1/4-2 — 1/4<br>3-6 — 1/2<br>7-12 — 1<br>12+ — 2 |
| Spike 20P | Soil applied | Double above rates for Spike 40P. |
| Spike 80W | Soil applied | Thoroughly mix 1 pound of product per gal. of water and apply 1 oz. of solution per 2-4 inch stem diameter. Keep agitated. Do not exceed 7.5 lb. product/acre. *Will kill desirable vegetation where roots come in contact with the herbicide.* |

**Table 2.** Brazilian Pepper (*Schinus terebinthifolius* Raddi)

| Herbicide | Application Method | Comments |
|---|---|---|
| Arsenal | Foliar | Dilution and rate of application depends on formulation. Refer to herbicide label. *Arsenal is soil active. Desirable vegetation can be killed if roots come in contact with the herbicide.* |
| Garlon 4 | Basal bark | Use undiluted or as 2% - 25% solution in diesel. Refer to herbicide label for additional application instructions. Follow-up treatment may be necessary on large trees. |

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**Table 2.** Brazilian Pepper (*Schinus terebinthifolius* Raddi)

| | | |
|---|---|---|
| Garlon 3A | Injection | Inject undiluted herbicide using special injection equipment. |
| | Cut stump | Use undiluted herbicide or dilute 1:1 with water. Apply to cambium. |
| | Frill/Girdle | Use undiluted herbcide or dilute 1:1 with water. |
| | Foliar | Dilute in 50-400 gal. of water and include an approved nonionic surfactant in spray mixture. |
| Trooper | Cut stump | Dilute herbicide 1:1 in water and concentrate mixture on cambium. |
| Velpar L | Soil applied | Apply .4 tsp. (24 drops) of undiluted herbicide per inch of tree diameter within 6 inches of base with spot gun. Do not exceed 3 gal./acre. *Will kill desirable vegetation where roots come in contact with the herbicide.* |
| | Frill/Girdle | Apply .4 tsp. (24 drops) of undiluted herbicide per inch of tree diameter to frill. Do not exceed 3 gal./acre. |
| | Injection | Apply .4 tsp. (24 drops) of undiluted herbicide per inch of tree diameter using special injection equipment. |
| Spike 40P | Soil applied | Can be applied by aerial application, backpack blower or by hand. Do not exceed 15 lbs./acre. Will kill desirable vegetation where roots come in contact with the herbicide. For spot treatments use the following application rates:<br>Stem Diameter (inches) — Ounces<br>1/4-2 — 1/4<br>3-6 — 1/2<br>7-12 — 1<br>12+ — 2 |
| Spike 20P | Soil applied | Double above rates for Spike 40P. |
| Spike 80W | Soil applied | Thoroughly mix 1 pound of product per gal. of water and apply 1 oz. of solution per 2-4 inch stem diameter. Keep agitated. Do not exceed 7.5 lb. Product/acre. *Will kill desirable vegetation where roots come in contact with the herbicide.* |

**Habitat:** Coastal beach and dune vegetation, coastal hammocks.

**General Description:** Rambling, twining shrub.

**Leaves:** Dark green and lustrous above, paler below, 1 1/2-3 1/2 in. long, ovate or elliptic-ovate, serrate or crenate-serrate.

**Bark:** Pale in color and somewhat rough.

**Flowers:** Flowers greenish, 1/6 in. in diameter, on 1/8 in. pedicels subtended by minute bracts, in small axillary clusters on common peduncle about 1/12 in. long. Sepals 1/12 in. long, petals 1/12 in. long.

**Fruit:** Brown (orange when immature), trilocular, 3-grooved, 1/4-1/2 in. wide.

**Problem:** Asiatic colubrina was introduced into the Caribbean Islands from Asia where it escaped from cultivation and then dispersed to coastal Florida. It has floating seeds that are transported by seawater. It is most often found growing in the uplands - submerged lands interface; the seeds reach the uplands during spring and storm tides. Asiatic colubrina can form dense walls which are virtually impenetrable. Its climbing growth habit allows it to grow over the native vegetation canopy and can often effectively shade out native flora. It has been known to replace native communities of buttonwood, mangrove and mangrove fringe communities.

Archival copy: for current recommendations see http://edis.ifas.ufl.edu or your local extension office.



**Biological Control:** Biological conof this species has not been investigated.

**Manual Removal:** Twining stems should be removed from desirable vegetation where possible. Additional control measures are necessary to kill rooted portions.

**Mechanical Removal:** Usually not practical.

**Physical Control:** No information available.

**Herbicides:** Guidelines for initial development of a herbicide control program for Asiatic colubrina are listed below. Control with herbicide is difficult due to its rambling habit and difficulty in identifying the main trunk. *Always follow current herbicide label instructions for determining rates of application, approved application sites, safety clothing, and use precautions.* (Figure 8)

**Figure 8.**

**Table 3.** Asiatic Colubrina (Colubrina asiatica (L.) Brongn.)

| Herbicide | Application Method | Comments |
|---|---|---|
| Garlon 4 | Basal bark | Dilute to 2% in diesel |

## Melaleuca

**Other Common Names:** Paperbark tree, punk tree, cajeput tree, white bottlebrush tree.

**Native Country:** Australia and New Guinea.

**General Description:** Tree usually grows to 50 ft.

**Habitat:** Can tolerate most subtropiecosystems with a preference for seasonally wet sites, also flourishes in standing water.

**Leaves:** Alternate, lanceolate, 12 in. long, grey-green, smell of camwhen crushed.

**Bark:** White, spongy, paper like.

**Flowers:** White in brushlike spikes.

**Seed Capsules:** Woody, numerous, clustered on branches.

**Seed Dispersal:** Wind and water dispersed.

**Problem:** Melaleuca was introduced into South Florida in the early 1900's for landscaping purposes, and to help dry up what were then considered useless swamps. Since its introduction, it has spread so rapidly that, according to one survey, it now infests 3 million acres. Melaleuca produces seed in 2 or 3 years after germination and a mature tree can eventually store over 20 million seeds. Fire, frost, herbicide application or other stresses cause the capsules to open and seed to be released. In a few years a single tree can release millions of seeds that result in impenetrable thickets. Melaleuca threatens to permanently replace natural plant communities and the animals that live in them.

**Biological Control:** Potential biological controls have been identified that should aid in future melaleuca management. Greatest interest is in insects that destroy seeds and seedlings in order to prevent or reduce the spread of melaleuca.

**Manual Removal:** Seedlings and saplings can be hand removed but remaining root fragments usually resprout.

**Mechanical Removal:** Mechanical removal is used for mature melaleuca trees. Since damage to the trees causes subsequent seed release, any seed capsules should be destroyed. Follow-up control measures are necesary to prevent reinvasion and resprouting.

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**Physical Control:** Fire with sufficient fuel will control small (> 2 ft.) seedlings, but mature trees are fire tolerant. Fire usually results in massive seed release, thus increasing the problem. Rising water level folseed release has been found to control newly germinated seedlings.

**Herbicides:** Guidelines for initial development of a herbicide control program for melaleuca are listed below. *Always follow current herbicide label instructions for determinrates of application, approved application sites, safety clothing, and use precautions.* (Figure 9)

**Figure 9.**

**Table 4.** Melaleuca (Melaleuca quinquenervia (Cav.) Blake)

| Herbicide | Application Method | Comments |
|---|---|---|
| Arsenal | Frill/Girdle | Dilution and rate of application depends on formulation. Refer to herbicide label. *Arsenal is soil active. Desirable vegetation can be killed if roots come in contact with the herbicide.* |
| | Foliar | Seedlings are more susceptible to foliar applications than larger trees. Large mature trees with dense crowns may not be effectively controlled. |
| Banvel 720 | Foliar | Seedlings only. Dilute in 20-100 gal. of water. |
| Garlon 3A | Cut stump | Cut stump close to ground to minimize resprouting. Use undiluted herbicide or dilute 1:1 with water. Apply to cambium. |
| | Frill/Girdle | Use undiluted herbcide or dilute 1:1 with water. |
| | Foliar | Seedlings are more susceptible to foliar applications than larger trees. Large mature trees with dense crowns may not be effectively controlled. Dilute in 50-400 gal. of water and include an approved nonionic surfactant in spray mixture. Do not exceed 3 gal. of herbicide per acre. |

Archival copy: for current recommendations see http://edis.ifas.ufl.edu or your local extension office.



**Table 4.** Melaleuca (Melaleuca quinquenervia (Cav.) Blake)

| | | |
|---|---|---|
| Rodeo | Frill/Girdle | Make cuts no more than 2 in. apart, spaced evenly around trunk. Apply .2 tsp. (12 drops) undiluted herbicide to each cut. Application should be made during periods of active growth and full leaf expansion. Trees growing in flooded conditions are tolerant. |
| | Foliar | Dilute 1 1/2 gal. Herbicide in 100 gal. water and include an approved surfactant. Spray foliage to wet. Do not exceed labeled rate per acre. Seedlings are more susceptible to foliar applications than larger trees. Large mature trees with dense crowns may not be effectively controlled. |
| Spike 40P | Soil applied | Can be applied by aerial application, backpack blower or by hand. Do not exceed 15 lbs./acre. *Will kill desirable vegetation where roots come in contact with the herbicide*. For spot treatments use the following application rates:<br>Stem Diameter (inches) — Ounces<br>1/4-2 — 1/4<br>3-6 — 1/2<br>7-12 — 1<br>12+ — 2 |
| Spike 20P | Soil applied | Double above rates for Spike 40P. |
| Spike 80W | Soil applied | Thoroughly mix 1 pound of product per gal. of water and apply 1 oz. of solution per 2-4 inch stem diameter. Keep agitated. Do not exceed 7.5 lb. product/acre. *Will kill desirable vegetation where roots come in contact with the herbicide.* |
| Velpar L | Soil applied | Apply .4 tsp. (24 drops) of undiluted herbicide per inch of tree diameter within 6 inches of base with spot gun. Do not exceed 3 gal./acre. *Will kill desirable vegetation where roots come in contact with the herbicide.* |
| | Frill/Girdle | Apply .4 tsp. (24 drops) of undiluted herbicide per inch of tree diameter to frill. Do not exceed 3 gal./acre. |
| | Injection | Apply .4 tsp. (24 drops) of undiluted herbicide per inch of tree diameter using special injection equipment. |

**Table 5.**

Appendix A: Metric/English Equivalents Used in This Circular

| English Unit | Metric Equivalent |
|---|---|
| 1 tsp. | 5.00 ml |
| 1 oz. | 29.57 ml |
| 1 gal. | 3.79 l |
| 1 in. | 2.54 cm |
| 1ft. | 0.30 m |
| 1 acre | 0.41 ha |

Appendix B: Herbicides Mentioned in this Circular

| Trade Name | Common Name | Chemical Name |
|---|---|---|
| Arsenal | Imazapyr | Isopropylamine salt of 2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyridinecarboxylic acid |
| | 2,4-D | 2,4-dichlorophenoxy-acetic acid |
| Banvel 720 | 2,4-D+ Dicamba | Dimethylamine salt of 2,4-dichlorphenoxy-acetic acid + dimethylamine salt of 3,6-dichloro-o-anisic acid |

Archival copy: for current recommendations see http://edis.ifas.ufl.edu or your local extension office.



**Table 5.**

| | | |
|---|---|---|
| Garlon 3A | Triclopyr | Triethylamine salt of 3,5,6-trichloro-2-pyridinyloxyacetic acid |
| Garlon 4 | Triclopyr | Butoxy ethyl ester of 3,5,6-trichloro-2-pyridinyloxyacetic acid |
| Spike 40P | Tebuthiuron | N-[5-(1,1-dimethylethyl)-1,3,4-thiadiazol-2-yl]-N, N'dimethylurea |
| Spike 20P | Tebuthiuron | same as above |
| Spike 80W | Tebuthiuron | same as above |
| Rodeo | Glyphosate | Isopropylamineamine salt of N-(phosphonomethyl) glycine |
| Trooper | Dicamba | Dimethyl amine salt of 3,6-dichloro-o-anisic acid |
| Velpar L | Hexazinone | 3-cyclohexyl-6-(dimethylamino)-1-methyl-1,3,5-triazine-2,4(1H,3H)-dione |